CAPITAL INVESTMENT ON WEST SCOTLAND DAIRY FARMS

by

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Submitted for the Degree of Master of Letters

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July 1975

Acknowledgements

The author wishes to acknowledge the guidance of his supervisor, Professor G. Houston, during the preparation of this report. He is indebted to the Economics Division of the West of Scotland Agricultural College for the facilities provided, without which the study would not have been possible, and in particular thanks are due to Mr. R. W. T. Hunt for his advice and encouragement.

Thanks are also due to Dr. J. E. Bessell, of Nottingham University, for guidance on the econometric aspects of the report and to colleagues within the Division for their advice and constructive criticism. Finally, the author wishes to thank the farmers who willingly undertook to answer survey questions and also the typists of Economics Division, who like my wife, showed great patience and forebearance.

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SUMMARY

Problems of capital investment on West Scotland dairy farms are examined in this study. The need to increase the input of tenants capital to attain an optimum allocation of capital and the methods of so doing, are considered.

Econometric models, regression analysis, and a farmer survey were used to establish the capital situation of dairy farmers in 1969-71 with respect to the existing allocation and sources of capital, the relationship between capital and output, and the attitude to investment.

The study indicated that net capital formation in the order of £3400 and £8800 was required to optimise the average owner occupier's and tenant's input of tenants capital. Potential sources of cash to meet this cash requirement were farm income, increased borrowing, and Government assistance. The contribution of, and constraints on, these sources of funds were considered in detail. This analysis was aided by the farmer attitude survey.

It was concluded that many farmers experience difficulty in optimising their tenants capital input due to their low income position and the existence of a capital formation versus consumption cycle. Government assistance is probably required if the efficiency of capital deployment on West Scotland dairy farms is to be improved.

CHAPTER I

INTRODUCTION

1.1. The Capital Problem and Aims of the Study

During the last three decades the United Kingdom agricultural industry has been exhorted by successive Governments to increase production and/or increase efficiency through reduced costs of production. Indeed, the current situation (Spring 1975) is such that the Government wish to continue to emphasise the need for expansion and capital investment in agriculture[(1)]. The individual farmer faced with an expansionary situation has been encouraged, through the availability of capital grants, to see increased capital intensity as the means of achieving the required expansion.

The declared objectives of Government agricultural policy create an economic problem at both the macro and micro levels of the agricultural industry -
The macro economic problem has two main components. Firstly, what amount of the nation's scarce capital resources should be devoted to the agricultural industry? Currently, this balance is strongly influenced by the relative cost of imported food to home produced food; the balance has recently moved more in favour of home agriculture than in 1969-71[(2)] (the period of the present study). Secondly, how is it best to achieve the desired result with the resources available? This latter problem entails determining which sectors of agriculture are to be favoured and the policy instruments to adopt. Dairying has been singled out in 1975 as one of the main areas for expansion and capital investment[(3)], thus the study of capital investment on West Scotland dairy farms is relevant to the renewed emphasis on dairy farm production and investment. This study indicates that the existing more intensively capitalised farms provided a higher return on capital invested and this suggests that Government measures to improve the efficiency of production from dairy farms should be specific in their operation.

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(1) Food from our Own Resources White Paper Cmnd. 6020 HMSO, April 1975, para. 56 p. 17

(2) Ibid., para. 24 p. 7

(3) Ibid., para. 47 p.14

The micro-economic problem faced by the average dairy farmer in 1969-71 was the difficulty involved in obtaining capital and servicing loans. This difficulty in servicing loans arose from insufficient cash flow. Recently farm cash flows have been aggravated by an increase in capital values and interest rates on borrowed capital. To solve the cash flow problem, increased levels of funding are required until the additional output from capital investment flows into the business. In the period subsequent to that studied, dairy farming has been subject to rising costs but these have been largely offset by an increase in the value of output. The year 1973 was "very good" for the dairy farmer as high cattle prices inflated the value of the output and the full effect of cost increases, especially those of feeds and fertilisers, was not being felt at that time. The first half of 1974 was characterised by very rapid escalation of feed, fertiliser and fuel costs, coinciding with falling prices for cattle sales. Currently, feed prices are showing a down-turn but not before an adverse effect has been felt on farm incomes in 1974-75. Although the circumstances may be changed, it is considered that the problems facing dairy farmers in 1969-71, and the methods of examining these problems, are still relevant at the present time. Based on the findings for West Scotland dairy farmers in 1969-71, the success of the Government plan to expand milk production through increased capital intensity financed from within the industry itself must hinge on the creation of "reasonable profitability"(4) as, under the existing conditions, the capacity of the industry to self-finance the required investment must be questioned.

The main aim of the study can now be stated as an examination of the role of capital within the dairy farming industry of West Scotland in order to formulate a means whereby dairy farmers can operate more effectively within the constraints imposed by Government, managerial ability and the physical/financial farming situation.

(4) Ibid., para. 52 p. 16 "given reasonable profitability, it should be within the industry's capacity to finance this."

At the level of the individual farmer, the solution to an inadequate income is often to increase his volume of production. In most cases, the desired increase in production can be achieved only through an increase in capital intensity. The provision of capital resources therefore assumes major importance to the average dairy farmer in West Scotland. A farmer's capacity to finance new capital developments depends initially on the credit worthiness of his business and on his existing income, which is important both to service new loans and as a source of saving for investment. One of the primary tasks of the study, therefore, was to estimate the capital structure of dairy farming in West Scotland, on which security for any further loans for expansion would be based. When the existing capital structure and farm output are known, it is also possible to determine the relationship between capital and output, thereby enabling an assessment of the adequacy of the return on capital. The effective use of capital resources is dependent on the optimum allocation of capital. It was felt important, therefore, to estimate the optimum input of tenants capital for the average dairy farmer. When this optimum level of capital was ascertained, it was possible to indicate that the average dairy farmer in West Scotland was not operating at the optimum capital input: in fact, he was under-capitalised. In view of the under-capitalisation which existed, a major area of investigation of the study was an assessment of the sources of capital available to the dairy farmer, and whether or not the average farmer was able to self-finance, or borrow, adequate funds to move to an optimum capital input position. A capital formation versus consumption cycle can be seen to exist on many West Scotland dairy farms, from which it would be difficult for the farmers involved to "break free". The existing measures of Government assistance - in the form of capital grants - to such farmers are examined, and the future role of the Government in the provision of capital is considered. Since decisions to invest are dependent on the philosophy of the farmer towards capital formation, an attitude survey was conducted which cast doubt on whether many farmers take account of, or are aware of, the relationship between capital input and the output achieved. Such a situation acts as a constraint on the optimum allocation of capital resources and leads to the possible need for farm management advice.

The main part of the study deals with capital at the level of the individual farmer but it is also relevant to examine the level of capital investment in the industry as a whole. Estimating the stock of capital utilised by Scottish and West Scotland agriculture allows comment on the short term changes in asset structure and also allows the capital situation of West Scotland dairy farmers to be placed in context.

1.2. Concepts of Capital Relevant to the Study

Capital is derived from that part of the output of a production process which is not immediately consumed. The value of this output is stored, in the form of money, that it may be used in a future period to create additional wealth but, before any additional wealth will be forthcoming, the money capital requires to be transformed into real assets or physical capital goods which will remain in existence over a given time period. These assets will contribute a diminishing amount of services to the production process and will ultimately require replacement.

The future capital of agriculture is derived mainly from the present output of the industry. This output is the result of a factor input mix of existing capital, labour, land and enterprise. Capital can therefore be considered as a factor input, in addition to being unconsumed output.

In its role of factor of production, capital creates a conceptual problem as to whether it should be considered as a physical input or as supplying an intangible service. The answer must be both, depending on the circumstances. In the context of planning production possibilities, capital must be considered a physical resource e.g. the availability of X machines or Y tons of fertilisers. If, however, capital is viewed in the context of input/output analysis, then the capital input is rendering an intangible service. This situation pertains because capital is not normally required for its own sake, (excepting status capital e.g. buildings) but for the service it renders in increasing the efficiency of the production process e.g. to increase labour efficiency, to permit more timely farming operations, etc. Capital in this context can be viewed as an extention of the labour input in a production process.

A further theoretical concept which is relevant to this study is the Marginal Theory of Distribution. Application of this principle to the capital input in a production process introduces the concepts of Marginal, Average, and Total Capital. Marginal capital is normally defined as the additional capital introduced into a farm business as a result of an investment decision by the farmer. Average capital is the average of the opening and closing values of capital utilised on a farm, but this concept can be extended to account for monthly variations in capital input. Total capital represents the value of all farm assets at any selected point in time. These concepts of capital have important practical implications in the forward planning of a farm business i.e. in estimating the return on capital and the profitability of capital investment in the business. In determining whether a change in the capital invested in a business would be profitable or not, the return on Marginal capital would be the appropriate choice indicator, whereas an estimation of the efficiency of existing capital deployment is best evaluated using either the average or total capital input to the business.

The principal value of considering theoretical concepts of capital is that it aids clarity of thought in the formulation of investment models, i.e. it allows the logic of a model to be developed to indicate sequences of causation. The quantification and application of investment models, such as are developed later in this study does, however, require the theory outlined above to be translated into practical terms i.e. methods of measuring marginal capital, replacement and additional capital formation, and the capital invested in a farm business, must be determined.

Theory suggests capital to be a physical resource or a 'service rendered' in the production process. Since capital is not just an amorphous mass, but exists in many definite forms and performs multifarious services, some method of valuing the input of capital to the production process must be introduced: most frequently this measure is money. Measuring capital has its own attendant problems, hence this aspect is discussed separately in Section 1.3.

Two distinct approaches to capital are indicated from the theoretical concepts discussed. Firstly, capital is required in a business to create additional output, and secondly, capital may be viewed as a component of the output produced by a business. The practical implication of the first distinction is the need to analyse the determinants of farm output and the factors which govern the allocation of this output between investment and consumption - this aspect forms the basis of the study undertaken in Chapter VI. ("The Source and Distribution of Funds on Dairy Farms"). The second distinction, where capital is considered as a factor input, requires a study of the relationship between capital input, and the output achieved - this is undertaken in Chapters IV and V ("The Capital Stock of Dairy Farms and its Contribution to their Productivity" and "The Efficiency of Capital Deployment").

The theoretical concepts of average and total capital have practical applications in the measurement of the efficiency of capital deployment, and the concept of marginal capital is important in the area of future farm planning as it leads directly to partial budgeting, where, for example, the effect on the farm business of an extra cow could be examined. The application of the theory of marginal productivity of capital involves practical problems of capital input measurement etc., which are considered to merit a separate discussion (Chapter V Section 5.6 - The Marginal Productivity of Capital).

In conclusion, the concept of capital used in this study must be one which is flexible, thus allowing capital to be defined according to the prevailing circumstances and the nature of analysis being undertaken.

1.3. <u>The Problem of Measuring Capital and Investment in Agriculture</u>

In a study which has as its prime object the investigation of capital and investment in dairy farming, it is imperative to consider the problems associated with the measurement of capital and investment.

1.3.1. Measuring Capital

The problem of measuring capital arises because the resource capital is not 'used up' in one operation; it can be used more than once in the production process, thus time is involved.

Time introduces two main difficulties to the measurement of capital. Firstly, the age of the capital item must be considered, as over a period its productivity will decline e.g. the services rendered by a five year old machine will be less than a new machine. Secondly, time introduces uncertainty as to the future revenue created by the capital, due to yield variation factor and product price changes etc.

In practice, the means used to measure the value of capital is partly determined by the purpose of the measurement. The approach to capital measurement is likely to differ depending on whether the capital value is being assessed in order to compare two or more capital projects (in this situation a Discounted Cash Flow technique is frequently used) or on whether the aim is to estimate the value of existing capital stocks (the use of Replacement or Original Cost of the Capital is more likely).

Non-Monetary Measures of Capital Value

Measures of value which avoid the use of money attempt to use a relatively homogeneous variable. Such a variable should also have the advantage of being free of the inflationary effects on the utility of money. The most usual non-monetary measure of capital value is in terms of labour forgone in order to produce the capital i.e. capital is viewed in terms of labour equivalents. This method appears attractive since the item capital can be seen as equivalent to "so many" labour units forgone. The advantages of this measure are lessened by the fact that not only is labour forgone to produce capital, but also alternative product is forgone, and the labour content of the capital used with labour to produce additional capital is less easy to measure in terms of labour units.

Monetary Measures of Capital Value

Capital can be valued in terms of its Real Cost of Production i.e. the value of the labour and other factors used in its production, or it may be valued in terms of the Discounted Value of its Future or Expected Product. Capital can therefore be seen to be either a 'cost' or a 'value'. Robinson(5) has shown that under conditions of certainty the real cost is equivalent to the discounted value but in practice, where unexpected events occur, the two measures diverge.

Most work on measuring capital stocks has been based on the Original Cost or the Present Day Replacement Cost of the capital (assuming it is possible to purchase identical capital - unlikely in many cases). Either method of valuation can result in existing capital being over or under-valued. In addition, the value of capital can fluctuate due to exogenous factors such as price inflation. Capital can also be valued in relation to the current value of its output, but again this could be difficult to measure and the value obtained might bear no relation to the original or replacement value of the capital. One further difficulty arises when valuing agricultural capital: this is the question of separating the value of land from the value of buildings, as in agriculture the buildings are largely an intrinsic part of land. Thus in many cases it would be unrelistic to attempt to distinguish between land and buildings. Work by Hill(6) showed a method of estimating the value of buildings separately from land.

1.3.2. Measuring Investment

Investment is the term applied to the process of capital formation which is the creation of capital assets by the conversion of money into physical assets.

One of the features of capital described earlier was that it depreciates over time. This means that investment cannot simply be defined as additional capital assets since any investment or gross capital formation must contain a component of replacement investment as well as any true addition to the existing stock of

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(5)Robinson, J. "The Production Function and the Theory of Capital" Journal of Economic Studies, Vol. XXI(2) No. 55 1953/54

(6)Hill, B. Some Economic Aspects of Farming's Fixed Capital in the United Kingdom, Ph.D. Thesis submitted to Reading University, 1970.

capital - net capital formation. In theory, it is possible to estimate, via a depreciation charge, that part of investment which could be classed as replacement capital. In practice, it is extremely difficult to separate a given amount of investment into its replacement and net components. The problems involved were examined in Section 6.4.2.1.

The difficulty of determining a value for existing capital on the farm clearly also applied to investment, since it is recently created capital. The method used to value investment in farms is usually the current cost, or, the current cost less depreciation. This method is adequate for most analytical purposes and has been used in this study.

1.4. Format of the Thesis

The majority of previous studies of capital investment in Scottish agriculture have been descriptive in nature, concentrating on the sources and distribution of cash, structure of assets, etc. These studies have tried to explain why certain changes occurred so as to formulate conclusions about the future. The present study uses explanatory analysis and also, where appropriate, functional analysis of the variables involved in capital investment, in order to comment on the present situation and the future needs of West Scotland Dairy farmers with respect to capital.

A statement of the capital problem and aims of the study is followed in the present chapter by a brief examination of the concepts of capital applicable to West Scotland dairy farming. In Chapter two the relevant literature associated with capital investment in agriculture is reviewed, and in Chapter three the economic situation of agriculture with particular reference to the role of capital is outlined.

As previously indicated, the present study approaches agricultural capital at two levels. Firstly, the aggregate capital stock of Scottish and West Scotland agriculture is examined over a period, to place the entire study in context, and since the published statistics on the aggregate capital stock in agriculture tend to be inconsistent, an alternative method of estimating the capital stock, from census data, is developed (Section 3.5.). Secondly, the major part of the study involves the analysis of dairy farm investment in West Scotland, by utilising balance sheet data which became available post 1969. The existing asset structure of the sample farms is established first (Section 4.2.) before econometric models are developed. These models relate the quantity of capital stock inputed to the output of product, measured in terms of gross output and gross margin (Section 4.3.).

Measuring the output obtained, from the use of capital assets, in terms of gross output or gross margin, neglects to account for the fixed costs associated with the production of output. The analysis is therefore extended, in Chapter V (The Efficiency of Capital Deployment), to include the return on capital investment, after allocation of all the costs of production. An important aspect of any capital investment is its marginal return. Estimates of the marginal productivity of dairy farm capital (Section 5.6.) have been prepared which thus enable comment on the level of capital utilisation under the assumed conditions of profit maximisation.

In the following chapter (Chapter VI) the sources and importance of the funds available for investment (liability structure) are analysed, together with an examination of the functional determinants of the "available cash", thus enabling the subsequent determination of the capital required to achieve the optimum allocation of capital on dairy farms, as assessed from the results in Chapter V. The distribution of "available cash" on the farms is then considered and and the concept of gross and net capital formation developed.

Since the motives of farmers are an important factor in determining the capital formation which is undertaken, a small attitude survey (Chapter VII) was conducted on the sample of dairy farmers in West Scotland, in order to assess their attitude to capital investment.

In conclusion, the results of the study are used to formulate the likely future capital requirements of dairy farms in West Scotland, and to indicate the likely role of the farmer, the Government, and the educationalist/adviser in achieving the optimum capital allocation.

CHAPTER II

CAPITAL IN AGRICULTURE - A REVIEW OF THE LITERATURE

2.1. Introduction

Although records of capital studies relating to the determination of the stock of capital invested in agriculture exist for the late nineteenth century, few attempts have been made to estimate the capital invested in Scottish agriculture at the national level and none have been made for West Scotland agriculture, at the regional level. The preparation of capital stock estimates for Scottish and West Scotland agriculture was therefore considered an essential prerequisite to the main study of capital investment on West Scotland Dairy farms in order to place the dairy farm study in context.

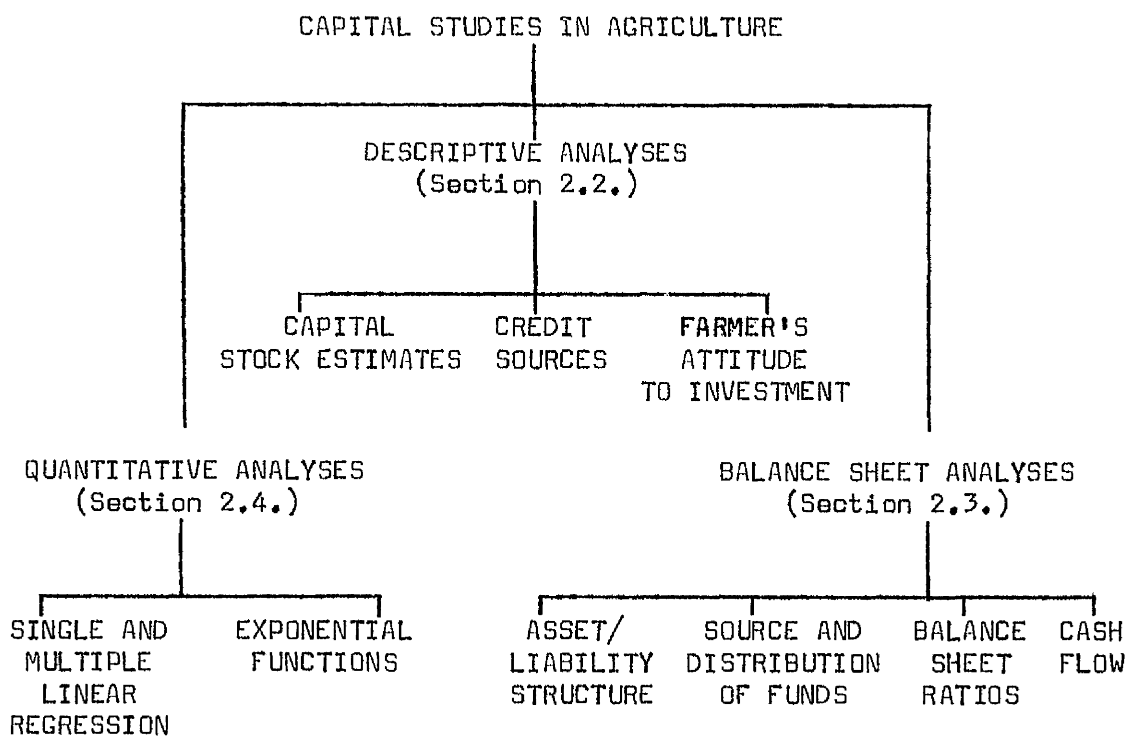
At the micro-economic level of capital studies considerable work has been published, concerned mainly with balance sheet ratios and the asset and liability structure of farms. However, a deficiency of information on Scottish farming regarding these aspects of capital deployment and business success criteria does exist. Attempts were therefore made, in the present study, to rectify this situation for West Scotland dairy farming.

Quantitative studies of capital investment on United Kingdom farms increased in volume in the 1960's but the application of quantitative analysis techniques to the capital deployed on Scottish farms was found to be almost non-existent. Regression techniques are therefore applied in this study, to the available farm capital and output data in order to establish the functional relationship between the capital input and output on West Scotland dairy farms. It is also intended to quantify the determinants of the "available cash" for investment on these dairy farms, with a view to the assessment of the optimum capital requirements of the average dairy farms. The sources of capital and the functions of credit institutions have been well documented in past literature. Thus, in the present study, it was decided to concentrate on the nature of credit available to dairy farmers and on the measurement of its adequacy in the light of the optimum capital requirement of dairy farms.

The investment decisions of farmers are not based solely on economic criteria but are modified by their personal experiences and circumstances. There is, however, a complete absence of any published work relating to this aspect of investment in Scottish agriculture. A farmer-attitude survey was therefore conducted as part of this capital study in order to obtain tentative conclusions on the factors which impinge on the decision of the farmer to invest.

In the sections which follow the relevant literature to this study is reviewed, for convenience, in three main sections - Section 2.2. Descriptive Analyses; Section 2.3. Balance Sheet Analyses; Section 2.4. Quantitative Analyses. The diagram in Figure 2.1.1. indicates the literature reviewed under the main headings.

Figure 2.1.1. Diagramtic Representation of Literature Reviewed



2.2. Descriptive Analyses

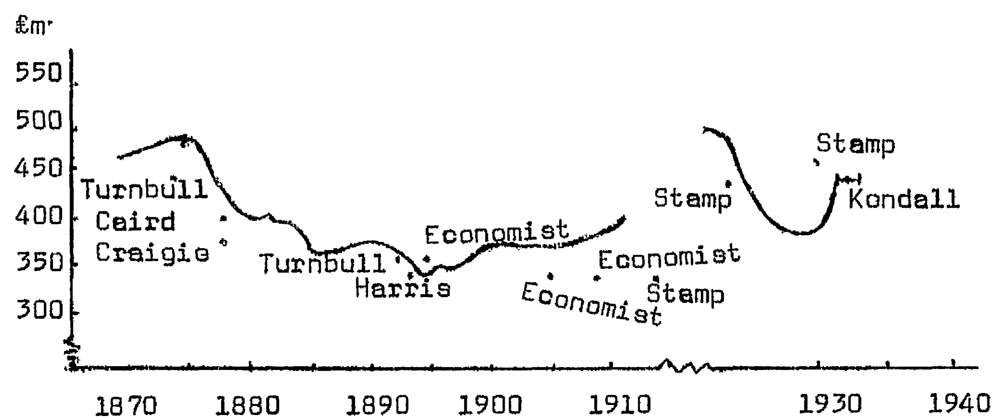
Descriptive studies at both the national and farm level constitute the most prolific type of work published on the subject of agricultural capital. The studies relevant to this thesis have followed three main streams, namely, capital stock estimates, credit requirements and sources, and farmer-attitude investigations. These three areas of research are discussed in the sections which follow.

2.2.1. Aggregate Capital Stock and Capital Formation Estimates for Agriculture

Estimates of the value of farm capital have been published by various economists since the middle of the last century. During this period most emphasis has been on estimating the capital investment of occupiers (i.e. total tenants capital) in agriculture, rather than on total capital investment.

A review of estimates of occupiers capital investment in U.K. agriculture prior to 1939 was given by Bellerby (1953). The diagram below shows the relationship between the various estimates.

Figure 2.2.1. Farm Occupiers Capital, United Kingdom: comparisons of historical estimates and smoothed annual series (5 year moving av. of A.J. Boreham's annual estimates)



Source:- Bellerby, J.R. (1953)

A striking feature of the estimates was their variability, especially in the earlier years around 1975-1875. The difference between the estimate of Giffen (1878) and Harris (1894) was largely due to differences in what the authors considered should be valued in the inventory of farm capital. The three estimates of capital stock by Turnbull (1893), 'The Economist' (1895), and Harris (1895) were in general agreement, which suggested that either the capital stock was accurately determined at this time or that collusion had occurred among the authors.

After 1895, the capital stock of agriculture increased at current values but also in real terms until the depression years of the late 1920's, due to higher prices and to advancing mechanisation. The three estimates in Figure 2.2.1. relating to this period could have underestimated the capital position in agriculture. In the case of the Economists (1911) estimates for 1905 and 1909, a likely cause was the arbitrary use of sixteen years purchase of profits to represent the capitalisation of income. Sixteen years was selected only on the basis of the increasing levels of stock density in that period. This illustrates the recurrent problem, in capital stock estimates, of devising an accurate method of measuring the value of a capital investment. The estimate by Stamp (1912) was based on work by other researchers and in the opinion of Bellerby (1953), underestimated the capital invested in agriculture, when viewed relative to the movements in general prices and increased mechanisation.

The smoothed annual series by Boreham (1953) shown in Figure 2.2.1. gave a series of estimates of occupiers capital from 1867 to 1939, based on an inventory type calculation. The method used later in this study to estimate the tenants capital investment in Scottish Agriculture is based on a modification of Boreham's technique. The inventory used by Boreham is very comprehensive and, as the results follow the general trend of prosperity in agriculture over the period covered, it is not unreasonable to assume that the estimates represent an accurate assessment of the capital invested by occupiers in agriculture. The estimates show that the level of investment fell during the depression years before beginning to rise.

It is likely that had Boreham made an estimate for 1938-39 it would have agreed with the £450 million estimate of capital invested in agriculture in 1937-39, published by Kendall (1941).

It was noted previously that up till the 1920's few attempts were made to measure the level of landlord's capital invested in agriculture. Ward (1952) made estimates for the years 1925, 1931, 1939 and 1949. He noted that the problem of valuing investment in land was that it had no original or replacement cost, thus one has to value land by comparison of market values or capitalisation of annual yield neither of which is completely satisfactory. He found little difference in numerical value using either of these methods. The lack of reliable estimates of capital invested in agriculture, at the national level, prompted Clark (1958) to write in the 'Farm Economist'; "We know little about the amount of capital used in agriculture. Still less can we make any valid judgements of capital requirements". He advocated a survey to determine the value of existing buildings. Dobb and Griffiths (1965) reported on a 1961 survey into gross capital investment in farm land, buildings, houses and services, but it was not until Hill (1972), writing some fourteen years after Clark's comments, that a serious attempt was made to estimate separately the value of buildings and land. The feature of Hill's work most open to criticism is the length of asset life chosen. Sayce (1966) commented six years previously, "deciding on a life is crude and misleading", since buildings linked in a common enterprise may have a different economic life e.g. milking parlour 10 years, yard 25 years, tower silo 15 years. To try and simplify this problem, Hill used a range of five assumed lives for buildings but scarcity of data makes it difficult to see how Hill's method could be substituted for land values in calculating the aggregate level of landlords type capital in agriculture.

Returning to estimates of occupiers capital, Taylor and Bellerby (1954) prepared an index of capital investment in UK agriculture between 1937-38 and 1951-52, using a similar inventory method to that used by Boreham (1953). Price (1952) also calculated the capital invested in UK agriculture but used the "raised" sample technique: this gave a higher value for the capital stock in 1950 than the equivalent estimate by Taylor and Bellerby. In the post 1953 period, several estimates were made of the capital stock of agriculture. The Cheveley and Price (1955) estimates were, in fact, revised unpublished estimates by Taylor and Bellerby but they also attempted to include the value of landlords capital as did Price (1952). Further estimates were made by Reid (1968) Obery (1968) and Bosanquet (1968).

The majority of work on capital stock estimates of United Kingdom agriculture have been based on the inventory or "raised" sample methods. An alternative method, based on the creation of a time series of capital stock, has been tried by Johnstone (1970) for New Zealand agriculture. The method involved the calculation of the yearly gross and net capital formation which, together with a base year calculation of the stocks of capital, were used to estimate the stock of capital employed. Such a method could be criticised on the use of arbitrary depreciation rates to convert from gross to net capital formation and on the critical importance attached to the base year estimate. Moreover, no attempt was made to estimate the value of land or buildings, apart from the standard procedure of acreage times land value per acre equals land and buildings value.

The determination of 'real' capital formation in United Kingdom agriculture has largely been restricted to estimates obtained by the application of published price indices to capital stock estimates. The published price indices, however, are not always suited to measuring the rate of inflation in value of agricultural capital. Hoover (1962), writing on United States agriculture, attempted to overcome this problem by using a composite index of: 1) Wages paid to wage earners 2) Wholesale commodities 3) Price paid by farmers for farm commodities and 4) Price paid by farmers for domestic goods. This showed the striking result that nominal capital gains were four times the "real" gain.

Very little research has been carried out to evaluate the capital invested in Scottish agriculture, as distinct from that of the United Kingdom. Price (1952) did include a separate estimate for tenants capital in Scottish agriculture in his estimate for the United Kingdom.

Apart from this, three published estimates of the capital stock in Scottish agriculture exist: Hendry (1955), Stewart (1965) and McEwan (1971). All these estimates made use of the "raised" sample technique to estimate the capital stock, at current values.

The accuracy of a "raised" sample calculation is largely dependent on the representativeness of the average opening and closing capital stock values at the farm level. These are known to be variable. Kerr (1969) attempted to link the opening and closing values of the farm capital to the monthly farm cash flow and so estimate monthly values for the capital employed, in the hope that this would supply a more accurate average capital value. Unfortunately this did not prove to be the case, mainly because the accuracy of the method depended on the accuracy with which the opening valuation was determined.

The complete dependence of published data on the "raised" sample technique to estimate the capital stock of Scottish agriculture, together with the possible inaccuracies of this method, indicated the need for the examination of the alternative measure (Valuation of census data) used in Chapter III Section 3.5.2. of this study.

2.2.2. Capital Requirements and Credit Sources of Agriculture

Adequate sources of supply of credit are of importance to the productivity of agriculture: they have therefore attracted the attention of economists over a considerable period, but especially from the mid 1960's onwards. This interest was stimulated by land values increasing, the accelerating rate of technological advance necessitating an expanding credit supply at a time of credit squeeze, and rapid inflation inducing a cash flow shortage.

Orwin (1928, 1933), writing at the time of the depression, said that the long-term credit requirements of agriculture had been satisfied by the creation of the Agricultural Mortgage Company in 1928 but that short-term credit requirements had not been dealt with satisfactorily. After ten years of research by the Government into the credit requirements of farmers, Orwin called for it to take some action regarding this, and also asked the National Farmers' Union to take up the matter of credit (which it did in the form of the Fatstock Marketing Corporation in the 1950's - some twenty years later). Subsequent to

1933, and prior to 1955, there was little published work on the descriptive aspects of credit. This does not mean that there was no interest in credit during that period but that most credit analysis was done in connection with the farm balance sheet (reviewed in a later section). The apparent period of dormancy in credit studies ended with a discussion by Sturmey (1955) on the performance of the Agricultural Mortgage Corporation since its inception, and on farmers' problems in gaining credit. These problems are still largely relevant at the present time i.e. capacity to service loans and obtain capital. Two years later the International Journal of Agrarian Affairs (1957, 1958) published a series of papers which explained how credit shortages arise in different countries, including the United Kingdom (Ashby), and how these shortages could be met. In the following year, an anonymous article in the Westminster Bank Review (1959) debated the validity of a land bank to provide the capital agriculture requires. A similar type of study to that referred to in the International Journal of Agrarian Affairs was carried out by Pateman (1972) for the EEC countries, other than the United Kingdom, which suggested possible changes when the United Kingdom joined the EEC. The question of increasing the credit available to British agriculture had still not been solved at that time. He commented that, "increased credit availability should be British policy" and that this could be achieved through sale and leaseback, increased capital grants, and reduced interest rates.

