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GROWTH OF THE FAMILY FARM BUSINESS IN THE CARMAN AREA OF MANITOBA, WITH PARTICULAR REFERENCE TO FIRM-HOUSEHOLD INTERRELATIONSHIPS AND EFFICIENCY WITHIN THE FARM 1957-1967

by

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ABSTRACT

This study was based on data obtained from twenty-eight members of the Carman District Farm Business Association. These farms have consecutively kept farm records from 1957 to 1967. This data provided the basis for the study on the growth process of the family farm. There has been relatively little research into the detailed aspects of the growth process itself. Such information is necessary in order to not only better understand the nature of this process, but, also to enable recommendations for farm growth to be more reliably made. Another reason for the need for more research on farm growth is the existence of the "biological cycle" a problem unique to agriculture.

It was the objective of the study to quantify the internal determinants of farm growth in order to aid decision making by farmers and policy makers in their efforts to increase net income.

An econometric model was constructed for evaluating the factors that influence production, household consumption and capital investment. A two- and three-factor production function expressed in the Solow's model was used to analyze technological change.

The production, consumption and investment functions were quantified by using ordinary least squares regression analysis. The parameters or regression coefficients indicated the influence that the specific factors had on farm growth.

An examination of the data, on the twenty-eight farms in the Carman area of Manitoba, indicated that there had been considerable

economic growth throughout 1957-67. The farm families' standards of living increased and the farmers were also able to acquire large capital investments necessary to generate more production.

The econometric results indicated that additional use of capital had increased growth. Material inputs were also a very important part of growth throughout the whole period. Solow's model revealed that labour productivity had risen substantially, with technology providing a definite impact. The consumption model points out that both the marginal propensity to consume and the average propensity to consume were quite low. The availability of credit, current farm earnings and the previous year's net worth position of the farmer were important factors in the acquisition of capital.

In general, the analysis revealed that as the farm unit expands in size net income also increases. Therefore, the farm family must make wise decisions in allocating the income between household and business. The rate of growth in equity was influenced by the rate of return on capital, the interest rate on borrowed capital, income tax, household consumption and debt leverage or the debt to equity ratio.

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CHAPTER I

INTRODUCTION

What factors cause some farm firms to grow and prosper while others stagnate? The income required for growth is generated from production. However, all forthcoming income is not available to "plow" back into the farm business. A portion is required to sustain the farm family's consumption. Growth will be dependent on the portion of income that is saved for future investment since the primary resource which the farmer needs to accumulate is capital. Therefore discreet planning is required to increase income. Most farmers attempt to organize their resources in a manner that yields the optimum plan, given their objectives. However, uncertainties of the future and lack of knowledge in specific areas heavily influence their decision-making process. Often the correct decisions are not made. What is required is a quantitative examination of the process of capital accumulation on farms and the factors affecting growth.

To perform this analysis it is necessary to examine previous farm growth and the specific forces influencing growth. That is, how a specific group of farms have grown in size and development over a period of time.

THE PROBLEMS

The development of agriculture has exerted a considerable influence on farm management research--both in terms of problem

orientation and methodology. As knowledge from farm management studies accumulated, this research has generally confirmed that size of farm is an important determinant of net income. Farm size has been increasing as has been the adoption of technology.

The progressive farm firm of today is becoming far different from the farm of the past, not only in physical dimensions, but internally as well. Some of the internal changes that have taken place relate to: the level of technology adopted and the amount of capital employed; the quality of management; the system of information processing and decision making; the skill of labour; intrafarm co-ordination and integration of production processes.

Many Canadian farmers are presently in a state of economic poverty. Some of these farmers did not make the changes mentioned above or did so under extreme difficulty and with poor results. The Economic Council of Canada contends that low income families are those whose incomes are insufficient to purchase more than the basic essentials. For the purposes of their estimates, low-income families and individuals would include single persons with incomes below $1,500, families of two with less than $2,500, and families of three, four, and five or more with incomes of less than $3,000, $3,500, and $4,000 respectively. The E.C.C. indicated that, in 1961, roughly 150,000 farm families[1] may have

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[1] The E.C.C. states that the total number of families primarily dependent on farming for a livelihood in 1961 was in the order of 275,000. Thus more than half these families were below the specified income levels.

been living below these income levels.[2] In 1968 the net income[3] of farm operators from farming operations was below that for 1948 in all provinces but Ontario, Alberta and British Columbia (Newfoundland excluded).[4]

The situation facing many farmers is one of rising input costs and constant or declining product prices. Consequently their critical farm problem is low income. In order to increase net income, under these circumstances, total production must be increased and the average cost per unit of production must be reduced or, at least, held constant.

Many farmers and economists contend that the per unit cost of production can be reduced through growth. While the results of farm management research have generally corroborated this contention, there has been relatively little research into the detailed aspects of the growth process itself.[5]

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[2]Economic Council of Canada, "The Problem of Poverty," Poverty and Social Policy in Canada, ed. W. E. Mann (Copp Clark Publishing Company, 1970), p. 54.

[3]Net income is the sum of cash income from the sale of farm products, income in kind and federal government supplementary payments less operating expenses, depreciation, interest on debt and is adjusted for inventory changes.

[4]Selected Statistical Information on Agriculture in Canada, Economics Branch, Canada Department of Agriculture (October, 1969), p. 62.

[5]Limited research has been done in the United States. For example, see: Joseph B. Goodwin, Melvin G. Blase, and Dale Colyer, "A Development Planning Model for Technological Change in Agriculture," American Journal of Agricultural Economics, 52: 81-90, February, 1970; see also J. M. Vandeputte and C. B. Baker, "Specifying the Allocation of Income Among Taxes, Consumption, and Savings in Linear Programming Models," American Journal of Agricultural Economics, 52: 521-527, November, 1970; see also Michael Boehlje, "An Analysis of the Impact of Selected Factors on the Process of Farm Firm Growth" (unpublished Master's dissertation, Purdue University, 1967); see also A. N. Halter, "Models of Firm Growth," Journal of Farm Economics, 48 (5): 1503-1509, 1966. A review of the literature in the Canadian Journal of Agricultural Economics indicated that, in Canada, very little research had been done on the growth process of the family farm.

It is necessary to have detailed information on the growth process, in order to not only better understand the nature of this process, but, also to enable recommendations for farm growth to be more reliably made. The nature of farm growth will be revealed only when the internal determinants of growth are quantified.

Another reason for the need for more research on farm growth is the existence of the "biological cycle" a problem unique to agriculture. The cycle through which the family farm goes once very generation starts with the beginning farmer and ends with retirement. In the early phase of the cycle the young farmer is confronted with the difficulty of obtaining an economic size of farm unit. The stage that follows is usually characterized by a growing family. This introduces competition between the requirements of the business and the household for the limited savings of the farm family. In the final or retirement phase, the capital that has been accumulated typically is depleted to provide a pension and home for the retiring farmer and his wife. Thus each new firm-household combination is faced with furnishing its own capital and planning for its accumulation. The young farmer is sometimes unaware of various growth opportunities because he does not realize the productivity of certain resources and may underutilize them in favour of present consumption.

SCOPE AND OBJECTIVES OF THE STUDY

The primary purpose of this study is to examine the nature of the growth process of the family farm in the Carman area of Manitoba. Farms in this specific area were selected for analysis because of the availability of detailed data, from the farm records, maintained by members of the Carman Farm Business Association since 1957. This data comprises of quantitative information on production, resource use, household expenditures and capital investment. Consistent data were available for twenty-eight farms for each year from 1957 to 1967. These data were used in the analysis because of the need for detailed information, over a substantial period of time on individual farms, for examining the complex process of farm growth.

The study was directed at the internal determinants of farm growth in order to aid decision making by farmers and policy makers in their efforts to increase net income. A crucial element in growth was hypothesized to be the relationship between the firm and the household. Emphasis was placed on the competition for resources between these two aspects of the farm business.

The following specific objectives were formulated to guide the study:

1. To construct an econometric model for evaluating the factors that influence production, consumption and investment within the agricultural firm-household.

2. To analyze resource productivity and its effect along with that of the tax rate, technology, consumption and credit on farm growth.

3. To provide results that will be useful for planning farm growth under alternative conditions of increased capital intensity, different levels of material input use, consumption expenditures and credit utilization.

4. Suggest means which can be taken to increase net farm income and to overcome some of the present social and economic problems faced by many farm families.

The following chapter will examine some of the theoretical considerations relevant to the growth of the farm business. Chapter III deals with the model used to analyze the data. Chapter IV examines the physical characteristics of the Carman area and the structural change that took place within the farms throughout the time period analyzed. An interpretation of the econometric results is presented in Chapter V. The final chapter deals with the summary, conclusions and implications of the results.

CHAPTER II

THEORETICAL CONSIDERATIONS

Capital accumulation within the context of today's family farm is the essence of this study. This chapter will entail a short comment of the conceptual framework on which the study rests. It will point out the capital formation process involved in the farm business over time.

THE CAPITAL FORMATION PROCESS IN AGRICULTURE

A farm operator and his family usually have specific goals which they are striving to achieve. These goals must be considered in any investigation of the capital formation process. To achieve these goals the farm must produce income. Income is forthcoming only if capital goods (land, buildings, equipment and livestock) are used in combination with variable inputs (labour, seed, fertilizer, etc.) to produce economic output (livestock, livestock products and field crops). The output must be sold to produce an income. The size of net income earned will reflect the value of the capital and indicates the rate of interest which links income and capital.

Most often the farm operator's basic goal is to own the entire amount of capital comprising the farm business. This is why farmers own such large capital investments by the time of retirement. Their entire equity usually comes from the savings of the firm-household. The rate at which the farm business accumulates capital will depend upon the

amount of income generated and the proportion of this income that is withdrawn for household consumption and income tax payments.

John R. Brake[1] contends that the operator interested in business growth cannot ignore the effects of income tax. Taxes need to be included in the growth model because they constitute a significant cash withdrawal with prior claim over investment. Farm family consumption, another cash withdrawal from the business, must also be included. If these withdrawals are not included, results of growth studies will be biased upward.

The capital formation process in the farm business may be illustrated by starting with the savings and investment problems of the typical beginning farmer and following him through to retirement. The circumstances involved are illustrated in Figure 1.[2]

The three short run average cost (SAC) curves represent three different sizes of farm business. A young man starting to farm would require a minimum amount of capital OA and size of business represented by SAC_1. The unit cost could be reduced by expanding output to the amount associated with point G, the minimum point on SAC_1. This size of business most likely would be associated with the early stages of the farm family "biological cycle".

With an initial amount of net worth, OA, the farmer should be able to obtain credit to purchase AB amount of capital goods. When

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[1]John R. Brake, "Firm Growth Models Often Neglect Important Cash Withdrawals," American Journal of Agricultural Economics, Vol. 50, No. 3 (August, 1968).

[2]J. C. Gilson, "Agricultural Capital and Credit in Canada" (unpublished manuscript, University of Manitoba, [n.d.]), Ch. 6, pp. 1-7.

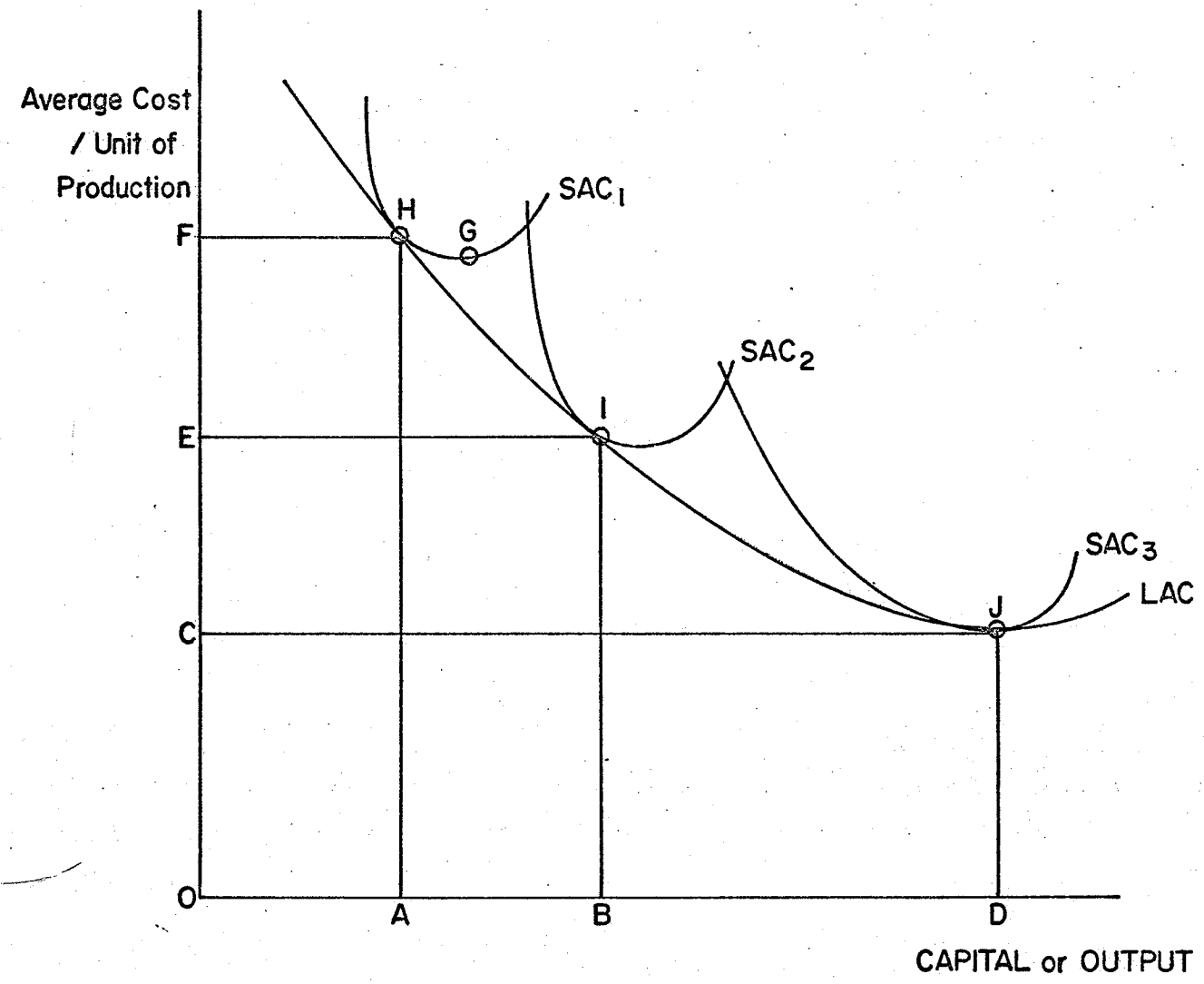

Figure 1. The Relationship Between Average Cost of Production and Capital or Output

setting his future plans the farmer would increase his business to the size represented by SAC_2 to further reduce the average costs of production. He would operate at point I and lower his unit cost by EF. The SAC_2 curve could be characteristic of the size of business in the middle stages of the "biological cycle".

The long-run average cost, LAC, curve is a locus of points showing the cost of producing the output at different farm sizes. The entrepreneur will determine his size of farm by reference to this curve. He will choose the short run size SAC_3 which yields the least unit cost of production. To remain competitive and to ensure the generation of income a farmer should expand his size of business toward a capital investment of OD. This size is characteristic of many farms at the end of the farm cycle or the retirement phase. However, even though the size may be characteristic of this stage in the cycle this would likely not be the most efficient stage. As the farmer gets older he may have other objectives besides maximizing profit.

If a farmer is a good manager and credit is available it is quite possible for him to acquire a large capital investment. However, in addition to repaying the interest and principal to his creditor the farmer must supply the annual operating costs. Thus it is possible for a farm operator and his family to own a large business but it usually takes a lifetime. During this time a farm family often finds itself in a situation of "forced savings", having to forego current consumption.

The consumption and investment processes involved in agriculture are illustrated in Figure 2.

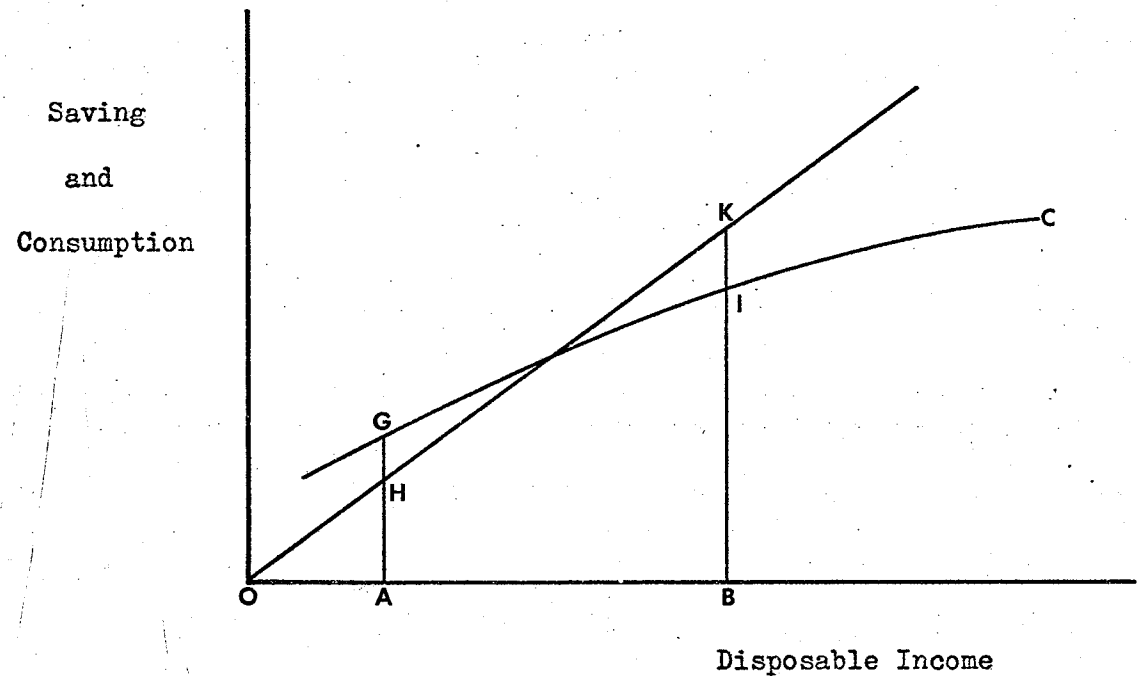

Figure 2. Consumption and Savings at Different Income Levels

The curved line labelled C designates the quantity consumed at different levels of disposable income.

The difference between this curve, and the straight line indicates savings (or dissavings) available for new investment. With an income of OA a farmer has dissavings of HG. A farmer with a larger income, OB, has IK amount of savings to re-invest in more capital. The additional capital base will generate a larger disposable income and greater savings.[3]

The amount of capital that a farmer operates depends on his previous decisions and the farm's ability to generate income rests heavily on this capital base. The rate of capital accumulation depends on the allocation of this income between consumption and investment.

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[3]Ibid., Ch. 6.

As stated in economic theory consumption will depend on the size of disposable income. However, this is not the only factor influencing consumption. In recent years, there has been a tendency not only to extend the Keynesian consumption function but to modify it significantly as is evidenced by the "new" theories of the consumption function. Attempts have been made to include dynamic factors so as to more accurately simulate reality. Population or family size is often included as well as previous year's consumption. The size of the family will influence consumption and previous year's consumption will indicate habits and an established standard of living.

FIRM-HOUSEHOLD INTERRELATIONSHIPS

In 1952 Heady[4] provided a theoretical analysis of these two relationships. The analysis involves the use of indifference curves and production possibility functions to arrive at the optimum allocation of income between consumption and investment. The analysis will be examined here since it offers a good explanation of the choice process facing the firm-household and consequently is relevant to this study.

The analysis considers the conflict between the firm and the household over the portions of annual disposable income to be allocated between current consumption and re-investment in the business as a basis for later income and consumption.

The allocation of income between consumption and capital accumulation depends on the farm family's desire for the utility of the discounted future returns from investment of current savings against the

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[4]E. O. Heady, Economics of Agricultural Production and Resource Use (New York: Prentice Hall, 1952), pp. 417-424.

satisfaction of current income spent on consumption.

The alternatives may be depicted by time-indifference curves as shown in Figure 3.

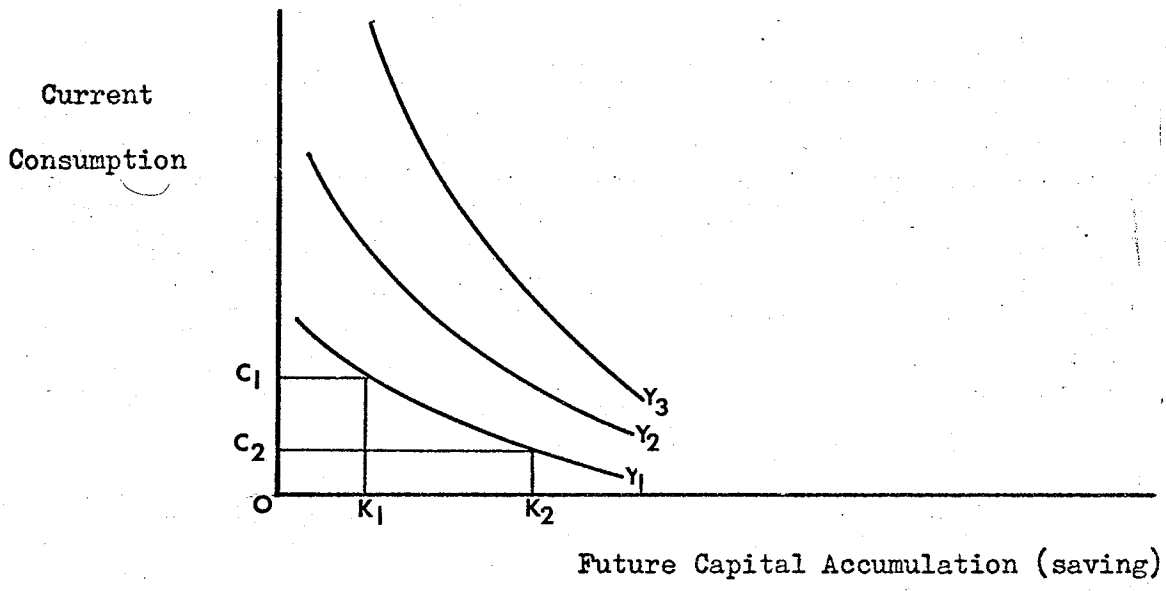

Figure 3. Inter-temporal Consumption and Investment Possibilities

Each indifference curve exhibits a different level of income. The slope indicates the time preference and the amount of consumption foregone in period 1 to save for future capital accumulation. If a farm family consumes OC_1 in period 1 they will purchase OK_1 amount of capital in period 2. If only OC_2 is consumed in period 1 and the net return on investment is profitable then OK_2 will be invested in capital in period 2.

Indifference curve Y_1 represents a low income level and suggests that a high value is placed on present consumption compared to later consumption, i.e. the average propensity to consume is quite high. As higher levels of income are reached, as suggested by curves Y_2 and Y_3,

the farm family places less value on current consumption as compared to future capital accumulation. On any one indifference curve, the problem facing the farm family is to choose, within the opportunities available, an optimal time pattern of consumption and investment.

To generate future income for consumption and investment the farmer must make intelligent management decisions. The nature of the production possibilities are shown in Figure 4.

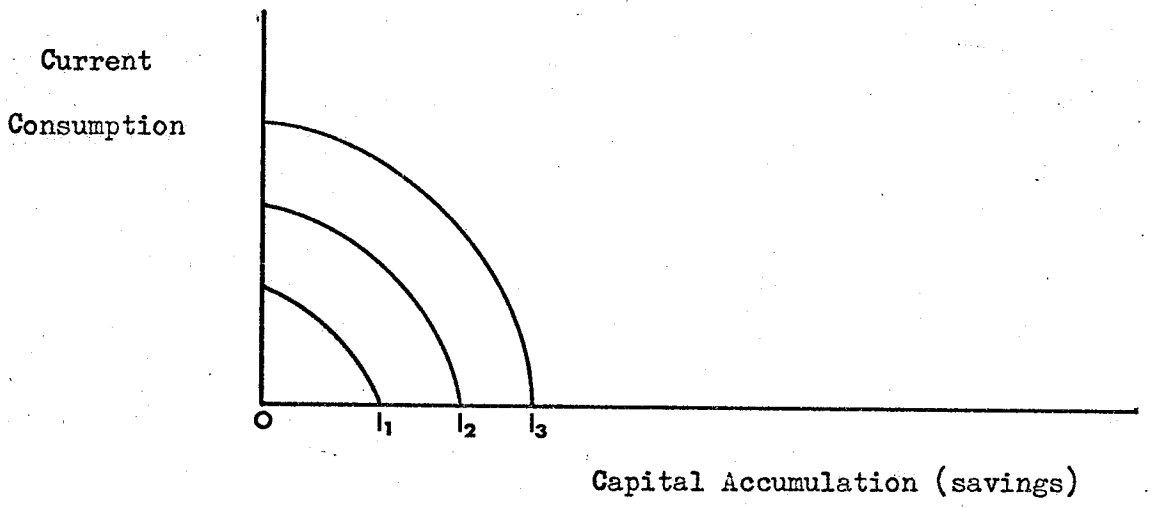

Figure 4. Production Possibility Frontier

The farm family desiring to gain a higher income in period 2 will invest in productive capital goods to produce an economic return. Each production possibility curve represents a different level of capital investment. Given his current resources and level of technology the farmer must decide on the level of investment to undertake to generate future income. The curve I_1 indicates one production possibility available to generate income for current consumption and investment in period 2.

In Figure 5 we see the farm family's optimum choice for the

allocation of production between consumption and capital accumulation.

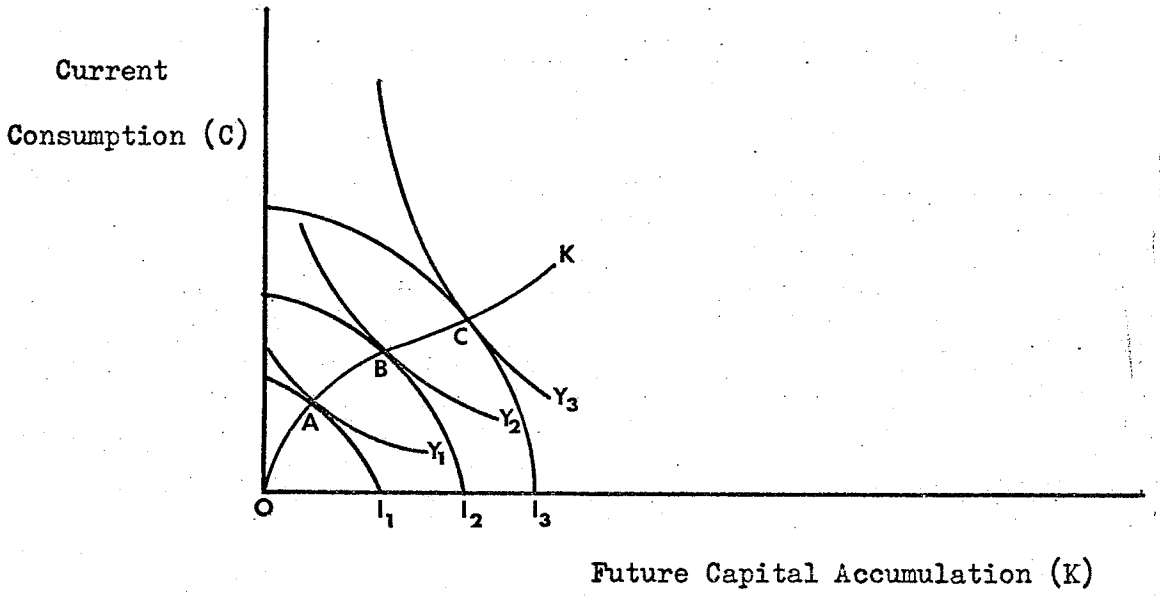

Figure 5. The Optimum Path of Capital Accumulation

The farm family has, therefore, a solution to the optimal time pattern of consumption and investment. At the lowest level of income almost all production (income) is consumed as shown by point A. Savings account for a greater disposition of current income at a higher level of income as indicated by C.

The decision to allocate income, generated from the farm's resources, between consumption and investment relates to the future growth of the farm business. Special attention must be given to the efficient allocation of resources to produce the maximum income possible. Once this income is available every farm family and farm management consultant must make intelligent decisions to allocate it properly to ensure an optimum growth rate. We have seen that the decisions made in period 1 affect the alternatives available in period 2. Thus top

quality management is the key to the attainment of a capital investment large enough to reach a minimum point on the long-run average cost curve shown in Figure 1. Line OK indicates the optimum growth path over time for the given indifference curves and available production possibilities.

The problems, the objectives and theoretical considerations have been delineated. The next chapter will deal with the model used to analyze the data.

CHAPTER III

METHODOLOGY

This chapter will outline the model used and its empirical basis.

THE MODEL

An econometric model has three aspects: its economic content, its mathematical structure, and its statistical properties.[1] Mathematics determines the logical consistency and completeness of the model. The statistical methods are employed to estimate the model's parameters and to make quantitative prediction.

The construction of econometric models serves three main purposes.[2] The first is that the construction of such models provides a systematic way of studying the past and specifying the interrelationships of economic variables that have prevailed over the period for which data is available. This helps to lay a foundation for the second purpose which is the exercise of forecasting or saying something about the future. The third purpose is to provide a framework within which to consider policy alternatives related to the problem.

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[1] M. J. Brennan, Preface to Econometrics (Chicago: South-Western Publishing Company, 1965), p. 210.

[2] R. J. Ball, "Econometric Model Building," Mathematical Model Building in Economics and Industry (London: Char. Griffin and Co. Ltd., 1968), p. 23.

Graphical analysis and a priori considerations were used to arrive at the proper form of the relationship for each function. As a result the Cobb-Douglas formulation was used to quantify the production and consumption relationships. A linear formulation was used for analyzing the investment function.

Multiple regression analyses or ordinary least squares is the basic tool used to estimate the relationships. However, the Solow or geometric model was also used in the analysis of production. This approach was used to calculate the technological change involved.

The Production Function

To estimate the parameters of the production function a single equation Cobb-Douglas formulation was chosen. This method was suggested by Hildreth[3] and has been used since by Mundlak[4] and Hoch.[5] The basic algebraic form of the Cobb-Douglas model is:

$$YG = aK^{b_1} L^{b_2} MI^{b_3} u$$

where: YG = Gross Profit (Value of Farm Production)

K = Capital

L = Labour

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[3]Clifford Hildreth, "Combining Time-Series Data and Cross Section Data," Cowles Commission Discussion Paper, No. 347 (May, 1950).

[4]Yair Mundlak, "Empirical Production Function Free of Management Bias," Journal of Farm Economics, Vol. 43, No. 1 (February, 1961), pp. 44-56.

[5]Irving Hoch, "Estimation of Production Function Parameters Combining Time-Series and Cross Section Data," Econometrica, Vol. 30, No. 1 (January, 1962), pp. 34-53.

MI = Material Inputs

a = The Constant Term

The b-values are the estimated ordinary least squares parameters and u is the random error term.

The capital variable, K, can be broken down into its component parts and each variable divided by the labour input, L. Each variable was divided by L to allow for one more degree of freedom and to eliminate some of the multicollinearity that could exist between labour and the other independent variables. The function can be expressed as follows:

$$\frac{YG}{L} = a \left(\frac{RE}{L}\right)^{b_1} \left(\frac{ME}{L}\right)^{b_2} \left(\frac{LLK}{L}\right)^{b_3} \left(\frac{MI}{L}\right)^{b_4} u$$

where: RE = the real estate input

ME = machinery and equipment

LLK = livestock

The b-values are the estimated ordinary least squares parameters and will differ from those in the previous function.

The approach adopted is to try to isolate the physical production function from the other relations which surround it. The justification for using ordinary least squares to estimate the parameters has been that, in agriculture at least, inputs precede output in time and therefore they cannot be determined, at the time of application, by maximizing known profit; anticipated output and prices will differ from realized output and prices. The random characteristics of u give the decision making process random characteristics too; one of these characteristics might be the effect of weather on output. The decision, in

this case, may be based on some motive other than maximum profit. Some allowance for risk, such as minimizing the expected loss arising from the difference between anticipated and realized output might be included.

One can see, from the preceding argument that there are components of u which properly belong in the deterministic part of the function. One such component is almost certainly the management factor, although a large part of management likely would be reflected in the amount of capital and material inputs used.

There was no statistical evidence available to distinguish between the managerial ability of the farmers in the group analyzed. However, since these farmers belonged to a Farm Business Association one could assume that, over time, their use of resources was not all that different. A surface fitted, by ordinary least squares, to observations on these farms should detail the production a farm could be expected to achieve if it possessed this type of managerial ability. Two other components of u which should also be included in the deterministic part of the function are prices and weather. However, the data on these factors were insufficient so they were not included. The incorporation of dummy variables in the function considers the effects of these factors. The production functions are estimated with and without dummy variables to see if any bias arises from not including prices and weather. To incorporate the dummy variables in the function the first year of analysis is selected as the base year for which there is no dummy observation and its value is reflected in the constant. For the other observations when a particular year takes on a value of one each other year is assigned a value of zero. The coefficients of the dummy variables indicate the deviation from the constant or the first year.