In more recent years the growing concern of how to finance agriculture has caused several authors to consider the likely future credit requirements, namely, the Agricultural Adjustment Unit, Workshop Report (1968), and Davey (1968). They agreed that increased amounts of credit were required to allow substitution of capital for labour and that this would have to be supplied increasingly from non-farm sources. In addition, Kerr (1968) stressed the need for farmers to avoid borrowing "short" to finance long-term projects. Two studies of the credit requirements of overseas agriculture, one by Brake (1966) on U.S. agriculture and the other by Andal (1969) on Canadian agriculture, supply valuable pointers to the pattern of events which United Kingdom agriculture may increasingly experience - the substitution of capital for labour, fewer but larger farms, more purchased inputs, and rising land values. The problem confronting farmers has subsequently been shown to be that indicated by the pointers. The question is how to obtain control over sufficient capital - the solution could be through the adaptation of existing credit agencies to meet agriculture's needs. This conclusion was in fact, reached for United Kingdom agriculture at a seminar, attended by the author, and led by Dunford (1973) on "Farmers Use of Credit". In addition, the need for the farmer to be able to service and repay the credit supplied, was stressed at the seminar - a point which was made several years earlier in America by Gardner (1961), and in the U.K., in a series of articles in Farm Business (1966, 1967, 1968), when most other authors were solely concerned with the availability of credit.

Later in this study, models of farm capital investment are developed. An essential part of this process is the formulation of the underlying logic. It was important, therefore, to identify the main determinants of the supply of external (on farm) credit to farmers. Four articles on credit, written by bankers Hooper (1955), Tuke (1956), Course (1960) and Collingwood (1967), identified the important factors as being: a) Income of farmer, b) Conservation of part of income, c) Equity position of farmer.

The published works on sources of capital are at two levels. Firstly, there are informative type articles - Jawetz (1959), Cobham and Strong (1967), Davey (1967), Fordham (1968), Thomas (1970) and Hill (1973), which appear in journals read by farmers, and perform a valuable educational function by indicating the sources of agricultural credit and its main uses. Secondly, there were articles in professional publications which analysed more deeply the sources of credit and the means of allocating capital, the adequacy of the sources of capital, etc. An important article on this subject concerned with the functions and place of credit institutions in supplying types of credit, was written by Tuck (1956). The official view regarding the adequacy of credit institutions supplying agriculture was expressed in one of the conclusions of the Radcliffe Report (1959) on the "The Workings of the Monetary System" -

.... We have not been able to reach the conclusion that there is any obvious and serious gap in the provision of credit for credit-worthy agricultural borrowers, such as to justify the establishment of any new institutions in this field.

Eight years after the publication of the above report, Collingwood (1967), a banker, in commenting on the current relevance of the report, agreed that the needs of creditowrthy farmers were adequately served for short-term credit but was rather more sceptical about the role and achievements of banks in providing longer term credit - a role which was recommended by the Radcliffe report.

One of the features of agricultural credit is the low incidence of credit raised on the stock exchange due to large numbers of family farms - Jawetz (1959) and Wood (1965). It was suggested by Camamile (1969), and Clarkson and Elliot (1970), that the joint stock principle may be a possible solution to the large-farm credit requirements. The low return on the landlord type assets of agriculture is considered by the author to militate against a significant increase in credit from this source in the near future, as the large institutional investors were only interested in agriculture with its low return on capital while there was the prospect of rising land values. The future of land values in 1975 is extremely doubtful.

A survey of capital and credit in agriculture was commissioned by the Government in 1970, the result of which was published in 1973 (Wilson report). The report provided valuable information on the net worth position of farmers, the asset and liability structure, return on capital, etc. One of the main conclusions - that existing sources of credit were largely adequate - has since become outdated due to the rapid increase in land prices and interest rates. The problem was clearly defined by De Paula (1974) who stated that the rapid increase in land values and interest rates had made it impossible for new entrants and existing farmers, under the threat of capital taxation, to continue with previous levels of equity holding. As he says, "The inescapable solution for the farmer involves parting with all or some of his equity".

It may be concluded from these comments that a means has to be found to supply adequate credit and/or capital funds to the agricultural industry if farms are not to become fragmented due to the sale of portions of the farm land to meet the tax liability on the rapidly increasing asset value of most farms.

2.2.3. The Farmer's Attitude to Investment

Studies into farmers' attitudes to investment and motivation to invest are of relatively recent origin. Writing in 1963, Jones commented that agricultural economists had ignored the "human factor" in agricultural change and adjustment. Furthermore, Morris (1964) said

.... In this country we have progressed only a very little along the path which leads to the understanding of social conditions and human motives in farming.

These views were largely true, as only a few studies involving farmers' attitudes to saving and investment had been executed by that time. Ashby (1957), McFarlane (1957, 1958), and Harrison (1960) had all noted the preference of farmers to invest from farm-generated funds rather than with borrowed funds, i.e. there was a tendency towards credit shyness. In contrast, Green (1958), comparing the credit structure of British and Australian agriculture, found that Australian lower-income farmers used considerable hire-purchase credit. Several studies have shown the conservativeness of farmers in other respects, such as the reluctance to invest in new ideas - Jones (1963), and Metcalf (1969). This may not be entirely the fault of the farmer but it could be due to the way the proposed investment was presented to him - Byrnes (1968). At the same time, there is a characteristic among certain farmers to overinvest in agriculture. Breimyer (1966) attributed this feature, in American farming, to the existence of joint costs in agriculture and to the fact that the farmer did not see his output as contributing to over-supply. He (Breimyer) did not think there was a "psychotic urge" among farmers to invest. Campbell (1958), examining the reasoning of a group of Australian farmers, concluded that much investment was irrational. No evidence could be found of United Kingdom work which questioned the rationality of farmers in making investment decisions. Most researchers have accepted de facto investment decisions and then sought to rationalise the decision.

The results of British work by Dew (1964) and Harrison (1967, 1972), American work by Heady et al (1953), Garoian et al (1963), Wirth (1964) and Australian work by Brien et al (1965), all concluded that the important factor in farmer motivation was age and career stage which includes such factors as number of dependents and management skill.

This brief review of a farmer's attitude to investment has shown that the main determinants of farmer motivation are known, but there was an obvious lack of quantitative studies to establish the functional relationships between motivational and economic variables and the investment decisions of farmers. In a recent paper, Gasson (1973), although not directly concerned with investment, suggested that:

> .... A better understanding of motivation taken in conjunction with information already available on material resources and constraints, could lead to a more adequate explanation and prediction of farmers' economic behaviour.

A short chapter (Chapter VII) is included in the present study, on the attitude of West Scotland dairy farmers, in order to explain more fully the investment decisions and problems of these farmers, which otherwise could only be analysed in terms of the financial result of their actions.

2.3. Balance Sheet Analyses

Awareness of the value of farm balance sheet studies is comparatively recent. Most activity in balance sheet analysis has been concentrated on the examination of balance sheet ratios and the structure of assets and liabilities, largely for farm performance assessment. It was only from the latter half of the 1960's onwards that the flow aspects (source and distribution of funds) of the balance sheet were fully appreciated. Concurrent with the above studies were attempts to analyse the cash flow pattern of various farm types. It is therefore proposed to review the published balance sheet studies within the framework of the activities mentioned above.

2.3.1. Asset and Liability Structure

Prior to 1962 very scanty information existed on the asset and liability structure of farms. An early attempt was made by Dawe and Nutt (1934) to estimate the capital requirements on a sample of 24 poultry farms. Apart from this, Witney (1936) had compared the tenants capital structure of two Scottish smallholdings and Imper (1938) had investigated the relationship between capital investment in power per 100 acres and size of farms, for 97 North of Scotland farms. He concluded there was an inverse relationship. The only English work during this period was a description of working capital requirements of various farm types by Bennet-Jones (1955). In 1961, the construction of a balance sheet was such a mystery to farmers that Davies and Dunford (1961) felt obliged to write an article on the use of a balance sheet. This study, although not first in the field, also developed the construction and use of a source and distribution of funds statement for agricultural businesses, which was advanced thinking at that period.

Bennet-Jones (1963, 1964) investigated investment improvements on a sample of farms, but it was Dunford and Davies (1964) who made the first attempt to obtain detailed information on fixed capital investment on a regional basis. A similar study was conducted for Scottish farms by Bonthron (1969).

Information on the asset and liability structure of farming was still so limited in the 1960's, that the work on balance sheets was restricted to the basic investigation of the asset and liability structure. It should also be noted that this work was confined to two centres, namely, Harrison (1965, 1967) working on Buckingham farms, and Davies and Dunford (1967, 1967), at Exeter.

By 1971, Davies et al (1971) had accumulated sufficient balance sheet information over the ten year period up to 1967/68, to allow the trend in asset structure to be evaluated. They found that total assets were increasing, while the relative importance of tenants assets was decreasing. Appreciating land values had enabled net worth to keep pace with increased borrowings. Harrison (1972) was also able, by this time, to comment on farmers' borrowing patterns. Other regions of the United Kingdom were much less fortunate in the information available on the farm asset and liability position. The situation was typified by the following statement in the University of Leeds Farmers Report (1971):

.... During the year 1969/70 we started to make a closer enquiry into some of the questions relating to capital investment on farms, and it is hoped to continue this in future years, as little information relating to farm capital is available.

The Government was also aware of the deficiency of information on capital since it commissioned a survey, on a United Kingdom basis, into the assets and liabilities of agriculture, which was commenced in 1970 and reported by Wilson (1973). The report provided information on the liability and asset structure of Scottish farms. The low number of dairy farms (21 owner occupier and 4 tenant) taken to represent all Scotland dairy farms may cast doubts on the reliability of the results. The results, however, do supply an indication of the asset/liability position on Scottish dairy farms although no concentrated attempt was made to analyse the constraints on each source of credit or the factors determining the asset structure of the businesses.

The present situation in Scotland has been improving prior to the Wilson Report (1973), as Cason (1971) reported (on a group of North Scotland farms), while Whitehouse (1973) presented summarised balance sheets for four types of Scottish farming.

There still exists a definite need for more accurate information on the structure of the assets and liabilities of dairy farms in West Scotland. An attempt is made, therefore, in Chapter four of this thesis, to estimate, using regression analysis, the asset structure of dairy farms in the West province.

2.3.2. Balance Sheet Ratios

The normal function of balance sheet ratios, of which there are several, e.g. rate of return on capital, equity percentage, gearing and rate of turnover of capital, is to act as a measure of capital utilisation and/or to monitor farm resource productivity.

The rate of turnover of capital, as a measure of capital utilisation, was suggested by Knox (1934) and Imper (1936). Both authors considered there was a positive correlation between the level of turnover and the number of farms making a profit, i.e. higher turnover, higher profit. The study by Imper was to be elaborated at a later date, but no subsequent record of this could be found, nor was there any record of other published information on the use of the rate of turnover of capital as a measure of profitability, since that period. Hence it was decided to examine rate of turnover as a measure of capital utilisation in this thesis.

In 1956, Tuck defined capital in the farm business and made the significant distinction between marginal return and average return on capital, as a method of allocating additional capital to the farm business. It was to be another ten years before this concept became widely accepted.

The lack of information concerning return on agricultural capital during the 1950's and early 1960's was made clear by Long (1960), who commented in 'Agriculture':

.... The absence of information on the returns to capital in different forms and under different circumstances, is a major handicap to efficient planning on the basis of equi-marginalisation of returns to productive factors.

Rightly, Ashby (1961) was also very critical about agricultural economists and their avoidance of return on capital as a measure of profitability. As proof, he quoted the absence of such a measure in the Ministry of Agriculture publication 'Costs and Efficiency in Milk Production' (1960), where it was concluded that capital was only a limiting factor on larger farms and that acreage was the limiting factor on smaller farms. Harrison (1961), in a rejoinder in 'The Farm Economist', commented that in many cases only inadequate data was available but did not deny the continued use of secondary data e.g. profit per cow, when superior data was available. He also cited Stewart (1961) and McFarquhar (1961) as two economists currently working on the question of marginal capital. (These two studies involved linear programming solutions to least cost combinations of factors of production). By 1965, N.A.A.S. were stressing the importance of the marginal return to marginal investments in a 'Technical Management Note' by Giles et al (1965).

A series of anonymous articles in 'Farm Business' (1966, 1967, 1968) moved the emphasis from the need for a measure of return on capital to the inadequacy of net farm income expressed as a percentage of the capital employed, as a measure of capital utilisation or return on capital. This measure does not take account of the gearing of a farm (which partly determines the amount of interest payments on borrowed capital) or the fact that living expenses are not a residual (the farmer requires to live before a profit is made). Concurrently, Davies et al (1967) were advocating greater use of balance sheet ratios as measures of capital utilisation, the emphasis being placed on capital gearing. In attempts to obtain a better measure of business success, Tracy (1967) used the concept of increase or decrease in net worth as a measure of capital utilisation, concluding that the increase or decrease in net worth was 'a more basic yardstick of success than either profit or loss taken alone'. This appears to avoid the question of the use of existing capital but, he continues, "...in practice average return on existing capital appears to look after itself very well", provided marginal capital investments are properly justified when applied. This view was shared by Sayce (1968). The concept of net worth increase as a measure of growth was also being developed by Baker and Hopkin (1969), in America, who found that equity increase was a function of leverage and the rate of interest on borrowed capital, where leverage is the ratio of debt capital to equity capital (i.e. gearing ratio).

At the macro-economic level, attempts were made by Dexter (1967), Peters (1967, 1970) and Tracy (1970), to measure the efficiency of capital utilisation in agriculture with the aid of incremental capital/output ratios (I.C.O.R.'s) Whitby (1968) attributed the difficulty of obtaining a meaningful result from the use of an I.C.O.R. to the twin difficulties of measuring the amount of capital formation in a period and the valuation of incremental capital and output. These problems are also particularly relevant to the use of balance sheet ratios at the micro-economic level of the farm business.

In Scotland, Blyth and Rowbottom (1968), were aware of the inadequacy of the existing profit per acre type of performance measures, especially when capital was limited. They stressed the need for a good marginal return on additional investment to maintain and/or increase the overall return on existing capital, and also the importance of the ratio of equity to borrowed capital (gearing).

Reid (1969), writing on the interpretation of balance sheets, commented that the use of capital had become "the dominant point of discussion in the field of farm management", as is illustrated by the number of writers who took an interest in the interpretation of balance sheet ratios and return on capital in agriculture. Among these were Mordaunt (1969), Calder (1969), and Saunders (1969), who concluded that one of the problems of using balance sheet ratios for farm management purposes was to determine the level of ratio which was best. Generally, in the case of gearing, low gearing suits a farm business best, since this reduces the demands on operating efficiency. The activity in balance sheet analysis continued into 1970 with Hayes (1970) advocating further development of ratios for farm planning. Godfrey (1970) delineated the various measures of capital in the balance sheet and the return thereon, from the profit and loss account. He also included a valuable section on the pitfalls associated with capital valuation in a rate of return on capital calculation.

The methods of measuring capital utilisation in agriculture have not yet reached a sophisticated level. Panić (1972) developed, for manufacturing industry, a measure of capital utilisation based on quarterly capital/output ratios. He calculated the linear trend line for the quarterly capital/output ratios and then moved it upwards to pass through the highest capital/output ratio. Each point on the shifted trend line then represented 'full capital utilisation'. To obtain the degree of capital utilisation in any quarter, the ratio of capital/output for that quarter was divided by the corresponding value on the shifted trend line. This method was closely examined for possible application to the farm situation, but it was rejected due to inadequate quarterly data and the fact that the agricultural production cycle is considerably longer than three months.

Agriculture has not escaped the inflationary pressures operating on the economy at large. Recent work on balance sheet ratio analysis by Williams (1972), Anderson (1972), Giles (1973) and, in Scotland, Whitehouse (1973), has been directed at methods to meet the capital pressures of the future (the likely need to borrow more funds) with particular attention being paid to the marginal return on capital.

In 1969 Saunders stated:

.... Hitherto the balance sheet has been rather the Cinderella of farm economic appreciation. In the endeavour to lift output the relationship between capital employed liquidity and other factors have tended to be pushed into second place.

The situation described above is still appropriate at present. Thus it was considered desirable to adopt a different approach to balance sheet ratio analysis in this study. Certain aspects of balance sheet ratios and their functional relationships in investment models, especially the marginal productivity of capital, were therefore examined.

2.3.3. Cash Flow

The preparation of a cash flow statement is a first stage in the development of the flow aspects of a balance sheet. It represents cognizance of the links between the profit and loss account (income and expenditure) and the financial structure of the business (the balance sheet). Hence it was surprising that between 1936 and 1956 there was no published evidence of research into cash flows in agriculture. Nutt (1936) prepared a flow of the monthly cash receipts and expenses on eighteen Yorkshire poultry farms. He did not include cumulative monthly cash balances, but merely noted the monthly pattern of receipts and payments. However, Harrison (1956) did develop the cash flow to include the cumulative monthly cash/bank balances for 172 farms in the South West England, and was able to assess the seasonal credit requirements of the farmers. Harrison (1956, 1957) next developed the cash flow into the capital profile, which differed from the simple cash flow in that it included the capital structure of the business i.e. the sources of finance and amount of debt owed to the business. The capital profile is a much more useful aid to decision making as it can be used to examine the cash needs of the farm and also to allocate new capital to achieve a high marginal return.

In the ensuing period the capital profile was considered by Lloyd (1957), De Regt (1958), Beynon (1961) and McFarquhar (1962), all of whom were mainly concerned with its construction and use as a farm management tool.

Marks (1961) undertook a monthly cash receipts and expenses analysis for forty farms and came to similar conclusions to those of Harrison in 1956, namely, that if better provision were made for purely seasonal credit, then a farmer's reserves, required to cover seasonal credit requirements, could be put to more productive purposes.

The general situation in 1968, with respect to capital control in the farm business, was aptly expressed by Reid (1968) who stated 'Management accounting procedures in the United Kingdom deal inadequately with the capital aspects of the business'. This view was shared by Blyth and Rowbottom (1968) and Crozier (1968). The urgent need was, and still is, for the cash flow to be tied into the balance sheet, since it is important to know where the money is coming from as well as where it is being used. Such a source and distribution of funds statement is the logical continuation of the analysis of the flow aspects of a balance sheet. The extent to which this concept has been developed is reviewed in Section 2.3.4.

No published work exists on the cash flow pattern of dairy farms in West Scotland. A digression from the main theme of this thesis was therefore felt to be justified in Chapter six, in order to examine the cash flow pattern for a sub-sample of dairy farms. In the event, this proved a useful indicator of some of the questions, the answers to which would give insight into the farmer's attitude to investment. Accordingly, questions designed to elicit these answers were included in the farmer attitude survey (Chapter seven).

2.3.4. Source and Distribution of Funds

Source and distribution of funds statements are the final development in the harmonization of the profit and loss account and the balance sheet, to represent the flow of funds through a business. This stage was first reached by Black (1959), who derived a value from the profit and loss account and the balance sheet to represent the disposable resources of the farmer. He then related this value to the investments of the farmer and found a good relationship existed between disposable resources and investment and also that the farmer put farm investment before living standards. Similar findings were reported by Rickard et al (1962) who also indicated that the degree of self-financing of farm investments was high, being over 80%.

Davies and Dunford (1961) advocated the construction and use of source and distribution of funds statements as an aid to capital allocation in the farm business. But it was Black (1965, 1966, 1967), in a series of studies, who made the next most significant contribution to the application of source and distribution of funds statements, to agriculture. He used regression analysis to relate the level of disposable income to the level of capital investment. Prior investigations had not adopted this functional approach. The results were good, all regression coefficients being significant at the P = 0.001 level except land and buildings investment on tenanted farms.

There then followed a period when attempts were made to popularise the use of the source and distribution of funds statement and to show its practical value in capital allocation in the farm business. The authors who contributed most to this educational function were Davies and Dunford (1967), Reid (1968), Dunford (1969) and Kerr (1969).

The most recent uses of sources and distribution of funds statements in England were by Cowland and Sharp (1971), and Davies et al (1971). Both studies examined the sources of finance on sample farms and how these were allocated. In the Davies et al study, comparisons were made with the earlier study by Rickard et al (1962) and the results were found to be remarkably constant.

The application of the concept of disposable funds to Scottish Agriculture has been limited to a study by Cason (1971), of North Scotland farms, and Whitehouse (1973), who considered a sample of farms distributed over all Scotland. These two studies were restricted to an explanation of the sources of funds in farming and their distribution within the farms into various classes of investment and personal consumption by the farm household.

There is an obvious need for further work on the utilisation of source and distribution of funds statements and the concept of disposable funds. It is intended, therefore, to use data on the sample dairy farms in West Scotland to enable the incorporation of the functional determinants of the disposable funds on these farms into a concept of investment on dairy farms.

2.4. Quantitative Analyses

Quantitative analyses in agricultural economics are of relatively recent origin, having been developed mainly within the last twenty years. Development has followed two main streams: firstly, econometric models which are based on linear regression and extensions thereof, and secondly, mathematical programming, which is used for farm planning purposes and normally seeks to maximise some objective, such as profit, or to minimise cost. The latter form of quantitative analysis is outside the scope of this present study, which seeks to establish relationships between the level of capital investment and other variables, rather than to derive optimum farm plans. Hence the following review of quantitative analyses involving capital relates to econometric models.

2.4.1. Econometric Models (Single and Multiple Regression Equations)

The use of simple regression analysis as a means of determining the relationship between the amount of capital in use and the output achieved on farms has been limited. Even more infrequent have been studies designed to quantify the variables which are the determinants of the level of capital investment (both incremental and absolute) on farms.

Jones (1955) attempted to relate the level of net farm product to the input of land, labour, and capital, but could establish no relationship between capital and output. He concluded that "capital, as defined, can vary almost independently of output," and suggested there was a need for further research. If, in fact, no relationship existed between output and the level of capital employed, a negation of the basis of the economic principles regarding the use of land, labour and capital, as factors of production, would be indicated. Such a circumstance is unlikely, and is tested in subsequent chapters of this study. Assuming that no relationship did exist between capital and output. Jones' conclusion that capital "varied independently of output" is wrong and should read, output varied independently of capital.

A major advance in the analysis of capital investment on farms was made by Black (1965, 1966), when he established significant relationships between the level of disposable farm resources and capital investment in land and buildings, and in tenants capital. In contrast to other work on regression analysis, Black substituted disposable resources for net farm income as a measure of business capacity. Unfortunately he did not include livestock capital in the value of tenants capital.

According to Hardaker (1965) "economic success in any business depends on the efficient use of capital". He rightly maintained that little progress had been made by that time in the development of models to include investment, and suggested that the intuition of the farmer was one of the main determinants of investment.

Very few aggregate studies of capital investment in agriculture have been executed using quantitative techniques: there is no evidence of any in the U.K. Scott and Heady (1966) carried out an aggregate study for the United States, of investment in farm buildings, based on a time series. One of the major problems, they found, was the need to deflate values when a long time series is used. An important conclusion of the study was that farmers might embark on investment with the intent of increasing output, rather than be stimulated by recent or current net income, as was suggested by Black (1965, 1966) in his 'Residual Theory of Investment'. Hill (1970) used the study by Scott and Heady as an indicator of the important independent variables, to include in his analysis of the determinants of investment in buildings e.g. equity ratio, gross output, farm size. He obtained statistically significant results but restricted his analysis to the use of linear functions - the use of curvilinear relationships could well have improved his findings. Hill was not able to complete such a comprehensive study as Scott and Heady due to the unavailability of data to permit a long time series. Nevertheless, he was able to make a contribution to an area of research deficient in United Kingdom agriculture.

Returning to micro-economic studies, Baker and Hopkin (1969) considered the effect of leverage (gearing) on the growth of equity in United States farm businesses. They found that the growth of equity was a function of leverage and the rate of interest on borrowed funds. No similar work has been attempted for United Kingdom farms. There is a need, therefore, to examine the relevance of balance sheet ratios as determinants of investment.

Ady (1971) experimented with the application of a Nerlove model as a means of determining the capital stock of jute from the acreage and price of jute in the previous time period (t - 1). He was not satisfied with the specification of this model even after including the acreage and price of jute in the period (t - 1), as well as the price ratio of jute to a competitive crop (rice) in period (t - 1). The lack of significance of the results would appear to preclude the possible use of such a model in Scottish agriculture at present, until there is fuller knowledge of more fundamental capital relationships.

There has been only one application of simple regression analysis in studies of capital investment in Scottish agriculture. Cason (1971) used the technique in a limited way to establish the trend in gross capital formation, by asset type, from official statistics.

The lack of United Kingdom studies utilising the technique of regression analysis, indicates that there is considerable scope to develop the relationships between capital and output, and also to establish the factors which determine the level of capital in use in farm businesses.

2.4.2. Econometric Models (Exponential Functions)

Studies using exponential type production functions have been mainly concerned with resource productivity and as such have included, as independent variables, factors other than capital, i.e. land, labour, and occasionally, management. The aim of the majority of these studies was the estimation of the marginal resource productivity, at the mean level of factor input. Cobb-Douglas functions have been the most frequently used form of exponential production function, due to their supplying an adequate fit to most agricultural production data and their relative ease of computation, as well as their ability to supply values for the marginal product of resource inputs as mentioned above.

The early studies using the Cobb-Douglas function were fairly consistent in the method used to estimate the input of land and labour, e.g. land measured in terms of acreage. The measurement of capital input has been much more diverse. Tintner (1944) used: Farm Improvements (buildings and fences); Liquid assets (livestock feed, seed, fertiliser); Working assets (machinery, breeding stock, equipment); Cash operating expenses (repairs, fuel, oil, purchased feed). Heady (1946) used: Real estate; Machinery and Equipment (inventory value plus value of repairs, fuel, lubricants); Livestock and Feed (stock on land and purchased, livestock expenses, feed); Miscellaneous operating expenses. Bradford and Johnson (1953) used: Machinery investment (inventory value); Livestock (inventory value); Forage production investment (replacement value of hay and pasture stands) plus investment in structures on land clearing necessary to establish such crops); Operating cash expenses. Rasmussen (1954) used: Capital (estimated market value of land, buildings, machinery, implements, animals). Finally, Antill (1955) used: Purchased feeds; Other capital inputs (interest on crops, livestock, machinery and equipment inventories, depreciation on machinery and equipment, rent or rental value of real estate, cost of salaried management).

The above selected list of references illustrates the diversity of approaches that have been used in classifying capital. The tendency, over time, has been to reduce the number of capital input categories and to measure the actual input of capital in the production period, by means of the maintenance and depreciation costs associated with the capital use, rather than use the inventory value of the capital.

The work by Rasmussen (1954), mentioned above, was one of the first successful attempts to apply a Cobb-Douglas function to United Kingdom farm account data. He did not include land as a separate input but included it in the capital input. Labour was measured as the total labour costs for the year, including farmer and wife labour. It should be noted that the lack of homogeneity of the labour and capital inputs could be a possible source of bias in the estimated parameters.

In the following year Antill (1956) published an article which was concerned primarily with the theory and statistical methodology of a Cobb-Douglas function, although the values obtained for the dairy farm production function were valuable at that period. The author warned against the possibility of multicollinearity between the input variables, and tested for this using confluence analysis. He found a meaningful relationship existed between gross output, labour, and purchased feed, but on the introduction of a fourth variable, either rent or capital, all the symptoms of multi-collinearity appeared. A discussion followed on the validity of using an estimated production function for prediction purposes. It was concluded that this was permissible where farms had a single well-defined revenue and were located in a district having a common farm type classification. These conditions are satisfied by dairy farms in West Scotland.

By 1955, sufficient studies had been carried out, using the Cobb-Douglas production function, to permit Plaxico (1955) to comment on the possible bias in the estimated parameters, arising from the aggregation of products into a dependent variable and the aggregation of inputs into different independent variables. Heady and Dillon (1961) suggested that, provided only good substitutes or good complements are aggregated within an input category and provided that, relative to each other, the input categories are not perfect substitutes or complements, then the effect of aggregation bias should be reduced. Care should therefore be exercised in calculating the aggregated inputs. Caution similar to that of Plaxico, in the U.S.A., was also given by Wragg and Godsell (1956), working with United Kingdom data. They suggested that aggregations can be tested by correlation analysis, but that time and cost must be set against the reduction of bias. The authors split their sample of dairy farms into high and low yield cow herds, in an effort to improve the reliability of the Cobb-Douglas function. The estimated production functions were used with other farm data to predict the net output which was then compared with the actual net output achieved. This test was only moderately successful.

Clark and Bessell (1956) applied a Cobb-Douglas production function to dairy farm data, to compare the effects of changes in the levels of various farm inputs upon the gross output from grazing livestock. Only three inputs were found to have a significant effect: rate of nitrogen fertiliser, expenditure on feed, and labour costs. In this, and in a subsequent study by Bessell (1958), the character of the function differed in two respects from most other published works in a) the inputs included - the value of labour input included machinery costs, due to a high level of correlation between labour and machinery costs, (Heady (1954), had used a similar technique in the U.S.A.) and b) the use of per acre values for all inputs and outputs - this was to increase the efficiency of the function by restricting the effect of farm size. Bessell commented, "The desirability of restricting farm size arises because the capacity of management may vary according to the size of the farm".

In an analysis of resource productivity, on farms in the Newdale - Harriota area of Manitoba, Auer (1961) attempted to increase the efficiency of the Cobb-Douglas function by including qualitative aspects in the inputs. He imputed land in terms of value, rather than acreage, and included an index of managerial ability. Labour input was in terms of adjusted hours to indicate actual labour input, and capital was taken as the annual capital input. The results were encouraging, but the author concluded that resources were misallocated on these farms as the marginal productivities were not equal to market prices. When quality differences in the inputs were ignored, different parameter estimates were obtained for the production function, e.g. when acreage replaced land value, the elasticity of production of the entire function (sum of exponents) fell from 1.547 to 1.319, which was tentatively explained by the quality of land being inversely related to acreage.

A comprehensive review of agricultural production functions was carried out by Grilliches (1962), in which he considered the problems of fitting production functions to non-experimental data. The basic problem was considered to be the specification of the econometric model which generated the data. This difficulty, however, did not deter Grilliches from applying a Cobb-Douglas function to aggregate, cross-sectional data, of 98 United States regions. In this study, he attempted to reduce the residual output by including the quality of land, labour and capital. This was not a new concept, as has already been noted, but he did include an educational variable which was statistically significant, and its coefficient was not much different from the coefficient of the man years variable. It would be possible, therefore, to 'inflate' the labour variable by the computed 'quality' (education) per man index, before estimating the production function.

Working with farm account data, Rasmussen and Sandilands (1962) used a Cobb-Douglas function to relate farm output to the input of land, labour and capital, on British and Irish farms. This work was widely acclaimed in review articles e.g. Attwood (1962) and Antill (1965). Four years after the article was first published Crotty and Stone (1966) published criticisms of the Rasmussen and Sandilands work, mainly with regard to the marginal productivity values for the inputs to the Irish farms. They also criticised, as had Antill (1965), the assumption by Rasmussen and Sandilands, that the correlation was not 'strong' between farmers' managerial ability and the way they combine their resources. If a strong correlation between managerial ability and the use of inputs exists, then the use of inter-farms regression, as an estimate of the consequences of intra-farm changes in the use of inputs, would be invalidated. Crotty and Stone concluded that Rasmussen's and Sandiland's analysis highlighted this weakness and suggested that future research should attempt to quantify managerial capacity and incorporate this concept into the production function.

In a recent article, Wragg (1972) argues that, although a Cobb-Douglas production function estimated from cross-sectional data does not purport to measure the true parameters of the underlying biological relationships, it has advantages for predicting the output of similar farm inputs. Estimates, based on cross-sectional data, are likely to be more efficient than any possible corresponding parameters obtained from controlled experiments. Such experiments would not incorporate the modifications imposed on the true production relationship by the uncontrolled real world environment.

This brief review of capital studies, incorporating the use of Cobb-Douglas functions, has shown that, provided care is exercised in the selection of inputs, it is likely that meaningful relationships between capital and output could be established. Hence it is proposed to attempt to measure the marginal productivity of the capital on dairy farms in West Scotland, using this technique.