The Solow model is used to measure the technological change involved and it is based on a two factor production function of general form:[6]

$$YN = N\ (K, L : t)$$

where YN represents net production, K and L are capital and labour inputs respectively; and the variable t for time allows for technical change. Technical change (t) is a "catch all" expression for any kind of shift in the production function.

Solow's derivation is easily extended to the case where output is gross and material inputs are included. A production function incorporating three factors is generalized as the form:

$$YG = G\ (K, L, MI : t)$$

where YG represents gross output; K, L, and MI are capital, labour and material inputs respectively; while t for time allows for technical change.[7]

The Consumption Function

The consumption function is based on theoretical postulates previously considered. For the cross section model where data for only one period was available it was hypothesized that consumption was a function

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[6] R. M. Solow, "Technical Change and the Aggregate Production Function," Review of Economics and Statistics, Vol. 39 (1957).

[7] For derivation of the Solow model to measure net and gross technological change see M. H. Yeh and Lew-king Li, "Technological Change in Canadian Agriculture," Research Report No. 15 (University of Manitoba, 1968).

of disposable income and family size. The general form of this function can be expressed as:

$$C = a\ YD^{b_1}\ F^{b_2}\ u$$

where: C = real consumption

YD = real disposable income

F = family size

It was felt that the annual change in net worth should also be included to act as a proxy for short term changes in wealth. However, in the accounting procedure that the farmers used, income included any changes in product inventory. This change in inventory was also included as a part of net worth. Therefore, changes in grain and livestock inventory would be reflected in both disposable income and net worth. For this reason the intercorrelation between disposable income and change in net worth would likely be high. To avoid double counting and problems of multicollinearity only disposable income and family size were included in the consumption function.

With time series data available the same function was used but another relationship was also formulated. It was hypothesized that current consumption depends on current disposable income, current family size and consumption lagged one period. The question of habit persistence and lags in consumer behaviour was first explored by Brown.[8] Brown stresses that the habits and customs that people have previously

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[8] T. M. Brown, "Habit Persistence and Lags in Consumer Behaviour," Econometrica, Vol. 20, No. 3 (July, 1952), pp. 355-371.

enjoyed became "impressed" on their minds, which produces inertia in their behaviour. The most suitable form for testing this hypothesis, Brown argues, is to include previous consumption as the relevant lagged variable rather than previous income. The function can be represented as:

$$C_t = a\ YD_t^{b_1}\ F_t^{b_2}\ C_{t-1}^{b_3}\ u$$

where the subscript t represents time periods.

The Investment Function

In the cross-section analysis investment in farm capital is hypothesized to be dependent on savings and credit. The function could be expressed as follows:

$$I_t = a + b_1\ S_t + b_2\ Cr_t + u$$

where: I_t = current capital investment

S_t = current savings

Cr_t = current farm business financial liabilities

However, in the combined time series and cross section analysis one more variable, the farmer's net worth position lagged one period, is also added. It is lagged one period because often a farmer will make the decision to purchase capital only if he can obtain credit. Credit will be granted on the basis of his repayment ability and previous net worth position. Past savings in the form of bonds or money in the bank is also a part of net worth and a farmer's decision to make a capital purchase may be influenced by what he previously saved. Current savings

must also be included in the function since it indicates the farmer's repayment capacity. The hypothesized relationship is indicated below:

$$I_t = a + b_1 S_t + b_2 Cr_t + b_3 NW_{t-1} + u$$

where: NW_{t-1} = previous year's net worth position.

The Farm Business Growth Equation[9]

The equation presented in this section incorporates the factors which affect the farmers' potential to increase their equity. It includes the income tax rate, the rate at which the family consumes the farm income, the rate of return on total investment and the farmers' use of debt leverage or his debt to equity ratio. The equation is illustrated below:

$$g = (1 - t)\ (1 - c)\ [r + (r - i)\ D/E]$$

where: g = growth rate expressed as a percentage of owner equity

t = income tax rate

c = rate at which the family consumes the farm income

r = rate of return on total capital investment

i = interest rate on borrowed capital

D/E = debt to equity ratio.

Tax management. Most farmers attempt to minimize their taxes. However, if they examine their farm records and tax situation to find

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[9]C. B. Baker and J. A. Hopkin, "Concepts of Finance Capital for a Capital Using Agriculture," American Journal of Agricultural Economics, Vol. 51, No. 5 (December, 1969), pp. 1055-1064.

their tax rate can be reduced their growth rate will increase.

Family consumption. A family would seldom be willing to reduce its level of living. But often steps can be taken to insure that the farm family is getting its money's worth from its expenditures. If family consumption expenditures are reduced the growth rate will increase.

Rate of return. Everything that relates to effective management comes to bear at this point - selecting the right products, using latest proven technology to increase quality and yield or reduce per unit costs.

Careful capital budgeting of alternative opportunities must be the basis for making better investment decisions. The farmer should continually examine every capital item on the farm to see if investments no longer paying their way should be converted into more promising opportunities.

An increase in the rate of return will increase the rate of growth.

The use of debt leverage. If farmers can attract debt they should be able to materially increase the size of their business to make possible some additional economies of scale and raise the rate of return on investment. By increasing their debt to equity ratio they should increase the annual rate of growth.

CHOICE AND DEFINITION OF THE VARIABLES[10]

The variables selected for the analysis were those that would typically have an influence on farm growth. The choice of variables rested heavily on conventional economic theory.

Gross Profit (YG) is the current value[11] of gross receipts which includes cash income, income in kind and net change in inventories. It excludes the value of purchased livestock, feed and seed to indicate the actual value of farm production. A consideration made with respect to share renting was the one third value of production paid to the landlord. This payment was not included as a receipt in the farm accounts but it was a part of total production. Had it been excluded the gross profit figure would be lower than the actual and the productivity of the resources biased downward. A suitable proxy for the rent payment would be the opportunity cost of the land investment. Presumably, the landlord would want to receive at least this amount. However, he also pays the land tax and would want the rent payment to cover this also. To compute the payment the rate used was one percentage point higher than the current rate. The one per cent was included to cover land tax. The

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[10] The definition for some of the variables is taken from the Annual Reports of the Carman District Farm Business Association prepared by Mr. J. P. Hudson, Department of Agricultural Economics, University of Manitoba.

[11] If it had been desired to measure only the change in the physical productivities of the resources over time then gross profit should have been measured in constant dollar values. However, the objective was to determine whether the farmers were allocating their resources efficiently given the prevailing prices and costs in that time period. Even if it had been desirable to deflate the output an appropriate deflator was unavailable since the gross output was comprised of numerous components including wheat, oats, barley, flax, rapeseed, sugar beets, potatoes, sunflowers, hogs, beef, poultry, and eggs.

resulting figure was then added to the gross profit figure in the account books. The sum of these two figures was the value used in the analysis.

Gross profit was chosen as a measure of growth since it can be compared with gross profit figures in other regions. Net profit cannot be compared as easily because often the production costs in various areas are not known.

Material Inputs (MI) include expenditures on items such as fertilizer, seed, feed, fuel, lubricants, repairs, etc. It excludes the value of hired labour and any cash payments for land rent because labour and land are separate variables to be quantified.

Net Farm Income (YN) equals gross profit minus material inputs (except purchased feed and seed), farm overhead, hired labour cost, total economic depreciation on buildings, machinery and equipment, interest on debt, and the allowance for the share rent. Income in kind should also be deducted from net income so that the savings would not be biased upward. But, since income in kind is taxable it was deducted from disposable income. However, both income in kind and share rent had to be accounted for in gross profit to indicate the economic return to the resources.

Farm Labour Input (L) was measured in terms of the man-equivalent. A man-equivalent is defined as an adult male of average capacity, fully employed for a twelve month period. There are two serious deficiencies in the data on labour. The available labour, measured in man-equivalents, is not a precise measure of the flow of labour, which is hours worked. The other deficiency is the lack of information on quality. The man-equivalents measurement will show very little variation between farms of

different size. There was no additional information available to weigh the data.

The Capital Input (K) for the production function analysis in this study is measured by service flow units, i.e., the value of annual depreciation on buildings, machinery and equipment plus the current level opportunity-interest charge on land and buildings (RE), machinery and equipment (ME) and the livestock investment (LLK). Griliches[12] argues that most capital price indexes do poorly as far as quality change is concerned and if the deflators are poor, so will also be the resulting "constant price" capital estimates. The Prices Paid Index was the only one available and it does not consider quality change so capital was left undeflated.

The value of buildings (dwellings excluded) and machinery was taken directly from the farm records where new buildings and machinery were valued at market price and older items at a depreciated (net) value. The annual value for depreciation of buildings and machinery was also obtained from the farm accounts.

The land input includes both rented and owned land to permit analysis of the whole farm unit. The farmers did not value their land in bare land value terms. The estimated value of their land included the buildings. This was the value recorded in their farm account book. If the value of buildings was subtracted from this value to get a bare land value the resulting figure would be too low. The land input could have been measured in acres but this would have ignored the qualitative

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[12] Z. Griliches, "The Sources of Measured Productivity Growth: U.S. Agriculture, 1940-60," Journal Pol. Econ., Aug. 1963, p. 340.

differences that existed among farms, and even within farms. To eliminate this difficulty the land resource was quantified in terms of the "assessed" value of the land.[13] This value reflected both the quantitative (acres) and qualitative (inherent productivity) differences that existed among different parcels of land. The assessed value is based on a morphological index of productivity. In this sense the assessed value may be regarded as a valid input for production function analysis.[14]

To determine the 1957 market value the assessed value was multiplied by a factor of 1.5. This figure was then appreciated nine per cent annually to arrive at a value for each year throughout the study period.[15] If a farmer purchased land at a specific time throughout this period its assessed value was multiplied by the same factor to arrive at an estimated market value. The estimated bare land value could rarely be compared to the actual market value because of the buildings on the land. It was only possible to make a comparison when a farmer purchased a parcel of bare land. In all cases the estimated value was in line with the actual.

This method did not take into account the increase in land values from bush clearing or construction of drainage ditches after the time of assessment. However, the farm records provided a breakdown of

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[13] This value was available from the farm records.

[14] J. C. Gilson and M. H. Yeh, "Productivity of Farm Resources in the Carman Area of Manitoba," Technical Bulletin No. 1 (September, 1959, University of Manitoba), p. 15.

[15] A factor of 1.5 was used because the assessed value was approximately two-thirds of the market value for bare land. A nine per cent annual appreciation rate was used since land values in the area doubled over the eleven year period.

annual costs and indicated the improved acreage owned and rented. It was possible to examine these figures to see how much land clearing and ditch construction had taken place over the time period. Very little of this work had been done so it was assumed that these two factors did not contribute significantly to the increase in land value.

The livestock investment is the beginning of year inventory value plus any additions to it by purchases and/or stock raised on the farm and subtractions from it by sales and/or death loss.

Disposable Income (YD) is the money left after income tax and income in kind have been deducted from net income. Income in kind was deducted to arrive at the actual money available for consumption and savings (capital investment). The disposable income was deflated by the Winnipeg Consumer Price Index.[16]

Consumption (C) is the amount of disposable income spent on items such as food, clothing, health, furniture and appliances, education, household repairs and heating fuel. This value was deflated by the Consumer Price Index.

Family Size (F) is the number of individuals in the farm family and their age. Family size was calculated in terms of equivalent adults by weighting different age groups by their estimated consumption requirements. The weights used are as follows:[17]

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[16] Dominion Bureau of Statistics, Catalogue Number 62-002, Prices and Price Indexes, Vol. 47.

[17] Richard Stone, Measurement of Consumer Expenditure and Behaviour in the United Kingdom 1920-1938, Volume 1 (Cambridge University Press, 1954).

Age Group	Male	Female
Under 5 year	.28	.28
5 to 14 years	.675	.675
15 years and over	1.000	.900

Current Investment (I_t) is the value of land, buildings, machinery and equipment and livestock measured by the stock concept.

Net Worth (NW). The operator's capital along with personal assets and liabilities make up his net worth. This shows the financial position of the operator's business and is an important record when a farmer wishes to obtain credit.

Availability of Credit (Cr) is measured by the size of the financial liabilities within each farm.

Savings (S) is the amount of money available from disposable income after consumption has been deducted. Also included in this figure is the amount of annual depreciation. Depreciation was included because it was assumed that it was used to make payments on current debt incurred through capital purchases. Often a farmer increased his net worth in this manner rather than putting money into a savings account. This assumption seems justifiable since the farmers in this study made large capital purchases through the utilization of credit. The debt was then amortized over a number of years.

SOURCE OF THE DATA

The data for this study were obtained from the farm business records kept by members of the Carman Farm Business Association. The analysis is based on 28 annual records for 1957-67. These twenty-eight

farms were chosen because they provided the required economic information for the total period.

THE FLOW CHART

Figure 6 is a flow chart of the major factors influencing the growth of a farm business. An understanding of this diagram is required for interpretation of the results. The exogenous variables are represented by circles and the endogenous variables are shown as rectangles. The paths of major influence are shown by lines with arrows at their heads.

Most often a young farmer must begin his career with a small capital base which he hopes to expand. Given these capital goods and his labour resource he must make efficient use of the other variable inputs and the available technology in order to increase output and reduce unit cost of production. He must also plan his production process under the uncertainty of weather effects and changing product-factor prices. All these factors cause continuous shifts in optimal farm organization and income.

To compute net farm income one must subtract total operating expenses, economic depreciation and interest on debt from the gross profit. This net income is then allocated between income tax, consumption and savings. When income tax has been deducted the disposable income becomes available for consumption and savings. Family size and age distribution will affect the quantity of disposable income flowing to the household and out of the business. However, a farm family will strive to maintain a respectable standard of living that will be

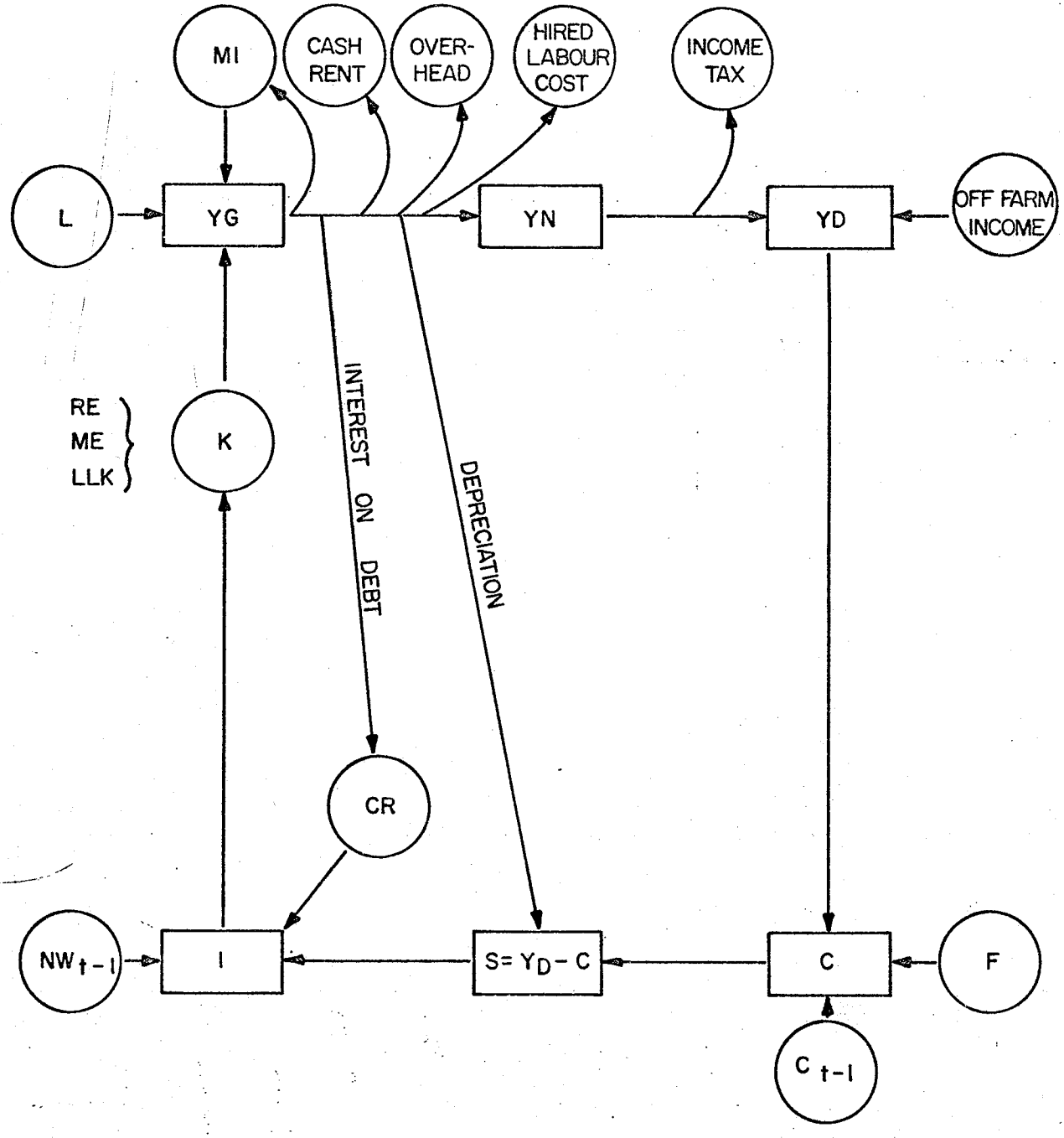

Figure 6. Major Factors Influencing the Growth of the Farm Business

influenced largely by the quantity of disposable income available and previous year's consumption level.