CHAPTER III

THE ROLE OF CAPITAL IN AGRICULTURE

3.1 Introduction

Investment in agriculture does not occur spontaneously but it is the result of conscious decisions by the farmer. The farmer is not completely free to make arbitrary decisions as he must operate within the macro and micro economic climate of the agricultural industry. Since the majority of United Kingdom farms are not run on the joint stock company principle, the investment decisions of the farmer will also be closely linked with his personal and family status. Investment in agriculture is therefore governed by Economic, Technical and Personal Constraints, the most important of which are summarised below.

The level of investment in agriculture is largely constrained by the general economic climate of the United Kingdom which is to some extent generated by the Government. A resume of the attitude of successive Governments to agricultural investment is presented in Section 3.2. The agricultural industry is unique in being subject to an Annual Government Review which indicates to the farmer which commodity production has to be expanded or contracted. The implementation of Government policy which is itself conditioned by the Common Agricultural Policy of the European Economic Community, results in farmers' prices, subsidies, grants etc. being adjusted to implement the overall policy.

The aggregate supply of land and labour affect the level of investment in agriculture. At present, the amount of land and labour used in United Kingdom agriculture is falling: land by 180,000 acres between 1971 and 1972, and labour by about five per cent per annum in the recent past(1). The trend in acreage and labour reduction will tend to act as a stimulus to investment rather than as a constraint as an increase in intensity of production will be required to compensate for the reduction in land

(1) Annual Review of Agriculture 1973. White Paper Cmnd 5254, HMSO., London, March 1973, P.10 and P.14.

and labour input. The extent of labour substitution by capital is not as great as may be suggested by the stated rate of decline in labour force. Russell(2) found that a six per cent reduction in the hired labour force resulted in approximately a three per cent reduction in labour input to farming, due to the large number of working occupiers.

Another constraint on the level of investment in the agricultural industry is the absolute level of technology and the rate at which this is increasing. Tostlebe(3) showed, regarding United States agriculture, that functional relationships existed between the level of technical knowledge and gross capital formation, and he suggested that capital formation was influenced, or perhaps even governed, by technological changes. No attempt, however, will be made to measure technological progress in the present study.

At the farm level, the degree of intensity of production can restrict further investment - the higher the existing intensity of capital utilisation, the greater may be the difficulty in making additional investment. If, for example, the dairy herd is already at its optimum size regarding building facilities and available land, size of farm in the physical sense could lead to other factors of production being forced into the region of diminishing returns, thus acting as an inhibition to investment.

A major economic constraint on investment is the availability of investment funds. Investment funds have three main sources. 1) Farm Profits 2) Borrowed Funds 3) Private Funds. Several pieces of published work indicated that farm generated funds were the principal source of investment funds(4,5,6). In effect post

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(2) Russell, T.P., "The Size Structure of Scottish Agriculture", Scottish Agricultural Economics, Vol.XX, DAFS, HMSO, Edin.,1970.

(3) Tostlebe, Alvin S., Capital in Agriculture: Its Functions Financing Since 1970. Princeton Univ. Press; Princeton, 1957.

(4) Rickard, R.C. et al., Financing the Farm Business Exeter University, Report No. 137 1962 p.149.

(5) Cason, R.G., Sources and Allocation of Capital Investment in Agriculture Economic Report No. 129 North of Scotland Agricultural College, July 1971.

(6) Davies, G.D.D. et al., Aspects of Farm Financial Structure Univ. of Exeter, Agric.Econ. Unit Report No. 185, Sept. 1971.

tax profit levels, or return on existing capital, are the important constraints on future capital investment. Where investment funds have to be borrowed, the principal restrictions are likely to be the borrowing base of the farm (equity position), the rate of interest to be paid on borrowed capital, and the actual or potential profits from the investment. Assuming abundant investment funds are available and the desire and opportunity exists to invest, the theoretical economic optimum level of investment can be derived. In its simplest form, the theory states that investment should be continued until the marginal discounted return on the investment is just equal to the marginal cost of the investment[7]. If this condition is satisfied, maximum profit should result.

The close personal association of the farmer with his business introduces the question of motivation, or the propensity of the individual to invest in farming. Motivation depends on the personal characteristics of the farmer, but the economic circumstances of the farmer will also interact with his personal characteristics. The purely personal constraints on investment could be categorised as follows:

a) Family Circumstances
b) Farmer Psychology
c) Innate Ability

Although many factors could be included under the heading of 'Family Circumstances' the principal factors are probably age, family commitments, and social factors. Age has been shown to influence the amount of borrowing which a farmer is prepared to undertake[8] - the older the farmer, the less inclined he becomes to borrow capital. Family status has also a strong motivating effect. Personal visits to farms suggested that the larger the farmer's family, especially where a son will inherit the business, the greater was the incentive to expand the farm. This impression of the influence family circumstances have on investment is

(7) Stonier, A.W. and Hague, D.C., A Textbook of Economic Theory. Longmans & Co.Ltd., London 1967.pp. 306-315.

(8) Harrison, A., The Financial Structure of Farm Businesses Univ. of Reading, Dept. of Ag.Econ. and Management, Misc.Study No.53, 1972.

supported by Harrison[9]. The modern dairy farmer is becoming more 'social conscious' e.g. the task of twice daily milking, especially at weekends is now onerous to him. In a more recent article Butterwick et al.,[10] forsaw social factors as an important restriction on future increases in milk yield.

The psychology of a farmer could be revealed by his aspiration to increase his profits or the size of his farm, or to be a leader in the industry: such factors will act as a stimulus to investment. Regrettably, the majority of farmers appear to be conservative in outlook. As a result, the rate of diffusion of new ideas tends to be slow[11] but Byrnes[12] suggests that poor presentation of a possible change, or the inappropriateness of a change, may be more important than conservativeness. The attitude of farmers to borrowing must be considered a constraint on investment as was shown by McFarlane[13,14] who found that farmers were reluctant to borrow capital and preferred to invest from farm profits. Most approaches to investment have assumed rational behaviour by the farmer. Campbell[15], in an interesting study on a group of Australian farmers, found that they did not treat depreciation as a regular recurring production cost, but treated the replacement of machinery in the same way as additional capital outlays. This led the author to suggest that farmers' choice of investment was irrational.

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(9) Ibid., p.2

(10) Butterwick, M. and Neville-Rolfe, E. "The Outlook for British Farmers in an Enlarged EEC". The Three Banks Review No. 96; December 1972.

(11) Jones, Gwyn E., "The Diffusion of Agricultural Innovations" Journal of Agricultural Economics Vol. XV, No.3; June 1963.

(12) Byrnes, F.C. "Farmers' resistance to what?" Some missing variables in diffusion research and innovation strategy New York Agric. Development Council. pp 11. 1968.

(13) McFarlane, G.C., "Some Observations on Farmers' Attitudes to Finance and Investment Univ. of Bristol, Report No. 102; 1957.

(14) McFarlane, G.C., "Farmers' Attitudes to Borrowing Money" Agriculture, Vol. 65, No. 2; 1958 pp. 53-57.

(15) Campbell, K.O., "Some Reflections on Agricultural Investment" Australian Journal of Agricultural Economics, Dec. 1958, p.93.

Innate ability is a particularly difficult concept to quantify, but it does influence the motivation of a farmer through such factors as level of education and judgement.which are related to innate ability. Many of the above variables are reflected in Management Efficiency. Attempts at measuring management efficiency have been made by Bessell[16] who has demonstrated the importance of such factors.

The likely effect on agricultural investment of the constraint just outlined, is a reduction in the efficiency of capital employment. One of the aims of this study, therefore, is to establish the nature of the capital problem confronting dairy farmers in West Scotland in order to formulate a means whereby these farmers might operate more effectively within the constraints dictated by Government agricultural policy, existing economic conditions and personal factors. It is proposed to commence by examining the role successive Governments have seen for capital in agriculture.

3.2 The National Attitude to Agriculture

The passing of the 1947 Agriculture Act officially recognised the role which agriculture had to play in the post war economy of the United Kingdom. The relevant passage of the act states:

> ...... a stable and efficient agricultural industry capable of producing such part of the nation's food and other agricultural produce as in the national interest it is desirable to produce in the United Kingdom, and of producing it at minimum prices consistent with proper remuneration and living conditions for farmers and workers in agriculture and an adequate return on capital invested in the industry.[17]

Since the passing of the 1947 Agriculture Act, the Government has consistently reiterated the important role of agriculture and the necessity to improve efficiency. The White Paper entitled, 'Long-Term Assurances for Agriculture',[18] stated that "the best way of

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(16) Bessell, J.E. "The Measurement of Managerial Efficiency in Agriculture", Journal of Agricultural Economics, Vol. XX1, No. 3; September 1970.

(17) Agriculture Act 1947 Part 1, p.1 para. 1.

(18) Long-Term Assurances for Agriculture, Cmnd. 23, HMSO, London, Nov. 1956, p.8. para. 22.

making an effective contribution towards lowering production costs" was to modernise "inadequate or out-of-date farm buildings or other permanent farm equipment".

Almost a decade later, in 1965, the National Plan[19] was published, which set out the Government view on the part it wished agriculture to play in the national economy over the following five years. In particular, the plan stressed the need for agriculture to "ease the pressure on our bill for imports of temperate agricultural produce" and secondly, noted that:

> by improving its labour productivity more rapidly than the increase in production, agriculture will continue to release substantial manpower resources and so help in closing the manpower gap expected during the plan period[20]

This stress on improving productivity, and so releasing labour, was aided by direct farming grants.

Part II of the Agriculture Act, 1967[21], indicated the increasing importance placed by the Government on improving farm structure and promoting agricultural investment. This investment was encouraged by grants towards expenditure on fixed equipment and improvements for purposes of agricultural business. This type of Government aid continued under the terms of the Agriculture Act, 1970[22], which permitted the state to make capital grants to farmers.

The Annual Review and Determination of Guarantees, 1970[23], confirmed that the Government still wished to continue the selective expansion programme announced in 1968, to save imports. In addition the Government saw a need -

> to replenish the industry's resources, to contain costs, to increase investment for expansion and to provide reasonable stability of markets[24]

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(19) The National Plan, Cmnd. 2764. HMSO London, Sept. 1965.

(20) ibid., Ch.13, p.135, para. 3.

(21) Agriculture Act 1967. HMSO London, 1967.

(22) Agriculture Act 1970. HMSO London, 1970, Part II, p.23.

(23) Annual Review and Determination of Guarantees 1970 White Paper Cmnd. 4321. HMSO London Mach. 1970.

(24) ibid., p.6, para 11.

In 1972, the aim of the Government was still to encourage selective expansion of agriculture, with a view to improving the competitive position of agriculture within the EEC. This aim was to be achieved by "stimulating the investment which is needed for expansion and by securing the advantages of increased scale"[(25)].

In 1974, the Government declared that "Continued expansion of efficient food production remains in the national interest"[(26)]. The White paper entitled 'Food from Our Own Resources' published in 1975[(27)] reiterates this policy aim and states that milk, dairy beef, cereal and sheep production should be expanded in the period up to 1980.

Since 1947 the Government has actively encouraged increased investment in buildings, machinery, and other inputs (fertilisers, feed, etc.). Table 3.2.1. on the following page goes some way towards indicating the performance of agriculture in response to Government agricultural policy. The gross output of agriculture, at constant prices, has almost doubled in the last twenty years, as has the level of net income. Agriculture has therefore exhibited a remarkable level of productivity increase which is illustrated by the more than fourfold increase in labour productivity (output, at constant prices, per employee) between 1947 and 1973/74. This increase in labour productivity has been made possible mainly by an increasing rate of capital formation and reduction in labour employed. In the fifteen years up to 1970, Beynon and Houston[(28)] writing for the agriculture E.D.C., commented that 40 per cent of the increase in productivity was due to increased inputs and 60 per cent to increased productivity. The present high levels of capital formation, aided by capital grants, suggest that the recent expansion in output will continue in the future.

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(25) Annual Review and Determination of Guarantees 1972 White Paper Cmnd. 4928. HMSO. London, March 1972, p.5, para. 3.

(26) Annual Review of Agriculture 1974. White Paper Cmnd. 5565. HMSO. March 1973, p.3. para. 1.

(27) Food from Our Own Resources. White Paper Cmnd. 6020. HMSO. London, April 1975, p.1. para. 4.

(28) Beynon, V.H. and Houston, A.M. Farm Productivity. E.D.C. (Agriculture) HMSO. 1973.

Table 3.2.1. Selected Indicators of the Effect on Agriculture of Post-War U.K. Agricultural Policy (Constant 1946-47 Prices)

	Gross Output £m	Net Income £m	Gross Capital Formation £m	Capital Grants £m	Labour Employed '000	Output per Employee £
1947	764	217	84	N.A.	980	779
1952	*894	254	*80	N.A.	869	1028
1957	*1046	297	*86	2.2	750	1395
1962	*1191	338	*119	10.3	633	1881
1967	1245	353	141	9.1	485 (745)	2567
1972	1443	410	271	38.4	413 (710)	3493
1973-74	1466	416	366	45.5	416 (704)	3524

Sources The figures marked thus * were calculated from

Annual Abstract of Statistics No. 89, 1952. CSO, HMSO.
" " " " No. 96, 1956. CSO, HMSO.
" " " " No.101, 1964. CSO, HMSO.

The remaining figures with the exception of the Output for Employee Values were calculated from the following Annual Review White Papers:-

Annual Review and Determination of Guarantees 1964. Cmnd. 2315.
" " " " " " 1969. " 3965.
" " " " " " 1971. " 4623.
" " " " " " 1972. " 4928.
Annual Review of Agriculture 1974. " 5565.

The figures in brackets ( ) represent the total numbers engaged in agriculture.

Output/Employee values were derived from data in table.

3.3 The Position of Scottish Agriculture

The value of the contribution of Scottish Agriculture to the United Kingdom food supply is demonstrated in Table 3.3.1. on the following page which presents, for Scotland, information similar to that in Table 3.2.1. for the United Kingdom Agricultural industry.

Table 3.3.1. Selected Indicators of the Performance of Post-War Scottish Agriculture (Constant 1946-47 Prices)

	Gross Output £m	Net Income	Gross Capital Formation £m	Capital Grants £m	Labour* Employed Nos.	Output per Employee £
1946-47	76.8	21.8	n.a.	n.a.	71,883	1,068
1951-52	87.3	25.5	n.a.	n.a.	72,969	1,196
1956-57	100.6	29.8	n.a.	0.50	71,800	1,393
1961-62	119.8	34.0	13.8	1.60	62,169	1,927
1966-67	125.2	35.5	n.a.	1.64	44,284	2,826
1971-72	145.1	41.2	18.8+	4.52	35,159	4,128
1973-74	147.5	41.8	40.0	6.24	34,075	4,328

Sources The values for Gross Output, and Capital Grants were calculated from the following issues of Scottish Agricultural Economics:-

Vol. XXIIV - 1974; Vol. XXII - 1972; Vol. XIX - 1969;
Vol. XIII - 1963; Vol. X - 1960; Vol. IV - 1953;
Vol. 1 - 1950.

*Labour Employed values were extracted from the 1950/51; 1961/62; 1971 and 1973 issues of Agricultural Statistics - Scotland.

+Mackenzie, A.M. "Capital Expenditure - An Analysis of Data from the Farm Capital Grant Scheme". Scottish Agricultural Economics, Vol. XXIII - 1973. DAFS, HMSO April 1973.

Scottish agricultural output has been increasing at a rate comparable to that in the United Kingdom as a whole and in 1973/74 the aggregate gross output of Scottish Agriculture was 10.1 per cent of the United Kingdom total. The value of output per employee in Scottish agriculture has increased rapidly in the post-war period and compares favourably with the national performance. In 1973, the level of capital formation in Scottish agriculture was £88.3m (£40.0m at constant 1946-47 prices). This level of capital formation represented 11.4 per cent of the United Kingdom total gross capital formation which was a slightly higher percentage than might have been expected on the basis of Scottish agriculture's contribution to the total gross output of agriculture (approximately 10 per cent). In 1973-74, capital grants absorbed by Scottish agriculture were 13.4 per cent of the national total which, taken together with the values for gross capital formation, suggest that Scottish agriculture is keeping pace with the general pattern of investment in United Kingdom agriculture. These levels of capital formation and capital grant uptake also indicate the large amount of capital required, which, in turn, has to be financed to a large extent by farm generated funds.

3.4 The Economic Background to Capital Investment on W. Scotland Dairy Farms

Dairy farming in West Scotland has been undergoing economic and technical change in the recent past. In order to illustrate the main trends, a sample of 146 dairy farms, used by the Economics Division of the W.S.A.C.for statistical analysis purposes, was studied over a six year period between 1967/68 and 1972/73. A summary of the results is shown in Table 3.4.1. on the following page.

In the period 1967/68 to 1972/73, the trend in West Scotland dairy farming has been towards fewer registered milk producers and an increased herd size per farm. The small farmers have made the greatest progress in this respect, with an increase of 22 per cent in cow herd size over the period, compared to nine and 20 per cent respectively for the medium and large size farms. During the period under review the average yield of milk per cow has increased. This, taken together with the increase in capital investment in cows, has resulted in an increase in the efficiency of milk production. There was a gradual increase in the realised milk price per gallon between 1967/68 and 1970/71 prior to the large increase in 1971/72, and a further smaller increase in 1972/73 designed to compensate farmers in part, for the increase in production costs which had occurred.

Table 3.4.1. The Economic Trends in Dairy Farming in West Scotland 1967/68 to 1972/73

		YEAR					
		1967-68 (1)	1968-69 (1)	1969-70 (1)	1970-71 (2)	1971-72 (3)	1972-73 (4)
	ITEM	£					
SMALL FARMS (UP TO 125 AC) 52 FARMS	N.F.I.	1136	1363	1512	1595	3253	4147
	M.I.I.	111	297	393	328	1784	2613
	MILK SOLD/ COW (£)	128	135	135	144	168	172
	No. of COWS/ FARM	36	37	39	40	43	44
	MILK PRICE (p/GAL)	16.37	16.76	16.75	18.29	20.35	21.16
	MILK SOLD/ COW (GAL)	781	806	805	795	831	859
	ITEM	£					
MEDIUM FARMS (126-200 AC) 50 FARMS	N.F.I.	1573	1894	2146	2310	4790	6029
	M.I.I.	544	810	984	1040	3344	4428
	MILK SOLD/ COW (£)	129	317	136	149	173	190
	No. of COWS/ FARM	53	55	58	59	59	58
	MILK PRICE (p/GAL)	16.74	16.96	16.97	18.67	20.79	21.47
	MILK SOLD/ COW (GAL)	773	810	804	807	842	868
	ITEM	£					
LARGE FARMS (OVER 200 AC) 44 FARMS	N.F.I.	2995	3723	3910	4596	8955	10900
	M.I.I.	2150	2844	2958	3478	7675	9445
	MILK SOLD/ COW (£)	140	142	144	165	187	192
	No. of COWS/ FARM	82	87	89	94	95	99
	MILK PRICE (p/GAL)	16.57	16.85	16.93	18.53	20.66	21.45
	MILK SOLD/ COW (GAL)	843	845	850	897	911	932
REGISTERED MILK PRODUCERS IN W. SCOTLAND (5)		4385	4228	4001	3810	3642	2962

See Appendix III for Sources of data

The overall effect of the increase in milk production efficiency and cost changes has resulted, in those farms which remained in milk production, in a rise in their net farm income. The amount of the increase in the final year up to 1972/73 was 27, 26 and 22 per cent per annum for the small, medium, and large size farms respectively. The rate of increase in income was more than keeping pace with the rate of inflation in the economy at large. The increase in net farm income between 1970/71 and 1971/72 and 1972/73 was largely "paper" profit arising from stock revaluation gain. Setting this revaluation gain on a per acre basis it is possible to determine from Table 3.4.1. that the gain was equivalent to a N.F.I. of £9 and £15 per acre in 1971/72 and 1972/73 respectively.

The moderate rate of growth of net farm income, when valuation gains were excluded, was accompanied by increased pressure on available cash resources for use in current consumption, required to maintain a reasonable standard of living rather than for further capital investment. In this situation, the decision which the farmer has to consider is whether to opt out of farming, opt out of dairying, or commit himself to further capital investment in his existing enterprise in order to increase his efficiency. Since the main enterprise on the dairy farm is milk production, considerable information regarding the economic climate of dairy farming can be gained, by analysing the components responsible for the increase in the value of milk output per farm. Such an analysis is presented in Table 3.4.2. on the following page for the sample dairy farms.

In the first period under review (Section 'a' of Table 3.4.2.), sixty-three per cent of the increase in value of milk output was due to investment in dairy stock and 18 per cent due to an increase in milk yield per cow. Thus eighty-one per cent of the increase in the value of milk output was attributable to higher levels of milk production per farm, rather than due to product price increases. In terms of farm size, the performance of the small farms was similar to the all groups average, but the medium size farms showed less dependence on the milk price increase to account for their increase in value of output. The large farms increased their output mostly from investment in cows, but they

Table 3.4.2. Analysis of the Increase in Value of Milk Output on West Scotland Dairy Farms 1967/68 to 1972/73

Section a) 1967/68 to 1969/70 - 2 Year Period

	INCREASE IN VALUE OF MILK OUTPUT				
	TOTAL	ATTRIBUTABLE TO			
		COW NUMBERS	COW YIELDS	MILK PRICE	RESIDUAL
FARM SIZE		£ per FARM			
UP TO 125 acres	701	428	139	107	27
126-200 acres	962	559	277	92	34
OVER 200 acres	1263	880	101	252	30
ALL FARMS	960	609	175	145	31
ALL FARMS %	100	63	18	15	4

Source: "Some Economic Aspects of Dairy Farming in West of Scotland 1969/70" R.F. Munro. Report No. 136. Econ. Div. W.S.A.C. October 1971.

Section b) 1969/70 to 1970/71 - 1 Year Period

	INCREASE IN VALUE OF MILK OUTPUT				
	TOTAL	ATTRIBUTABLE TO			
		COW NUMBERS	COW YIELDS	MILK PRICE	RESIDUAL
FARM SIZE		£ per FARM			
UP TO 125 acres	557	135	-65	483	4
126-200 acres	976	136	29	793	18
OVER 200 acres	2791	719	708	1210	154
ALL FARMS	1391	315	205	815	56
ALL FARMS %	100	23	15	58	4

Table 3.4.2. continued on following page

Table 3.4.2. (Continued)

Section c) 1970/71 to 1971/72 - 1 Year Period

	INCREASE IN VALUE OF MILK OUTPUT				
	TOTAL	ATTRIBUTABLE TO			
		COW NUMBERS	COW YIELDS	MILK PRICE	RESIDUAL
FARM SIZE		£ per FARM			
UP TO 125 acres	1455	436	263	655	101
126-200 acres	1438	0	385	1009	44
OVER 200 acres	2256	166	244	1796	50
ALL FARMS	1690	194	302	1129	65
ALL FARMS %	100	11	18	67	4

Section d) 1971/72 to 1972/73 - 1 Year Period

	INCREASE IN VALUE OF MILK OUTPUT				
	TOTAL	ATTRIBUTABLE TO			
		COW NUMBERS	COW YIELDS	MILK PRICE	RESIDUAL
UP TO 125 acres	726	169	245	289	23
126-200 acres	853	175	319	338	21
OVER 200 acres	1911	752	412	684	63
ALL FARMS	1162	355	340	432	35
ALL FARMS %	100	31	29	37	3

did not improve their cow milk yield performance to the same extent as the other two groups.

During the year 1969/70 to 1970/71 (Section 'b' of Table 3.4.2.) price increases for milk became the greatest influence on the increase in value of milk output, with increased investment taking second place, accounting for 23 per cent of the "all farms" group increase in value of output.

Section 'c' of Table 3.4.2. indicated that the large price increase per gallon, for milk, during the year 1970/71 to 1971/72, dominated the increase in value of milk output. The contribution of investment in dairy cow capital to the increase in value of milk output fell to eleven per cent, on average, for the "all farms" group. There were, however, deviations from this mean value - the medium size farms had no increase in cow numbers, hence there was no increase in output attributable to this cause, whereas the small farm group increased the value of their milk output by 30 per cent, through increased cow numbers.

The situation for 1971/72 - 72/73 (Section 'd' of Table 3.4.2.) improved over that in the previous year, with the influence of milk price being surpassed by increased output per cow and capital investment in the form of dairy cows.

The general pattern over the six seasons studied has been one of increased value of milk output per farm, which in the periods 1967/68 to 1969/70 and 1971/72 to 1972/73 arose mainly from increases in capital intensity and improved milk yield per cow. In the year 1969/70 to 1970/71, and to an even greater extent in the year 1970/71 to 1971/72, the increase in value of milk output arose mostly from increased milk prices, indicating that the actual increase in milk production was less than the increase in value of milk output. In the long-term, increases in milk value arising primarily from price rises, is an undesirable situation unless these increases arise as a result of aggressive marketing policies by the Milk Marketing Boards or other factors stimulating the total demand for milk. Growth in real income (productivity) is dependent on investment in dairy cows and improved milk yield per cow. Data is not yet available for the value of increased milk output in 1973/74, but it is expected that farmers will continue to seek to expand their output to combat the effects of a reducing real income due to general price inflation within the economy. Under such circumstances farmers will require a continuing supply of funds, from farm or borrowing sources, to invest in the capital required for expansion.

3.5. Estimates of the Capital Stock of Agriculture

Much of the past work on agricultural capital has had, as its aim, the estimation of the value of capital stocks in agriculture(29). Such estimates of the value of capital stocks can be justified on three grounds:

Firstly, in order to estimate the income generated by the factor of production, capital, it is necessary to estimate the degree of annual capital consumption, so that part of the current income, produced by the capital stock, can be set aside to cover capital consumption (depreciation). If such an allowance is not set aside, the income generated will be overstated and the return on capital exaggerated. It is also clear that a return on capital calculation will require knowledge of the amount of capital stock in use.

Secondly, the level of net capital formation is used frequently as a measure of the growth of an industry or business. It is not possible to estimate the level of net capital formation (Gross capital formation - Replacement capital formation) without first knowing the absolute value of the existing capital stock, together with an estimate of the life of the capital stock.

Finally, the distribution of the capital stock is important. At the macro-economic level the differing determinants of the total capital stock in various sectors of the economy could cause unequal distribution of the capital stock between sectors, resulting in differences in the marginal efficiency of capital

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(29) Literature review Section 2.2.1. p. 14 et seq.

(M.E.C.) within different sectors of the economy. At the macro and micro-economic levels, it is important to determine the distribution of capital stock between landlord and tenant type capital and the income attributable to each type. Also, at both the macro and micro-economic levels, it is necessary to estimate the distribution of capital stock among the various categories of capital e.g. livestock, crop and machinery, before it is possible to analyse the effectiveness of capital investment.

3.5.1. The Capital Stock of Scottish Agriculture - Published Estimates

The only series of published estimates of the aggregate stock of capital, in Scottish agriculture, is by the Department of Agriculture for Scotland. This series is shown up to 1968/69 in Table 3.5.1. on page 56. Post 1968/69 the estimates of capital stock were published on a per farm basis. The estimates of capital stock may be divided, for analysis purposes, into landlords and tenants type capital.

Landlords Capital

The published estimates for landlords capital were prepared by valuing the acreage of agricultural land at the appropriate average value of land, with or without vacant possession. The authors of these estimates were aware of the limitations of this method but argue that it was the only realistic method then. Hill[30], in 1970, estimated the investment in farm buildings through the use of floor area. It is difficult to see how this alternative technique could be extended from the micro to macro-economic level of landlords capital estimation without the knowledge of building floor area for all farms in Scotland. Even if building floor area were known, doubt exists as to whether or not the technique would be an improvement over estimating landlords capital through valuing the farm acreage, since building floor area bore a simple functional relationship to farm acreage in Hill's study.

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(30) Hill, N.B. Some Economic Aspects of Farming's Fixed Capital Capital in the United Kingdom. Unpublished Thesis, University of Reading, 1970.

Table 3.5.1. The Capital Stock of Scottish Agriculture 1948 - 1968/69 £m (Current Prices)

	YEAR													
	1948	1949	1950	1951	1952	1953	1954	1958	1959	1960	1961	1962	1967/68	1968/69
MACHINERY	30.9	35.0	39.0	42.8	48.0	52.6	57.1	67.7	74.0	79.5	83.6	88.3	n.a.	85.2
LIVESTOCK	86.0	96.3	101.5	105.6	112.2	129.0	137.9	127.8	136.9	143.0	153.4	157.5	n.a.	150.6
STORES, CULTS. CROPS	22.4 6.9	23.2 8.8	23.3 8.5	23.1 9.1	23.8 10.5	23.6 12.0	23.2 11.5	38.7	38.5	38.5	39.2	39.4	n.a.	44.3
WORKING CAPITAL								40.6	39.9	40.9	43.7	45.1	n.a.	15.4
TOTAL TENANTS CAPITAL	146.2	163.3	172.5	180.6	194.5	217.2	229.8	276.8	289.3	301.9	319.1	330.3	n.a.	295.5
LANDLORDS CAPITAL	n.a.	n.a.	n.a.	n.a.	188.4	n.a.	n.a.	343.2	386.6	438.8	494.6	516.5	752.6	n.a.
TOTAL CAPITAL					382.9			620.0	675.9	740.7	814.5	846.8		

Sources: Series 1948 - 1954. Hendry, G.F. "The Value of Capital Assets of Agriculture in Scotland". Scottish Agricultural Economics, Vol. VI. HMSO 1955.

Series 1958 - 1962. Stewart, I. "Capital in Scottish Agriculture". Scottish Agricultural Economics, Vol. XV. HMSO 1965.

Series 1967/68 - 1968/69. McEwan, L.V. "Capital in Scottish Agriculture". Scottish Agricultural Economics, Vol. XXI. HMSO 1971.

The value of landlords capital invested in Scottish agriculture was not available for every year since 1948 but between 1952 and 1967/68, the value did rise by £564.2 million (current prices), which was about a three fold increase. This increase in total value was brought about by changes in the value of money (inflation) and demand pressure on land, but the increase in value of land also reflected actual investment in landlords capital.

This large increase in the value of landlords capital may be viewed in different ways. It can be seen as a very secure base for additional borrowing and expansion; conversely, the high value of landlords capital could act as a constraint or barrier to anyone contemplating the purchase of agricultural land. Also, landlords capital represents funds committed to a form of assets which do not generate high levels of return.

Tenants Capital

The method used to determine the published estimates of tenants capital in Scottish agriculture, was to "raise" farm financial account data to the national level. Variation in the method of computation has meant that strict continuity has not been maintained throughout this series of estimates of the value of the components of tenants capital. However, the estimates do serve to give an indication of the approximate absolute level and rate of increase of the tenants capital in use in Scottish agriculture.

During the six years from 1948 to 1954, tenants capital increased by approximately eighty four million pounds (current prices). Two periods within this time showed increases above the annual average, i.e. the years 1948/49 and 1952/53, which probably reflect the Government's expansion policy of 1947 and 1951. Of the fifty six per cent increase in the value of tenants capital between 1948 and 1954, the major part was livestock capital. Part of this increase "is accounted for by higher values rather than larger numbers"[31] but in general,

(31) Hendry, G.F. loc.cit.

agriculture operated in favourable conditions during this period. The second series of estimates of tenants capital invested in Scottish agriculture show an increase of £53 million or nineteen per cent, between 1958 and 1952. Again these estimates were at current values and would therefore contain an element of inflation but the actual quantity of livestock and machinery rose by ten and fifteen per cent respectively, in that period. The evidence from Table 3.5.1. suggests that the investment climate was not so favourable then as in the earlier period studied.

The reduction in the estimated value of tenants capital for 1968/69, compared to that for 1962, was due to modifications in the method of computation. Even though the absolute level of tenants capital was less in 1968/69 the relative importance of livestock capital to Scottish agriculture was still apparent.

If the published estimates for the value of tenants type capital are related to the Net Farm Income for Scottish agriculture, it is found that the return on capital varied from 13.6 per cent in 1961/62 through approximately 10 per cent in the late 1950's and early 1960's to 12.0 per cent in 1968/69. The return to agricultural capital was therefore above the cost of borrowed capital during the period under study.

3.5.2. An Alternative Method of Estimating the Tenants Capital Stock of Agriculture

An alternative method of estimating the value of tenants capital was considered desirable in the light of the inconsistencies already noted in the methods used in the published data.