Hence, no income is available for capital accumulation until current operating expenses, income tax and personal living expenses have been accounted for. Investment in additional capital is heavily influenced by the annual depreciation fund and the remainder of disposable income after consumption. This amount will not purchase all the capital required, however, it will give creditors a good indication of the farm's repayment capacity. If credit is used properly it can be a very effective instrument for augmenting farm growth. The availability of long- and intermediate-term credit is often dependent on previous net worth since creditors require security to issue this type of loan.

RECURSIVENESS OF THE MODEL

Having specified the econometric model the question arises whether the model is truly recursive or interdependent. The concept of causal ordering outlined by Karl A. Fox[18] will be helpful in determining the relationship. With respect to the model production, disposable income, consumption, savings and investment are all endogenous variables. The remainder of the variables are exogenous and are of causal order 0. We can diagram this causal ordering as in Figure 7.

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[18]Karl A. Fox, Intermediate Economic Statistics (New York: John Wiley & Sons, Inc., 1968), p. 410.

Causal Order								
0	L	K	MI		C_{t-1}	F	NW_{t-1}	Cr
1			YG					
2				YD				
3						C		
4							S	
5								I

Figure 7. An Illustration of Causal Ordering in Farm Growth Determination

If any endogenous variable is a function only of exogenous variables we assign it to Causal Order 1. This is true of YG, gross profit. At this point three exogenous variables and YG are fully determined. No endogenous variable other than YG could be determined at Causal Order 1 because no other endogenous variables are explained exclusively by exogenous variables. Given YG we can now determine the value of YD and assign it to Causal Order 2. Having determined disposable income, consumption can now be estimated since it is a function of YD, F, and C_{t-1}; we assign C to Causal Order 3. With the consumption value known we can determine savings at Causal Order 4. Finally, the value of I is determined at Causal Order 5 as a function of S, NW_{t-1} and Cr. It could not have been determined logically at any earlier stage.

The recursive structure can also be exposed by producing a triangular matrix of coefficients of the endogenous variables, as shown in Table I.

TABLE I

MATRIX OF ENDOGENOUS VARIABLES

		(j)				
	Equation Number	YG	YD	C	S	I
(i)	1	x				
	2		x	x		
	3				x	x

In this table, empty cells designate zero coefficients, whereas occupied cells designate non-zero coefficients in the matrix. Thus if the (i) - (j) th cell contains an entry x it means that the (j) th variable appears in the (i) th equation with a non-zero coefficient.

It is evident from Table I that the model is recursive, since there are no non-zero coefficients of endogenous variables above the main diagonal of the matrix, that is, the matrix is triangular.

The recursive character of the model can also be seen from the flow chart in Figure 6. It is evident that there can be no additional investment in capital goods if all disposable income is consumed. A farmer could obtain a loan on the bases of his existing assets but if there is no repayment capacity he would eventually lose the farm. Consumption is influenced by disposable income, family size and previous year's consumption. The disposable income depends on the tax structure, costs of production, depreciation and interest on debt. Efficient management in the production process will increase the income available for consumption and investment. A larger disposable income will raise

the farmer's standard of living and also provide him with greater savings for capital formation. An addition to existing capital goods will increase gross production which in turn will influence net income, consumption and investment.

Before utilizing the data to quantify the models outlined in this chapter it would be suitable to examine both the physical characteristics of the area and the structural change that took place throughout the time period analyzed. This is the subject of the next chapter.

CHAPTER IV

THE PHYSICAL CHARACTERISTICS AND ADJUSTMENT PROCESS OF THE FAMILY FARMS IN THE CARMAN AREA OF MANITOBA 1957-67

THE PHYSICAL CHARACTERISTICS

Geographic factors are basic to the development of an area. They largely determine the possibilities and limitations under given technological conditions. Three physical factors which influence the agricultural growth in an area are:

1. Location - accessibility to markets;
2. Climate - seasonal distribution of temperature and precipitation;
3. Soil productivity.

These factors as related to the farms under study will now be examined.

Location

The agricultural area which formed the basis for this study is located in the Carman area of Manitoba. The farms are included in the area which extends from Township 4 to 8 and from Range 2E to 7W. This area includes the towns of Carman, Elm Creek, Sperling, Roland, Morris and Graysville. The farms are located within approximately a sixty mile radius of Winnipeg. The area is shown in Figure 8.

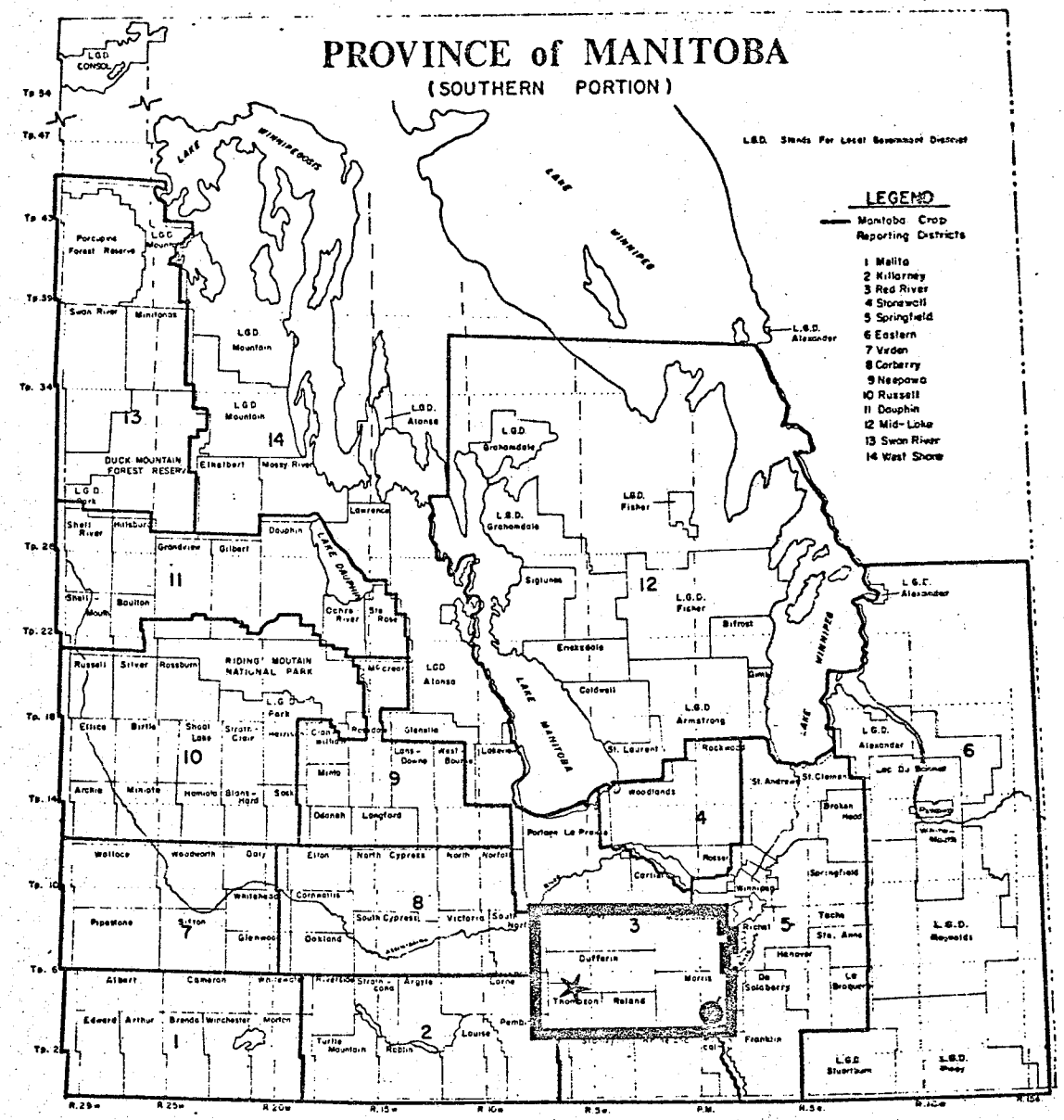

Figure 8. The Location of The Farms Under Study.[1]

. Morris

x Graysville

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[1]The map was adapted from the Yearbook of Manitoba Agriculture 1969, Manitoba Department of Agriculture, Winnipeg, Manitoba (1970), p. 4.

Climate

The temperature and length of growing season in an area are major factors influencing crop production. Where the average temperature, from May to August, falls below 60.5°F, conditions are less favourable for crop production.[2] The average temperature for this period at the two points examined was above this level (see Table II).

The amount of precipitation and its seasonal distribution make the area suitable for the cultivation of grain crops and special crops[3] (Table II).

Soil

When the farm business association was initiated the predominant soil type of every parcel of land in each farm unit was identified. A relative productivity rating was established for each farm in order to place it in one of three soil groups. The soil groups and the textural association of each group are as follows:[4]

1. Good to excellent soils - light clays and loams.
2. Good soils - heavy clays.
3. Fair to good soils - sandy loams.

The location, climate and soils of the area provide the environment for a variety of farm enterprises and show the potential for economic growth.

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[2] Principles and Practices of Commercial Farming, The Faculty of Agriculture, University of Manitoba, Winnipeg (1971), p. 16.

[3] Special crops include such field crops as potatoes, sugar beets, sunflowers, etc., which are usually grown on a contract basis.

[4] J. P. Hudson, Carman District Farm Business Association 1958 Annual Report, Department of Agricultural Economics and Farm Management (June, 1959), p. 1.

TABLE II

PRECIPITATION (INCHES) IN THE AREA
(BASED ON NORMALS 1931-1960)

Location	Annual Average Precipitation	Precipitation by Month						Total in Growing Season (May to August)
		Apr.	May	June	July	August	Sept.	
Graysville	18.24	1.20	1.72	3.19	2.35	2.12	1.96	9.38
Morris		1.08	1.75	3.20	2.55	2.52	1.96	10.02

TEMPERATURE (DEG. F) IN THE AREA
(BASED ON NORMALS 1931-1960)

Location	Annual Average Temperature	Average of Daily Mean Temperature						Average Temperature (May to August)
		Apr.	May	June	July	August	Sept.	
Graysville	37.0	38.3	52.4	61.8	68.4	65.4	54.6	62.0
Morris	37.6	40.0	53.8	63.0	69.5	67.2	56.1	63.4

Source:

Department of Transport, Meteorological Branch, Monthly Record-Meteorological Observations in Canada, Toronto, Ontario, 1965.

THE ADJUSTMENT PROCESS

This study is primarily concerned with the factors that influence long-run economic growth. Factor and product price changes influence the farmer's short-run decisions. In looking at the overall adjustment process little attention is given to short-run decisions.

Classification of the farms according to their value of gross production should provide a good insight into the transition that took place during 1957-67. This growth in economic output is outlined in Table III. The number of farms with a gross profit of less than $10,000 declined by 14 or 50 per cent during 1957-67. In 1962 there were nine more farms producing between $10,000 and $30,000 worth of output than in 1957. Between 1962-67 ten farms moved out of this range of production into the $30,000 and over group. By 1967 fifteen farms had a gross profit greater than $30,000. In 1957 no farms had reached this level of production. It is obvious that the farms quickly moved into larger producing units. There is an 83 per cent change in the value of gross output from 1957 to 1962. This indicates an annual average growth in output of 13.8 per cent. The same rate prevails in the later years from 1962-67. This growth in economic output may have resulted from the acquisition of additional land and capital goods as well as increased efficiency in their use. Other factors that could have had an impact include more intensive use of material inputs, full employment of available labour, the use of credit and discretionary planning in the allocation of disposable income between consumption and investment.

To get an indication of the role that these factors had in augmenting output we will examine the total change in the economic

TABLE III

CLASSIFICATION OF FARMS BY VALUE OF GROSS FARM PRODUCTION (CURRENT VALUE), 1957, 1962, 1967

	1957			1962			1967		
Economic Class	No.	%	Less Than 5,000-9,999	No.	%	5,000-9,999	No.	%	
			No. %			No. %			
Less than 5,000	1	3.6		-	-		-	-	
5,000-7,499	6	21.4	14 50	-	-	1 3.6	-	-	
7,500-9,999	7	25.0		1	3.6		-	-	
10,000-19,999	13	46.4	10,000-29,999	15	53.6	10,000-29,999	3	10.7	10,000-29,000
			No. %			No. %			No. %
20,000-29,999	1	3.6	14 50	8	28.6	23 82.2	10	35.7	13 46.4
30,000-49,999	-	-		4	14.2	30,000-50,000+	10	35.7	30,000-50,000+
						No. %			No. %
50,000 and over	-	-		-	-	4 14.2	5	17.9	15 53.6
Total	28	100		28	100		28	100	
Average Gross Production Per Farm	$11,401		% Change 83	$20,989		% Change 84	$38,719		

system. However, we shall first investigate the relationship between gross profit and net income.

In Table IV the farms are classified according to net income. In 1957 the majority of farms were concentrated in the lower net income groups. Fifteen of them had a net income of less than $5,000. By 1962 eight of these fifteen farms had increased their net income above $5,000 and the average per farm was almost double that for 1957. In 1967 only one farm had a net income of less than $5,000, seven were generating an income between $5,000 and $11,000 while twenty or 71.4 per cent had a net income greater than $11,000. The average net income per farm was $17,500.

There is definitely a positive relationship between gross profit and net income. Now our task is to evaluate the factors that would increase net farm income and lead us to a solution of the problem. The first resource we shall examine is the land input.

The change in the structure of improved acres per farm is outlined in Table V. The improved acreage per farm increased 8.3 per cent during 1957-62 and 36.2 per cent throughout 1962-67. In 1957 there were 19 farms operating less than 560 acres each. Most farms purchased and/or rented additional land and by 1967 11 of the 19 had increased their land holdings to more than 560 improved acres. Thus the number of farms in the 560 to 1,000 acre size group increased from nine in 1957 to 14 in 1967, a 56 per cent increase. By this time six of the 28 farms operated over 1,000 acres each. The increase in improved acres per farm has been substantial. This enlargement in physical dimensions should permit the introduction of new technology and enable a farm to move downward on the

TABLE IV

CLASSIFICATION OF FIRMS ACCORDING TO NET FARM INCOME, 1957, 1962, 1967

	1957			1962			1967		
Economic Class	No.	%	Less Than 1,000-4,999 No. %	No.	%	Less Than 1,000-4,999 No. %	No.	%	Less Than 1,000-4,999 No. %
Less than 1,000	3	10.7		1	3.6		-	-	
			15 53.6			7 25.0			1 3.6
1,000-2,999	7	25.0		3	10.7		1	3.6	
3,000-4,999	5	17.9		3	10.7		-	-	
5,000-6,999	6	21.4	5,000-10,999 No. %	5	17.9	5,000-10,999 No. %	-	-	5,000-10,999 No. %
7,000-8,999	4	14.3	12 42.8	5	17.9	15 53.7	3	10.7	7 25.0
9,000-10,999	2	7.1		5	17.9		4	14.3	
11,000-12,999	1	3.6	11,000+ No. %	1	3.6	11,000+ No. %	2	7.1	11,000+ No. %
13,000-14,999	-	-	1 3.6	3	10.7	6 21.4	1	3.6	20 71.4
15,000 and over	-	-		2	7.1		17	60.7	
Average Net Income Per Farm	$4,565.70			$8,537.70			$17,500		

TABLE V

CLASSIFICATION OF FIRMS ACCORDING TO IMPROVED ACRES (OWNED AND RENTED), 1957, 1962, 1967

Size Group	1957 No.	1957 %	Less Than 320-559 No.	Less Than 320-559 %	1962 No.	1962 %	Less Than 320-559 No.	Less Than 320-559 %	1967 No.	1967 %	Less Than 320-559 No.	Less Than 320-559 %
Less than 320	7	25.0	19	67.9	2	7.1	15	53.5	2	7.1	8	29.5
320-399	3	10.7			3	10.7			1	3.6		
400-479	5	17.9			6	21.4			3	10.7		
480-559	4	14.3			4	14.3			2	7.1		
560-639	6	21.4	560-999 No.	560-999 %	7	25.0	560-999 No.	560-999 %	6	21.4	560-999 No.	560-999 %
640-719	-	-	9	32.1	4	14.3	13	46.5	3	10.7	14	50.0
720-999	3	10.7			2	7.1			5	17.9	1,000+ No.	1,000+ %
1,000 and over	-	-	0		-	-	0		6	21.4	6	21.5
Average Improved Acres Per Farm	492.4				543.5				741.2			

long run average cost curve shown in Figure 1. As the per unit cost of production declines net income will increase, resulting in additional savings and growth.

Along with the increase in land holdings one would expect the investment in capital to rise. Table VI classifies the farms into different capital size groups.

In 1957 twenty-seven of the farms had a capital investment of less than $60,000 whereas by 1962 nineteen had moved out of this size group bringing the number in the $60,000-$100,000 capital size group to eighteen. There were only two farms with a capital investment greater than $100,000. The average capital investment per farm increased 66 per cent or 11 per cent a year. By 1967 all of the farms had moved out of the lowest capital size group. There were now twelve farms in the intermediate size group and sixteen in the largest size group, twelve of which had an investment greater than $120,000. The average investment per farm increased 75 per cent throughout 1962-67.

There was a very fast movement of farms into the higher capital classes. Often this is a growth augmenting factor, however, farmers can over-invest in capital. The share of capital in output will be examined in the econometric analysis to see if its opportunity cost is met. A close look at the components of this capital will also provide a better understanding of its influence.

Table VII points out that the increase in the value of machinery and equipment is higher than the percentage increase in the other components for the same period. This change reflects both the increase in quantity and quality (improvement in technology) of the input. Additional use of machinery and equipment could be a growth augmenting

TABLE VI

CLASSIFICATION OF FIRMS ACCORDING TO CAPITAL INVESTMENT, 1957, 1962, 1967

	1957		1962		1967					
Size Group	No.	%	<$35,000-59,999		No.	%	<$35,000-59,999		No.	%
			No.	%			No.	%		
Less than $35,000	7	25.0			-	-			-	-
			27	96.4			8	28.6		
$35,000-59,999	20	71.4			8	28.6			-	-
			$60,000-99,999				$60,000-99,999			$60,000-99,999
			No.	%			No.	%		No. %
$60,000-79,999	1	3.6			11	39.2			3	10.7
			1	3.6			18	64.2		12 43.9
$80,000-99,999	-	-			7	25.0			9	32.2
							$100,000-120,000+			$100,000-120,000+
							No.	%		No. %
$100,000-119,000	-	-			1	3.6			4	14.3
							2	7.2		16 58.1
$120,000 and over	-	-			1	3.6			12	42.8
Average Capital Per Farm	$42,086				$72,019				$122,728	

TABLE VII

COMPONENTS OF FARM CAPITAL INVESTMENT, TOTAL OF 28 FARMS, 1957, 1962, 1967

		1957 to 1962			1962 to 1967		
Items	1957	Investment Change	% Change	1962	Investment Change	% Change	1967
Value of Land & Buildings	$769,879	532,662	69.2	$1,302,541	1,137,511	87.3	$2,440,052
Value of Machinery and Equipment	283,420	212,773	75.0	496,193	354,728	72.0	850,921
Value of Livestock & Poultry	125,172	92,642	74.0	217,814	-72,408	-33.2	145,406
Total	$1,178,471	838,077	71.0	$2,016,548	1,419,831	70.0	$3,436,379

factor and result in higher labour productivity, however, it is doubtful unless the land base is also increased.

The value of land and buildings increased 69.2 per cent during 1957-62 and was 87.3 per cent higher in 1967 than in 1962. During these two periods the improved acreage per farm increased 8.3 per cent and 36.2 per cent while the percentage increment in the value of the buildings was 20 and 13 respectively.[5] The balance must be due to capital gain since the combined per cent increase in improved acres and value of buildings does not account for the substantial percentage increase in the total value of real estate. Increasing land values will not augment agricultural output. However, to the extent that additional land will increase crop production and buildings are necessary to house livestock, store grain inventory and protect equipment from weathering the increase in the value of real estate could be considered as contributing to growth.

The investment in livestock and poultry increased 74 per cent during 1957-62 but had decreased 33.2 per cent by 1967. Since gross output increased substantially over the eleven years it is difficult to conclude whether the livestock input affected growth. The decrease in livestock certainly did not retard the growth process. The grain market was good during the latter period. This is likely the reason for the decrease in livestock. The less efficient livestock managers would tend to specialize in crop production.

Closely related to land and machinery is the use of material

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[5]The value of buildings was obtained from the raw data, their separate value was not given in the table.

inputs. Items such as fertilizer, seed, herbicides, fuel, etc. are a very important part of the production process. These inputs are usually a growth augmenting factor since they generate additional gross profit from a given capital base.

Turning to Table VIII we shall examine the change that took place in the use of material inputs. In 1957 86 per cent of the farms spent less than $5,000 on material inputs and the remainder used between $5,000 and $10,000 worth. By 1962 11 farms had moved out of the less than $5,000 size group into larger classes. Farmers would be using more of this input because of increased land use and also as a result of increased managerial ability gained from membership in the association. Forty-three per cent of the farms were using between $5,000 and $10,000 worth of fertilizer, herbicides, fuel, repairs, etc. In 1967 there were only three farms spending less than $5,000 on these inputs. Fifty per cent were allocating between $5,000 and $10,000 of their total operating expenses to material inputs with 39 per cent spending more than $12,500. The average expenditure per farm in 1967 was about triple that of 1957. The farmers undoubtedly realized the value of these inputs in production and increased the use of them. The increased use of these inputs would normally result in additional gross profit.

In Table IX the farms are stratified by the amount of borrowed capital employed in the business. In 1957 79 per cent of the farms had financial liabilities less than $10,000 with 60 per cent of these being in the less than $5,000 classification. By 1962 21 per cent of the farms employed more than $20,000 worth of borrowed capital. In 1967 60 per cent of the farms were in the $20,000 and over size group with only 29

TABLE VIII

CLASSIFICATION OF THE TWENTY-EIGHT FARMS ACCORDING TO THE VALUE OF MATERIAL INPUTS USED, 1957, 1962, 1967

Size Group	1957 No.	1957 %	Less Than $5000 No.	Less Than $5000 %	1962 No.	1962 %	Less Than $5000 No.	Less Than $5000 %	1967 No.	1967 %	Less Than $5000 No.	Less Than $5000 %
Less than $2500	10	36			1	4			-	-		
			24	86			13	46			3	11
2500-4999	14	50			12	42			3	11		
5000-7549	4	14	5000-9999		7	25	5000-9999		4	14	5000-9999	
7500-9999			No.	%	5	18	No.	%	10	36	No.	%
			4	14			12	43			14	50
10000-12499					1	4	10,000+		5	18	10,000+	
							No.	%			No.	%
12500 and over					2	7	3	11	6	21	11	39
Average	$3,339				$6,347				$9,917			

TABLE IX

CLASSIFICATION OF FARMS ACCORDING TO THEIR USE OF CREDITS, 1957, 1962, 1967

	1957				1962				1967			
Size Group	No.	%	Less Than 10,000 No.	%	No.	%	Less Than 10,000 No.	%	No.	%	Less Than 10,000 No.	%
Less than 5,000	13	47	22	79	9	32	13	47	3	11	8	29
5,000-9,999	9	32			4	14			5	18		
10,000-14,999	4	14	10,000-19,999 No.	%	6	21	10,000-19,999 No.	%	1	4	10,000-19,999 No.	%
15,000-19,999	2	7	6	21	3	11	9	32	2	7	3	11
20,000-24,999					3	11	20,000+ No.	%	2	7	20,000+ No.	%
25,000-29,999					1	4	6	21	-	-	17	60
30,000 and over					2	7			15	53		
Average	6,237				11,987				31,513			

per cent remaining in the less than $10,000 group. There was a definite increase in the use of credit. If credit is used properly it is a good business practice and would surely increase the rate of growth. Much of the economic growth in agriculture is related to the development of sizes of farms that will effectively utilize modern technology. In order for a farmer to attain an economic size of farm he must use borrowed capital.

Closely associated with farm growth is another factor which is often overlooked. This is the portion of the income flowing out of the business into the household. Looking at Table X we see that in 1957 96 per cent of the farms spent less than $4,000 on household and personal living expenses. By 1962 42 per cent of the farms had moved into an expenditure class between $4,000 and $8,000. In 1967 only two of the farms were still in the less than $4,000 class with 64 per cent now between $4,000 to $8,000 and 29 per cent spending more than $8,000 on household expenditures. It is quite obvious that consumption expenditures are positively related to farm growth, i.e. output or income. Off-farm income must also be considered and in this study it is added to net farm income. In 1957 the average off-farm income per farm was $650, in 1962 it was $585 and had decreased to $397 by 1967. This is not a substantial amount but it would influence consumption and savings. However, it is quite evident that the increase in consumption is largely a result of the rise in net farm income.

Another factor influencing the amount of income flowing from the business to the household is the size and age distribution of the family. In Table XI the farms are classified according to family size in terms

TABLE X

CLASSIFICATION OF FARMS ACCORDING TO CONSUMPTION EXPENDITURES, 1957, 1962, 1967

Size Group	1957 No.	1957 %	1957 Less Than 3,999 No.	1957 Less Than 3,999 %	1962 No.	1962 %	1962 Less Than 3,999 No.	1962 Less Than 3,999 %	1967 No.	1967 %	1967 Less Than 3,999 No.	1967 Less Than 3,999 %
Less than 2,000	7	25	27	96	3	11	15	54	-	-	2	7
2,000-3,999	20	71			21	43			2	7		
4,000-5,999	1	4	4,000-5,999 No. 1	% 4	11	39	4,000-5,999 No. 12	% 46	9	32	4,000-5,999 No. 18	% 64
6,000-7,999	-	-			2	7			9	32		
8,000 and over	-	-			-	-			8	29	8,000+ No. 8	% 29
Average	2,517				3,922				7,400			

TABLE XI

CLASSIFICATION OF FARMS ACCORDING TO FAMILY SIZE (ADULT EQUIVALENTS), 1957, 1962, 1967

	1957				1962				1967	
Size	No.	%	2.0-3.99 No.	%	No.	%	2.0-3.99 No.	%	No.	%
2.0-2.99	9	32.0	19	67.8	2	7.2	12	43	2	7.2
3.0-3.99	10	35.8			10	35.8			10	35.8
4.0-4.99	7	25.0	4.0-6.99 No.	%	11	39.0	4.0-6.99 No.	%	11	39.0
5.0-5.99	2	7.2	9	32.2	4	14.4	16	57	4	14.4
6.0-6.99	-	-			1	3.6			1	3.6
Average Size	3.59				4.24				4.05	

of adult equivalents. In 1957 there were 19 farms with a family size between 2.0 and 3.99, the average size was 3.59. By 1962 the average size had increased to 4.24 and the number of farms with a family size between 2.0 and 3.99 had diminished from 19 to 12. However, the number of farms classified in the 4.0 to 6.99 size group increased from nine to 16. The increase in family size would be the result of new births and children moving into higher age groups. In 1967 the situation was identical to that in 1962. However, it was observed that two families were now each comprised of only the parents, the children having left home. There were also families which had increased in size because their son was staying on the farm. By this time some farmers were also helping a son or daughter finance their way through university or other special training. Thus as the size of the family increases more income is withdrawn from the business and there is less available to "plow" back into capital purchases.

There appears to be a definite functional relationship between many of the variables examined. The econometric results in the next chapter will indicate the magnitude of the relationship.

CHAPTER V

THE ECONOMETRIC RESULTS AND THEIR INTERPRETATION

In this chapter the results of the econometric analysis are examined and interpreted. The presentation is separated into four sections. The results from the production analysis are presented in the first section, the second section provides the estimates of the consumption function parameters and the factors influencing investment are quantified in the third section. The final section utilizes these results from the first three sections to outline the family farm's overall growth process

THE PRODUCTION FUNCTION

Tables XII to XVII present the parameter estimates for the different specifications. An asterisk (*) indicates that the estimates are significantly different from zero at the 1 per cent level, two asterisks (**) indicate significance at the 5 per cent level, three asterisks (***) represent significance at the 10 per cent level. The constants are presented in real values rather than logarithmic values for the Cobb-Douglas functions. The figures in parantheses are the standard errors of the estimates. The computed F-Ratio indicates the significance of the R^2 term and the Von-Neuman Ratio is used to test for the presence of autocorrelation. The marginal value productivity of the resource is abbreviated as MVP.

Table XII presents the estimates of the production parameters and marginal value productivities using aggregated capital for each of the years 1957-67.

Capital

The parameters for 1957-59 were statistically insignificant indicating that capital was not closely related to gross profit during this time. In 1960 the coefficient was significant but the MVP was less than the cost[1] of capital indicating that a loss was incurred. The coefficient was insignificant again in 1961. Capital and production likely were not closely related in this year because of the drought and poor crop. Throughout 1962-67 the capital variable was significant in each year and there was a positive net return, given the existing prices. During the latter years the expansion in capital was definitely profitable. This would indicate that the farmers were using good management by efficiently allocating their capital resources into the production of output that would yield gains on the marginal dollar invested, given the prices in these years.

Material Inputs

The increased use of material inputs was very beneficial throughout the entire period. An additional dollar spent on these inputs would always yield a gain. This indicates that the farmers were

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[1]Since capital is measured in service flow units or annual input the market price was set at $1.05 per dollar invested. However, this would vary with the current interest rate. If optimum conditions of resource allocation are to be satisfied the marginal value productivity of the input must equal its market price.

TABLE XII

PRODUCTION PARAMETERS AND MARGINAL VALUE PRODUCTIVITIES[a] USING AGGREGATED CAPITAL FOR EACH YEAR THROUGHOUT 1957-67

Year	K	MVP	MI	MVP	L	MVP	Sum of the Parameters	Constant	R^2	F-Ratio
1957	.14 (.153)		.55* (.16)	$1.86	.31 (.22)			36.3	.65*	15
1958	.12 (.15)		.47* (.09)	$1.53	.14 (.19)			104.5	.69*	18
1959	.16 (.13)		.59* (.095)	$1.84	.15 (.13)			25.5	.79*	30
1960	.26*** (.13)	$ .86	.43* (.11)	$1.41	.02 (.18)			43.8	.72*	21
1961	.22 (.15)		.51* (.09)	$1.28	.12 (.15)			27.6	.76*	25
1962	.64* (.16)	$2.24	.31* (.08)	$1.37	.21 (.17)			4.9	.72*	21
1963	.40* (.10)	$1.20	.34* (.10)	$1.05	.45* (.15)	$5461	1.19	25.2	.74*	23
1964	.62* (.12)	$1.92	.28* (.09)	$1.06	.15 (.11)			8.3	.76*	25
1965	.50* (.13)	$1.71	.37* (.10)	$1.44	.25*** (.13)	$4151	1.12	10.7	.80*	31
1966	.47*** (.24)	$1.09	.40** (.18)	$1.12	.29 (.22)			7.25	.59*	11
1967	.80* (.10)	$2.66	.34* (.07)	$1.34	.13 (.11)			.867	.89*	67

[a]The marginal value productivities were calculated at the geometric means. Since the output (Y) is measured in dollars the marginal productivities $\frac{\partial Y}{\partial X}$ of the resources are equivalent to marginal value productivities. If Ex is the calculated elasticity of the resource X then the marginal value productivity of the resource is expressed as:

$$\frac{\partial Y}{\partial X} = Ex \cdot \frac{Y}{X}$$

The MVP were not calculated for the coefficients that were statistically insignificant.

allocating their money wisely when they purchased additional material inputs. Theoretically, to get maximum benefit from this input they should have increased their use of it until the MVP was equal to the market price of the input.[2] However, taking risk into consideration, there would be a tendency to use less of this input than if no risk was involved.