The choice of method of valuing tenants capital is largely restricted to the use of one of two methods. Either the June and December census material is arranged in the form of an inventory and valued, or sample farm account data is 'raised' to represent the value of tenant type assets on the national farm. As previously stated, the latter method is that which has been used in the majority of published data, for Scotland.

In the following estimates of tenants capital, the census method is used.

The 'raised' sample technique makes use of cost prices or standard values to derive the value of tenants capital. This method estimates the original cost of the investment involved in accumulating the capital stock. Average market values, however, were used to value the census material, as this allowed direct comparison of the value of the total tenants capital, and the total landlords capital, as determined by valuing the acreage of agricultural land. In any event, it is possible to reduce the market value of tenants capital to a cost value, by applying a factor to represent the profit margin e.g. multiply the market value by 0.8 to obtain an estimate of the cost.

Estimates based on census data facilitates the use of calendar years to compare the values for the components of tenants capital. The utilisation of calendar year is most important in estimating the capital invested in crops, since using census data enables the average capital involvement over the year to be considered, which is a more dynamic approach to the problem of measuring crop capital values, than an annual valuation of an inventory at some arbitrary and variable point in time. Thus under-estimation of the value of capital invested in stocks of crops is avoided, as conventionally the 'on farm' inventory, used in the 'raised' sample technique, is carried out at the time of year when stocks are at their lowest or, in the case of non-cash crops, e.g. hay, silage, non-existent. Basing the estimate of livestock capital value on census data also permits the changing age structure of animals, during the year, to be incorporated into the capital valuation.

The method of creating the indices required to determine the value of tenants capital using census data, although important from a development of methodology aspect, is not absolutely necessary to interpret the results in Table 3.5.2. Full details of the methods used in the determination are given, therefore, in Appendix I at the end of this chapter.

The results of the estimates of the capital stocks in Scottish Agriculture are shown in Table 3.5.2.

Table 3.5.2. Estimate of the Capital Stock of Scottish Agriculture 1968, 1970 and 1972. £m. (Current values)

	VALUE OF ASSETS		
1) Landlords Capital	809.64	818.74	1825.36
Tenants Capital:			
2) Livestock	176.78	200.37	331.82
3) Crops	73.7	97.05	101.85
4) Machinery*	84.83	102.79	128.52
5) Concentrate Feed Stocks	1.48	1.92	2.24
6) Other	4.71	5.63	7.90
Total (2-6)	341.50	407.76	573.33
Total (1-6)	1151.14	1226.50	2971.02

*Includes value of farm vehicles

The value of landlords capital rose between 1968, 1970 and 1972 but, as a proportion of total capital, it fell to 66.7 and 61.4 per cent in 1970 and 1972 respectively as opposed to 70.3 per cent in 1968. This fall in relative importance was partly attributable to an alteration in the holdings included in the annual census and the rapid rate of increase in the value of tenants capital.

The total investment in tenants capital has risen considerably. In the first two year period under study, it rose by £66.26 million, while in the second, it rose £164.57 million. Part of this increase was attributable to inflation. If the values stated are deflated to constant 1968 prices, they become £59.1 million and £135.2 million respectively. These figures represent a real increase in tenants capital value of £206.3 million between 1968 and 1972. If increases of this magnitude continue, Scottish Agriculture will be faced with the increasingly difficult task of maintaining intact, and/or increasing, its capital stock. Assuming a return on tenants capital of 12 per cent, and that half the return on capital generated by agriculture is available for reinvestment, the amount of cash available for reinvestment from this source can be estimated. Based on the tenants capital stock in 1972, the amount would be £34.4 million. In addition, there would be available, for investment, the depreciation reserve, (assumed to be 20 per cent of the total capital stock) less the increase in 'paper' value of the capital stock (assumed to be 15 per cent of the total capital stock). The net result is the availability of £28.6 million to add to the £34.4 million already estimated. The total cash available for investment, from farm sources, would be £63 million. To this must be added £13.7 million which represents the value of capital grants to Scottish agriculture in 1973-74. The total cash now available becomes £76.7 million, which is less than the gross capital formation of £88 million in 1973-74. The shortfall must be supplied, in the main, by borrowing, with a resultant increase in the cash outflow from agriculture required to service the borrowed capital.

Analysis of the components of tenants capital indicated that the main reason for the increase in total tenants capital was the large increase of 65.6 per cent in livestock capital between 1970 and 1972. Part of this increase was due to the relative movements in the price of crop and livestock capital. In the earlier 1968-70 period, the gap between crop capital and livestock capital decreased, which supported evidence of crops becoming more profitable relative to livestock in that period. In the 1970-72 period, the balance was again turning in favour of livestock enterprises becoming relatively more profitable, with the resultant increase in livestock capital. Conditions of supply scarcity in 1972, especially in the livestock sector, also tended to inflate the value of livestock capital.

The capital invested in machinery increased over the period 1968-72 by £43.69 million, as farmers continued to substitute capital for labour and use increasingly sophisticated machinery. The increase in sophistication can be gauged from a study of machinery catalogues e.g. tractors offer more gears and power etc.

Estimates of the capital stock in Scottish agriculture, using census data, can be compared only with published estimates by the Department of Agriculture for 1968[32], since that was the most recent estimate on an aggregate national basis.

The Department of Agriculture estimate of the capital in agriculture in 1968/69 used market values. The two methods should therefore be reasonably comparable. If the values for the three main categories of tenants capital, namely, livestock, crops (including stores and cultivations), and machinery, are compared for 1968/69 (Tables 3.5.1. and 3.5.2.), it is seen that the values for machinery are within £0.4 million and that the estimates for livestock and crops are higher using the census method. Higher values are to be expected since, as already stated, the 'raised' sample technique bases crop values on the farm year-end inventory, which will tend to underestimate the average crop stocks on the farm. In the case of livestock, the 'raised' sample techniques will underestimate the capital invested, since it makes no allowance for the change in age structure of the animal population during a year. This is especially important regarding trading livestock and when livestock numbers are expanding. Overall, there was a difference of £46 million in the estimates of total tenants capital which was explainable, to a large extent, in terms of computational differences.

The June and December census data is also published on a regional basis, which enables its use for the estimation of the capital stock of West Scotland agriculture, Table 3.5.3. page 63.

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(32) McEwan, L.V., <u>loc.cit.</u>

Table 3.5.3. Estimate of the Capital Stock of West Scotland Agriculture+ 1968, 1970 and 1972 £m (Current Values)

	VALUE OF ASSETS		
	1968	1970	1972
1) Landlords Capital	265.81	273.67	601.28
Tenants Capital:			
2) Livestock	73.14	86.77	135.04
3) Crops	19.39	21.60	21.86
4) Machinery*	25.18	37.13	44.39
5) Concentrate Feed Stocks	0.50	0.97	0.80
6) Other	1.65	2.75	2.82
Total (2-6)	119.86	149.22	204.91
Total (1-6)	385.67	422.89	1011.10

+ West Scotland includes the counties of: Argyll, Ayr, Clackmannan, Dumfries, Dumbarton, Kirkcudbright, Lanark, Renfrew, Stirling, Wigtown and West Perth.

* Includes value of farm vehicles.

Comparison of Table 3.5.3. with Table 3.5.2. indicates that West Scotland agriculture absorbs just over one third of the total capital invested in Scottish agriculture in 1972. As might be expected, in a livestock farming,region, the proportion of the total tenants capital allocated to livestock was 8-9 per cent higher in the West region than for all Scotland. The rate of increase in the value of total tenants capital in West Scotland was slightly above the national increase in the period 1968-70 (24.4 percent compared to 19.4 percent), whereas in the 1970-72 period the rate of increase was slightly less (37.3 per cent compared to 40.3 per cent).

In general, farmers in the West region have increased the capital invested in all categories of tenants capital except concentrate feed stocks. The increase in tenants capital adjusted for inflation, over the four year period to 1972, was £71.95 million (60 per cent). Part of this increase, as in the case of all Scotland, was a physical increase in assets, but part was also due to scarcity increasing the value of livestock and crops.

3.6 Conclusions

Dairy farmers in West Scotland must invest in, and operate, their farms within the broad framework of Government agricultural policy as well as accept economic and technical limitations imposed by their farm businesses and personal capacity.

At the national level, the immediate post-war agricultural policy of the United Kingdom was designed largely to expand agricultural production. As imported food became generally more available, the policy switched (1958-64) to increased efficiency through cost reduction, then returned to import saving (1964-67). During the early 1970's, the policy was selective expansion, subject to continued improvement in productivity. The deteriorating balance of payments situation in 1974-75 has once again directed selective agricultural expansion towards an import-saving role.

In response to Government policy, the output of both United Kingdom and Scottish agriculture has increased two-fold in real terms during the last twenty five years. Much of this expansion was directly attributable to capital formation in the agricultural industry initiated to replace obsolete equipment and/or substitute capital for labour, which has resulted in the production per employee rising 4.5 times since 1947. The importance placed by Governments on regenerating United Kingdom agriculture has been demonstrated by the increasing levels of capital formation in real terms on an annual basis which were encouraged by the availability of capital grants. However, Government capital grants have only accounted for approximately 12.4 per cent, on average , of the annual gross capital formation in agriculture. The agricultural industry, therefore, has reinvested a considerable proportion of its profits, together with increased levels of borrowing, in order to attain the present high levels of domestic food production.

The major part of this study is concerned with dairy farming in The West of Scotland: The economic situation of these farmers is therefore particularly relevant. In the recent past, dairy farming has been changing, with fewer farmers investing in more cows per farm. The result, for those farmers remaining in dairying, has been an increased level of net farm income. At the lower end of the scale these increases in net farm income (if valuation gains are discounted) have just kept pace with price inflation, in the general economy, and there is increasing pressure from consumption requirements, on the funds available to farmers for investment. Data in Table 3.4.2. p. 52 showed that in the two year period up to 1971/72 increases in the value of milk output were mainly attributable to price increases per gallon of milk. Price rises, other than those necessary to cover the increased cost of factor inputs or resulting from expansion of aggregate milk demand, are less desirable than real productivity growth resulting from additional capital investment. The results for the most recent year for which data were available (1972/73) indicated a partial recovery in productivity growth through increased cow numbers and yield per cow.

The estimates of the capital stock in agriculture indicated increasing amounts of capital being absorbed by the agricultural sector of the economy. There will clearly be an increasing requirement for investment funds from farm and borrowed sources, e.g. the depreciation alone, on tenants capital, in 1972, at twenty per cent per annum, was £114.46 million, which will have to be funded, in the future, before the farmer can consider additional investment for further growth. The increases in capital stock in the West province paralleled those at the national level, but there was a definite emphasis on livestock capital.

An improved economic situation of dairy farmers in the West of Scotland was indicated by rising levels of net farm income in 1972/73. However, the continuing pressure to contain rising costs and the lack of cash resources because of the valuation increase element in the improved profits, means that it will continue to be difficult for farmers to supply the capital required for future investment, which is essential to maintain viable dairy farm units.

APPENDIX I

Estimation of the Capital Stock of Scottish and West Scotland Agriculture - Method of Procedure and Sources of Data

In order to simplify the discussion, the year 1968 is taken as an example. It follows that the method used will be exactly similar for the subsequent years 1970 and 1972.

Definition of Terms Used

a) Landlords' Capital: This is defined as the current asset value of land and buildings.

b) Tenants' Capital: This was divided into several classes of asset which were summed to give the total investment in tenants' capital. The groups of assets are indicated below.

   I. Capital Invested in Livestock: represented by the value of livestock at current market values in 1968.

   II. Capital Invested in Crops: Comprises the average value of crops in store during calendar year 1968, plus the value of growing crops, cultivations, fertilisers, etc. The crops were valued at market value i.e. before payment of deficiency payment.

   III. Capital Invested in Machinery; Cars; Lorries, etc: is represented by the depreciated value at 1968 prices.

   IV. Capital Invested in Stocks of Concentrate Feedstuffs: is the average value of monthly stocks of foodstuffs at current market value.

   V. Other Items: Includes stores of animal producet, oil fuel, etc., and all miscellaneous items of tenants capital.

Methodology

The method adopted was to prepare an inventory of the capital assets of the national farm and thereafter to value the inventory, thus determining the aggregate value of capital assets in Scottish Agriculture.

The calculation was divided into two parts 1) The valuation of tenant type assets and 2) The valuation of landlord type assets.

1) Tenants Capital

a) Livestock

The numbers of animals at the fourth June census cannot be used directly to determine the annual average holding of each type of animal, due to the seasonal pattern of the animal population, The fourth June figures were therefore adjusted by the use of seasonal indexes which were calculated as follows: The numbers of animals at the December 1967 cenus, (which for the purpose in hand were assumed to equal the numbers at the start of January 1968), and the June and December 1968 censuses were converted into index form using June 1968 as the base period. The average index number for 1968 was then calculated. This figure represented the ratio of the average population number over the year to the June population number. By applying this ratio to the June population number the annual average population numbers were obtained. The annual average population numbers were then valued at the weighted average prices for milking cows and store stock published by the Ministry of Agriculture and Fisheries for Scotland.

b) Crops

The calculation of the annual average value of crops was split into two parts: 1) The valuation of stocks of harvested and 2) The valuation of growing crop, cultivations etc.

1) The Value of Harvested Crop Stocks

Wheat, Barley, Oats From the monthly sale pattern of grain it was possible to establish that the new season's grain (1969 production) came on to the market in substantial amounts in September, thus by expressing the sales of grain between September and December as a percentage of the total sales for 1968, it was possible to determine that 47 per cent of the wheat, 50 per cent of the barley, and 31 per cent of the oat production in 1968 was utilised in 1968. A similar pattern of utilisation is assumed to apply to grain retained for stockfeed. The composition of the grain used in calendar year 1968 is shown in Table 1.

Table 1 Utilisation of Grain Stocks

	Utilisation in 1968 Calendar Year	
	1967 Production	1968 Production
Wheat	53%	47%
Barley	50	50
Oats	69	31

From Table 1 it can be seen that the stock of grain at the end of December 1967 (start of January 1968) will be 53, 50 and 69 per cent of 1967 production, for wheat, barley and oats respectively. At the end of September 1968, the stocks of grain for stockfeed and future sale will be the production of 1968 minus the sales of grain in September. The stocks of grain for feed and future sale can be calaulated for the remaining months of the year by subtracting the monthly stocks of grain from the initial stocks, assuming farms have completely exhausted their stocks of the previous year's grain by the start of the marketing of the new season's production. This would mean that by the end of August their stocks on hand would be zero. Any residual stock at the end of August must, therefore, represent the grain retained on the farm as stockfeed, between January and the end of August. By also assuming that the stockfeed used between September and December is one-third of the total for the year, and that the total retained stockfeed is distributed early over the year it is possible, by subtracting the monthly figures for stockfeed utilisation from the monthly figures for stocks with unallocated stockfeed, already calculated, to derive the actual monthly stocks of grain and hence the average annual stocks of grain. These stocks were then valued at the average price for cereals, in calendar year 1968.

Mixed Grain - The main constituent of mixed grain was considered to be oats: it was therefore treated above as 'oats'.

Potatoes - The monthly stocks of potatoes were calculated from the monthly sale pattern. As the sale pattern for Scotland was not available, that for the United Kingdom was used. It was assumed that the sale pattern also represents the pattern of utilisation of potatoes retained for stockfeed. It was then possible to determine the percentage of 1967 production utilised in 1968, by expressing the sales between January and September inclusive, as a percentage of the total sales during the year (71 per cent), provided it was assumed there are no stocks of 1967 potatoes by the end of September, 1968. The stocks of potatoes at the end of January will therefore be 71 per cent of 1967 production, less the stocks used in January, and at the end of October 1968 the stocks will be 1968 production, less the potatoes used in October. To derive the monthly stocks of potatoes between January and the end of September 1968, a monthly cumulative percentage sales index was prepared by expressing the monthly sales as a percentage of the total sales between January and September. The monthly cumulative percentage sales index for October till December was derived in a like manner, and was the monthly sales as a percentage of the total sales during the year. The monthly cumulative percentage stocks index was the reciprocal of the sales index. The actual monthly stocks were calculated by applying the monthly cumulative percentage stocks index to the production figures. The average monthly stocks were then valued.

Sugar Beet

Sugar beet is mostly sold as it is harvested, therefore the growing crop after maturity represents the stocks of sugar beet. It was assumed the crop was harvested evenly over the period October till December: hence the stocks were reduced by one-third per month over this period.

The stock at October was the 1968 production. The average stocks over the whole year were then calculated and valued.

Non-Cash Crops

No sales pattern is available or meaningful for the root crops, silale, etc. It was necessary therefore, to prepare utilisation patterns for such crops, e.g. silage. It was assumed the silage was cut in two equal instalments. This meant 50 per cent of the 1968 crop was in store at the start of June and 100 per cent in store by August. The period of silage utilisation was assumed to be November till April inclusive, hence two-thirds of the 1967 production was utilised in 1968.

$\left(\frac{\text{Jan-April}}{\text{Nov-April}} = \frac{4 \text{ months}}{6 \text{ months}} = \frac{2}{3}\right)$ and one-third of the 1968 crop. The stocks in store at January were therefore two-thirds of the 1967 production, and at November the total 1968 production. To calculate the stocks between November and April inclusive, a monthly cumulative percentage stocks index was prepared, which assumed equal monthly percentage reductions in stocks and that no stocks would be on hand at the end of April. By applying this index to the production figures, actual stocks per month were derived. The annual stocks were then calculated and valued.

2) The Value of Growing Crops, Cultivations, etc.

Growing crops means that the farmer has to lay out sums of money which will not be returned until the crop is harvested. This money is, in fact, part of his working capital, which must be included in any assessment of the capital invested in agriculture. In order to measure this capital is was assumed that the steady build up in value of a crop from cultivation to harvest, reflected the value of the capital employed. By expressing the value of the growing crop cultivations, etc., as a percentage of the annual value of the crop, it was possbble to estimate the capital involved in growing that crop. The average values for the growing crops were calculated as follows: e.g. Turnips. It was assumed that all the cultivations, sowing, etc., were completed between March and November and that there was a constant monthly cumulative percentage increase(1) in the value of the growing crop, from 0 per cent in March to 100 per cent in November at the time of harvest. The average monthly value of the growing crop (38.6 per cent) was then applied to the value of the 1968 turnip crop, which resulted in the average value of the capital required for the growing crop, cultivations, etc., being obtained.

c) Machinery

The value of machinery and implements was based on the numbers of machines at the machinery census in 1967. The machines were first valued at 1968 new prices and then they had an average value percentage applied to them which gave the depreciated value of the machines at 1968 prices. The average value percentages were calculated on the basis of a 20 per cent depreciation rate, using the reducing balance method and the average machine life as quoted by Culpin(2).

Cars It was nominally assumed that all full-time farmers (i.e. over two hundred and fifty, S.M.D. per annum) owned a motor car, which was assumed to be used five-fifths of its time on business and that its average life was five years, depreciating at 20 per cent per annum on the reducing balance method. The average value new was assumed to be £800.

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(1) See Appendix II, Table 1.

(2) Culpin, C. Profitable Farm Mechanisation. Crosby and Lockwood 1968 p.297 Table A2(1) Note. For tractors and electric motors 1000 hrs./annum, utilisation was assumed, all other equipment 100 hrs./annum. See Appendix II, Table 2 for Av. Value Percentages.

d) Value of Concentrate Feedingstuffs

It was assumed that basically supply equals demand for feedingstuffs, hence the quarterly production figures for feedingstuffs would equal the purchases by farmers per quarter. The four quarterly totals were divided equally among the three months to which they apply, to give the monthly purchases. If it is assumed that the farmers have utilised the previous month's purchases of feedingstuffs before buying the next batch then the average on farm stocks will be 50 per cent of the monthly purchases. The average stocks per annum will be $\frac{50}{12}$ = 4.16 per cent of the annual total value of feedingstuffs purchases.

e) Other Items were assumed to be 1.4 per cent of the value of items (a) to (d) above.

The total value of tenants' assets in Scotland in 1968 was the sum of items (a) to (d) above.

2) Landlords Capital

Valuing landlords capital presents several problems, as land has no original or replacement cost. The method employed, therefore, must involve the use of present day land values. This will give a value for landlords capital which is in no way related to either the replacement cost of the items which make land usable or the actual investment in land made by the present owner. It will, however, indicate the present day asset value of the land and also the amount of capital which a potential land purchaser would require.

The view of the authors of the published data on landlords capital, that the only realistic method of estimating landlords capital at present is to value land at its current value, was adopted, since this method of estimation allowed comparison of the estimates of tenants assets with those for landlords assets.

Landlords capital was therefore taken to be the value of all agricultural land, as implicit in the value of land is the value of buildings, fences, etc. Accordingly, the total acreage of crops, grass, and rough grazing in Scotland was first split into the area owned, or mainly owned, and the area tenanted. This was done by multiplying the total acreage by the factor 0.563 which represents that part of the total acreage owned, or mainly owned, in Scotland in 1968. The factor 0.563 was derived from data supplied by the Department of Agriculture and Fisheries for Scotland, in a private communication.

The acreage of land owned, or mainly owned, was next valued using the average sale value of land owned, or mainlu owned, in Scotland in 1967-68. Similarly, the acreage of land tenanted was valued at the average sale value of tenanted land in Scotland in 1967-68. The total values for land owned, or mainly owned, and tenanted land, were then assumed to derive the total asset value of agricultural land in Scotland.

Sources of Data

Livestock and machinery numbers, crop production and price data were obtained from the relevant year of Agricultural Statistics, Scotland, H.M.S.O.

Land Prices: Scottish Agricultural Economics, H.M.S.O.

Sale Pattern of Cereals: Weekly Agricultural Market Records, Dept. of Agric. and Fisheries for Scotland, Economics and Statistice Unit, Edinburgh.

Sale Pattern of Potatoes: Monthly Digest of Statistics, C.S.O., H.M.S.O.

Concentrate Production Figures: Ministry of Agric. Fisheries and Food Statistics. Ref. Stats. 87/68; 132/68; 174/68; 30/69.

TABLE 1

PERCENTAGE CUMULATIVE VALUE OF GROWING CROP, CULTS. ETC.

Month	Wheat	Barley	Oats	Mixed Grain	Potatoes	Sugar Beet	Grass Silage	Arable Silage	Hay	Beans	Turnips Swedes Mangolds	Rape Cabbage Kale	Straw
JAN	22	0	0	0	0	0	0	0	0	0	0	0	0
FEB	22	0	0	0	0	0	0	0	0	11	0	0	0
MAR	33	14	14	14	14	12	20	20	20	22	0	0	0
APR	44	28	28	28	28	24	40	40	40	33	13	13	0
MAY	55	42	42	42	42	36	60	60	60	44	26	26	0
JUNE	66	56	56	56	56	48	80	80	80	55	39	39	0
JULY	77	70	70	70	70	60	100	100	100	66	52	52	0
AUG	88	84	84	84	84	72	0	0	0	77	65	65	0
SEPT	100	100	100	100	100	84	0	0	0	88	78	78	100
OCT	11	0	0	0	0	100	0	0	0	100	91	91	0
NOV	22	0	0	0	0	0	0	0	0	0	100	100	0
DEC	22	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	562	394	394	394	436	355	300	300	300	496	464	464	100
AVERAGE	46.8	32.8	32.8	32.8	32.8	36.3	29.5	25.0	25.0	41.3	38.6	38.6	8.3

TABLE 2

MACHINERY AVERAGE VALUE PERCENTAGES

Life of Machine Years	Depreciated Value as % of Original Value	Average Value %
0	100.0	
1	80.0	80.0
2	64.0	72.0
3	51.2	65.1
4	41.0	59.0
5	32.8	53.8
6	26.3	49.2
7	21.1	45.2
8	16.9	41.7
9	13.5	38.5
10	10.8	35.7
11	8.7	33.3
12	7.0	31.1

APPENDIX III

Sources of Data for Table 3.4.1. p. 49

(1) Adapted from tabular data prepared by R.F. Munro, "Some Economic Aspects of Dairy Farming in the West of Scotland 1969/70". Report No. 136. Economics Department W.S.A.C.

(2) R.F. Munro. "Your Farm and Others" Dairy Farms, 1970/71. Statement No. 155. Economics Division W.S.A.C.

(3) M.L. Pickersgill. "Your Farm and Others". Dairy Farms 1971/72. Statement No. 164. Economics Division W.S.A.C.

(4) R.F. Munro. "Your Farm and Others" Dairy Farms 1972/73. Statement No. 172. Economics Division W.S.A.C. May 1974.

(5) Federation of Milk Marketing Boards. "Dairy Facts and Figures 1973".

CHAPTER IV

THE CAPITAL STOCK OF DAIRY FARMS AND ITS CONTRIBUTION TO THEIR PRODUCTIVITY

4.1 Introduction

The information available on the structure of the assets on dairy farms in Scotland and in West Scotland in particular is limited[(1)]. Estimates were therefore prepared, for the sample farms, in order to demonstrate the array of capital stocks, and to evaluate whether the quantity of a particular type of asset changed as farm size increased. The existence of different capital resource mixes on farms of different tenure type and size and the less intensive use of capital on larger farms indicated possible variation in the utilisation of tenants capital and a need to examine whether the more intensive use of capital on the smaller farms was as efficient as its less intensive use on the larger farms. In order to comment on the effect of capital intensity on the level of farm output achieved it was necessary to attempt to quantify the relationship between the capital used and the output obtained. In this study an econometric model of the explicit causal chain type, was used for this purpose as it offered scope to test the hypothesis; that a causal sequence existed between livestock capital, total tenants capital and the acreage employed and the gross output and gross margin generated on the sample farms. The use of both gross output and gross margin as measures of the effective utilisation of tenants capital permitted the inclusion of an analysis of the effect on capital utilisation of the variable costs associated with the use of tenants capital. The results obtained indicated that within a limited range it was possible for the dairy farmer to substitute livestock capital for acreage and still maintain similar levels of gross margin from his farm. Certain modifications to the structure of dairy farm assets and the entrepreneurial policy of the farmers were therefore indicated but the actual determination of the optimum input of tenants capital required to maximise profits was not considered till the following chapter.

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(1) Literature review p. 24

4.1.1. The Sample Farms

The sample of dairy farms in West Scotland which was used in the subsequent analyses of this study was drawn from that used by the Economics Division of the W.S.A.C. The sample was therefore composed of two types of financial account a) Monthly Summary Accounts (M.S. accounts) and b) Your Own Book Accounts (Y.O.B. accounts).

a) M.S. Accounts

These are among the earliest financial accounts collected by the Economics Division and some of the present sample date back to the 1930's, when financial accounts did not, by law, require to be kept by farmers. The information which may be derived from the M.S. accounts is in great detail. The proportion of this type of account in the total Economics Division sample has tended to decline.

b) Y.O.B. Accounts

The Y.O.B. accounts are copies of the farmer's accounts as he receives them, after auditing, from his accountant. This type of account also had its origins in the early years. More recently (within the last ten years) new and replacement accounts for divisional statistical analysis work have normally been of this type.

Permission to use balance sheet data, as opposed to trading account data, was first sought from both types of cooperating farmers in 1969. This request was received favourably in the majority of cases.

4.1.2. The Representativeness of the Sample Used in this Capital Study

The total number of owner occupied and tenanted dairy farms within West Scotland (the College Province) was 3,939 in nineteen-seventy. The total number of farms in the present sample was ninety, which represented 2.3 per cent of the total dairy farms in West Scotland. A Chi-square test was used in order to obtain some measure of the adequacy of the sample farms to represent the distribution of dairy farms, by size and tenure type, in the universe. For the purpose of this test the sample farms were divided into the size and tenure classes used by the Economics Division.

Table 4.1.1. The Expected and Observed Dairy Farm Numbers Within Each Class of the Sample

	Tenanted Farms			Owner Occupied Farms		
	Acreage Range			Acreage Range		
	0-125	125.1 - 200	200.1 - 450	0-125	125.1 - 200	200.1 - 450
Expected No. in Sample	12	13	11	19	16	19
Observed No. in Sample	10	15	11	20	14	20

Tenanted Farms $\chi^2_{(2)} = 0.63$ (P=0.70)

Owner Occupied Farms $\chi^2_{(2)} = 0.35$ (P=0.80)

The χ^2 test was consistent with the hypothesis that, for the sub-classes chosen, the sample of farms was representative of the frequency of occurrence of dairy farm types in West Scotland (P=0.70 or P=0.80).

The sample was not randomly selected due to the historical factors mentioned earlier. There was no evidence to suggest that the farms would differ from a randomly selected sample of dairy farms in West Scotland, i.e. the farms are believed to represent the type, size, output etc. of farms in the area. The sample of farms was also assessed, using scatter diagrams, for the presence of heteroscedasticity in the variables analysed later in the study. All the relationships presented were free from heteroscedasticity amongst the variables.

4.1.3. Definition of Terms

Adjusted Acres

The acreage of arable and grassland together with the acreage of rough grazing (if any) reduced by the ratio of 4:1.

Assets

1) Crop Assets: The average of the opening and closing valuation of crops in the ground and in store.

11) Livestock Assets: The average of the opening and closing valuation of all livestock.

111) Machinery Assets: The average of the opening and closing valuation of farm equipment, vehicles and fixed assets (Section 314).

IV) Other Assets: The average of the opening and closing cash balance plus sundry debtors.

V) Heritable assets: The value of the heritable property (buildings etc.) in 1969/70.

VI) Total Assets: The sum of items 1 to V above.

Capital

In this study the term assets was used interchangeably with capital e.g. livestock assets or livestock capital.

1) Landlords Capital: as heritable assets in V above.

11) Tenants Capital: The total assets less the value of heritable property.

Gross Output; Total: The value of sales of product (livestock and crops) including crop deficiency payments, fatstock deficiency payments, the value of produce consumed in the house and supplied to workers for which no payment is made, less purchases of livestock or other products bought for resale. The total was then adjusted for valuation changes.

Gross Margin; Total: Gross output less variable costs.

Net Worth: Represents the extent of the farmer's own capital investment in the business. It is comprised of total assets less sundry creditors and loans to the business.

Prices: In general, the values used in the study are at current prices. In specific circumstances when it was considered relevant, values were adjusted to a constant price basis. Livestock values followed the convention of 'standard values' being applied to all stock. As a result, any increase in livestock value does in fact represent a physical increase in livestock assets.

The use of constant prices was considered unnecessary in the majority of cases for the following reasons. Firstly, the adjustment of values could introduce more bias than was removed, due to the application of an average price change for the period, i.e. an individual farmer's prices may not change by the average price change. This is particularly relevant to agriculture where the judicious purchase and sale of stock may be important. Secondly, the input, output mix may vary slightly annually. Finally, the short time period of the study, over two relatively stable years in question, will involve only small price changes as is demonstrated in Table 10, Appendix II, Chapter V.

4.2 The Deployment of Assets on West Scotland Dairy Farms

Capital is required in a farm business, as in any business, in order that production may proceed. The capital or assets of a business are fundamental to the production process. The logical first stage in an investigation of capital investment on dairy farms is therefore an examination of the assets array of the sample farms. Such an examination, will enable the quantification of the existing deployment of capital resources, in both absolute terms, and with regard to the relative importance of the various categories of assets.

The majority of previous work on the asset structure of farms, including recent studies by Whitehouse(2), and Wilson(3), in 1973, has relied on a tabular presentation of farm sample averages. The constraints imposed on analyses through the use of averages are widely known and accepted. Regression analysis using cross-sectional data was therefore adopted in the present study as a means of overcoming many of these difficulties.

Time-series analysis was considered but rejected as it was felt that the results for a limited number of years would not necessarily be applicable to farms in general. To be worthwhile a time-series with cross-sectional data requires upwards of 15

(2) Literature Review p.25

(3) Literature Review p.25

years. Even then the nature of change in agriculture would probably render the series of little value. The type of information forthcoming from such an analysis e.g. movements in the structure of capital inputs and the effect of policy decisions on inputs was also seen as being beyond the scope of the study.

Estimating equations are presented in Table 4.2.1., which portray the direct relationships between the various asset types and farm size. Two alternative forms of estimating equation were used. These were i) $Y = a + b$ and ii) $Y = \gamma X^{\beta}$. Both equations were fitted to the data and the 'best fit' equation was selected. The 'best fit' equation, in each case, was selected by testing the coefficients of determination of the equations for significant difference, using the F test. The results of these tests are shown in Appendix I, Table 1. The selected equations in Table 4.2.1. were all statistically significant at the $P=0.001$ level, as were the regression coefficients.