Labour

The coefficients for labour are all insignificant except for the years 1963 and 1965. The lack of significance may be accounted for by the imprecise measure of labour. Labour is expressed in man-equivalents, an adult male of average capacity, fully employed for a twelve-month period. In any given year, between farms, farm size changes markedly but the measured labour input changes little because of the indivisibility of the labour units. It would be expected that the true labour input would be closely related to farm size. Labour appears to be fairly constant whereas, in fact, it varies with farm size. However, over time it is suspected that labour will be more significant since a specific farm will maintain approximately the same labour input throughout.

Table XIII presents the estimates of the production parameters and marginal value productivities from combining time series and cross section data. Dummy variables were also used to extract the price and weather effects associated with the coefficients over time. These results were compared to those where the analysis did not include dummy variables.

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[2] The market price would be an expenditure of $1.00 plus the current interest rate.

TABLE XIII

PRODUCTION PARAMETERS AND MARGINAL VALUE PRODUCTIVITIES USING AGGREGATED CAPITAL AND COMBINED CROSS SECTION AND TIME SERIES DATA, INCLUDING THE RESULTS FROM USING DUMMY VARIABLES, 1957-67[3]

Independent Variable	No Dummy Variables		Includes Dummy Variables	
	Elasticity	MVP	Elasticity	MVP
Capital	.46* (.036)	$1.50	.43* (.043)	$1.40
Material Input	.38* (.035)	$1.26	.37* (.032)	$1.24
Labour	.18* (.049)	$2269	.22* (.049)	$2774
Sum	1.02		1.02	
R^2	.75*		.80*	
F-Ratio	298.00		93.30	
Constant	11.95		15.48	
Von Neuman	1.45*		1.85*	

[3]The correlation matrix for the variables is given in Appendix I, Table XXIV.

When dummy variables are not used the coefficients may be somewhat biased since prices and weather change over time but they are not included in the deterministic part of the function. The inclusion of dummy variables will eliminate this bias. The results indicate that there is very little change in the size and significance of the coefficients when the dummy variables are included. The multiple coefficient of determination (R^2) increases by only .05 when they are included. They explain only 5 per cent more of the variation in gross output. It appears as if price and weather effects do not bias the parameters significantly.

The coefficients indicate constant returns to scale for the farm business in the Carman area as a whole and inelastic production with respect to each of capital, material inputs and labour. The marginal value productivity of capital indicates that this resource was used efficiently. An additional dollar spent on capital expansion would return a gain. The use of material inputs was also profitable and farmers could have utilized more of this input for marginal gains in income since the MVP of this resource exceeded its cost. The elasticity of production for labour was quite low. This indicates that a 1 per cent change in labour results in only a small increase in gross profit.

The time period was divided into two periods and they were analyzed separately. The results are presented in Table XIV. They are quite consistent with the results in Table XIII. The coefficient for capital increases by .19 in the latter period. This would be due to more efficient use of capital resulting from better management. Dummy variables were not used for the two periods since there was very little bias throughout the whole time period.

TABLE XIV

PRODUCTION PARAMETERS AND MARGINAL VALUE PRODUCTIVITIES USING AGGREGATED CAPITAL AND COMBINED CROSS SECTION AND TIME SERIES DATA FOR TWO PERIODS, 1957-62 AND 1963-67[4]

Independent Variable	1957-62		1963-67	
	Elasticity	MVP	Elasticity	MVP
Capital	.36* (.057)	$1.29	.55* (.064)	$1.70
Material Input	.38* (.04)	$1.22	.38* (.057)	$1.32
Labour	.18* (.074)	$1731	.22* (.073)	$3583
Sum	.92		1.15	
R^2	.67*		.70*	
F-Ratio	113.00		104.00	
Constant	26.32		4.88	
Von Neuman	1.67*		1.30*	

[4]The correlation matrix is presented in Appendix I, Table XXV.

Interest now centres on which components of capital contribute most to marginal returns. Table XV presents the estimates of the production parameters using disaggregated capital in per labour terms for each of the years throughout 1957-67.

Real Estate Per Labour

In 1957 and 1958 the parameters of this input were insignificant. This would indicate that the available land and buildings were not being used to their full capacity. Material inputs were not used extensively in these initial years and the optimum amount of output was not realized. The MVP of material inputs was high during these two years indicating that quite substantial returns could have been gained from additional use of this input. At this stage of time it is possible that the available land and buildings were under utilized. However, as the farmer's management skills improved and more material inputs were used the real estate input became significant since more output would be generated from a given amount of input. This would increase the productivity of the land and increase the use of buildings for storage. Both land and buildings would be used more productively.

Machinery and Equipment Per Labour

During 1957-62 the coefficient for this input was significant in only two years, 1958 and 1962. Initially this was difficult to understand but examination of Table V indicated that the average improved acreage per farm increased by only 10 per cent during 1957-62. The additional investment in machinery and equipment could not increase output substantially, since crop production did not expand sufficiently, with only a small increase in the improved acreage. During 1962-67 the

TABLE XV

PRODUCTION PARAMETERS AND MARGINAL VALUE PRODUCTIVITIES USING DISAGGREGATED CAPITAL FOR EACH YEAR THROUGHOUT 1957-1967

Year	Real Estate Per Labour	MVP	Machinery and Equipment Per Labour	MVP	Livestock Per Labour	MVP	Material Inputs Per Labour	MVP	Constant	R^2	F-Ratio
1957	-.001 (.169)		.10 (.12)		.006 (.08)		.57* (.19)	$1.94	44.9	.43*	4.4
1958	-.02 (.03)		.24*** (.12)	$2.30	.06 (.07)		.39* (.11)	$1.33	72.9	.62*	9.5
1959	.28*** (.11)	$1.81	-.05 (.07)		-.04 (.04)		.54* (.09)	$1.70	29.7	.78*	20.0
1960	.45* (.16)	$3.30	-.04 (.08)		-.03 (.04)		.36* (.11)	$1.23	32.6	.57*	7.7
1961	.35*** (.15)	$2.08	-.02 (.09)		-.02 (.03)		.47* (.10)	$1.23	19.2	.70*	13.2
1962	.02 (.13)		.31* (.09)	$2.42	-.05 (.03)		.42* (.07)	$1.42	48.6	.73*	15.9
1963	.07 (.19)		.24*** (.12)	$2.52	.003 (.03)		.39* (.12)	$1.16	45.0	.51*	5.9
1964	.25*** (.14)	$1.68	.27* (.08)	$1.71	.006 (.02)		.29* (.10)	$1.06	21.3	.77*	18.9
1965	.11 (.15)		.28* (.10)	$1.90	.018 (.018)		.39* (.11)	$1.51	28.1	.73*	15.9
1966	.20 (.29)		.19 (.22)		.02 (.03)		.37* (.19)	$1.02	24.9	.40**	3.9
1967	.32*** (.18)	$2.18	.40* (.14)	$2.10	.03 (.02)		.21***	$1.06	38.9	.86*	35.2

parameters were positive and additional investment was profitable in all years except 1966. The coefficient was likely insignificant in this year because crop production was low due to wet weather. The improved acreage increased 36 per cent during this period. The purchased equipment was more productive when used on a larger land base.

Livestock Per Labour

The coefficients for this input were insignificant for every year since the standard error was quite high. However, there was still a 74 per cent increase in the value of the livestock investment during 1957-62 (Table VIII). Throughout 1962-67 there was a 33 per cent decline. These results were not consistent with previous hypotheses. It was felt that livestock would increase gross profit. There is a need for further research in this area.

Material Inputs Per Labour

The results were comparable to those with aggregated capital. Additional use of material inputs yielded marginal gains in every year of the period.

Table XVI presents the results of the production parameters and marginal value productivities from combined cross section and time series data. The results were derived by including dummy variables and not including them. The coefficients were then compared to see if any bias arose from price changes and weather effects over time. No significant change was observable. The coefficients indicate the average influence throughout 1957-67. It did not pay the average farmer to increase the real estate input whereas the increase in machinery and

TABLE XVI

PRODUCTION PARAMETERS AND MARGINAL VALUE PRODUCTIVITIES USING DISAGGREGATED CAPITAL AND COMBINED CROSS SECTION AND TIME SERIES DATA, INCLUDING THE RESULTS FROM USING DUMMY VARIABLES, 1957-67[5]

Independent Variable	No Dummy Variables		Includes Dummy Variables	
	Elasticity	MVP	Elasticity	MVP
Real Estate per Labour	.06*** (.03)	$ .39	.04*** (.026)	$ .26
Machinery and Equipment per Labour	.24* (.03)	$1.64	.22* (.029)	$1.51
Livestock per Labour	-.0002 (.009)		-.0003 (.009)	
Material Inputs per Labour	.50* (.03)	$1.66	.47* (.03)	$1.56
Constant	22.20		32.60	
R^2	.72*		.78*	
F-Ratio	194.00		75.00	
Von Neuman	1.45*		1.85*	

[5]The correlation matrix is presented in Appendix I, Table XXVI.

equipment yielded marginal returns. This phenomena is difficult to explain since most farmers feel it would be more profitable to increase their land base rather than their machinery complement. The analysis will be divided into two time periods to see if there is any explanation. The livestock input is insignificant and the use of material inputs is consistent with previous results.

The results of separating the whole period into two sections are presented in Table XVII. During 1957-62 the real estate input was insignificant. The machinery and equipment variable was significant, livestock was insignificant and material inputs were significant. Throughout 1963-67 all the coefficients were significant and additional use of each input yielded marginal returns. The real estate input and livestock input yielded better returns in the second period than in the first. This is probably because of better management and increased use of material inputs.

Land would become more productive as the use of material inputs increased. It is difficult to determine why the sign and significance of the livestock input changed after 1962. However, throughout the period some farmers expanded towards larger livestock enterprises while others liquidated their investment. This would tend to result in an overall increase in efficiency. The better livestock managers tended to expand their scale of production whereas the less efficient livestock managers moved into crop production. The livestock enterprise was definitely returning a profit during the latter period.

From Table XIV one can see that the MVP for capital increased by $.41 from the first to the second period. This would largely be due to

TABLE XVII

PRODUCTION PARAMETERS AND MARGINAL VALUE PRODUCTIVITIES USING DISAGGREGATED CAPITAL AND COMBINED CROSS SECTION AND TIME SERIES DATA FOR TWO PERIODS, 1957-62 AND 1963-67[6]

Independent Variable	1957-62		1963-67[a]	
	Elasticity	MVP	Elasticity	MVP
Real Estate per Labour	.02 (.03)		.31* (.09)	$2.00
Machinery and Equipment per Labour	.16* (.04)	$1.39	.24* (.06)	$1.43
Livestock per Labour	-.02 (.02)		.02*** (.012)	$1.94
Material Inputs per Labour	.53* (.04)	$1.70	.35* (.06)	$1.20
Constant	43.20		11.90	
R^2	.60*		.66*	
F-Ratio	61.00		65.00	
Von Neuman	1.66*		1.25*	

[a] The correlation coefficient between real estate and machinery and equipment was .76 during this period. However, it was felt that this degree of multicollinearity would not present a problem of interpretation, especially in an agricultural production function where real estate and machinery would tend to be highly correlated over time.

[6] The correlation matrix is presented in Appendix I, Table XXVII.

the improved returns from the real estate input and the livestock enterprise.

During 1957-67 expansion of the capital base and increased use of material inputs was profitable for the average farmer in the Carman Farm Business Association. This would very likely be the result of better management and increased use of technology. Technological change was measured using the Solow or geometric model and the results are presented in Table XVIII. This table also indicates the annual change in the value of gross profit, material inputs, net production, the flow of services contributed by the capital stock and the physical labour input. These values are not deflated for price changes and the output is not adjusted for changes in weather. This should be considered when examining the results derived from the Solow model. However, in the econometric analysis, the parameters did not change significantly when the dummy variables were included to account for changes in prices and weather. Therefore, the measurement of long run technological change should be unbiased even if these factors are not accounted for.

The relative share of capital in gross profit was .309; the relative share of material inputs was .301 and the relative share of labour was .390 based upon the 1957-67 average. The results obtained from the value of net production indicate that the relative share of capital was .442 while the relative share of labour was .558, based upon the 1957-67 average. In both cases the relative share of labour is quite high. Since the share of labour is measured as the residual it would be relatively high because better management was able to extract more output from the available resources.

TABLE XVIII

MEASUREMENTS OF GROSS AND NET GEOMETRIC GROWTH RATES OF TECHNOLOGICAL CHANGE IN THE CARMAN AREA OF MANITOBA 1957-1967

Year	Gross Profit (Current Value) (1)	Material Inputs (Current Value) (2)	Net Value of Production (Current Value) (3)	Capital Service Input (Current Value) (4)	Labour (man-equivalents) (5)	Capital Share in Gross Output (6)	Capital Share in Net Output (7)	Material Inputs Share in Gross Output (8)	Labour in Gross Output (9)	Labour in Net Output (10)	Year-to-Year Rates of Change in Technology Gross Measure (11)	Year-to-Year Rates of Change in Technology Net Measure (12)	Cumulated Technological Change Gross Measure (GM) (13)	Cumulated Technological Change Net Measure (NM) (14)
1957	315230	93492	225738	92934	48	.291	.412	.293	.416	.588			1.000	1.000
1958	402567	124824	277743	107023	46	.266	.385	.310	.424	.615	.134	.198	1.134	1.198
1959	398291	126392	271899	110683	46	.278	.407	.317	.405	.593	.016	-.283	1.118	.915
1960	507000	141176	365824	128923	53	.254	.352	.278	.468	.648	.127	.663	1.245	1.578
1961	457148	179844	277304	145312	51	.318	.524	.393	.289	.476	-.282	-.291	.963	1.287
1962	587709	177716	409993	168016	47	.286	.410	.302	.412	.590	.269	.460	1.232	1.746
1963	560636	185668	374968	183063	48	.326	.488	.331	.343	.512	-.104	-.144	1.128	1.602
1964	613027	179004	434023	197790	57	.322	.456	.292	.386	.544	.015	.019	1.143	1.621
1965	762413	194880	567533	223685	47	.293	.394	.256	.451	.606	.244	.362	1.387	1.983
1966	627671	222460	405211	270948	47	.432	.669	.354	.223	.331	-.317	-.474	1.070	1.509
1967	1084145	277676	806469	325337	41	.300	.403	.256	.444	.597	.661	.985	1.731	2.494
1957-67 Average	574531	173012	401519	177610	48	.309	.442	.301	.390	.558				

Notes: Columns (6) and (7) are calculated as $\frac{(4)}{(1)}$ and $\frac{(4)}{(3)}$ respectively.

Column (8) = (2)/(1)

Column (9) = 1 - (6) - (8)

Column (10) = 1 - (7)

Column (11) = $\frac{\Delta(1)}{(1)}$ - (6) $\frac{\Delta(4)}{(4)}$ - (8) $\frac{\Delta(2)}{(2)}$ - (9) $\frac{\Delta(5)}{(5)}$

Column (12) = $\Delta(3)/(3)$ - (7) $\frac{\Delta(4)}{(4)}$ - (10) $\frac{\Delta(5)}{(5)}$

Column (13) and (14) are calculated from (11) and (12) respectively, with 1957 = 1.

Using the information in Table XVIII, it is possible to divide the total increase in the value of gross labour productivity (the value of gross profit per man-equivalent) into two parts: one part can be measured by the shift of the aggregate production function which results from technological change, and another is the movement along the production function attributable to both the increased use of capital per man-equivalent and material inputs per man-equivalent. One can also examine the change in the value of net labour productivity (the value of net production per man-equivalent). The total increase can be attributed to technological change and the increased use of capital per man-equivalent. The calculated share of the factors are given in Table XIX.

TABLE XIX

PERCENTAGE SHARE OF CAPITAL INTENSITY, MATERIAL INPUTS AND TECHNOLOGICAL CHANGE IN INCREASED GROSS AND NET LABOUR PRODUCTIVITY, IN THE CARMAN AREA, 1957-67[7]

Classification	Labour Productivity		Percentage Share of		
	Total Increase	Annual Increase	Capital Intensity	Material Inputs	Technological Change
	. . . . . per cent				
Gross	318	29	22	21	57
Net	298	27	22		78

The results indicate that there was a 318 per cent increase in the value of gross output per man-equivalent. Capital intensity accounted

[7]The method of calculation is presented in Appendix II.

for 22 per cent, material inputs for 21 per cent and technological change for 57 per cent. The increase in the value of net production per man-equivalent was 298 per cent with capital contributing 22 per cent and technology 78 per cent. The share of technological change is higher in net production since 21 per cent of the rise in the value of gross labour productivity has been attributed to material inputs.

Technology was definitely a dominant factor in growth. The ability to extract more production from a given bundle of inputs by better resource allocation and technical innovations certainly is a growth augmenting factor.

Having examined the nature of the production process and the specific factors that influence the generation of farm income, interest now centres on the allocation of this income between consumption and investment in additional capital.

THE CONSUMPTION FUNCTION

The coefficients of the independent variables in the Cobb-Douglas consumption function are the elasticities. They indicate the percentage change in consumption associated with a 1 per cent change in the independent variable to which they refer, other independent variables held constant.

Table XX presents the results of the annual cross section analysis from 1957-1967.

The parameters for disposable income are statistically insignificant from 1957 to 1961 indicating that the income level did not significantly influence consumption during this period. However, the average

TABLE XX

CONSUMPTION PARAMETERS, MARGINAL PROPENSITIES TO CONSUME AND AVERAGE PROPENSITIES TO CONSUME[8]

Year	Disposable Income	Family Size	Constant	R^2	F-Ratio	APC	MPC
1957	-.016 (.085)	.171 (.23)	21.9	.02	.28	.55	
1958	.010 (.08)	.479** (.21)	15.5	.19***	2.85	.48	
1959	.104 (.167)	.391** (.22)	12.7	.12	1.70	.56	
1960	.083 (.20)	.310 (.34)	16.0	.04	.58	.49	
1961	.001 (.107)	.194 (.33)	25.4	.02	.22	.72	
1962	.186*** (.14)	.233 (.20)	11.7	.10	1.48	.51	.095
1963	.215*** (.12)	.201 (.27)	12.3	.14	1.93	.58	.125
1964	.356* (.13)	.174 (.22)	7.8	.26))	4.50	.58	.206
1965	.287* (.11)	.314 (.21)	8.5	.31**	5.55	.42	.121
1966	.215** (.11)	.134 (.27)	20.4	.17***	2.58	.97	.209
1967	.139 (.188)	-.109 (.26)	34.6	.03	.30	.43	

[8]The marginal propensity to consume and average propensity to consume are abbreviated MPC and APC respectively. The MPC is calculated at the mean and therefore is the elasticity of disposable income multiplied by the APC. The MPC was not calculated if the coefficient for disposable income was insignificant.

propensity to consume indicates that consumption was quite proportional to income except in years of low income such as 1961 and 1966. This indicates that the competition between the household and farm business is particularily strong during this period, prior to accumulation of a margin large enough for the family to easily finance its needs in both areas. The farm family must maintain a certain level of consumption even though the income available does not justify it. This was revealed by the significance of the family size parameters. With an increase in family size the consumption level will increase even though income remains constant. During the period 1962 to 1967 the disposable income parameters were statistically significant for all the years except 1967. It would appear that consumption was influenced by the income level during this time period. But as income continually increases, (Table IV, Chapter IV), so does the margin for future capital accumulation as indicated by a relatively constant APC. Although consumption was influenced by income there seems to be more value placed on the margin for growth, as compared to consumption, at these higher income levels. The year 1966 was one of relatively lower income. The field crops looked good and they reached full maturity but most of them never were harvested because of the wet fall. The farm family would base their consumption on current income expecting to be able to harvest their crop. The crop failure likely affected their consumption pattern in 1967 resulting in the statistically insignificant parameter for income.

A phenomenon illustrated throughout and consistent with the "live poor - die rich" philosophy usually attributed to farmers is the low value of the marginal propensity to consume and average propensity to consume.

Table XXI presents the results from an analysis of a model utilizing a combination of time series and cross section data. The analysis is split into two periods 1957-62 and 1963-67.

All the variables in Table XXI are significantly different from zero at the 5 per cent level or better. It is difficult to determine why family size was not significant, however, lagged consumption may explain some of the variability in current consumption due to family size. The average propensity to consume for the farm families in the Carman area throughout 1957-62 was .54 and the marginal propensity to consume was .043. During 1963-67 the APC was .55 and the MPC was .055. In general, the farm families consumed about 55 per cent of their disposable income and saved the balance. The savings would most likely be used to retire debt and increase the equity in the farm business. To a large extent this would be "forced" savings, indicating why the marginal propensity to consume was so low. The MPC may also be low because only cash expenditures on consumption were included, farm perquisites were excluded. They were excluded because they would have biased the residual (savings) downward if they had been included in consumption expenditures. The significance of savings in the capital investment function will be examined in the next section.

THE INVESTMENT FUNCTION

Table XXII indicates the results from the annual cross section investment model for the years 1957-67.

The results from the cross section model indicate that the coefficient for current savings is statistically significant and is

TABLE XXI

CONSUMPTION PARAMETERS, MARGINAL PROPENSITY TO CONSUME AND AVERAGE PROPENSITY TO CONSUME UTILIZING CROSS SECTION AND TIME SERIES DATA[9]

Independent Variable	1957-62* Elasticity	MPC	APC	1963-67* Elasticity	MPC	APC
Real Disposable	.08** (.04)	.043	.54	.10** (.05)	.055	.55
Lagged Consumption	.63* (.07)			.48* (.07)		
Constant	2.77			5.23		
R^2	.41*			.34*		
F-Ratio	46.7			35.5		
Von Neuman Ratio	2.24*			1.97*		

*The parameter for family size was statistically insignificant during both periods. Thus it was deleted and the results shown are from a specification including only disposable income and lagged consumption.

[9]The correlation matrix is presented in Appendix I, Table XXVIII.

TABLE XXII

THE INVESTMENT COEFFICIENTS AND ELASTICITIES USING AGGREGATED CAPITAL STOCK, 1957-67

	Liabilities		Current Savings				
Year	b-value	Elasticity	b-value	Elasticity	Constant	R^2	F-Ratio
1957	.338 (.30)	.059	5.04* (.77)	.574	11958	.72*	21.9
1958	.003 (.526)	.0005	4.26* (1.05)	.572	15934	.50*	8.4
1959	.303 (.287)	.050	6.24* (.99)	.546	17227	.70*	19.9
1960	-.025 (.22)	-.005	4.74* (.86)	.592	18839	.77*	21.4
1961	-.229 (.220)	-.040	3.08* (.74)	.212	41167	.52*	9.4
1962	-.07 (.24)	-.010	2.01* (.56)	.204	45797	.44*	7.0
1963	.235 (.23)	.050	2.43* (.766)	.220	44829	.35*	5.1
1964	.023 (.27)	.004	3.11* (.797)	.284	47696	.49*	7.6
1965	.131 (.22)	.029	2.22* (.424)	.284	55018	.61*	15.0
1966	.201 (.200)	.050	1.17 (.96)	.069	77318	.21***	2.3
1967	-.106 (.21)	-.030	2.73* (.393)	.372	70403	.83*	39.7

positively related to capital investment. In 1966 the coefficient was low and statistically insignificant. This would be due to the poor crop situation in this area in 1966 resulting in a low amount of savings. The significance of the parameters illustrates that the farmers in the group were definitely "plowing" their savings back into capital investments. The production function analysis indicated that the farmers allocated their capital so its marginal value productivity exceeded the market price. The use of more capital was profitable while this situation prevailed. Along with additional profits the farmers were also benefiting from capital gains in land investment. This would provide an added incentive for them to invest their savings in land. The farmers were making rational decisions in purchasing more capital. However, the low average and marginal propensities to consume indicate that they did forego any meaningful increases in household expenditures in order to do so.

Liabilities do not seem to be related to capital investment in the cross section model. This is difficult to resolve, since credit is an important tool in expanding the capital base. Possibly it is not significant because the previous net worth position of the farmer is not included in the specification. Liabilities may be of more importance if this is included since a loan is made if a farmer's repayment ability is good, but, some of the farmer's net worth is usually taken as security. Previous net worth is included in the cross section - time series model and it will now be examined.

Table XXIII presents the investment parameters for the two time periods 1957-62 and 1963-67.

TABLE XXIII

INVESTMENT PARAMETERS USING CROSS SECTION AND TIME SERIES DATA FOR 1957-62 AND 1963-67[10]

Independent Variable	1957-62 b-value	1957-62 Elasticity	1963-67 b-value	1963-67 Elasticity
Liabilities	.94* (.12)	.16	.82* (.065)	.19
Savings	1.57* (.295)	.16	.89* (.15)	.09
Net Worth Lagged One Year	.55* (.05)	.53	.62* (.037)	.56
Constant	7233		12133	
R^2	.74*		.90*	
F-Ratio	87.60		308.30	
Von Neuman	1.35*		1.76*	

In both periods the three variables are statistically significant at the 1 per cent level or better. All three variables are highly related to capital investment and therefore have an influence on the growth in capital. Liabilities are statistically significant in this specification, indicating that the net worth position of the farmer, as well as his repayment ability, is important when he is involved in borrowing.

The results indicate that during the first period a one dollar increase in each of credit, savings and previous net worth would increase

[10]The correlation matrix is presented in Appendix I, Table XXIX.

capital investment by $.94, $1.57 and $.55 respectively. Throughout the second period a one dollar increase in each of credit, savings and previous net worth would increase capital investment by $.82, $.89 and $.62 respectively. A dollar increase in savings was associated with a smaller increase in investment in the latter period than in the former. The elasticities indicate that a 10 per cent increase in savings increased capital investment by 1.6 per cent in the first period and only .9 per cent in the second period. During the second period the savings were higher and the money left after payment on capital investment was invested off the farm.

The production process generates income for consumption and savings. The various factors influencing the production necessary to generate net income have been examined. An indication of how this income is allocated, between consumption and investment, has been made in the consumption and investment analysis. In the next section these results are all combined to indicate the nature of the growth process of the family farm.

THE NATURE OF THE GROWTH PROCESS OF THE FAMILY FARM

In this section the results of the two time periods are presented in equation form. The recursiveness of the system is illustrated by combining the three equations into one model. The value of the variables, typical for an average farm, are incorporated in this model and the results are presented in Appendix III. These results are used in the farm business growth equation presented in this section.

The first time period from 1957-62:

$$\hat{YG} = 1.42\ K^{.36}\ MI^{.38}\ L^{.18} \qquad (1)$$

$$\hat{C}_t = .443\ YD^{.08}\ C_{t-1}^{.63} \qquad (2)$$

where $YD = \hat{YG} - [MI + O + D + HL + ID + TX + IK]$

where O = Overhead

D = Depreciation

HL = Hired labour cost

ID = Interest on debt

TX = Income tax

IK = Income in kind

$$\hat{I}_t = 7233 + .94\ Cr_t + 1.57\ S_t + .55\ NW_{t-1} \qquad (3)$$

where $S_t = YD - \hat{C}_t + D$

Substituting (1) into (2) and then (2) into (3):

$$\hat{I}_t = 7233 + .94\ Cr_t + 1.57\ [YD - .443\ [(1.42\ K^{.36}\ MI^{.38}\ L^{.18}) - (MI + O + D + HL + ID + TX + IK)]^{.08}\ C_{t-1}^{.63} + D] + .55\ NW_{t-1}$$

The farm business growth equation for 1957-62:

$$g = (1 - t)(1 - c)[r + (r - i)\ D/E]$$

$$g = (1 - .15)(1 - .49)[.090 + (.090 - .05)\ .19]$$

$$g = (.85)(.51)[.090 + .0076]$$

$$g = .4335\ (.0976)$$

$$g = .0423$$

$$g = 4.23\%$$

The second time period from 1963-67:

$$\hat{YG} = .689\ K^{.55}\ MI^{.38}\ L^{.22} \qquad (4)$$

$$\hat{C}_t = .719\ YD^{.10}\ C_{t-1}^{.48} \qquad (5)$$

where $YD = \hat{YG} - [MI + O + D + HL + ID + R + TX + IK]$

where R = cash rent

$$\hat{I}_t = 12133 + .82\ Cr_t + .89\ S_t + .62\ NW_{t-1} \qquad (6)$$

Substituting equation (4) into (5) and then (5) into (6):

$$\hat{I}_t = 12133 + .82\ Cr_t + .89\ [YD - .719\ [(.689\ K^{.55}\ MI^{.38}\ L^{.22}) - (MI + O + D + HL + ID + R + TX + IK)]^{.10}\ C_{t-1}^{.48} + D] + .62\ NW_{t-1}$$

The farm business growth equation for 1963-67:

$$g = (1 - .17)\ (1 - .54)\ [.084 + (.084 - .05)\ .35]$$

$$g = (.83)\ (.46)\ [.084 + (.034 \times .35)]$$

$$g = (.382)\ (.084 + .0119)$$

$$g = .0366$$

$$g = 3.66\%$$

Throughout the first time period the rate of growth in farm equity was 4.23 per cent. The farm families consumed 49 per cent of their disposable income and with a return to total capital of 9.0 per cent, invested in additional capital to generate future income. The

growth in equity during the second period was slightly lower because of a small increase in both the rate of consumption and the tax rate. The debt to equity ratio was higher in the second period. This increase would raise the rate of growth in equity, partially offsetting the decrease from the rise in consumption and income tax.

CHAPTER VI

SUMMARY AND CONCLUSIONS

This study has investigated the family farm's production, consumption and investment decisions with a view to estimating the parameters of the underlying system. These parameters revealed the relationship between the dependent and independent variables indicating the nature of the growth process of the family farm.

An examination of the data, on the 28 farms in the Carman area of Manitoba, indicated that there had been remarkable economic growth throughout 1957-67. The average value of gross output in 1967 was $38,719, a 240 per cent increase over the $11,401 in 1957 (Table III, Chapter IV). The farm families' standards of living have increased as reflected by the rise in expenditure on consumption (Table X, Chapter IV). However, the farmers were also able to acquire large capital investments necessary to generate the output (Table VI, Chapter IV).

Various factors affecting production, consumption and investment have been identified. With respect to production the expansion in capital has been beneficial. However, there is no rationale for increasing the machinery and equipment investment unless the land base is also expanded. If a farmer has a good complement of machinery he should not make additional purchases even though he expands his land by either buying or renting. Since the annual fixed costs of the machinery remain constant the total cost per hour can be reduced by increasing the amount

of use. The coefficients for machinery and equipment were statistically insignificant for the years 1959 to 1961 inclusive (Table XV, Chapter V). This is probably because the expenditure on machinery increased at a faster rate than expansion in improved acres (Tables V and VII, Chapter IV) resulting in a high fixed cost for machinery relative to the value of gross profit. The livestock enterprise has become more profitable over time. The marginal returns to livestock were negative during 1957-62 but were positive throughout 1963-67 (Table XVII, Chapter V). Although livestock seemed to have inhibited growth in the first period the cash generated from livestock production during 1963-67 undoubtedly was growth augmenting.

The additional expenditure on material inputs was very beneficial throughout the whole period. The farmers increased their gross profit by using more material inputs. The use of material inputs is also much more flexible than capital investments. If prices change the use of material inputs can be altered accordingly and with less difficulty than capital.

The labour input remained quite constant throughout while gross profit increased substantially (Table XVIII, Chapter IV). This indicates an increase in labour productivity and illustrates the need for additional use of material inputs and capital on many submarginal farms. The increase in labour productivity is measured by the Solow model.

The results of the Solow model indicate an increase in the value of gross labour productivity of 318 per cent with a 298 per cent increase in the value of net labour productivity (Table XIX, Chapter V). Technological change contributed 57 per cent of the increase in the value of

gross labour productivity and 78 per cent of the increase in the value of net labour productivity. The share of technological change was larger in the net model than in the gross model due to the influence of material inputs. The percentage share of material inputs in gross labour productivity was 21 per cent, whereas that of capital was 22 per cent. The share of material inputs is very close to that of capital. However, material inputs do not require the large, long term financial commitments that capital does.

Technology has had a definite impact on farm growth. It permits the substitution of knowledge for resources and can result in substantial increases in output with only moderate increases in capital. A farmer's knowledge or managerial ability would be very closely related to technology. The most likely reason why the share of technology in output is quite high, for the Carman group, would be their increased managerial ability gained from membership in the Business Association.

The consumption model indicates the amount of income withdrawn from the business by the household. The results reveal that both the marginal propensity to consume and the average propensity to consume are quite low. However, this is consistent with the philosophy of "forced savings" often attributed to the farmer. Farm perquisites were not included in consumption expenditures and this may be one reason why the MPC and APC are quite low. Consumption of home grown items would likely be high if the farm family had a large debt to repay. The income within the firm-household was of major interest so farm perquisites were not considered. Throughout the period consumption was quite proportional to income except in years of low income such as 1961 and 1966. In these

years the APC was high indicating that current consumption is not necessarily reduced even though current disposable income declines. Individuals become accustomed to a certain level of living due to the habits and customs they have previously enjoyed and this produces an inertia in their behaviours. The significance of the lagged consumption variable also illustrates this phenomena. The results of the cross section model indicate that during the early years of the study period, when incomes were lower, there was very little relationship between income and consumption (Table XX, Chapter V). The family would have to maintain a certain minimum level of consumption irregardless of the income level. As income increases less emphasis may be put on consumption since the required minimum can easily be met. During the latter part of the study period, 1963-67, income was higher and consumption was more closely related to income. Consumption rose above the minimum required level but all income was never consumed since a portion of it was used to retire debt.