In all cases, if a relationship was linear or curvilinear in 1969/70 it took that form in the following year. The form of equation was therefore consistent in the two years under study. With regard to the variable, other assets (X_6), for the tenanted farm group, it was found that there was a more than proportional response to farm scale in 1969/70 compared to a less than proportional response in the later year. On testing, the difference in the value of the β coefficients was found to be non-significant. Considering the residual nature of this variable and its relatively minor importance relative to the other variables, this small inconsistency does not influence the analysis.

Results

The regression equations shown in Table 4.2.1. can be used to estimate the quantity of the various categories of assets which were used, as the size of the farm business increased. Estimates for six levels of farm size are tabulated in Table 4.2.2. These results for tenants type assets are also depicted graphically in Figures 4.2.1. and 4.2.2. in order to facilitate certain parts of the analysis.

Table 4.2.1. Relationship between Assets and Farm Size. 1969/70 and 1970/71

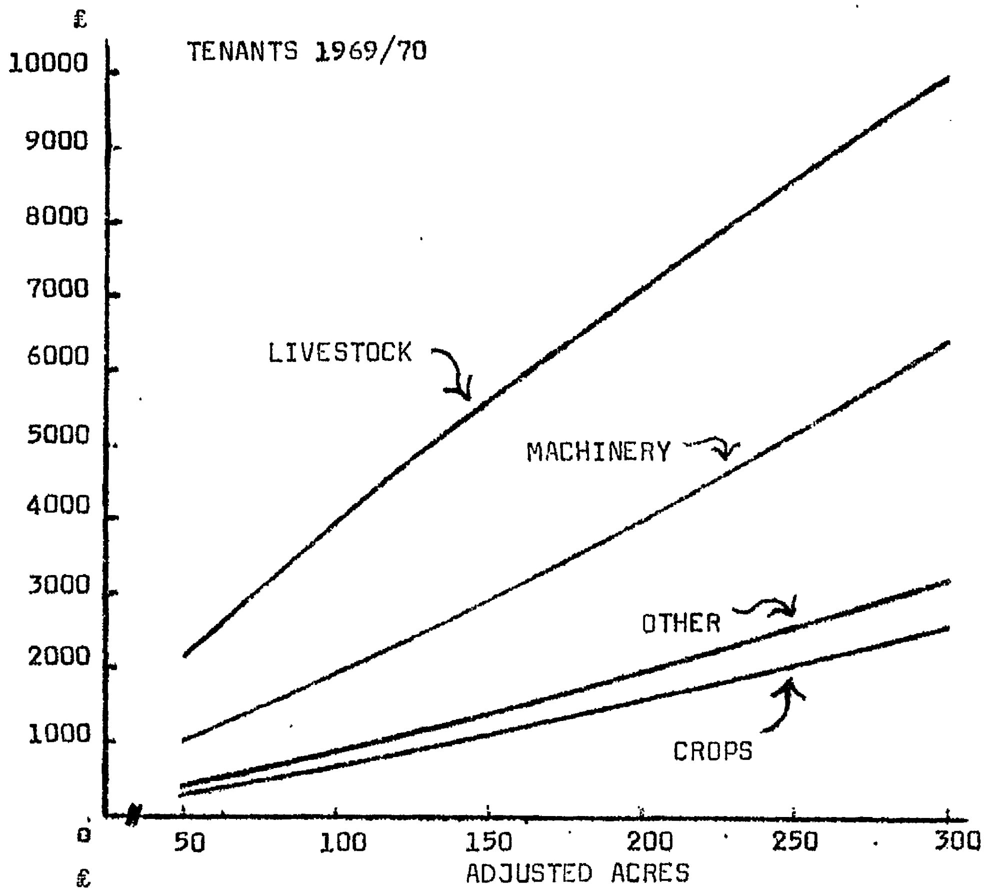
	1969/70									
	Tenanted Farms					Owner Occupied Farms				
Type of Asset	Relation Number	Constant	β or b	s.e. of β or b	% Variation Explained	Relation Number	Constant	β or b	s.e. of β or b	% Variation Explained
Machinery X_3	1	19.06	1.0170	0.1491	58	5	70.15	0.7881	0.1303	41
Livestock X_4	2	74.30	0.8601	0.0854	75	6	1372.29	30.7421	2.3707	76
Crop X_5	3	3.56	1.5081	0.1327	69	7	15.96	0.8802	0.1502	40
Other X_6	4	7.74	1.0476	0.2418	36	8	547.53	10.1134	2.6898	21
Heritable Property X_{32}	-	-	-	-	-	9	3866.00	137.6965	12.2126	71
	1970/71									
Machinery X_3	10	11.98	1.1175	0.8473	72	14	84.72	0.7601	0.6610	43
Livestock X_4	11	82.19	0.8531	0.8475	72	15	1486.08	32.2751	0.8669	75
Crop X_5	12	2.89	1.2090	0.8909	79	16	11.48	0.9505	0.6359	40
Other X_6	13	24.90	0.8494	0.5741	33	17	544.48	12.2143	0.4622	21

Note:- The relationships are all log-linear except for numbers 6, 8, 9, 15 and 17, which are linear functions. The r lationships all have adjusted farm acreage as the independent variable (X_1) and are statistically significant at the β=0.001 level as are the β or b coefficients. Heritable property values were available for one year only.

Table 4.2.2. The Asset Structure (£) of Dairy Farms in West of Scotland 1969/70 and 1970/71

Size of Farm (Adj. acres)	1969/70								
	Tenanted Farms				Owner occupied Farms				
	Livestock Assets (X4)	Machinery Assets (X3)	Other Assets (X6)	Crop Assets (X5)	Heritable Assets (X32)	Livestock Assets (X4)	Machinery Assets (X4)	Other Assets (X4)	Crop Assets (X5)
50	2150	1019	466	321	10750	2909	1531	1052	499
100	3903	2062	964	714	17635	4446	2644	1558	919
150	5531	3115	1475	1140	24519	5983	3641	2063	1314
200	7084	4174	1994	1586	31404	7520	4566	2569	1692
250	8582	5236	2519	2050	38288	9057	5445	3074	2060
300	10040	6304	3049	2529	45173	10594	6287	3580	2418
	1970/71								
50	2314	948	638	328	-	3100	1658	1155	473
100	4179	2057	1135	759	-	4713	2807	1765	913
150	5906	3236	1589	1240	-	6327	3820	2376	1344
200	7550	4463	2017	1755	-	7941	4754	2987	1766
250	9133	5727	2427	2298	-	9555	5632	3597	2183
300	10670	7021	2823	2865	-	11168	6471	4208	2596

Figure 4.2.1. Relation Between Assets and Farm Size



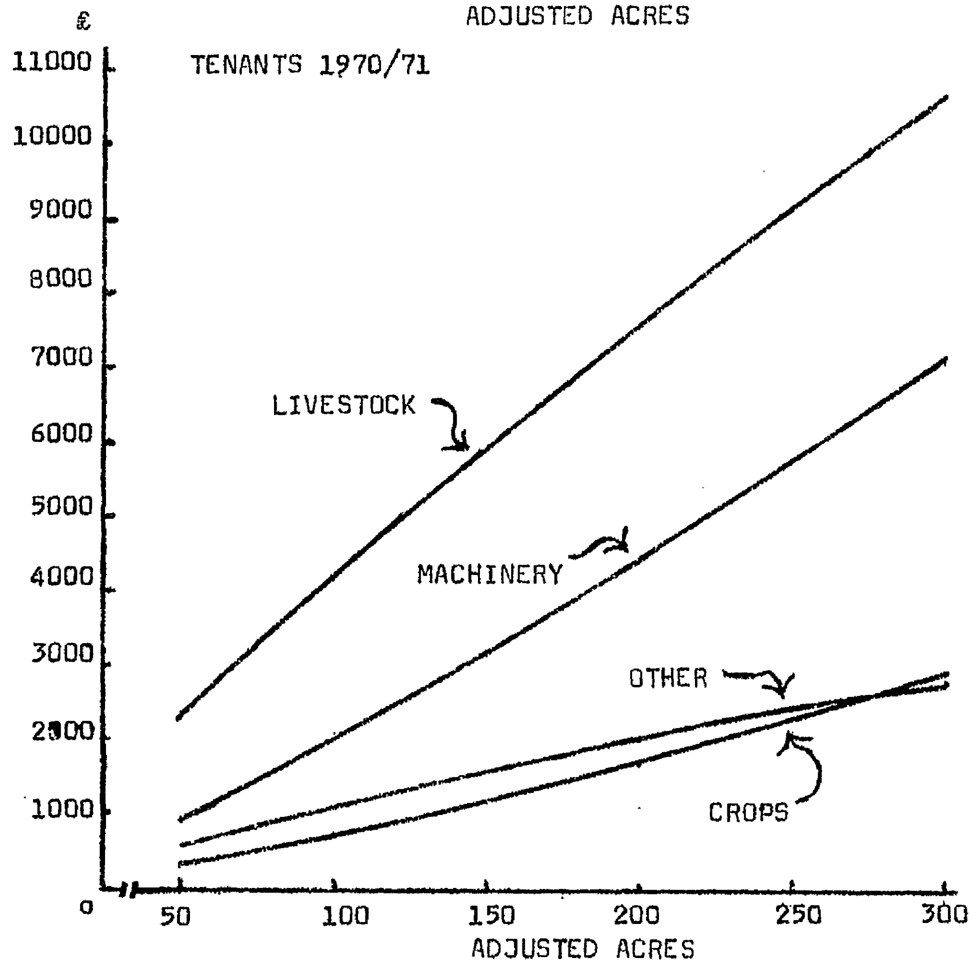
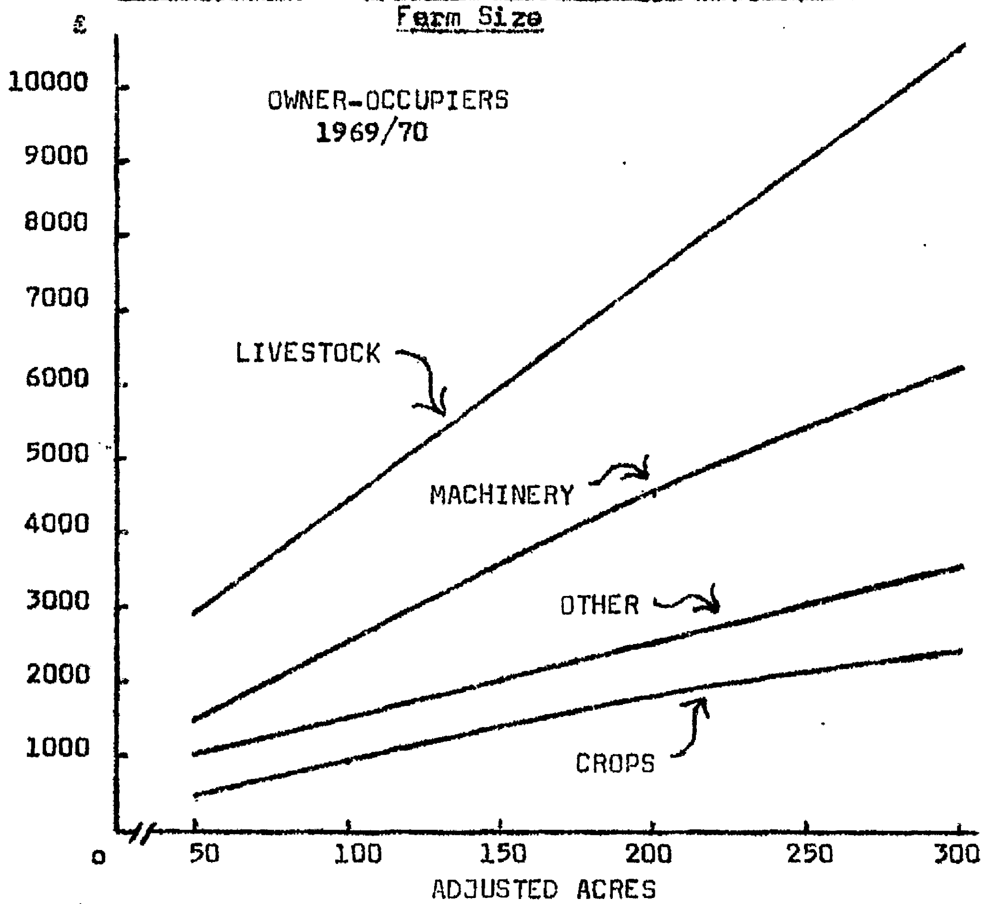
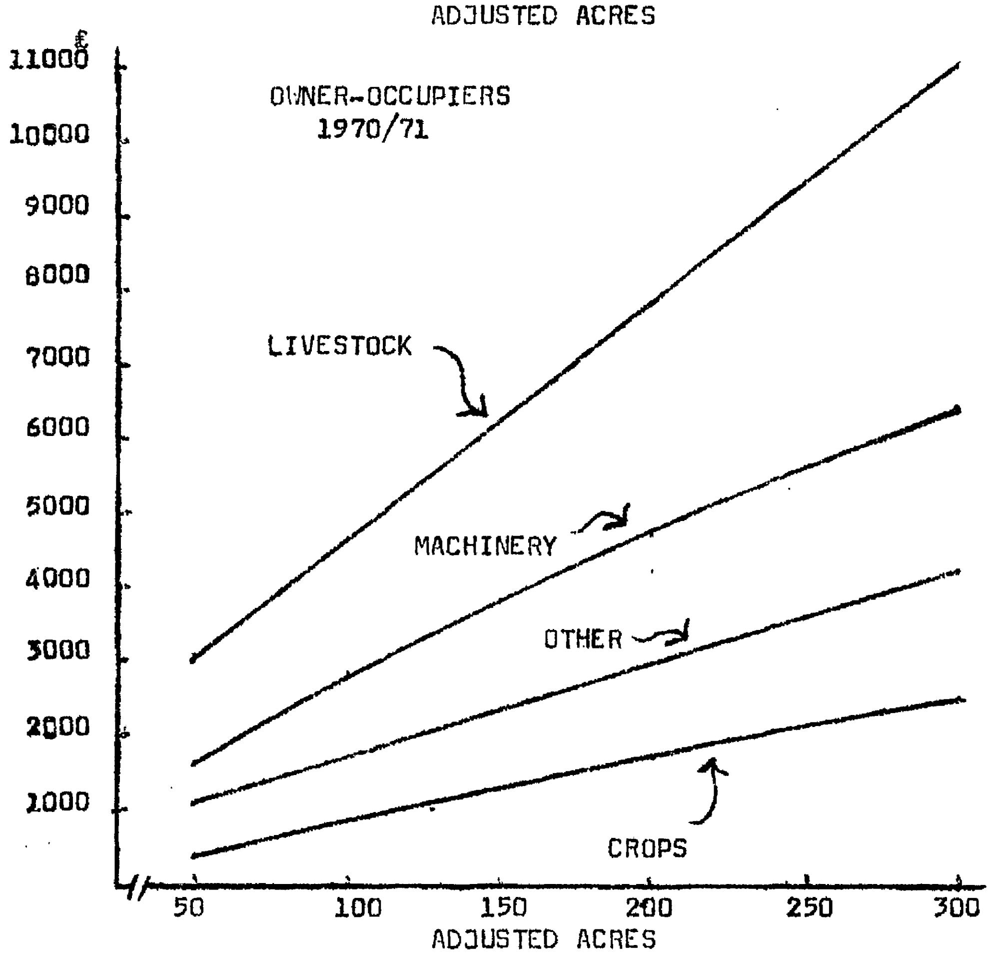


Figure 4.2.2. Relationship Between Assets and Farm Size





The values in Table 4.2.2. indicate, as expected, that when farm size increased there was an associated increase in the capital employed. From Figures 4.2.1. and 4.2.2. it can be seen that these increases may be more than, less than or in constant proportion to the increase in farm size, depending on the type of asset. This finding was important as it indicated that the mix of asset types used in the production process varied according to farm size and type of tenure.

In terms of the absolute value of the assets employed on owner occupied farms, most capital was invested in heritable property. Approximately four times the capital was invested in landlord type assets (heritable property) as in livestock assets. This factor can be to the advantage or disadvantage of the owner occupier. It has the disadvantage of causing considerable capital to be locked up in a type of asset which is demonstrated later to have a low rate of return. It does however have the advantage that the owner occupier has a larger borrowing base than a tenant when making applications for loans. Land also provides a degree of protection against inflation but in so doing creates a potential capital taxation problem. It should be noted that there was a linear dependence between heritable property(X_{32}) and farm acreage, which suggested farm size did not assist the owner occupier to reduce his capital outlay on buildings.

Turning to the tenants type assets of both the owner occupied and tenanted farms, the order of importance of assets was, livestock, machinery, other and crops. The importance of livestock capital on dairy farms was to be expected, however, it was valuable to verify this, as the input of livestock capital was subsequently taken as the commencement point of the model in Section 4.3.

Examination of Table 4.2.2. showed that owner occupied farmers were heavier users of all types of tenants capital resources, at all farm size levels, except in the case of variables X_3(machinery) and X_5(crops) at the three hundred acre level in 1969/70 and from the 250 acre level onwards in 1970/71. The evidence was not strong enough to conclude that tenants might be utilising capital more efficiently than owner occupiers. In order to justify a greater use of resources, the owner occupied farms would require to produce a higher gross output and gross margin than the tenanted farms. The evidence does however indicate the need to examine the relationship between capital use and output in subsequent sections.

A study of Table 4.2.1. or Figures 4.2.1. and 4.2.2. revealed a linear relationship existed between livestock assets and acreage on the owner occupied farms, but possibly of greater significance was the curvilinear relationship between livestock assets and farm size in the tenanted farm group. The value of the β coefficient in this group was less than one, indicating that as farm size increased proportionately less livestock capital was utilised. A possible explanation which was examined in this and the following chapter, was that tenants were using insufficient livestock capital to optimise output.

The remaining major category of tenant type assets is machinery. It was apparent from Figures 4.2.1. and 4.2.2. that the relationship between machinery assets and farm size was curvilinear and that in the case of the owner occupied farms the proportionate change in assets due to farm size was less than one, whereas for the tenants it was greater than one. The difference in the two regression lines was statistically significant at the P=0.01 levels in 1970/71 but only at the P=0.1 level in 1969/70. A logical reason for the difference between the owner occupied and tenanted groups was difficult to concieve, but perhaps it can be attributed to the fact that owner occupiers have to finance buildings as well as tenants capital. This could reduce the amount of cash available for investment in machinery as farm size increases. In both the tenanted and owner occupied farm groups, there was also a good relationship between the amount of machinery capital in use and the capital invested in crops, as is shown in Table 4.2.3.

Table 4.2.3. Zero Order Correlation Coefficients of Machinery and Crop Assets 1969/70 and 1970/71

1969/70			
Tenanted Farms		Owner Occupied Farms	
r	r^2	r	r^2
0.6643	0.4413	0.6236	0.3889
1970/71			
0.7992	0.6387	0.6333	0.4011

Note: The values of the correlation coefficient are all statistically significant at the P=0.001 level.

The explained variance between machinery and crop assets was high, when it is remembered that these farms are primarily dairy farms with cropping as a support enterprise to the dairy herd. The cropping policy of the farms does, however,influence the level of investment in machinery capital.

Comparing the values of the farm assets for the two years 1969/70 and 1970/71, a rise in the value of assets becomes apparent. The farms were becoming more highly capitalised and this could lead to the problem of financing the additional capital required, in the absence of a concomitant increase in farm income. This aspect is examined in a later section.

The analysis so far has dealt with individual categories of assets and their relationship to farm size. Individual groups of farm assets are not used in isolation in the farm business. It is therefore necessary to consider the relationship between the aggregated groups (i.e. the total assets employed on the farm) and farm size and also how the proportion of assets supplied by the farmer varies with farm size.

The equations used to estimate the total assets (including heritable property in the case of owner occupied farms) and net worth of the sample farms are tabulated in Table 4.2.4.

Table 4.2.4. Relationship between Total Assets, Net Worth and Farm Size. 1969/70 and 1970/71

	1969/70									
	Tenanted Farms					Owner Occupied Farms				
Type of Asset	Relation Number	Constant	β or b	s.e. of β or b	% of Variation Explained	Relation Number	Constant	β	s.e. of β	% of Variation Explained
Total Assets X_2	1	117.3	0.9211	0.0854	77	3	539.5	0.8473	0.0605	79
Net Worth X_3	2	119.2	0.8724	0.1041	67	4	424.0	0.8587	0.0995	59
	1970/71									
Total Assets X_2	5	110.5	0.9416	0.0923	75	7	549.1	0.8487	0.0579	80
Net Worth X_8	6	1336.2	57.3185	7.5756	63	8	430.7	0.8595	0.0970	60

Note:- All the relationships are log-linear except for relation number 6. The independent variable was adjusted acreage (X_1). The regression equations were all statistically significant at the $P=0.001$ level, as were the β and b coefficients.

The linear and log-linear functions were estimated for variables X_2 (Total assets) on X_1 (acres) and X_8 (Net worth) on X_1. In all the equations the value of the correlation coefficient was statistically significant at the $P=0.001$ level. Comparison of the coefficients of determination of the eight estimates showed that the log-linear function was the 'best fit' equation in all cases except for variable X_8 (Net worth) on X_1 (relation number 6), where the test of statistical difference was non significant. Values were derived for net worth using both equations and it was found that the estimated values for 1970/71 were less than those for 1969/70, within the acreage range, 50 to approximately two hundred acres, when the log-linear function was used, this situation was not supported by the raw data. The linear equation was therefore used, although no logical reason could be found to account for the inconsistency of this one equation in the series.

Results

The estimated total asset and net worth structure of the dairy farms is presented graphically in Figures 4.2.3. and 4.2.4.

The value of total assets (including heritable property of the owner occupiers) used by the farms increased from approximately £15,000 to £68,000 and £4,500 to £23,000 in the case of owner occupied and tenanted farms respectively, as farm size was increased from a small farm of fifty acres to a large dairy farm of 300 acres. This rise in the use of assets was less than proportional to the increase in farm size. The marginal increase in total assets resulting from a one acre increase in farm size, (measured at the geometric mean of acreages[4]), is given by $\frac{dX_2}{dX_1} = \beta X_1^{\beta-1}$ and was equivalent to £70.0, £77.8, £212.1 and £217.8 for the tenanted and owner occupied farms in 1969/70 and 1970/71 respectively. From these estimates it can be seen that the owner occupier invested approximately £151 per acre more capital than the tenant farmer, as farm size increased. However,

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[4] The marginal increase in total assets will vary according to the point of measurement e.g. tenants 1969/70, at 100 acres the marginal increase is £72.11 whereas at 250 acres it has fallen to £67.08. The confidence limits are at a minimum at the point of the geometric mean.

Figure 4.2.3. Relation Between Total Assets, Net Worth and Farm Size - Tenants

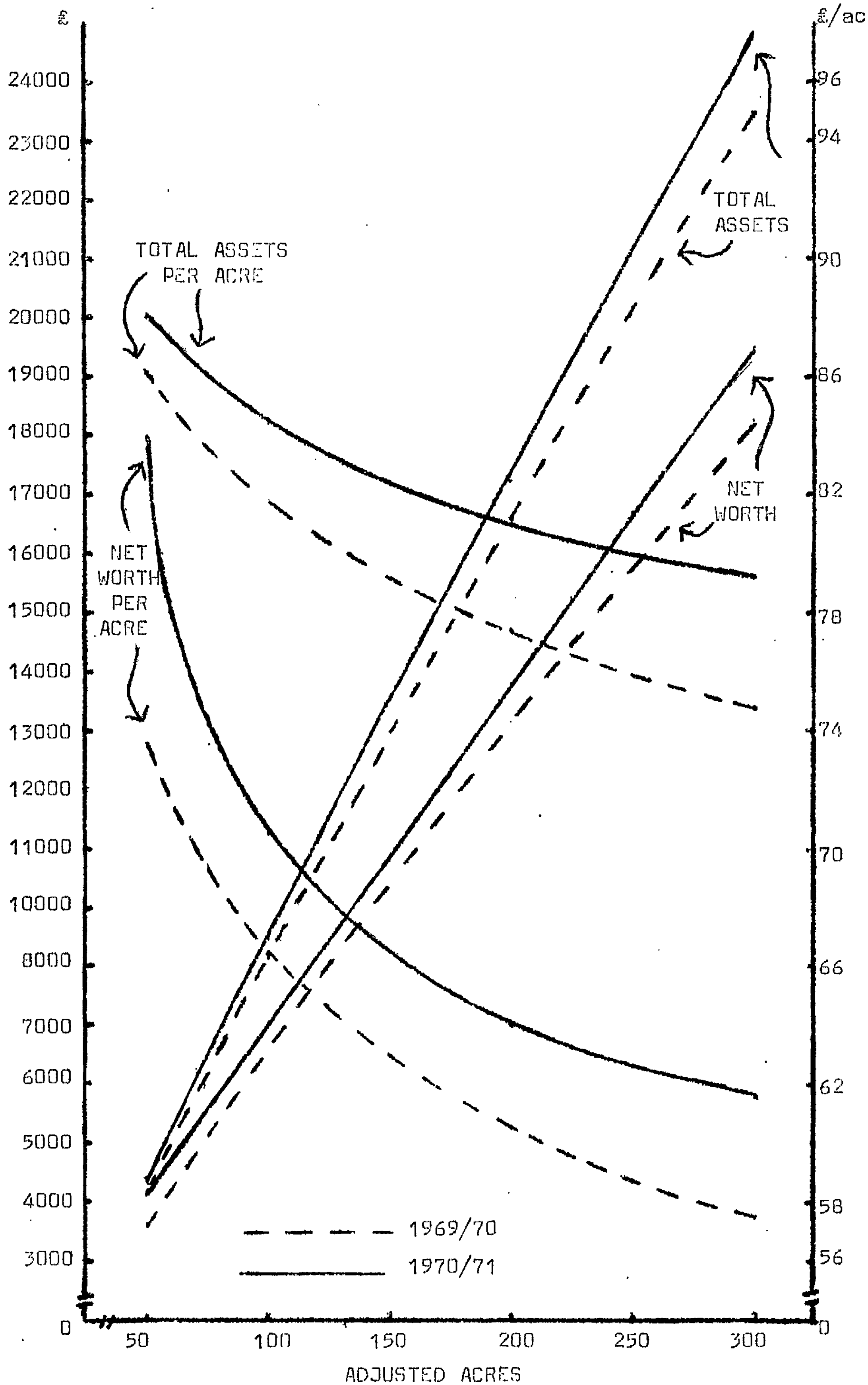
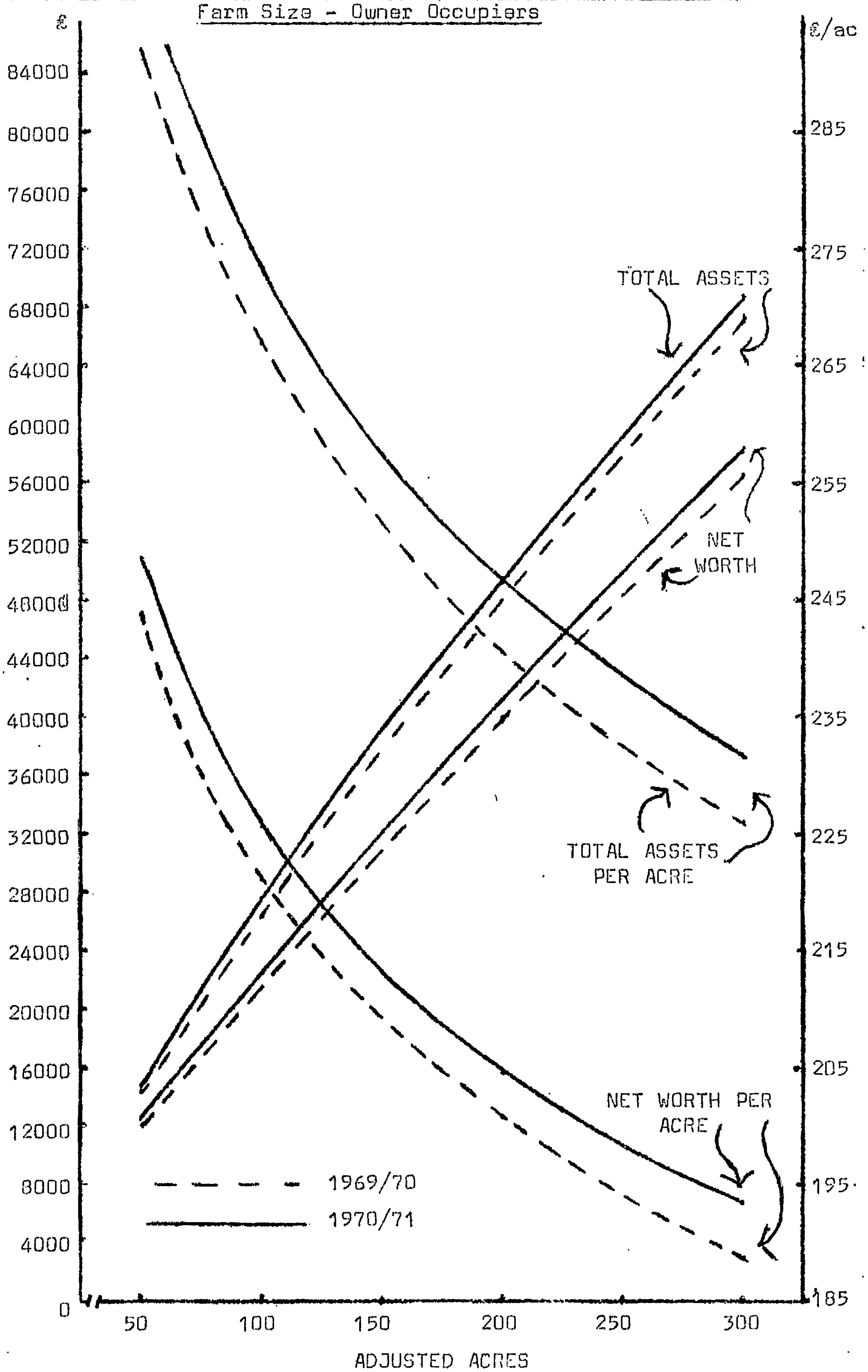


Figure 4.2.4. Relation Between Total Assets, Net Worth and Farm Size - Owner Occupiers



when the increment in marginal investment between the years 1969/70 and 1970/71 was considered it was found that the tenant supplied £7.8 per acre (£77.8-£70) to the owner-occupier £5.7 per acre (£217.8 - £212.1). The situation was therefore that between 1969/70 and 1970/71 the tenanted farm group achieved larger increments in the level of marginal investment than the owner occupied farm group, but these differences were not statistically significant at the $P=0.05$ level. In absolute terms the owner occupiers marginal investment was much greater than that of the tenant (approximately £215 compared to £75 due to the inclusion of landlords type assets).

The total assets and net worth curves in Figures 4.2.3 and 4.2.4. do not exhibit much visible curvature. Values for total assets and net worth per acre were therefore derived from the total assets and net worth values. In the per acre graphs the curvature was much more distinct and facilitates an easier visual appraisal of the relationships involved, as well as supplying a measure of the intensity of capital use. The total assets per acre of the farms reduced as the farms increased in size. The tenant and owner occupier of a 300 acre farm will be investing £7 and £71 per acre less, respectively, than their contemporaries on a 50 acre farm. These figures indicated less intensive capital use at higher acreages and were consistent with the possibility mentioned earlier that larger farm units may be more efficient users of capital resources. Whether this is the situation depends on the outcome of the investigation into the relationship between capital input and output (Section 4.3).

Comparison of the two years results showed that the total assets in use rose during the period, indicating additional investment had occurred. The absolute increase in capital usage was greater on the larger farms as was illustrated by the divergence of total assets and assets per acre curves in Figures 4.2.3. and 4.2.4. When the absolute increase in total assets was expressed as a proportion of the existing assets it became clear that the smaller farms were increasing their capital stock at a faster rate than the larger farms, but again the difference did not attain statistical significance ($P=0.05$ level).