The retained earnings that the farm generates are used to retire existing debt which a farmer incurs when he makes a capital investment. A farmer seldom has enough savings accumulated to independently make a capital purchase. He must rely on agricultural credit institutions to provide him with borrowed funds. After the investment has been made the creditor is repayed from the savings that the farm generates. The savings not used to retire debt are often put into bank accounts and/or used to purchase bonds. This portion of savings becomes a part of the farmer's net worth which is included in the investment relationship. Retained earnings or savings were statistically significant indicating

that capital investment was influenced by the farm's retained earnings. The cross section and time series model indicates that investment in capital was also highly dependent on credit (Table XXIII, Chapter V). This was revealed by the statistical significance of the variable measuring the financial liabilities within each farm. The lagged net worth position of the farmer was also statistically significant. It influences investment in capital since some of the farmer's net worth is usually taken as security by the creditor. It is also important since non-farm savings are a part of net worth and they may sometimes be used as partial payment for an asset.

The family farm unit is an extremely interdependent system. Production is dependent on capital, material inputs, labour, management and technology. The level of production influences the livelihood of the family. However, if all production is consumed by the family no income is left for expanding the unit. The results of the analysis reveal that as the unit expands income increases. Therefore, the farmer must make wise decisions in allocating the income between household and business. If too much income flows to the household production can be reduced, but, an unwise investment decision can have the same effect. Therefore both the amount of income allocated and the investment decision is important. The 28 farm families in the Carman Farm Business Association consumed about 50 per cent of their disposable income and invested the balance. Their rate of growth in equity ranged from 3.95 to 4.23 per cent, throughout the total period.

IMPLICATIONS OF THE RESULTS

The objective of the study was to examine the nature of the growth process of the family farm business and to suggest means which could be taken to increase farm income. An increase in income would help eliminate the low standard of living experienced by many of today's farm families. The analysis reveals that farm income will rise if the scale of operation and use of material inputs is increased. However, an increase in these items will not generate income unless there is a "catalyst" to aid the transformation. The "catalyst" being in the form of good farm management leading to optimum production, aggressive marketing of the farm products, a system of record keeping and good financial management.

Given that a farmer is a good manager it will be profitable for him to expand his land and building base. However, if the real estate base is not expanded a farmer should attempt to operate the farm with the machinery he has available. Since annual farm savings are an important part of investment the farmer must examine the amount of income he has after paying for current operating expenses and household needs. He should base his decision to invest in machinery on the amount of savings generated from the farm unit. If a farmer wishes to buy land he must consider whether additional net income will be generated from the purchase. Financial leverage or the use of credit can be helpful to a farmer but he should always examine his repayment capacity before going into debt. If a farmer borrows, but, does not have the ability to repay he will inevitably find himself in a financial "straight jacket".

In addition to a crop enterprise a farmer may also wish to have

a livestock operation. Diversification is a good means of reducing risk and the fluctuation in annual income. If a crop failure occurs the livestock enterprise should generate enough income to meet the farmer's requirements. However, the individual farmer must decide on the best use for the land. If the land is better suited for crop production a farmer would be better off to specialize in a crop enterprise, rather than have a livestock enterprise as well. Some savings earned in good years could be channeled into off-farm investments which would be available if a crop failure occurred in later years.

The importance of material inputs strongly suggests that all farmers must utilize these inputs to increase their gross profit. Theoretically, these inputs should be used to the point where their marginal return is equal to their market price. However, due to changes in prices and weather it may not be feasible for a farmer to attempt to reach this point. Often a farmer may not have the necessary capital to purchase annual material inputs, however, it would be profitable for him to borrow money to purchase these inputs.

Since good management is of major importance the government must continue to provide courses which will increase the farmers' managerial ability. However, low income farmers often do not respond well to group sessions. For this type of farmer there seems to be a need for more personal contact with agricultural specialists. Many farmers who do not use credit to a large extent will not encumber their existing equity. Without the use of debt leverage a farm will expand very slowly and sometimes not at all. To help these operators expand there seems to be a need for guaranteed credit that would be supervised. This could

change the farmers' attitude towards the use of credit as well as increase their level of managerial ability. With this help many uneconomic units could soon emerge as commercial farms.

The introduction of legislation involving a guaranteed form of income or income maintenance may also be helpful in the development of a farm unit. If a farmer were assured of a given income he should be more willing to experiment with new cultural practices. This could include using fertilizer, purchasing registered seed, using artificial insemination to upgrade his herd and other practices which add to the basic income. However, if the farmer does not have this certain income he may not want to purchase these material inputs because of the risk involved. If these inputs would not prove to be beneficial the whole family might suffer since the income used to purchase the inputs would have been used in the home.

The successful family farm can generate a gross profit large enough to meet annual operating expenses, provide the family with a respectable standard of living and have savings left to retire debt as well as influence additional investment. However, the family farms of today require quite large amounts of capital to operate effectively. By 1967 the farms being analyzed were generating a large output, but, they were also becoming highly capitalized. This brings up a problem unique to agriculture - the "biological cycle" through which the family farm goes once every generation. Farms with large capital investments are often turned over to the next generation. This presents problems of long and intermediate term financing as well as tax complications. There is a definite need for an arrangement to transfer the resources

from one generation to the next without destroying the benefits derived from the existing size. The corporate structure may well be the best vehicle for transferring control and assets from the father to other members of his family.

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APPENDIX I

THE INTERCORRELATION COEFFICIENTS

TABLE XXIV

THE INTERCORRELATION COEFFICIENTS BETWEEN THE VARIABLES OF THE PRODUCTION FUNCTION USING AGGREGATED CAPITAL FOR THE TOTAL PERIOD, 1957-67.

	YG	K	MI	L
YG	1.00			
K	.82	1.00		
MI	.78	.65	1.00	
L	.34	.23	.31	1.00

TABLE XXV

THE INTERCORRELATION COEFFICIENTS BETWEEN THE VARIABLES OF THE PRODUCTION FUNCTION USING AGGREGATED CAPITAL FOR TWO TIME PERIODS, 1957-62 AND 1963-67

1957-62

	YG	K	MI	L
YG	1.00			
K	.53	1.00		
MI	.78	.58	1.00	
L	.40	.48	.44	1.00

1963-67

	YG	K	MI	L
YG	1.00			
K	.67	1.00		
MI	.76	.62	1.00	
L	.35	.28	.28	1.00

TABLE XXVI

THE INTERCORRELATION COEFFICIENTS BETWEEN THE VARIABLES OF THE PRODUCTION FUNCTION USING DISAGGREGATED CAPITAL FOR THE TOTAL PERIOD, 1957-67. THE VARIABLES ARE IN TERMS OF PER MAN-EQUIVALENT.

	YG	RE	ME	LLK	MI
YG	1.00				
RE	.80	1.00			
ME	.80	.74	1.00		
LLK	.13	.00001	-.01	1.00	
MI	.81	.67	.61	.22	1.00

TABLE XXVII

THE INTERCORRELATION COEFFICIENTS BETWEEN THE VARIABLES OF THE PRODUCTION FUNCTION USING DISAGGREGATED CAPITAL FOR TWO TIME PERIODS, 1957-62 AND 1963-67. THE VARIABLES ARE IN TERMS OF PER MAN-EQUIVALENT.

1957-62

	YG	RE	ME	LLK	MI
YG	1.00				
RE	.52	1.00			
ME	.51	.52	1.00		
LLK	.14	.07	-.03	1.00	
MI	.72	.36	.23	.29	1.00

1963-67

	YG	RE	ME	LLK	MI
YG	1.00				
RE	.80	1.00			
ME	.77	.76	1.00		
LLK	.18	-.01	.01	1.00	
MI	.79	.66	.58	.24	1.00

TABLE XXVIII

THE INTERCORRELATION COEFFICIENT BETWEEN THE VARIABLES OF THE CONSUMPTION FUNCTION FOR TWO TIME PERIODS, 1957-62 AND 1963-67

	1957-62				1963-67			
	C_t	YD	C_{t-1}		C_t	YD	C_{t-1}	
C_t	1.00			C_t	1.00			
YD	.20	1.00		YD	.33	1.00		
C_{t-1}	.54	.05	1.00	C_{t-1}	.58	.46	1.00	

TABLE XXIX

THE INTERCORRELATION COEFFICIENT BETWEEN THE VARIABLES OF THE INVESTMENT FUNCTION FOR TWO TIME PERIODS, 1957-62 AND 1963-67

	1957-62					1963-67				
	I_t	Cr_t	S_t	NW_{t-1}		I_t	Cr_t	S_t	NW_{t-1}	
I_t	1.00				I_t	1.00				
Cr_t	.01	1.00			Cr_t	.49	1.00			
S_t	.58	-.15	1.00		S_t	.78	.46	1.00		
NW_{t-1}	.68	-.54	.42	1.00	NW_{t-1}	.67	-.20	.43	1.00	

APPENDIX II

THE PROCEDURE FOR CALCULATING THE COMPONENT SHARE IN LABOUR PRODUCTIVITY

The rise in net and gross profit per man-equivalent throughout the period 1957-67 is calculated as:[1] YN = YN (1967) - YN (1957) and YG = YG (1967) - YG (1957), respectively, where YN is net labour productivity and YG is gross labour productivity.

Net and gross labour productivities in 1967 are deflated by their respective technological change indices, GM (1967) and NM (1967) in Chapter V (Table XVIII) to obtain net and gross labour productivity with technological change removed. The excess of this over net labour productivity in 1957 is the increase imputed to capital (K) intensity, whereas the excess over gross labour productivity in 1957 is the increase imputed to capital intensity and material inputs (MI), i.e.,

$$YN, K = YN\ (1967) / NM\ (1967) - YN\ (1957) \quad \text{and}$$

$$YG, K \text{ and } MI = YG\ (1967) / GM\ (1967) - YG\ (1957)$$

The share imputed to each of K and MI is calculated using the 1957-67 average share of these inputs in gross output in Table XVIII.

The remainder of the increase is imputed to technological change (T), i.e.,

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[1] M. H. Yeh and Lew-king Li, "Technological Change in Canadian Agriculture," Research Report No. 15 (University of Manitoba, 1968), p. 28.

YN, T = YN - YN, K and

YG, T = YG - YG, K and MI

APPENDIX III

THE RECURSIVE SYSTEM AND THE FARM GROWTH PROCESS.

The values used in the computation or accounting procedure are typical of the average family farm in the two time periods. The values were obtained from the raw data.

The first time period from 1957-62:

$$\log \hat{YG} = 1.42 + .36 \log K + .38 \log MI + .18 \log L$$

$$K = \$4460$$

$$MI = \$5020$$

$$L = 1.6$$

$$\log \hat{YG} = 1.42 + .36 \log 4460 + .38 \log 5020 + .18 \log 1.6$$

$$\log \hat{YG} = 1.42 + .36\ (3.6493) + .38\ (3.7007) + .18\ (.2041)$$

$$\log \hat{YG} = 4.1766$$

$$\hat{YG} = \$15{,}020$$

Net Income (YN) = $\hat{YG}$ - (MI + Overhead + Depreciation + Hired Labour Cost + Interest on debt)

MI	= $5020
Overhead	= $1050
Depreciation	= $1300
Hired Labour Cost	= $ 350
Interest on Debt	= $ 375

YN = 15,020 - (5020 + 1050 + 1300 + 350 + 375)

YN = $6,925

Total Income = YN + Off Farm Income

= $6925 + $600

Total Income = $7525

The average farm family was comprised of the farmer, his wife and two children aged 5 and 7.

For income tax purposes the farmer's basic exemption was $1100, he could claim an additional $1000 for his wife and $300 for each of the children.

Taxable income = $7525 - (1100 + 1000 + 600)

Taxable income = $4825

Tax paid = $1046

Disposable Income including income in kind = $7525 - $1046

= $6479

Disposable Income (YD) = $6479 - $300 = $6179

$$\log \hat{C}_t = .443 + .08 \log YD_t + .63 \log C_{t-1}$$

Real YD_t = $63.70

Real C_{t-1} = $27.80

$$\log \hat{C}_t = .443 + .08 \log 63.70 + .63 \log 27.80$$

$$\log \hat{C}_t = .443 + .08 (1.8041) + .63 (1.4440)$$

$$\log \hat{C}_t = 1.4970$$

Real $\hat{C}_t$ = 31.41

$\hat{C}_t$ = $3047

$$\hat{I}_t = 7233 + .94\ Cr_t + 1.57\ S_t + .55\ NW_{t-1}$$

$$Cr_t = \$7500$$

$$S_t = YD - C_t + \text{Depreciation}$$

$$S_t = \$4432$$

$$\hat{I}_t = 7233 + .94\ (7500) + 1.57\ (4432) + .55\ (47000)$$

$$\hat{I}_t = \$47,091$$

$$\text{The farmer's equity capital} = \hat{I}_t - Cr_t$$

$$= \$47,091 - \$7,500$$

$$= \$39,591$$

If the consumption expenditures are considered as payment for the operator's work and management then the residual return to total capital (I) is the net income, except for interest, less the consumption expenditures.

$$\text{Return to total capital} = \frac{7300 - 3047}{47091} \times 100 = 9.0\%$$

$$\text{The average propensity to consume} = \frac{3050}{6261} = .49$$

$$\text{The income tax rate} = \frac{1046}{6925} \times 100 = 15\%$$

$$\text{The debt to equity ratio} = \frac{7500}{39591} = .19$$

The seond time period from 1963-67:

$$\log \hat{YG} = .689 + .55 \log K + .38 \log MI = .22 \log L$$

$$K = \$9550$$

$$MI = \$8670$$

$$L = 1.60$$

$$\log \hat{YG} = .689 + .55 \log \$9550 + .38 \log 8670 + .22 \log 1.60$$

$$\log \hat{YG} = .689 + .55\ (3.980) + .38\ (3.938) + .22\ (.2041)$$

$$\log \hat{YG} = 4.4193$$

$$\hat{YG} = \$26,260$$

Net farm income = $\hat{YG}$ - (MI + Overhead + Depreciation + Hired Labour Cost + Interest on debt + Cash rent)

MI	= $8670
Overhead	= $1550
Depreciation	= $3580
Hired labour cost	= $ 600
Interest on debt	= $ 900
Cash rent	= $1280

Net farm income = 26260 - (8670 + 1550 + 3580 + 600 + 900 + 1280)

Net farm income = $9680

Total income = Net farm income + off farm income

Total income = $9680 + $500

= $10,180

The average farm family in this time period was comprised of the farmer, his wife and three children ages 4, 11 and 13.

The farmer's basic exemption was $1100 an additional claim of $1000 for his wife and $300 for each of the children.

Taxable income = $10,180 - (1100 + 1000 + 900)

Taxable income = $7180

Tax paid = $1678

Disposable income including income in kind = \$10180 - \$1678

= \$8502

Disposable income (YD) = \$8502 - \$175

YD = \$8327

Real YD_t = 80.22

Real C_{t-1} = 32.40

$\log \hat{C}_t = .7190 + .10 \log 80.22 + .48 \log 32.40$

$\log \hat{C}_t = .7190 + .10\ (1.9043) + .48\ (1.5105)$

$\log \hat{C}_t = 1.6344$

Real $\hat{C}_t = 43.19$

$\hat{C}_t = \$4483$

$\hat{I}_t = 12133 + .82\ Cr_t + .89\ S_t + .62\ NW_{t-1}$

$S_t = \$8327 - \$4483 + \$3580$

$S_t = \$7424$

$Cr_t = \$18,730$

$NW_{t-1} = \$62,742$

$\hat{I}_t = 12133 + .82\ (18730) + .89\ (7424) + .62\ (62742)$

$\hat{I}_t = \$72,999$

The farmer's equity capital = $\hat{I}_t - Cr_t$

= \$72999 - \$18730

= \$54269

Return to total capital $= \frac{10580 - 4483}{72999} \times 100 = 8.35\%$

The average propensity to consume $= \frac{4483}{8327} = .54$

The income tax rate $= \frac{1678}{10180} \times 100 = 17\%$

The debt to equity ratio $= \frac{18730}{54269} = .35$