The net worth data of the farms is of importance as it indicates the farmer's own investment in the business. The proportion of the business owned by the farmer is one of the principal factors which determines the credit worthiness of the farmer. Banks are generally unwilling to lend more than one third of the equity of the farm business[5].

It was obvious from Figures 4.2.3. and 4.2.4. and expected, that the net worth of the farmer would increase in absolute terms, with increased farm size. The estimated total net worth of both groups of farms was greater in 1970/71 than in 1969/70 which indicated that farmers were still investing their own capital to finance new investment and not relying entirely on additional external finance.

The estimated values from the graphs of total assets and net worth (Figures 4.2.3. and 4.2.4.) were used to derive the equity percentages for the farm groups. Table 4.2.5. shows the equity percentages for six farm sizes.

Table 4.2.5. Equity Percentages 1969/70 and 1970/71

Farm Size (Acres)	Tenanted Farms		Owner Occupied Farms	
	Equity %			
	1969/70	1970/71	1969/70	1970/71
50	83.9	85.6	82.2	81.8
100	81.1	83.7	82.2	82.4
150	79.5	80.3	83.2	82.8
200	78.5	79.0	83.5	83.1
250	77.6	78.3	83.7	83.3
300	76.9	78.0	83.6	83.4

The average net worth proportions of the farms were high and agree with other recent published work[6]. The high equity percentages

(5) Course - Literature review p. 20

(6) Cason - Literature Review p. 25
Wilson - Literature Review p. 21 and p. 25

demonstrated that the level of indebtedness of the sample farms was low relative to the amount of the total assets, thus suggesting that provided the farm was capable of servicing any increased level of loans, the potential for obtaining further loans was considerable. High potential arises from the ability of the farmer to offer security, especially the owner occupier.

The effect of farm size on the net worth of the farmer differed between the owner occupied and tenanted farm groups. The proportion of the assets owned by the tenanted farm group fell approximately 7 per cent as the size of farm increased from 50 to 300 acres. In contrast the owner occupied farm group exhibited a stable net worth percentage, any slight tendency to change being upwards with increases in farm size. The larger tenanted farms were hence making more extensive use of borrowed funds. Lower net worth percentages could be viewed favourably as indicating the preparedness of farmers to grasp possible opportunities for expansion by extending their credit to finance new enterprises. Alternatively, a low equity percentage could be viewed as a reduction in credit worthiness for obtaining extra credit and therefore not desirable. Attempts were therefore made to link the degree of asset ownership to farm profitability. The results are discussed in the section on capital utilisation (Chapter V).

Table 4.2.5. indicated that the owner occupied farms had higher equity percentages than the tenanted farms. Recourse to the basic data showed this to be partially attributable to the inclusion of heritable property values in the calculation of the owner occupier equity percentage. The proportion of loan capital to equity capital was less for landlord type assets than for tenants type assets i.e. little differences existed in terms of equity position between the owner occupied farm group and the tenanted group, when tenants assets only were considered.

Comparison of the results for 1969/70 and 1970/71 indicated only marginal changes in equity percentage. Little significance can therefore be attached to them except that a status quo existed which suggested farmers were not being excessively pressurised to increase the proportion of credit in order to finance their additional investments.

In the foregoing section the deployment of assets on West Scotland dairy farms has been analysed. It is now appropriate to relate the capital stock of these dairy farms to the output obtained from its use.

4.3. The Capital Stock/Output Relationship on West Scotland Dairy Farms

Few studies have been made in the United Kingdom into the functional relationship between the capital stock input of a farm and the output obtained. The principal study of this type was by Jones[(7)] whose findings were that within the normal working range the quantity of capital has little effect on production. To test this he plotted capital against net product and concluded "capital, as defined, can vary almost independently of output". The validity of this conclusion has already been commented upon in the literature review. No studies using a multiple linear regression technique with cross-sectional farm data have been reported for Scotland. There therefore exists a clear requirement to attempt to quantify the causal relationship between the capital used on dairy farms and the output achieved.

Estimation of the capital stock/output relationship on a farm involves a sequence of events, the direction of which can be predetermined from empirical observation, e.g. the output produced is dependent on the capital in use, and not vice versa, within the same time period. In the present study, variables are introduced in a preconceived order - livestock capital and acreage; total tenant's capital; gross output; gross margin - thereby implying a sequence of causation. The variables used are seen to be highly correlated. The use of a single equation multiple regression technique where gross margin is regressed on acreage, livestock capital, tenant's capital and gross output would suffer from the problem of multicollinearity and would be unlikely to yield unbiased estimates of the regression coefficients. Nor would such an equation supply estimates of the functional relationship between variables at intermediate stages in the sequence of causation. The problem of the inter-relation of variables may

(7) Jones - Literature Review p.32

sometimes be overcome through the use of an explicit causal chain model. Such a model also premits the hypothesis of a sequence of causation, yielding at each stage in the system of causation, the functional relationship between variables.

4.3.1. Description of the Causal Chain Model

The variables used and the system of equations are illustrated in notational form below:-

X_1 : Livestock Capital, £.

X_2 : Acreage (Adjusted)

X_3 : Total Tenant's Capital, £.

X_4 : Gross Output, £.

X_5 : Total Gross Margin, £.

Model : $X_3 : f(X_1, X_2)$

$X_4 : f(\hat{X}_3, X_2)$

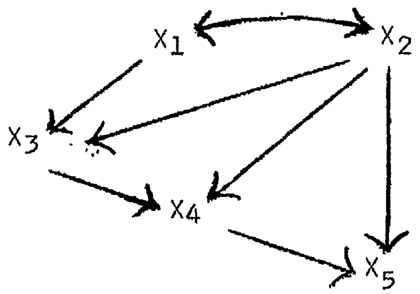
$X_5 : f(\hat{X}_4, X_2)$

Where ^ indicates a variable estimated from the previous relation.

The farms under study were dairy farms, on which it was assumed the basic form of capital was livestock capital. It was for this reason that one of the two exogenous variables chosen for the model was livestock capital (X_1). The assumption that livestock was the basic form of capital stemmed from the belief that farmers view other forms of capital as being necessary to support their primary enterprise - the dairy herd. The second exogenous or predetermined variable was taken as farm size (adjusted acreage) (X_2), as it was considered that livestock capital and acreage were the fundamental determinants of the amount of total tenants type capital required. The first of the three structures comprising the complete causal model can now be stated as: Total tenants capital (X_3) (endogenous variable) is a function of livestock capital (X_1) and farm size (X_2) (exogenous variables). The second structure in the causal sequence related the total tenants capital (X_3) and acreage (X_2) in use on the farm to the gross output (X_4) obtained. The logic of this structure was that output cannot be produced without the application of tenants capital and that the exogenous variable, acreage, had a direct causal effect on the total gross output obtained. The third and final structure of the model related the level of farm gross output (X_4) to the gross margin (X_5). The concept of gross margin acknowledged the existence of the variable costs associated with the generation of given levels of gross output and capital use. It was therefore desirable to investigate if a functional relationship could be established between gross output and gross margin, as the gross margin is a more accurate profit indicator than gross output. The third structure of the model was therefore: gross margin = f(gross output, acreage). Acreage was again included as a direct exogenous variable to anticipate farm size effects on the farm gross margin.

4.3.2. Schematic Diagram of the Hypothesised Causal Relationships

Figure 4.3.2.1. The Causal Model



X_1 = Livestock Capital

X2 = Acreage (adjusted)

X_3 = Total Tenants Capital

X_4 = Total Gross Output

X_5 = Total Gross Margin

In Figure 4.3.2.1. the straight lines represent the hypothesised causal relationships, the arrows indicate the direction of causation. For example, variable X_1 has a direct causal effect on variable X_3 and indirect causal effects on variable X_4 and X_5. Also note that variable X_2 has a direct causal effect on variable X_4 in addition to an indirect effect though variable X_3. The curved line with two arrows connecting variable X_1 and X_2 indicates no causal effect is hypothesised between variable X_1 and variable X_2. i.e. they are assumed in this model to be exogenous predetermined variables. The numbering of the variables indicates the cause-effect relationship.

4.3.3. The Structural Equations of the Causal Model

Table 4.3.3.1 Causal Chain I: Tenanted Farms 1969/70

Dependent Variable	Regression Coefficients b				Standard Errors of b				% Variance Explained
	X_1	X_2	X_3	X_4	X_1	X_2	X_3	X_4	
X_3	1.7490 ***	6.9001 N.S.			0.1582	6.2293			93
X_4		-7.0246 N.S.	1.2070 ***			11.6110	0.1561		86
X_5		12.1594 N.S.		0.5094 ***		7.485		0.0889	84

Note: Full equations, including value of constants are shown in Appendix . Table 2.

Table 4.3.3.2. Causal Chain II: Tenanted Farms 1970/71

Dependent Variable	Regression Coefficients b				Standard Errors of b				% Variance Explained
	X_1	X_2	X_3	X_4	X_1	X_2	X_3	X_4	
X_3	1.5850 ***	14.0510 *			0.1444	6.1520			93
X_4		-4.4290 N.S.	1.1583 ***			11.5349	0.1457		87
X_5		11.3275 N.S.		0.4634 ***		8.2628		0.0939	80

Table 4.3.3.3 Causal Chain III: Owner Occupied Farms 1969/70

Dependent Variable	Regression Coefficients b				Standard Errors of b				% Variance Explained
	X_1	X_2	X_3	X_4	X_1	X_2	X_3	X_4	
X_3	1.8581 ***	2.8481 N.S.			0.2266	7.9724			84
X_4		0.6813 N.S.	1.0113 ***			7.8734	0.1252		83
X_5		13.1046 *		0.4332 ***		6.0319		0.0957	76

Table 4.3.3.4 Causal Chain IV: Owner Occupied Farms 1970/71

Dependent Variable	Regression Coefficients b				Standard Errors of b				% Variance Explained
	X_1	X_2	X_3	X_4	X_1	X_2	X_3	X_4	
X_3	1.8094 ***	1.4934 N.S.			0.1484	9.1034			82
X_4		6.4980 N.S.	1.0279 ***			10.5888	0.1629		81
X_5		21.9067 *		0.3541 ***		8.9300		0.1228	75

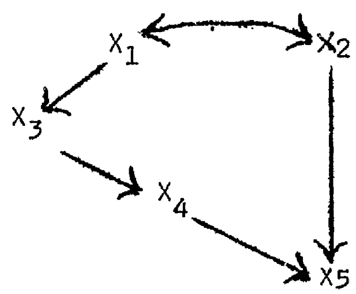
One of the problems which exists with the use of an explicit causal chain model, as with any multi-variable equation, is the predisposition of the equations to multicollinearity. Where equations contain more than one independent variable there may be some correlation between two or more variables. If this correlation is high the problem of multicollinearity will exist. The estimated structures of the model were therefore examined for the existence of collinearity, by comparing the zero-order correlation coefficients of the variables with the multiple correlation coefficients of each structure. This procedure showed the probable existence of some collinearity in the estimated structures, arising from the intercorrelation of the input variables. When a high level of collinearity is present the possibility exists that the regression coefficients are unstable. It must be stressed however that the existence of collinearity does not invalidate the results of this analysis since collinearity does not detract from the usefulness of the function for predictive purposes, especially over short time periods where the relationships between variables are likely to be stable. It does however mean that the structural parameters cannot be relied upon to interpret the relations causally i.e. a change in an exogenous variable will not necessarily result in the change in the endogenous variable implied by the structural parameters.

The coefficients of determination of the structures were all high - indicating that linear equations were a "good fit" to the data - and explained a high proportion of the variance in the endogenous variables. The tenanted farm group showed better results in this respect than the owner occupied group. Both groups of structures can however be used with considerable accuracy for predictive purposes.

In the first structure of the models the coefficients of the X_1 variable were all very highly significant(***). The X_2 coefficients were statistically non-significant except in the case of the tenants 1969/70 where the coefficient was statistically significant at the P=0.05(*) level. It is probable that the statistical significance of this coefficient was a random occurrence as in three out of the four equations this coefficient was statistically non-significant. In subsequent analysis the X_2 coefficient in the first structure of the 1970/71 tenanted farm group was assumed non-significant. This maintains consistency throughout the equations. The coefficients of the X_3 variable in structure two were all very highly significant, but those for the X_2 variable were all non-significant. In the final structure the coefficients of the X_4 variable were all highly significant and those of the X_2 variable in the owner occupied farm group were significant(*). The coefficients of the X_2 variable for the tenanted farms were greater than their standard errors but were not statistically significant at the P=0.05 level of significance. The coefficients were however significant at the P=0.2 level. In the interest of logical consistency with the owner occupier third structure equations it is therefore proposed to accept these coefficients as being significant, at a later stage in the analysis, although it should be borne in mind that the influence of these coefficients will be weak.

The existence of non-significant coefficients in the estimating equations indicated that the original hypothesised model required to be modified. The reformulated model is shown schematically below.

Figure 4.3.3.1. Schematic Diagram of the Hypothesised Causal Relationship (Modified)



In terms of logic, acreage would be expected to exert a causal effect on the amount of total capital employed on a farm. Earlier results showed a significant direct relationship (p.84) between acreage and livestock capital. The statistical results showed acreage to have a non-significant coefficient in the first structure of the causal chain. Although this indicated no direct causation between acreage and total tenants capital, it must not be assumed that no causation existed since, as explained below, there is likely to be an indirect influence through the level of livestock capital employed.

Within the system of causation outlined livestock capital (X_1) is now seen to be the major determinant of total tenants capital (X_3).

In the short-run situation the farmer has no means of adjusting his acreage, therefore his decisions on the intensity of livestock capital to be used on the available acreage is the important determining factor of the quantity of total tenants capital required. The absence of acreage from the system of causation indicated that the smaller farmer compensates for fewer acres by intensifying capital usage.

The second structure of the model indicates that the quantity of total tenants capital employed was the major determinant of the level of gross output produced. In this instance the smaller farmer clearly compensates for his lack of acres by intensifying the use of tenants capital i.e. he "buys" extra acres in the form of capital. Thus it is possible to have high levels of gross output produced by employing high levels of tenants capital, irrespective of acreage, the level of gross output actually achieved depending directly on the level of total tenants capital used and indirectly on the livestock capital of the farm.

The final structure of the model showed the main determinant of the gross margin obtained to be the level of gross output which was achieved, but farm size entered the system of causation. The difference between the gross output and gross margin of a farm is the level of variable costs on the farm. It therefore appears from the results that although the gross output of a small farm can be as high as the gross output of a larger farm, through the more intensive use of tenants capital, the larger farmer has the ability to spread the variable costs of production over a larger acreage. Recourse to the basic data confirmed that variable costs per acre decrease with increased farm size. This explains why acreage only became a significant factor at the gross margin level.

4.3.4. Estimates of Tenants Capital, Gross Output and Gross Margin. Tenanted and Owner Occupied Farms 1969/70 and 1970/71.

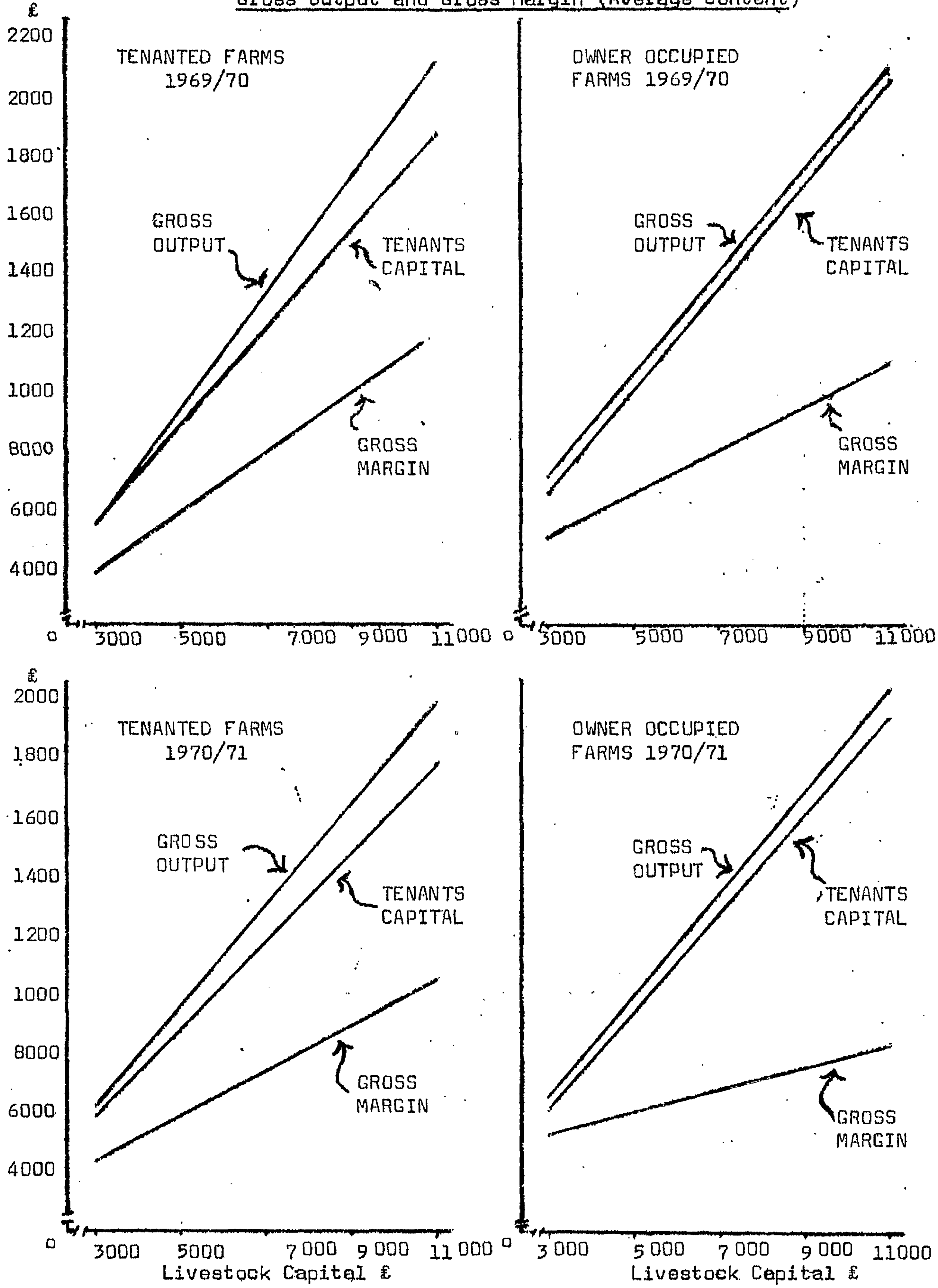
Figure 4.3.4.1. shows graphically, the results from the causal chain model, with the value of acreage (X_2) held constant at its mean value. The graphs in the figure present the estimated values of total tenants capital, gross output and gross margin in relation to livestock capital, for tenants and owner occupiers in each of the two years under study.

A positive relationship existed between livestock capital and total tenants capital. Taking the livestock capital at its mean value the ratio of total tenants capital to livestock capital was 1.8 and 2.0 respectively for the tenants and the owner occupiers. Between 0.8 and 1.0 units of tenants type capital, other than livestock capital, were therefore required per unit of investment in livestock capital. Owner occupiers were more highly capitalised in terms of non-livestock capital than were tenants.

In absolute terms the owner occupied and tenanted farms produced similar quantities of gross output and at the mean level of tenants capital input, the rate of turnover of tenants capital (Gross Output/Tenants Capital) was 1.04 for the owner occupiers and 1.08 for the tenants. Due to the lesser amounts of total tenants capital, used by the tenanted farm group, when generating the higher levels of gross output, the efficiency of capital utilisation by the tenanted farms appeared greater than the owner occupied farm group, at the higher capital usage levels i.e. for the tenanted group the gross output and tenants capital lines diverge with increases in tenants capital, whereas the gross output and tenants capital lines are approximately parallel for the owner occupiers - Figure 4.3.4.1. This divergence of gross output from total tenants capital was not however statistically significant. (Appendix, Table 3).

At the then current milk price and levels of variable cost the absolute amount of gross margin which a dairy farmer could expect was approximately half the value of the gross output generated (measured at the mean input of livestock capital). At lower

Figure 4.3.4.1. Relationship Between Livestock Capital, Total Capital, Gross Output and Gross Margin (Average Content)



livestock capital input levels i.e. below approximately £7000 of input, owner occupiers obtained better gross margins than tenants, but the converse applied at higher livestock capital input levels although again this difference was not statistically significant. The downward divergence of the gross margin line from the total tenants capital line (Figure 4.3.4.1.) as the input of tenants capital increased was statistically significant and demonstrated the effect of the variable costs associated with the use of increased levels of tenants capital. The output produced was obtained at an increase in variable cost per unit of tenants capital. This situation was consistent with a decline in variable costs/acre as farm size (acreage) increased, due to a reduction in tenants capital invested per acre as farm size increased(e.g. Figure 4.2.3.).

Expressing the gross margin achieved as a percentage of the total tenants capital invested, on the sample farms, the return varied from 77.8 per cent to 54.4 per cent for the owner occupied group and from 68,5 per cent to 61.0 per cent for the tenanted farm group (averages for two years) as the total tenants capital investment in a farm increased from £7000 to £18,000. This variation in rate of return on tenants capital, between the owner occupiers and tenants showed that potential existed for improved performance in both instances. The lower capital input tenanted farms and the higher capital input owner occupied farms both required to improve their efficiency of capital use. (The division between upper and lower capital input groups occurred at an input of approximately £7000 livestock capital). The methods of achieving the improvements possible differ from the tenanted group to the owner occupied group. The tenants should endeavour to increase their total gross output through increased investment in livestock and machinery (see also Chapter V, Section 5.7) whereas the owner occupiers require to reduce their variable costs, thus increasing the gross margin attained.

The estimated increase in gross margin per £1000 increase in tenants capital was £575 and £399 respectively for the tenanted and owner occupied farm groups (mean values for two years). Within the range of tenants capital investment under study, it was clearly profitable for many farmers to consider additional tenants capital investment. The high return on tenants capital emphasised further the need for farmers to concentrate on the optimum use of tenants capital in order to fully utilise existing capacity in terms of land and buildings. The lower return, in terms of gross margin, obtained by the owner occupiers may suggest that owner occupiers already operate closer to their optimum tenants capital input. This possibility is examined further in Section 5.6.

The results so far have demonstrated the effect on tenants capital, gross output and gross margin of changes in the input of livestock capital, without any influence from change in farm size. The final structures of the causal chain model (Section 4.3.3.) indicated that variable X_2 (acreage) had an independent influence on the level of gross margin obtained, although the effect was not so strong, especially in the tenanted farm group, as the X_4 (gross output) variable. Table 4.3.3.5. (p.110), illustrates the variation in gross margin attributable to farm size effects, using three levels of farm acreage.

Certain values were omitted from Table 4.3.3.5. as it was considered they were outside the experience of the data e.g. it was unlikely that a 275 acre farm would use only £3000 of livestock capital.

Since the values in Table 4.3.3.5. were estimated using the third structure equation of the causal chain, gross output was held constant at the concomitant livestock capital levels shown i.e. gross output was held constant at five levels while acreage was permitted to vary at three levels. By reading along any row of the table the increase in gross margin attributable to farm size is indicated e.g. at the £7000 level of livestock capital input, the increase in gross margin was £1311 per one hundred acre increase (owner occupiers 1969/70). The effect of acreage on the gross margin obtained therefore increased both absolutely and relatively, at any given gross output level or capital input level, as acreage increased. Since, from equation three of the model, it is known that the gross margin attributable to the influence of gross output has been allocated, the increase in gross margin due to acreage must result from the more effective spreading of variable costs at higher acreage levels. It should be remembered that the statistical significance of acreage was greater for the owner occupiers than the tenants. This appears logical as the average size of an owner occupied farm is approximately ten acres larger than the tenanted farm, which would allow more effective cost spreading.

Table 4.3.3.5. Total Gross Margin (£) Associated with Livestock Capital and Acreage. 1969/70 and 1970/71.

Livestock Capital £	1969/70					
	Tenanted Farms			Owner Occupied Farms		
	Gross Margin £			Gross Margin £		
	Acreage			Acreage		
	75	175	275	75	175	275
3000	2848	-	-	3803	-	-
5000	4999	6125	-	5328	6638	-
7000	7150	8366	9582	7059	8370	9680
9000	9301	10517	11733	8584	9895	11205
11000	11452	12668	13884	10212	11523	12833
	1970/71					
	Tenanted Farms			Owner Occupied Farms		
	Gross Margin £			Gross Margin £		
	Acreage			Acreage		
	75	175	275	75	175	275
3000	3538	-	-	3401	-	-
5000	5239	6369	-	4719	6909	-
7000	6308	7438	8568	6036	8227	10417
9000	8642	9772	10902	7353	9544	11735
11000	10343	11473	12603	8670	10861	13051

The effect of acreage on the gross margin obtained decreased with an increase in livestock capital input e.g. on a 75 acre tenanted farm in 1969/70 the acreage component of the gross margin was £911. Reading the 75 acre column for tenanted farms in 1969/70, vertically it can be shown that £911 represented 32 per cent of the gross margin at a livestock capital input of £3000 whereas at a livestock capital input of £9000, the acreage component of the gross margin had fallen to 9.8 per cent. This pointed directly to the situation mentioned earlier; that farmers were able to substitute capital for acreage. This situation confronts most farmers, as at any given period the ability to increase acreage is limited and the only option available is to increase capital intensity. To continue with the example of tenants in 1969/70: a small 75 acre farm with an investment in livestock capital of £9000 generated a similar gross margin to a larger 275 acre farm with less intensive livestock capital use of £7000. On this basis approximately £100 of livestock capital would be required to substitute for an acre of land.

Reading the values for total gross margin diagonally downwards from left to right (Table 4.3.3.5.) the combined effect on the gross margin of simultaneously increasing the livestock capital input and acreage is shown to be an increase in absolute gross margin, as is to be expected.

Reference to Table 4.3.3.6. on the following page shows the effect of increases in livestock capital and acreage in terms of gross margin per acre.

In all groups of farms the gross margin per acre declined with an increase in farm size, which was the result of a reduction in the intensity of livestock capital (and its associated tenants capital) investment. Therefore, although the gross margin per acre values indicated the small farmer to be a more effective producer, this need not necessarily be the situation, as the capital used per acre on the small farm was greater than on the large farm. Table 4.3.3.6. therefore confirms on a per acre basis the conclusions reached earlier when comparing the gross margin achieved from given levels of total tenants capital input.

Table 4.3.3.6. Gross Margin (£) per acre Associated with Livestock Capital and Acreage. 1969/70 and 1970/71.

Livestock Capital £	1969/70					
	Tenanted Farms			Owner Occupied Farms		
	Gross Margin/Acre £			Gross Margin/Acre £		
	Acreage			Acreage		
	75	175	275	75	175	275
3000	37.9	-	-	50.7	-	-
5000	66.6	35.5	-	71.0	37.9	-
7000	95.3	47.8	34.8	94.1	47.8	35.2
9000	124.0	60.0	42.6	114.4	56.5	40.7
11000	152.6	72.3	50.4	136.1	65.8	46.6
	1970/71					
	Tenanted Farms			Owner Occupied Farms		
	Gross Margin/Acre £			Gross Margin/Acre £		
	Acreage			Acreage		
	75	175	275	75	175	275
3000	47.1	-	-	45.3	-	-
5000	69.8	36.3	-	62.9	39.4	-
7000	84.1	42.5	31.1	80.48	47.0	37.8
9000	115.2	55.8	39.6	98.0	54.5	42.6
11000	137.9	65.5	45.8	115.6	62.0	47.4

4.4. Discussion/Conclusions

Depending on the type of asset and the nature of tenure of the farm group, the rate of increase in assets varied, as farm size increased (Figures 4.2.1. and 4.2.2.). These differing rates of increase indicated the existence of differing capital resource mixes, which were shown later to affect the efficiency of capital utilisation.

The estimated asset structure for the sample farms (Table 4.2.2.) demonstrated similarities and differences in the investment policies of the owner occupier and tenant dairy farmer. In both groups the order of importance of tenants type assets (measured in value terms) was livestock, machinery, 'other capital' and crops. The cropping enterprise of the dairy farm was, as expected, subsidiary to the livestock enterprise and was used in a supporting role. A difference in crop capitalisation policy existed between the owner occupied and tenanted farm groups. The investment in crop capital increased at an increasing rate with increases in farm size on the owner occupied farms, whereas the converse was true on the tenanted farm i.e. crop capital increased at a decreasing rate. The difference in cropping policy was shown to directly affect the farm machinery investment levels (Table 4.2.3.).

Owner occupier farmers were more intensive users of all types of capital resources, at all farm size levels, with the exception of machinery and crops capital on the large 300 acre farm size. The general higher level of capitalisation by owner occupiers was an indication of possible under utilisation in the use of resources by the tenants. This aspect is developed when the relationship between gross margin, gross output and tenants capital investment is discussed.

Owner occupier farmers also had a commitment to finance the capital invested in buildings (heritable property). The results of this section indicated that in absolute terms, the capital invested in buildings was four times that invested in livestock. The considerable capital sums involved in operating an owner occupied farm did provide such farms with a large borrowing base and greater security for borrowed capital than in the case of tenant farmers. It is, however, shown in Chapter five that the return on both owned and borrowed capital is adversely affected by this large commitment to landlords type assets. The "best fit" equation associating the capital invested in heritable property and farm size (acreage) was found to be linear; there was therefore no evidence of economies in building investment with increasing scale.

Between 1969/70 and 1970/71 a general increase in investment in all the categories of farm assets was apparent (Table 4.2.2.). In any period of increasing investment the possible difficulty of financing the necessary capital expenditure might occur. The sample farms were therefore examined in Chapter five, for evidence of any reduced ability to service loans or maintain an adequate return on capital.

Relating the total assets (including heritable property in the case of owner occupiers) employed on the sample farms to farm size indicated that the increase in total assets was less than proportional to the increase in farm size. In terms of total assets per acre the three hundred acre, owner occupied and tenanted farmers were investing approximately £71/acre and £7/acre less respectively than the small 50 acre dairy farm. The large dairy farmer was therefore a considerably less intensive user of capital than the small farmer. The question posed was whether the more intensive use of capital on the small farm was as efficient as the less intensive use on the large farm? This can only be established from further examination of the relationship between capital input and the output produced.

Associated with the total assets of a farm was the level of net worth or proportion of the assets actually owned by the farmer. The net worth percentages were high for both the owner occupied and tenanted farms. Size of farm had little effect on the net worth percentage of the owner occupied farms; the percentage was stable at approximately 83 per cent. In the tenanted farm group the net worth percentage fell from approximately 84 per cent to 77 per cent as farm size increased from fifty to three hundred acres. The borrowing potential of both farm groups was good especially the owner occupied farm group in terms of the proportion of business owned. The lower net worth percentage of the larger tenant farmers, together with the possibility of more efficient capital utilisation by the larger tenant farmers indicated a hypothesis which is tested in Chapter five: that the lower net worth percentage indicated a willingness to grasp expansion possibilities, thereby increasing the efficiency of production.

The results of the explicit causal chain model (Section 4.3.3.) showed that it was possible to establish a functional relationship between capital stock inputs and farm gross output and gross margin, thus refuting the contention of Jones [8] that capital varies independently of output.

The above mentioned model showed that farm acreage only exerted a significant direct influence at the gross margin level; even at that level the major determinant of the gross margin was variation in gross output. This result has considerable significance as it indicated that the varying intensity of capital use was the principal influence on the gross output achieved, which in sequence was the principal determinant of gross margin. In practical terms it indicated that the smaller farmer was able to produce similar gross output to the larger less intensive farmer, through more intensive capital use. However, because of the inability of the smaller farmer to spread variable costs as effectively, he was at a disadvantage in terms of gross margin produced.

In Section 4.2.1. it was demonstrated that a linear relationship existed between livestock capital and acreage for the owner occupied farms. The tenanted farm group, however, exhibited a less than proportional response in livestock capital use as acreage increased. A possible explanation was that tenants were using insufficient livestock capital to optimise output. Proof of this observation depends on the results of the model (Section 4.3.3.) and the Cobb-Douglas function in the following chapter (Section 5.6).

The first structure of the model indicated that a positive relationship existed between the level of livestock capital used in the dairy farm sample and the total amount of tenants capital. The approximate ratio of total tenants capital to livestock capital was 1.8 and 2.0 (mean values), for the tenanted and owner occupied groups respectively. Any farmer contemplating expansion of his dairy enterprise must therefore be prepared to supply approximately one pound of non-livestock tenants type capital per pound livestock capital invested.

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(8) Literature review p. 32

In the second stage of the model the mean gross output to tenants capital ratios for tenanted and owner occupied farms were 1.08 and 1.04 respectively, but the difference was not statistically significant. As has already been stated, the owner occupier used more total tenants capital at any given level of livestock capital, than the tenant farmer. It was shown in Figure 5.6.1. that this resulted in the owner occupier operating closer to the optimum input of capital than the tenant farmer.

The final structure of the model enabled the quantification of the causal relationship between gross margin, gross output and farm size. As mentioned previously farm size (acreage) was demonstrated to be a less important variable than gross output in determining the farm gross margin, especially in the case of the tenanted farm group.

The increase in gross margin attributable to an increase in gross output is shown in Table 4.4.1. below.

Table 4.4.1. Mean Expected Increase in Gross Margin (£) attributable to a £100 Increase in Gross Output (Acreage Constant) 1969/70 and 1970/71

	Tenanted Farms	Owner Occupied Farms
	Increase in G.Margin £	Increase in G.Martin £
1969/70	50.9	43.3
1970/71	46.3	35.4

The expected gross margin increase varied between about one third and one half of the gross output produced by the farms. The tenanted farms had a higher rate of gross margin increase than owner occupied farms which can be attributed to better control of the variable costs associated with the lower level of tenants capital used by the tenanted farm group to produce a given level of gross output.

Comparison of the results for the two years, in the above table, showed a reduction in the expected increase in gross margin attributable to a £100 increase in gross output. This indicated that the farmer's profit margin was being "squeezed" by failure to contain the increased cost of factor inputs.

In terms of the total gross margin produced (Figure 4.3.4.1.) the owner occupied farm group achieved better gross margins than the tenanted farm group at the lower levels of livestock capital input, but the converse was applicable at higher levels of livestock capital input. The total gross margin expressed as a percentage of tenants capital varied from 77.8 per cent to 54.4 per cent for owner occupiers and from 68.5 per cent to 61.0 per cent for tenants, as the input of total tenants capital was increased from £7000 to £18,000, while holding acreage constant at its mean value. Although this difference between the tenants and owner occupiers was not statistically significant, the results indicated that the performance of both farm groups could probably be improved, as measured in terms of gross margin per unit of tenants capital, if the best performance of either group could be attained by the other in each case. (The effect of the level of fixed costs on the ultimate return on capital is discussed in Section 5.2.2. Chapter V.) The required approach to improving the performance of the two farm groups differed, the dichotomy in efficiency occurring at an input of livestock capital of approximately £7000. The lower livestock capital input tenants would require to increase the level of gross output achieved by additional investment in tenants capital, whereas the higher livestock capital input owner occupiers would require to concentrate on the reduction of their variable costs through a more optimum use of non-livestock tenants type capital.

At this juncture it is possible to make initial comments on the efficiency of livestock capital utilisation of the farm groups. It was apparent from the results that the level of capital utilisation, in terms of gross margin return on livestock capital, varied at different levels of livestock capital input, irrespective of nature of tenure. The amount of livestock capital also varied on different farm sizes (variation in stocking density), (Table 4.2.2.). It can therefore be concluded that the utilisation of livestock capital will vary irrespective of whether farm size is measured in terms of capital intensity or acreage. Estimation of the optimum input of livestock capital to maximise profit is considered in Chapter V.

The direct effect of farm size on the gross margin produced was demonstrated in the third equation of the causal chain model. Since the influence arising from gross output has already been allocated, any increase in total gross margin attributable to acreage is the result of more effective spreading of the variable costs of production on higher acreage farms. This resulted in the ability of a farmer, within a limited range, to substitute livestock capital for acreage and achieve similar levels of gross margin e.g. approximately £200 livestock capital and £100 livestock capital can be substituted for one acre on owner occupied and tenanted farms respectively in 1969/70.

The gross margin per acre of the sample farms decreased as farm size increased, due to the reduced intensity of capital inputs as farm size increased. Hence, although the small farmer appeared to achieve higher performance in terms of gross margin per acre than the larger farm, the smaller farm may not be more effective in overall utilisation of the capital employed.

In the course of the present chapter it has become apparent that differences exist between the farm groups in terms of the type and amounts of capital used, which cause variation in performance at the gross output and gross margin levels of profitability of dairy farming. Since the concept of a gross margin does not allocate any of the fixed costs associated with the use of capital there is a need to develop this analysis of capital investment to encompass the overall efficiency of tenants capital utilisation and to determine the optimum input of tenants capital; this is the subject of the following chapter.

APPENDIX

Table 1. Test of Significant Difference between the r^2 of the Estimating Equations for Asset Type Regressed on Farm Size

Year	Farm Type	Dependent Variable	r^2 of Linear Est.	r^2 of Log-Linear Est.	Level of Significant Difference of higher r^2 over lower r^2
1969/70	Tenanted Farms	X_3	0.5079	0.5776	*
		X_4	0.6894	0.7487	**
		X_5	0.5729	0.6882	**
		X_6	0.2722	0.3557	*
	Owner Occupied Farms	X_3	0.2880	0.4127	**
		X_4	0.7637	0.7432	*
		X_5	0.2704	0.3974	**
		X_6	0.2137	0.1021	**
		X_{32}	0.7096	0.7054	N.S.
1970/71	Tenanted Farms	X_3	0.5717	0.7179	***
		X_4	0.6522	0.7183	**
		X_5	0.6156	0.7937	***
		X_6	0.2525	0.3296	N.S.
	Owner Occupied Farms	X_3	0.3305	0.4369	**
		X_4	0.7515	0.7360	N.S.
		X_5	0.2601	0.4044	***
		X_6	0.2136	0.0361 (N.S.)	**

* Significant at P = 0.05 level

** " " P = 0.01 "

*** " " P = 0.001 "

N.S. Not significant

Table 2. Structural Equations of the Causal Chain Model

Causal Chain I Tenants 1969/70

$$X_3 = -538.80 + \underset{\substack{(6.2293)\\ \text{N.S.}}}{6.9001}\,X_2 + \underset{\substack{(0.1582)\\ ***}}{1.7493}\,X_1 \qquad R^2 = 0.933$$

$$X_4 = -236.09 \underset{\substack{(11.6600)\\ \text{N.S.}}}{-7.0246}\,X_2 + \underset{\substack{(0.1561)\\ ***}}{1.2070}\,\hat{X}_3 \qquad R^2 = 0.857$$

$$X_5 = -946.79 + \underset{\substack{(7.4850)\\ \text{N.S.}}}{12.1594}\,X_2 + \underset{\substack{(0.0889)\\ ***}}{0.5094}\,\hat{X}_4 \qquad R^2 = 0.837$$

Causal Chain II Tenants 1970/71

$$X_3 = -759.46 + \underset{\substack{(6.1520)\\ *}}{14.0521}\,X_2 + \underset{\substack{(0.1444)\\ ***}}{1.5850}\,X_1 \qquad R^2 = 0.933$$

$$X_4 = 90.50 \underset{\substack{(11.5349)\\ \text{N.S.}}}{-4.4290}\,X_2 + \underset{\substack{(0.1457)\\ ***}}{1.1583}\,\hat{X}_3 \qquad R^2 = 0.870$$

$$X_5 = -400.05 + \underset{\substack{(8.2628)\\ \text{N.S.}}}{11.3275}\,X_2 + \underset{\substack{(0.0939)\\ ***}}{0.4634}\,\hat{X}_4 \qquad R^2 = 0.799$$

Causal Chain III Owner Occupiers 1969/70

$$X_3 = 849.90 \underset{\substack{(7.9724)\\ \text{N.S.}}}{+ 2.8481 X_2} \underset{\substack{(0.2266)\\ ***}}{+ 1.8581 X_1} \qquad R^2 = 0.838$$

$$X_4 = 281.14 \underset{\substack{(7.8734)\\ \text{N.S.}}}{-0.6813 X_2} \underset{\substack{(0.1252)\\ ***}}{+ 1.0113 \hat{X}_3} \qquad R^2 = 0.831$$

$$X_5 = -384.49 \underset{\substack{(6.0319)\\ *}}{+ 13.1046 X_2} \underset{\substack{(0.0957)\\ ***}}{+ 0.4332 \hat{X}_4} \qquad R^2 = 0.761$$

Causal Chain IV Owner Occupiers 1970/71

$$X_3 = 1042.39 \underset{\substack{(9.1034)\\ \text{N.S.}}}{-1.4934 X_2} \underset{\substack{(0.2484)\\ ***}}{+ 1.8904 X_1} \qquad R^2 = 0.824$$

$$X_4 = -626.45 \underset{\substack{(10.5888)\\ \text{N.S.}}}{+ 6.4980 X_2} \underset{\substack{(0.1629)\\ ***}}{+ 1.0279 \hat{X}_3} \qquad R^2 = 0.810$$

$$X_5 = -680.89 \underset{\substack{(8.9300)\\ *}}{+ 21.9067 X_2} \underset{\substack{(0.1228)\\ ***}}{+ 0.3541 \hat{X}_4} \qquad R^2 = 0.745$$

Table 3. Comparison of the b Coefficients (Explicit Causal Chain) for 1969/70 and 1970/71

	TENANTED FARMS								
	1969/70					1970/71			
Variable	df	tat P=0.05	s_b	t_{sb}	$b \pm t_{sb}$	Variable	s_b	t_{sb}	$b \pm t_{sb}$
X_3 on X_1	33	2.034	0.1582	0.328	$1.4272 < b < 2.0708$	X_3 on X_1	0.1444	0.2937	$1.2913 < b < 1.8787$
X_4 on X_3	33	2.034	0.1561	0.3175	$0.8895 < b < 1.5245$	X_4 on X_3	6.1457	0.2964	$0.8619 < b < 1.4547$
X_5 on X_4	33	2.034	0.0889	0.1809	$0.3285 < b < 0.6903$	X_5 on X_4	0.0939	0.1910	$0.2724 < b < 0.6544$
	OWNER OCCUPIED FARMS								
X_3 on X_1	51	2.009	0.2263	0.4546	$1.4035 < b < 2.3127$	X_3 on X_1	0.1484	0.2981	$1.5113 < b < 2.1075$
X_4 on X_3	51	2.009	0.1252	0.2515	$0.7598 < b < 1.2628$	X_4 on X_3	0.1629	0.3273	$0.7006 < b < 1.3552$
X_5 on X_4	51	2.009	0.0957	0.1923	$0.2409 < b < 0.6255$	X_5 on X_4	0.1228	0.2467	$0.1074 < b < 0.6008$

CHAPTER V

THE EFFICIENCY OF CAPITAL DEPLOYMENT

5.1 Introduction

Efficient capital deployment is an important criterion of a successful farm business. If the available farm capital is allocated in an inefficient manner, the farmer is sacrificing potential profits. It has already been shown in the previous chapter that differences between farms do exist in the utilisation of tenants capital, measured at the level of gross output and gross margin.

In the present chapter the analysis of the efficiency of capital utilisation between farms was extended in order to examine whether these differences in efficiency continue to exist when the fixed costs of using capital are taken into account.

Comparison of the rate of return on capital on farms in various size and tenure groups gives no indication of the efficiency of tenants capital use within farming relative to the cost of borrowing capital or the return on capital available outside farming. The return on dairy farming capital was therefore compared with the cost of borrowing capital in the period under study, thus enabling an assessment of the size of dairy farm which operates at the margin of profitability with regard to return on capital.

Variations in the efficiency of capital utilisation indicated that many farmers were not operating with the optimum input of tenants capital. The optimum tenants capital input was therefore estimated for the average dairy farm in West Scotland, using a Cobb-Douglas function. It was then possible to determine the extent to which additional capital investment was required in order to optimise the tenants capital input of the average dairy farm in West Scotland.

5.1.1. Definition of Terms[1]

Tenants Capital: Total assets less the value of heritable property (See p.81 for asset definitions).

Landlords Capital: The value of heritable property (buildings etc.).

Owner Occupiers Capital: Tenants assets plus heritable property value i.e. Total assets of the owner occupied farm.

Return on Tenants Capital: Management and Investment Income (M.I.I.) expressed as a percentage of tenants capital.

Return on Owner Occupiers Capital: Management and Investment Income excluding any deduction for imputed rent, expressed as a percentage of owner occupiers capital (total assets).

Putative Return on Landlords Capital: The imputed rent (owner-occupied farms) expressed as a percentage of landlords capital.

Marginal Productivity of Capital: Estimated from the partial derivative of gross output with respect to tenants capital input, with all other variables held constant at their geometric mean values. (Cobb-Douglas Function).

Rate of Turnover of Tenants Capital: The ratio of the total farm gross output, to total tenants capital.

Rate of Turnover of Total Capital: The ratio of the total farm gross output, to the total capital (owner occupied farms).

Equity Percentage: The net worth of the farm business expressed as a percentage of the total assets.

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[1] Terms already introduced in Chapter IV are not redefined in the current chapter.

Net Farm Income (N.F.I.): The trading revenue minus the total of 1) trading expenditure, excluding interest charges and 11) depreciation, including the fixed capital charge, the result is then adjusted for valuation charges.

Management and Investment Income (M.I.I.): Represents the net farm income reduced by an estimated charge for the manual work of the farmer and his wife.

5.2. Return on Capital

Widespread use of the concept of return on capital in agriculture is relatively recent. Ashby[(2)], as recently as 1961 criticised the lack of use of this measure of capital efficiency. The avoidance of the use of this measure of capital efficiency arose largely from a lack of suitable data for the calculation, and from problems of measurement, which are summarised below: Information on expected rates of return on capital is still relatively limited, although the recent report by Wilson[(3)] does go some way to rectifying this situation but the results of the above (Wilson) study may be biased due to the small sample of numbers involved (20 owner occupied and four tenanted farms to represent Scottish dairy farming).

Suitable data is available for the dairy farm sample in West Scotland. It is therefore proposed to estimate the return on several defined categories of capital, in order to assess the efficiency of use of these categories of capital.

5.2.1. The Problems Involved in the Measurement of the Rate of Return on Capital

Difficulties in determining the rate of return on capital arise because there may exist non-financial (immeasurable) returns to capital, in addition to the difficulties of measuring return in financial terms.

[(2)] Ashby. Literature review p.26.

[(3)] Wilson. Literature review p.21 and p.25.

Non-Financial Returns

Capital in industry is normally invested such that it receives the optimum possible financial reward. In agriculture where there is an extremely close association between the farm as a business and the farmer as an individual, capital may well be invested for non-financial reasons. The farmer may decide that he prefers more leisure, rather than additional income, and therefore he may invest in labour saving capital which could well show little additional return in financial terms. It would be difficult to argue that a farmer adopting the above attitude was being irrational. One must therefore be cautious when interpreting return on capital, as a performance measure, as a low financial return on farming capital need not necessarily indicate non-optimum capital utilisation or a dissatisfied farmer.

Financial Returns

The financial reward for the use of capital is normally measured in terms of a percentage rate of return, which is the ratio of the output obtained, less the costs associated with the capital used, expressed as a percentage of the capital used. Problems may arise in determining the values to use for both the numerator and denominator a) How to measure return and b) How to measure the capital utilised.

a) Measuring Return

Return can be measured in terms of the Gross Output obtained from the use of capital and in fact it is frequently measured in this way when Marginal Capital/Output Ratios are being derived. A possible disadvantage of measuring return by this method is that the costs associated with the use of capital may not be taken into account. Early attempts at measuring return on capital used N.F.I. as the numerator. This proved unsatisfactory as the measure neglected the value of the farmers manual and managerial effort. A more accurate measure of return is to measure output net of the associated costs of using capital i.e. to measure return in terms of Management and Investment Income. This is the most common measure of the efficiency of capital use in agriculture and is used in later sections of this report. Management and Investment Income as a percentage of the average capital invested in a farm is not however an appropriate measure of the return on capital in all cases. If, for example, a farmer is considering a marginal addition to his capital stock e.g. a cow, then a more appropriate measure is the return on the marginal capital investment. This can be measured by expressing the additional M.I.I. or Gross Margin obtained as a percentage of the marginal capital investment. (Note: at the margin additional M.I.I. equals gross margin.) An alternative approach to the question of measuring marginal capital output is to use a production function technique whereby the gross output obtained is functionally related to an imputed flow of capital and other resource services. This method was adopted in Section 5.6.

b) Measuring Capital Usage

The problems of measuring the amount of capital used on a farm, arise because the use of a capital item extends over a period of time. Time affects the measurement of capital in four ways.

Firstly, the value of capital varies over time due to exogenous factors e.g. price changes. This was not a particular problem in the present study as the results refer to two consecutive years in which prices were relatively stable.

Secondly, the return on capital is normally calculated on an annual basis. This means that the value of capital at the start of the year will most probably differ from the value at the end of the year, also, the amount of capital in use within the year can vary considerably, i.e. there are peaks and troughs in the working capital requirements of a business. The question is therefore which capital value to use in a rate of return determination. There is no direct answer; for farm management comparitive analysis purposes the average of the opening and closing capital values will suffice; this method was adopted in Section 5.2.2. (Return on tenants capital estimates). Where individual projects are being compared, the return achieved would need to be related to the additional capital employed and where projects are competing for capital in the future, the expected return on the project would require to be discounted in some manner to compensate for the effects of time and varying productivity. The two latter situations involving investment appraisal techniques are outwith the scope of this study.

Thirdly, time affects the degree of reliability of the value ascribed to capital items. Over time, capital depreciates and the replacement cost progressively deviates from the original cost of the capital. The question arises whether the rate of return should be based on the original cost, the depreciated original value of the capital, the replacement cost of the capital or the depreciated replacement cost of the capital. In practice the capacity of capital declines with increasing age; concurrently a reduction in output occurs.

In a period of low levels of inflation and stable factor/product price relationships it was considered that the depreciated original cost of the farm capital represented an adequate basis for the calculation of the return on capital estimates in later sections.

Finally, since the stock of capital exists over time and is not completely consumed in any one production process it could be argued that only the flow of services into a particular production process should be related to the production obtained. It has already been noted that this position is adopted in Section 5.6. (Marginal Productivity of Capital on West Scotland Dairy Farms).

As in the case of non-financial returns to capital it must be stressed that a low financial return on capital is not necessarily deleterious to the farm business e.g. investment in land; this traditionally has a low rate of return, but land does tend to accumulate capital value (appreciates) and is a good hedge against inflation, hence a low present return may be compensated by capital accumulation over the longer term. Also, a low rate of return on a large amount of capital may often generate more income than a higher rate of return on a lesser amount of capital.

If a farm balance sheet is studied it is possible to see that the return on capital could be measured using various aggregations of assets e.g. return on total assets return on tenants capital, return on marginal capital. Each point of measurement is perfectly valid and is used in the sections which follow to supply an indication of the efficiency of utilisation of various types of capital.

5.2.2. Return on Tenants Capital

Tenants type capital forms approximately half of the total investment of the owner-occupier and all that of the tenant farmer. The return on capital obtained is hence of vital importance. Two findings of Chapter IV indicated possible differences between owner occupiers and tenants in their use of tenants capital. Firstly, owner occupiers used more tenants type capital than tenants at most sizes of farm (acreage) and secondly, at the gross margin level of output measurement, differences existed in the ratio of gross margin to tenants capital for the sample farms.

In the present section the return on tenants capital is estimated using management and investment income (M.I.I.) in order to assess whether differences in capital utilisation established at the gross margin level of measurement still exist after allocation of the fixed costs associated with production.

Regression analysis was used to directly relate M.I.I. to the tenants capital employed. Tenants capital rather than farm acreage was used as the independent variable in order to allow comparison of the results with certain of the findings in Chapter IV and also to avoid introducing the problem of intensity of capital use which is known to vary at different acreage levels. Linear regressions were adopted since the existence of negative rate of return values precluded the use of log-linear equations. The estimated equations are shown in Table 5.2.2.1.

Table 5.2.2.1. Relationship Between Rate of Return on Tenants Capital and Total Tenants Capital. 1969/70 and 1970/71

Relation No.	Constant	b	s.e. of b	% Variation Explained
1969/70				
Tenanted Farms				
1	1.20	0.00081	0.00034	14
Owner Occupied Farms				
2	1.78	0.00058	0.00020	13
1970/71				
Tenanted Farms				
3	-7.75	0.00124	0.00036	25
Owner Occupied Farms				
4	-4.01	0.00095	0.00024	22

Note: The b coefficient is significant at P = 0.001 level in relation 4
The b coefficient is significant at P = 0.01 level in relations 2 and 3
The b coefficient is significant at P = 0.05 level in relation 1

The regression equations and regression coefficients of all the relationships in Table 5.2.2.1. were statistically significant, although the proportion of variation in the rate of return on tenants capital explained by the equations was not high. In both the case of the tenants and owner-occupiers the proportion of variation explained was higher in the second year than in the first. An examination of the residuals of the linear relationships showed that the low levels of explained variance were not due to systematic departure of the linear function fitted from the data. The linear equations were therefore used to estimate the return on tenants capital.

Results

Six levels of tenants capital were substituted into the equations in Table 5.2.2.1. to estimate the return on tenants capital on the sample farms. The estimates are tabulated in Table 5.2.2.2. below.

Table 5.2.2.2. Estimated Return on Tenants Capital Associated with Tenants Capital Input. 1969/70 and 1970/71

Tenants Cap. Input £	Tenants		Owner Occupier	
	1969/70	1970/71	1969/70	1970/71
	% Return on Capital			
8,000	7.68	2.17	6.42	3.59
11,000	10.11	5.44	8.16	6.43
14,000	12.54	9.61	9.90	9.29
17,000	14.97	12.64	11.64	12.13
20,000	17.40	17.02	13.38	14.99
23,000	19.83	20.74	15.12	17.84

The estimated equations tabulated in Table 5.2.2.1. indicated that a positive direct relationship existed between the rate of return on tenants capital and the quantity of tenants capital in use. Rate of return on capital can therefore be used as a measure of the efficiency of capital use. When the rate of return on tenants capital is known, an acceptable level of efficiency of capital use is indicated when the rate of return is greater than the cost of the capital. Whether the return on tenants capital for the dairy farm sample in West Scotland was adequate or not, is discussed later.

The estimated rate of return on tenants capital rose approximately 15 per cent and 13 per cent (2 year means) respectively, for the tenanted and owner occupied farm groups,as the input of tenants capital increased from £8000 to £23,000 (Table 5.2.2.2.).

This finding was significant as it indicated that large capital investments were more efficiently operated than small investments i.e. there were distinct economies of scale in operation.

From the regression equations (Table 5.2.2.1.) it can be established that the above increase in return on tenants capital was equivalent to an average rate of increase in return on tenants capital of 0.81, 1.24, 0.58 and 0.95 per cent per £1000 increase in tenants capital, for the tenanted and owner occupied farm groups in 1969 and 1970/71 respectively. By taking the difference between the rate of increase values for the tenanted and owner occupied groups, an average difference in efficiency, in favour of the tenanted group, of 0.23 and 0.17 per cent per £1000 increase in tenants capital in 1969/70 and 1970/71, became apparent, but this difference was not statistically significant.

Between 1969/70 and 1970/71 the return on tenants capital fell (current values) at all levels of tenants capital input, except at £17,000 and £23,000 capital input upwards for the owner occupiers and tenants respectively. The majority of farms experienced reduced profit margins in the period under study and farms with the lower levels of capital input were possibly more adversely affected.

In Chapter four it was noted that the absolute amount of capital used by farmers increased as the farm acreage increased. It follows therefore that the larger acreage farms can be expected to have higher rates of return on capital than smaller acreage farms, due to the higher rates of return available on the larger amounts of capital.

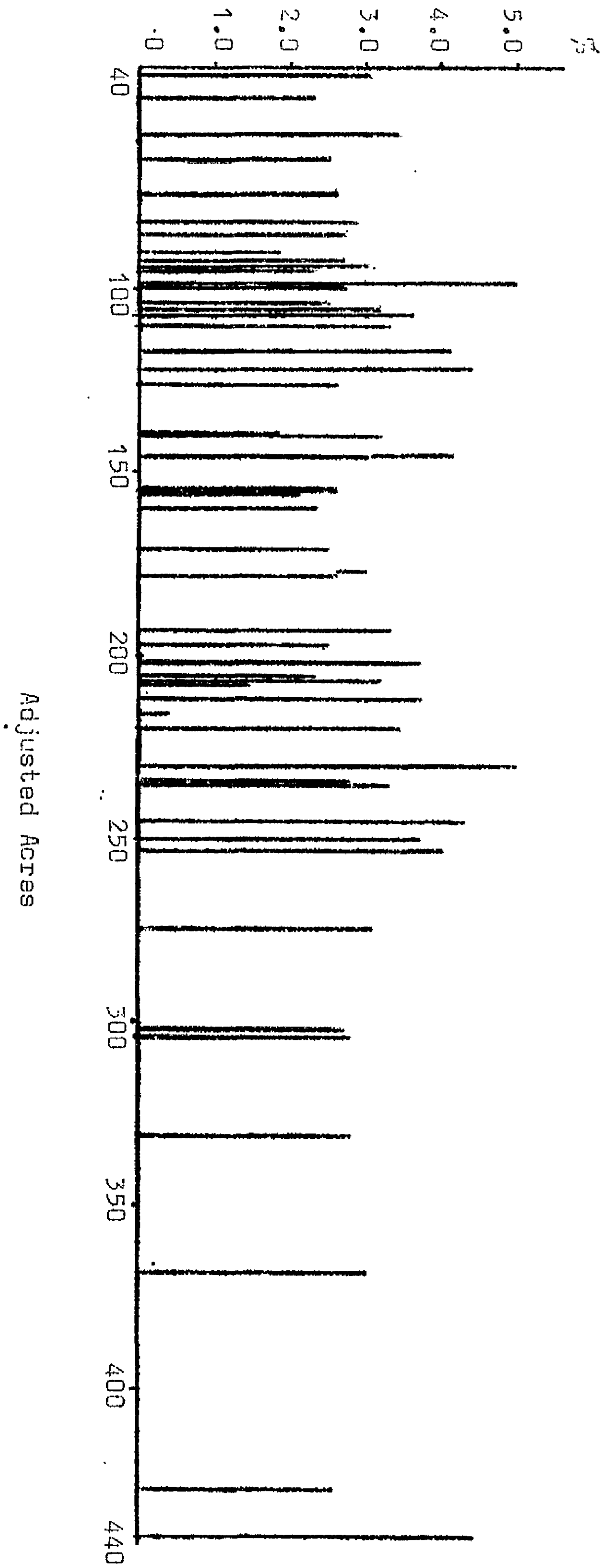
5.2.3. Putative Return on Landlords Capital

The method of computation of the return on landlords capital used in this study is based on an assessed rental value for the land and buildings. This method of computation could allow the return on landlords capital to be increased but in this event any increase in return on landlords capital would result in a reduction in the return on tenants capital. It could be argued that an arbitrary split between the return allocated to landlords capital and tenants type capital is involved. It could also be argued that when imputed rents are used on owner occupied farms there is an implicit assumption that the efficiency of landlords capital use on the owner occupied farm is the same as on the tenanted farm; this need not, and probably is not, the case. These arguments are invalid provided the value ascribed to the return on landlords capital reflects the true rental value of land and buildings in the locality of the individual farm. However, it is accepted that the estimates of return on landlords capital which follow cannot be taken to imply a measure of the efficiency of landlords capital use, but primarily that they should act as a guide to the probable level of return.

Values for the capital invested in landlords type assets were available for the owner occupied farms only. The return on landlords capital was calculated for 1970/71, as this allowed the most recent rent revisions to be incorporated. The gross rent is assessed by the fieldsman when visiting the farm and is updated every five years. The fieldsman must take into account the factors listed in Appendix I, when determining the rent.

No statistical analysis was undertaken to estimate the return on landlords capital as in a trial regression of return on landlords capital on farm size (acres), the variation explained did not attain statistically significant levels. (1 per cent variation explained). The actual values for the return on landlords capital are therefore presented as a distribution by farm size in Figure 5.2.1.

Figure 5.2.1. Gross Putative Return on Landlords Capital (%) Distribution by Farm Size 1970/71



The distribution of the return on landlords capital values depicted in Figure 5.2.1. shows a narrow dispersion around the meam return of 3.06 per cent. Approximately fifty four per cent of the farm sample fell in the range 2.6 to 3.3 per cent inclusive. The return on landlords capital was low and was very consistent throughout the full range of farm size, due in part to the definition of return on landlords capital which was adopted.

The results expressed in Figure 5.2.1. were the gross rent as a percentage of landlords capital. The net return on landlords capital after deducting ownership expenses will be at least one per cent less than the values shown.

If capital has to be borrowed for investment in landlords type capital, the results would seem to indicate that the return was inadequate to cover the cost of the borrowed capital. It is frequently argued that the low return on landlords type capital is offset by appreciation of the farm value i.e. land is a good hedge against inflation. The validity of this argument is developed in later discussion.

5.2.4. Return on Total Owner Occupiers Capital

Since the equity capital on an owner occupied farm is supplied by one person and since landlords and tenants type capital are essentially mutually exclusive (cash invested in one type of capital cannot be invested in the other concurrently), then the use of the measure, return on total owner occupier capital, has the merit of avoiding an arbitrary division between landlord and tenant type capital. The measure therefore provides the owner occupier with a guide to the overall efficiency of his capital investment.

Estimates of the return on total owner-occupiers capital were prepared using regression analysis to directly relate the owner occupiers capital employed to farm size (adjusted acres). Linear equations only were prepared but examination of the residuals indicated no curvilinear relationship. The estimated equations are shown in Table 5.2.4.1.

Table 5.2.4.1. Return on Owner Occupiers Capital (%) Associated with Farm Size. 1969/70 and 1970/71

	Relation No.	Constant	b	s.e. of b	% Variation Explained
1969/70	1	2.6025	0.0118	0.0048	14
1970/71	2	0.8255	0.0224	0.0045	31

The b coefficient and regression equation are significant at the P = 0.01 level in relation one and at the P = 0.001 level in relation two. In relationship two the variation explained was much higher than in relationship one. The former equation therefore provided a more accurate estimate of the expected return on owner occupiers capital.

The estimated returns on owner occupiers capital for six farm size levels are tabulated in Table 5.2.4.2. below.

Table 5.2.4.2. Estimated Return on Total Owner Occupiers Capital (%) 1969/70 and 1970/71

	% Return on Owner Occupiers Capital	
Farm Size (Adj. Acres)	1969/70	1970/71
50	3.19	1.94
100	3.78	3.03
150	4.37	4.13
200	4.96	5.23
250	5.55	6.33
300	6.14	7.43

The return on owner occupiers capital is directly related to farm size. Economies of scale clearly exist, with the large 300 acre farm achieving returns two to three times greater than the small fifty acre farm. Overall the return on owner-occupiers capital was not high ranging from approximately two to seven per cent, and can be considered largely inadequate if the return achieved is related to the short term borrowing rate during the period, which ranged from 9 per cent in 1969 to 5 per cent in 1971.

Comparison of the results for 1969/70 and 1970/71 showed the position of the farms below 170 acres in size to have deteriorated. The larger farms, however, were able to maintain and slightly increase their return on owner occupied capital. These differences between years were small and were not statistically significant.

The results in Table 5.2.4.2. represent the return on total owner occupiers capital; they do not represent the net return to the owner occupier, as an individual, since it has been shown that the owner occupier usually owns only 83 per cent of his business (Ch. IV Table 4.2.5.). In order to derive the actual cash available to the farmer the interest paid on borrowed capital would have to be deducted. This does not affect the validity of the results in Table 5.2.4.2., as we are concerned with the return on the total owner occupied capital (whether owned or borrowed). If the return to the individual owner occupier is desired, a simple theoretical calculation shows by how much, on average, the values in Table 5.2.4.2. would be reduced. e.g. assume the farmer owns 83 per cent of his business and the remainder of the assets are borrowed at 6 per cent interest per annum. The average deduction from the values in the table would be 17% x 6% = 1.02%.

5.3. Ratio of Dairy Cow Assets/Total Assets

In Chapter four (Section 4.3.4.) evidence was presented which suggested that variation in the gross margin produced by the sample farms could be attributed to the efficiency of capital utilisation. Differences in capital utilisation were traced, in part, to variation in the mix of livestock and non-livestock type capital in use on the farms. This evidence appeared to indicate the possibility of creating an index which could be used as a measure of capital utilisation. The index proposed is the ratio of dairy cow capital to total capital.

If the ratio of dairy cow assets to total assets (D.C./T.A. ratio) can be used as a measure of capital utilisation, it should be possible to establish a functional relationship between the DC/TA ratio and a farm profit indicator. The first stage in attempting to establish a functional relationship was to correlate the DC/TA ratio with the Net Farm Income (NFI) and also with the NFI per acre of the sample farms. NFI per acre was used as an alternative to NFI as a profit indicator in order to guard against any possible bias being introduced due to collinearity between the DC/TA ratio, NFI and acreage. The correlation coefficients between the DC/TA ratio and NFI and DC/TA ratio and NFI per acre were derived from their linear and quadratic relationships; it was not possible to use log-linear equations due to the existence of several negative NFI values.

The calculated values for the correlation coefficients failed to attain statistical significance in any of the relationships tested. No evidence was obtained to support the existence of a linear or curvilinear relationship between the DC/TA ratio and level of profit as measured in this study. A test scatter of the raw data indicated that the lack of association was not due to the existence of a curvilinear relationship, other than the quadratic tested, between the DC/TA ratio and level of profit.

On the evidence available an index based on the ratio of dairy cows to total assets is not a suitable method of assessing the efficiency of capital utilisation on dairy farms.

5.4. Rate of Turnover of Total Assets

The rate of turnover of assets is accepted in many non-agricultural industries as an index of the efficiency of capital utilisation. Study of the published literature on agricultural businesses gave no indication of the use of this measure in agriculture, since Knox and Imper each illustrated that a relationship existed between the rate of turnover and farm profitableness in the early 1930's.[4]

It is known from Section 4.3.4. of Chapter IV that the rate of turnover of tenants capital varied at different levels of capital use. For this reason and due to the lack of information on the rate of turnover on farms, the rate of turnover of total assets on the sample farms was investigated with a view to its potential use as a measure of capital utilisation.

The relationship between the rate of turnover values and farm size, was first determined for the sample farms. No statistically significant relationship could be established when using either linear or log-linear functions. It can therefore be concluded that the rate of turnover is not dependent on farm size. This finding was useful since it reduced the possibility of establishing a significant functional relationship between the rate of turnovers of capital and farm profitableness due to collinearity between these two variables and farm size.

The method used to determine whether a functional relationship existed between the rate of turnover and farm profitableness was identical to that of the previous Section 5.3. The correlation coefficients between the rate of turnover and N.F.I. per acre were hence derived from their linear and quadratic associations.

The calculated values for the correlation coefficients failed to be statistically significant in the relationships tested. There was no evidence of a linear or curvilinear relationship between the rate of turnover of assets and farm profitableness. A test scatter of the basic data did not suggest the lack of association to be attributable to the existence of a non-quadratic curvilinear relationship.

The rate of turnover of total assets is not a satisfactory measure to develop as a capital utilisation index. Nor does

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[4] Literature review p.25.

evidence exist to substantiate the findings of Knox and Imper, for dairy farming in West Scotland in 1969-71.

5.5. <u>The Efficiency of Borrowed Capital</u>

One possible disadvantage of the use of return on capital as a measure of the efficiency of capital utilisation is that the measure does not differentiate between that part of the total assets of the farm which is funded from borrowed capital and that part which is owned by the farmer. Other writers were aware of this problem e.g. Davies et.al. and Tracy,[(5)] who advocated the more extensive use of balance sheet ratios as a solution. In Chapter IV of the present study, evidence was shown which suggested differences in the ratios of net worth to total assets or equity percentage (N.W./T.A. ratio) of the sample farms according to farm size (Table 4.2.5.). In duscussing the said table the hypothesis was proposed that a lower equity percentage could perhaps indicate a willingness to expand through the use of borrowed capital, thus increasing the profitableness of the farm. It is therefore proposed to test this hypothesis.

The regressions for the N.W./T.A. ratio on farm acreage and N.W./T.A. ratio on total farm assets were first prepared. Neither of the two relationships were statistically significant. This result indicated that the proportion of a farm business which was owned varied independently of farm size, measured either in terms of farm acreage or total capital investment. The finding of no statistically significant relationship between the net worth percentage and farm size does not invalidate the tendency noted in Table 4.2.5, since the sign of the regression coefficients in the present case was negative for the tenanted farm group and positive for the owner occupied group. The same tendency does exist but is not statistically significant. As in the case of the rate of turnover calculation, the non-existence

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(5) Literature review p.27.

of a statistically significant relationship between the N.W./T.A. ratio and acreage or total capital, reduced the possibility of establishing a significant relationship between the N.W./T.A. ratio and farm profitability, due to collinearity between these two variables and farm size.

N.F.I. and N.F.I. per acre were once again used as profit indicators and the correlation coefficient between the N.W./T.A. ratio and N.F.I. and N.F.I. per acre were derived using linear functions. The correlation coefficients for the calculated relationships were not statistically significant. The proportion of a farm business funded from owned or borrowed capital did not appear to be a major determinant of the ultimate profitability of the business. On this basis, return on capital can be regarded as an adequate measure of the efficiency of capital utilisation. The hypothesis that a lower net worth percentage results in higher profitability was not substantiated for dairy farms in West Scotland.

Although the net worth percentage of a farm business was not a significant factor in determining the profitability of the farm business, it can be demonstrated that the amount of borrowed capital used by the dairy farm business is functionally related to the total capital employed by the farm. Equations were derived to show the relationship between the credit used and the total assets of the farm. These equations are tabulated in Table 5.5.1.

Table 5.5.1. Relationship Between Borrowed Capital and Total Assets 1969/70 and 1970/71

Relation No.	Constant	b	s.e. of b	% Variation Explained
1969/70				
Tenanted Farms				
1	-1560.58	0.3306	0.0716	35
Owner Occupied Farms				
2	1029.24	0.1172	0.0196	13
1970/71				
Tenanted Farms				
3	-1655.86	0.3321	0.0564	50
Owner Occupied Farms				
4	1441.57	0.1122	0.0182	12

Note: All relationships are statistically significant at the $P = 0.001$ level of significance.

The above relations have a strong linear component. The scatter of the residuals did not reveal bias to suggest the existence of a curvilinear function. The lower levels of variance explained, indicated that the level of total capital employed in the business is only one of several factors which influence the level of borrowing.

The b coefficients of the relationships in Table 5.5.1. were all positive, indicating that the total credit requirements of a farm increase as the total assets in use increase. The estimated increase in borrowed capital was £331 and £115 (2 year average) respectively for the tenanted and owner occupied farm groups, per £1000 increase in total assets. Capital expansion on the tenanted farm is thus financed with borrowed capital to a greater extent than in the owner occupied farm. Because of the greater amount of capital which the owner occupier has to provide to operate his farm, the absolute amount of credit used by the owner occupier is greater than that of the tenant of a similar sized farm. The question then arises of the effect the larger amounts of capital invested by the owner occupier may have on the relationship between N.F.I. and the amount of borrowed capital.

Accordingly, the functional relationship between borrowed capital and N.F.I.(6) was determined for the owner occupied and tenanted farm groups and is shown in Table 5.5.2.

Table 5.5.2. Relationship between Borrowed Capital and N.F.I. 1969/70 and 1970/71

Relation No.	Constant	b	s.e. of b	% Variation Explained
1969/70				
Tenanted Farms				
1	1740.84	0.2514	0.0670	30
Owner Occupied Farms				
2	2830.67	0.0844	0.0374	8
1970/71				
Tenanted Farms				
3	1677.43	0.2833	0.0692	34
Owner Occupied Farms				
4	2869.21	0.1203	0.0547	8

Note: Relationships 1 and 3 are statistically significant at the P = 0.001 level
Relationships 2 and 4 are statistically significant at the P = 0.05 level

(6) In this instance the values used for N.F.I. on the owner occupied farms includes the value of imputed rent added back, since the credit values of this group include long-term and short term credit. This allows the tenanted farm group to be compared with the owner occupied group.

The explained variation was much higher for the tenanted farm group equations, indicating that the level of N.F.I. attained on a tenanted farm was more sensitive to the amount of borrowed capital than on an owner occupied farm.

A linear relationship has been shown to exist between the amount of borrowed capital (credit) and N.F.I. The estimated increase in N.F.I. resulting from a given increase in borrowed capital is demonstrated in Table 5.5.3.

Table 5.5.3. Increase in N.F.I. per £100 Increase in Borrowed Capital. 1969/70 and 1970/71

Tenanted Farms		Owner Occupied Farms	
N.F.I. Increase £		N.F.I. Increase £	
1969/70	1970/71	1969/70	1970/71
25.14	28.83	8.44	12.03

The increase in N.F.I. per £100 increase in borrowed capital was higher on the tenanted farms than on the owner occupied farms. The long-term borrowing of the owner occupier in addition to borrowing for tenants type capital adversely affects the additional N.F.I. produced from the borrowed capital. Comparison of the results for 1969/70 and 1970/71 indicated an improved situation for both groups in the latter year, although this increase was not statistically significant. The adequacy of the observed return can be partially assessed by relating the increase in N.F.I. to the cost of borrowed capital in the period 1969-71.

Table 5.5.4. Cost of Borrowed Capital 1969-71[7]

	Cost of Borrowed Capital %
1969/70	9.2
1970/71	7.7

On the basis of the cost and return on additional borrowed capital depicted in Tables 5.5.3. and 5.5.4. the tenanted farm group obtained an increase in NFI from the use of additional capital, which was sufficient to cover the cost of the borrowed capital. The owner occupied farm group were not in such a favourable position. The increase in N.F.I. from the use of additional capital was not sufficient to cover the cost of the capital in 1969/70 but by 1970/71 the situation had improved allowing a margin over cost.

5.6. The Marginal Productivity of Capital on West Scotland Dairy Farms

In the previous section the return achieved on additional borrowed capital was examined. It is appropriate to extend this analysis to include the marginal return on all capital. The return on marginal capital inputs is important since it represents the additional income generated by additional investment. The expected marginal return on an investment is an important determinant of whether a lending institution will supply additional credit i.e. if the expected marginal return on capital is insufficient to cover the interest charges and repayment of a loan, no additional loan will be forthcoming. To the individual farmer the marginal return on his capital investment will indicate whether investment in farming is worthwhile or whether he should invest outside farming to obtain a more favourable return on his capital. At the national level, low

(7) The cost of borrowed capital is taken as Bank Rate plus 1.5 per cent.

marginal returns on agricultural capital indicate a non-optimum allocation of scarce capital resources.

5.6.1. Some Problems of Measuring the Marginal Productivity of Capital

In measuring the return on marginal capital a problem arises from the fact that a capital investment does not produce output on its own, but requires an associated amount of working capital e.g. a cow has to be fed (working capital) before any milk (output) is forthcoming. Provided only variable costs are involved in the application of the marginal capital, the problem can be overcome by using the gross margin obtained to represent the return on the marginal capital. If, however, the associated costs of the marginal capital investment are not all of a variable cost nature and changed levels of fixed costs are involved, then the gross margin is not an adequate measure of the return on marginal capital. In such a situation the marginal return on capital could only be represented by the additional net farm income or management and investment income. Any attempt to measure the marginal return on capital investment within years, by measuring the additional income generated by the capital investment in any one year, incurs methodological problems with the available data. The situation arises due to capital being a resource which is not consumed in one time period or production process thus capital generates a flow of income over a period. In practice major investment on farms is usually phased over a period of years e.g. the erection of new cow accommodation. As a result the additional income generated in the early years may be low until such time that the building reaches full utilisation. It is possible that regression analysis, used in conjunction with a time series of capital investment and income on the sample farms, could provide estimates of the marginal return on capital invested. It was not possible, however, to apply this technique, due to a lack of suitable data. The technique also has disadvantages: namely, that the nature of change in agriculture could make the serious itself of little value.

In order to use the two separate years cross-sectional data available for the sample farms, it was decided to estimate the functional relationship between the total capital employed on the farms and the total output produced by the capital. The marginal productivity of the capital was then estimated from the first derivative of total output regressed on total capital.

The marginal productivity of the farm capital estimated by the above means is the marginal output of the capital, not the marginal return of the capital, which is the marginal output less the associated costs of using the capital. Ideally, it is the marginal return on capital which should be measured but this is not possible using the available data. The marginal output of the capital inputs approximates the marginal return on the capital if the major costs associated with the use of the capital are included as independent variables in the regression equation used to estimate the functional relationship between total output and total capital input. This approach was adopted in the present study; details of the method used are recorded in Section 5.6.2.

If cross-sectional data is used for the input-output values when estimating the functional relationship between output, capital, labour and land, the resulting inter-farm relationship may introduce problems of interpretation. This problem may arise because the inter-farm relationship is used to explain the effect of changing levels of capital input on a single farm - an intra farm relationship. Objections to the use of inter-farm functions are lessened if the relationship is derived from farms of a similar type and situation and if a judicious choice of inputs is exercised[(8)]. The other main criticism of the use of an inter-farm function to represent an intra-farm situation is the possible correlation of intensity of resource input with managerial ability. Rasmussen and Sandilands[(9)] assumed that the correlation was not strong between farmers managerial ability and the way they combine their resources. This assumption was strongly criticised by Crotty and Stone, and by

[(8)] Literature review: Plaxico; Heady and Dillon; Wragg and Godsell. p.36.

[(9)] Literature review. p.38.

Antill[10]. It was felt, however, that in the case of single enterprise farms (dairy) in a restricted area of Scotland (reasonable similarity of conditions) that the observation of Bessell[11] "In the long term, the intensity of inputs on any farm will tend to adjust itself to the standard of management of the farm ...", would apply to the sample of dairy farms and provided that interpretation is restricted to a limited increase in intensity of capital use, then the inter-farm relationship will supply a reasonable estimate of the effect of intra-farm changes.

5.6.2. A Cobb-Douglas Model

The function selected to portray the relationship between capital input and output was the Cobb-Douglas function. This function is a log-linear function which is relatively simple to apply and is not extravagent in its use of economic data. It is also a good fit to the oconomic data used (see Section 5.6.3.). The general form of the function is as follows:

$$Y = \alpha X_1^{\beta_1} X_2^{\beta_2} \ldots\ldots\ldots\ldots X_p^{\beta_p}$$

The regression coefficients (β's) supply directly the elasticities of production, indicating the percentage increase in output from a one per cent increase in a given resource. The sum of the β exponents indicates the nature of returns to scale which are in operation. If the β's sum to less than unity then diminishing returns to scale operate and themarginal productivity of the resources decreases as additional units of resource are applied. Similarly, where the sum of the β exponents is unity, constant returns to scale apply, and if the sum is greater than unity, increasing returns to scale operate.

(10) Literature review. p.38.

(11) Literature review. p.37.

In order to estimate the marginal productivity of a single resource input the function is partially differentiated e.g.

$$\frac{\partial Y}{\partial X_1} = \beta_1 \alpha \left(\frac{X_1^{\beta_1} X_2^{\beta_2} \ldots\ldots\ldots X_p^{\beta_p}}{X_1} \right)$$

$\frac{\partial Y}{\partial X_1}$ represents the marginal output for a one unit change in input of X_1 with X_2 .... X_p held constant.

For the reasons stated it was considered that the Cobb-Douglas function was a suitable means of estimating the marginal productivity of capital on the dairy farm sample.

Two points regarding the use of a Cobb-Douglas function should be noted. Firstly, the function is transformed into a linear equation for estimation purposes: this results in estimates for the elasticity of production for each input and the elasticity of substitution being constant but this is not a problem with the present data (limited farm sizes and single enterprise farms). Secondly, the transformation also implies that proportional changes in inputs have equal weight through the range of data being fitted to the function. If this is untrue a bias will result, but the problem is minimised by restricting prediction from the function to a range close to the geometric mean of the various input factors.

Three problems may arise when using Cobb-Douglas functions: namely, inter versus intra farm functions, multicollinearity, and factor product aggregation. The first problem has already been discussed. If the problem of multicollinearity exists in the function the standard errors of the regression coefficients may be inflated and the coefficients themselves may be biased. The number of inputs in the function were therefore restricted in order to minimise the danger from multicollinearity. The extent of the existence of multicollinearity in the calculated functions for W. Scotland is discussed in Section 5.6.3.

Aggregation bias may exist in the dependent variable as well as the input variables of the function. In the sample of dairy farms, bias introduced due to product aggregation is likely to be slight since the principal constituent of output is the same product on all farms i.e. milk, and the price received by the producer for the milk will vary only slightly due to quality payments.

On the question of input variables, it was decided to introduce land and labour in addition to capital. The purpose was to attempt to minimise the residual variance in output, yet not introduce too many variables which could result in serious multicollinearity.

The variable used to represent land was adjusted acres, which went some way towards compensating for lower quality land. The use of rental value of the land was avoided as it was felt the existing rental values did not truly represent the variation in land value.

The labour variable was the total wage bill of the farm including an imputed value for farmer and wife manual labour and unpaid farm labour. In this way it was hoped to represent the true contribution of labour to the output produced.

The capital input variable presented more of a problem, since a choice is possible between the inventory value of the capital or an estimate of the actual input of capital services during the production period. A review of the relevant literature[12] indicated a trend away from the use of inventory values as the capital input variable. Since the relation between the capital stocks and output of the dairy farm was already investigated in Section 4.3.3. it was decided to adopt the concept of a flow of services provided by the existing capital. The requirement was therefore to estimate the annual flow of services from the tenants capital invested on the sample farms. The capital input

[12] Literature review pp.34-35.

variable was defined as the sum of a) Stock input and b) Machinery and fixed equipment input. The stock input was derived as follows:

1/5th of the opening valuation of stock plus feed expenses plus fertiliser expenses.

One fifth of the opening valuation of livestock was assumed to represent the annual input of livestock capital services, as the average cull rate on the dairy farm sample was twenty per cent. Feed and fertiliser expenses were added as output is measured gross i.e. no deduction was made for the variable costs associated with the use of tenants capital. The derivation of the machinery capital input was as follows:

Net total depreciation plus repairs and running costs of machinery and fixed equipment.

The rate of depreciation was assumed to represent the annual input of machinery services. Repairs and running costs were added for similar reasons as were feed and fertilisers in the case of stock capital.

Two Cobb-Douglas models were prepared, one using the aggregate capital input and the other using the capital input disaggregated into its two components, stock and machinery.

5.6.3. The Variables of the Cobb-Douglas Model

X_1 = Gross Output

X_2 = Adjusted acres

X_3 = Labour

X_4 = Total Tenants Capital

X_5 = Machinery Capital

X_6 = Stock Capital

Table 5.6.3.1 Cobb-Douglas Function: Tenanted Farms 1969/70

Rel. No.	Dep. Var.	Constant	Regression Coefficients β					Standard Error of β					% Var. Exp'nd
			X_2	X_3	X_4	X_5	X_6	X_2	X_3	X_4	X_5	X_6	
1	X_1	2.022	0.1779 **	0.2098 **	0.6870 ***	-	-	0.0540	0.0651	0.0522	-	-	97
2	X_1	2.932	0.1763 **	0.2313 **	-	0.1656 N.S.	0.5044 ***	0.0591	0.0807	-	0.0858	0.0511	97

Table 5.6.3.2 Cobb-Douglas Function: Tenanted Farms 1970/71

Rel. No.	Dep. Var.	Constant	Regression Coefficients β					Standard Error of β					% Var. Exp'nd
			X_2	X_3	X_4	X_5	X_6	X_2	X_3	X_4	X_5	X_6	
3	X_1	1.222	0.1740 *	0.2011 **	0.7517 ***	-	-	0.0578	0.0692	0.0517	-	-	97
4	X_1	2.108	0.1284 N.S.	0.1735 *	-	0.2992 ***	0.5052 ***	0.0640	0.0849	-	0.0937	0.0462	97

Table 5.6.3.3 Cobb-Douglas Function: Owner Occupied Farms 1969/70

Rel. No.	Dep. Var.	Constant	Regression Coefficients β					Standard Error of β					% Var. Exp'nd
			X_2	X_3	X_4	X_5	X_6	X_2	X_3	X_4	X_5	X_6	
5	X_1	1.565	0.0904 N.S.	0.2718 ***	0.7088 ***			0.0522	0.0747	0.0564			94
6	X_1	2.147	0.0648 N.S.	0.2668 ***		0.2734 ***	0.4773 ***	0.0532	0.0762		0.0600	0.0509	94

Table 5.6.3.4 Cobb-Douglas Function: Owner Occupied Farms 1970/71

Rel. No.	Dep. Var.	Constant	Regression Coefficients β					Standard Error of β					% Var. Exp'nd
			X_2	X_3	X_4	X_5	X_6	X_2	X_3	X_4	X_5	X_6	
7	X_1	1.007	0.1060 N.S.	0.3550 ***	0.6737 ***			0.0559	0.0854	0.0524			95
8	X_1	1.435	0.0884 N.S.	0.3534 ***		0.2264 ***	0.4702 ***	0.0571	0.0913		0.0598	0.0444	95

The "goodness of fit" of the data to the equations was high, 94-97 per cent explained variation. The tenanted farm groups were better than the owner occupied groups in this respect. A similar situation pertained in Section 4.3.3. - the causal chain model. The Cobb-Douglas model equations would seem to be quite reliable for prediction purposes. The aim of this section is not, however, prediction of gross output, but the estimation of the marginal productivity of capital, which relies on an accurate determination of the structural parameters. If multicollinearity is present, resulting in inflated standard errors and biased regression coefficients, the equations would not be suitable for the estimation of marginal productivities. In relations 1 to 8 there was not at any time more than one input variable in an equation which was statistically non-significant at the 5 per cent level of significance and in the case of relations 2, 4, 5 and 7 the lack of significance was marginal as the coefficients of the non-significant variables were significant at the 10 per cent level. Only in equations 6 and 8 were there input variables which were non-significant even at the 10 per cent level, but the presence of collinearity was not conclusive.

A study of the zero-order correlation coefficient matrices (Appendix II) (Tables 1-8) was made to further investigate the possibility of multicollinearity in the relationships. The matrices showed there were strong relationships between each of the input variables and gross output (the dependent variable) but in all cases the multiple coefficient of determination (R^2) was significantly greater than any one coefficient of determination of an input variable, indicating that no one variable accounted for all of the explained variation of the equation. If a high correlation exists between input variables, the regression coefficients (elasticities of production) may be biased. The problem arises in defining a high correlation. In practice, if not more than about 50-60 per cent of the variation between inputs is accounted for by a relationship, then multicollinearity may not have reached serious proportions. Of the relationships 1,3, 5 and 7 i.e. those where the capital input was aggregated, multicollinearity was not a serious problem with the possible exception of the association between land and labour in relations 5 and 7 (owner occupiers 1969/70 and 1970/71). In the remaining relationships 2, 4, 6 and 8 i.e. those where the capital input was disaggregated into stock and machinery capital, the problem of multicollinearity was probably more serious. In relationships 2 and 4 (Tenants 1969/70 and 1970/71) there existed a marked high collinearity between variables X_3(labour) and X_5(machinery capital) and also X_5(machinery capital) and X_6(stock). In relationships 6 and 8 (owner occupiers 1969/70 and 1970/71) the high collinearity was between X_2(land) and X_3(labour).

If the balance between costs and prices changes between years, the elasticities of the input variables will not be consistent. Reference to Section 3.4. p.48 showed that between 1969/70 and 1970/71 changes in costs were approximately balanced by changes in prices. The β coefficients were tested for consistency between the two years. No statistically significant difference at the $P = 0.05$ level could be established (Appendix II) (Tables 9a and 9b).

Although it is not possible to prove that there is no danger from multicollinearity, the equations are believed to be sufficiently reliable to permit useful estimates of the marginal productivity of capital to be derived. The capital input variables were statistically significant at the $P = 0.001$ level in all equations except for X_5(machinery capital) in relation 4 which was significant at the $P = 0.01$ level and X_5 in relation 2 which was non-significant at the $P = 0.05$ level. This variable, however, was statistically significant at the $P = 0.1$ level. It was therefore decided to accept the variable as being significant for estimation purposes, although the reliability of the estimates based on this variable will be lower, as is demonstrated in Figure 5.6.2. p.163.

The level of significance of the land and labour input variables was relatively unimportant as they will be held constant at their geometric mean values during the determination of the marginal productivity of the capital inputs. However, it was constructive to note that capital was a stronger determinant of gross output than labour input which in turn was stronger than the land input.

5.6.4. Marginal Productivity Estimates of Tenants Capital

Table 5.6.4.1. Average Capital Input and Marginal Productivity of Tenants Capital, 1969/70 and 1970/71

	Tenanted Farms		Owner Occupied Farms	
	1969/70	1970/71	1969/70	1970/71
Av.Farm Output £	10470	11200	11880	12760
Av.Input of Tenants Capital £:				
1) Total Tenants Capital X_4	6288	6985	7461	8127
2) Machinery Cap. X_5	1724	1825	1917	2018
3) Stock Cap. X_6	4479	5047	5456	5980
Marginal Output of Tenants Capital at Input Means £/£:				
1) Tot.Tenants Cap. X_4	1.144	1.206	1.127	1.058
2) Machinery Cap. X_5	1.004	1.835	1.693	1.431
3) Stock Cap. X_6	1.177	1.120	1.039	1.003

Note: Inputs all held at geometric mean values.

The above table shows the average (geometric mean) input of tenants capital per annum and its marginal productivity, for both farm groups in 1969/70 and 1970/71.

The average input of tenants capital was higher for the owner occupied farm group than for the tenanted farm group which may be the reason for the generally lower level of the marginal productivities of the capital inputs on the owner occupied farms. Machinery capital (X_5) in the tenanted farm group, 1969/70, did not follow this pattern. The likely cause of this exception was the low level of singificance ($P = 0.1$ level) of the β coefficient in relation 2. Section 5.6.3., which produced a less reliable estimate of the marginal productivity of variable X_5 in 1969/70. The marginal productivities of the owner occupied farm groups were expected to be less than those of the tenanted groups because the elasticities of production of the individual input variables in both groups were less than unity, indicating decreasing returns to scale of input use. (Owner occupiers operate at higher average input levels).

The absolute values for the marginal productivities of the total tenants capital (X_4) variable showed that the productivity of the capital invested was not particularly high. Whether the return achieved per pound invested was adequate is considered later.

A surprising feature of the results was the higher level of marginal productivity of machinery investment than of livestock investment, at the mean level of capital input (except in the case of the less reliable machinery variable (X_5) of the tenanted group in 1969/70). The values for the marginal productivities could indicate that the farmers were operating closer to the optimum input of capital regarding livestock investment, but were under-capitalised in terms of machinery investment. (Assuming the marginal cost of machinery and livestock capital is equal).

Comparison of the two years results indicated an increase in the tenants capital invested (current values) in all categories of capital inputs. The marginal productivities of the capital inputs can therefore be expected to be less in 1970/71 than in the previous year. This was verified in all cases for the owner occupied farm group and for stock capital in the tenanted group. Machinery and total tenants capital did not follow this pattern in the tenanted group. The less reliable estimate for machinery capital in 1969/70 was again the likely partial cause of the discrepancy in the case of the machinery capital. The increase in the marginal productivity of total tenants capital between 1969/70 and 1970/71 could be deceptive, due to the productivities being measured at current values.

Since the movement in costs and prices of agricultural products was approximately equal between 1969/70 and 1970/71 it was possible to recalculate the marginal productivities for 1970/71 using capital input values which were deflated by the unit cost increase of the inputs. This process enabled the estimated marginal productivities for the two years to be validly compared. It is not easy to estimate the increase in unit cost of the composite capital variables but calculated index numbers were prepared and are shown in Appendix II Table 10. The calculated index numbers were used to inflate the 1969/70 capital input means to 1970/71 values. The adjusted capital inputs were then used to recalculate the marginal productivities for the capital inputs in 1969/70 and 1970/71, using the 1970/71 estimates for the production elasticities.[13] The results are tabulated in Table 5.6.4.2.

Table 5.6.4.2. Marginal Productivity of Tenants Capital (at input means) Adjusted for Unit Changes in Costs. 1969/70 and 1970/71

	Tenanted Farms		Owner Occupied Farms	
	1969/70	1970/71	1969/70	1970/71
Marginal Productivities £/£:				
1) Total Tenants Capital	1.219	1.218	1.055	1.057
2) Machinery Capital	1.774	1.765	1.385	1.377
3) Stock Capital	1.087	1.090	1.009	1.014

The values for the marginal productivity of the three tenants capital categories in Table 5.6.4.2., represent the estimated marginal productivity after removal of the effect of unit price increases on the cost of the capital inputs and the effect of increased intensity of capital use (i.e. the increase in average input of capital between 1969/70 and 1970/71). In all cases the marginal productivities of the tenanted farm groups were higher

(13) The 1969/70 production elasticities were not used as R^2 for the 1970/71 equations was higher and all the capital input regression coefficients were statistically significant. Tables 9a and 9b Appendix II shows that no statistical difference exists between the β coefficient estimates in the two years. Overall, it was decided the 1970/71 equations were the more reliable estimators.

than the owner-occupied farm groups, indicating either more efficient capital utilisation by the tenant farmers or under-capitalisation.

Comparison of the two years results showed only slight changes in the marginal productivities in the second year. Since the effect of unit price changes in the cost of the inputs and the increase in capital intensity has been eliminated from these marginal productivity estimates, the changes in productivity must be due to exogenous factors e.g. weather. The change in productivity was similar for both the owner-occupied and tenanted farm groups; the exogenous factors therefore affected the farm groups equally, and to a limited extent.

The marginal productivity of the stock capital input was lower than that of the machinery capital input, indicating the possibility of under-capitalisation in terms of machinery capital input and over-capitalisation in terms of livestock capital input, if machinery and livestock capital were assumed to have equal costs per unit of capital invested.

The profit maximising input of machinery and livestock capital is determined when the marginal cost of the capital input equates with the marginal revenue product of the capital inputs.
If it is assumed that the capital invested in a farm has to be borrowed at interest-bearing rates, then the marginal cost of the capital will be represented by the interest rate on borrowed funds which existed in 1969-71. Table 5.6.4.3. shows the borrowing rates in force in 1969/70 and 1970/71 and the estimated marginal cost of capital in that period.

Table 5.6.4.3. Marginal Cost of Capital. 1969/70 and 1970/71

	Average Borrowing Rate %	Average Deposit Rate %	Marginal Cost of Capital £/£				
			Case 1	Case 2		Case 3	
			All Farms	Tenants	O.Occupiers	Tenants	O.Occupiers
1969/70	9.2	5.7	1.092	1.064	1.063	1.096	1.091
1970/71	7.7	4.2	1.077	1.049	1.048	1.082	1.076

In the above table the borrowing rate was assumed to be bank rate plus 1.5 per cent and the deposit rate, bank rate minus 2 per cent. The marginal cost of capital in case 1 was derived, assuming all capital had to be borrowed at the market rate of interest with no capital repayment. In case 2, the marginal cost of the capital represented the situation when the farmer was faced with supplying the average equity of the farm (80 per cent for tenants and 83 per cent for owner occupiers) at an opportunity cost assumed to be the deposit rate of interest, while supplying 17-20 per cent of the marginal capital at the market rate of interest for borrowed funds. No capital repayment was assumed. Case 3 represented the marginal cost of capital as in case 2 but with capital repaid over a five year period.

The graphs in Figure 5.6.1. and 5.6.2. represent the marginal productivity of the annual input of tenants capital, livestock capital, and machinery capital, for a range of capital input values. Where an input, e.g. land, is not being directly considered, it is held constant at its geometric mean. Three assumed levels of marginal cost of the capital inputs are shown on the diagrams. The intersection of the marginal cost and marginal revenue product lines represent the profit maximisation points. The vertical solid lines represent the average annual input of the various categories of capital. In this way, the actual average inputs can be compared with the optimum profit maximisation inputs of capital.

Figure 5.6.1. Marginal Productivity Curves of Total Tenants Capital

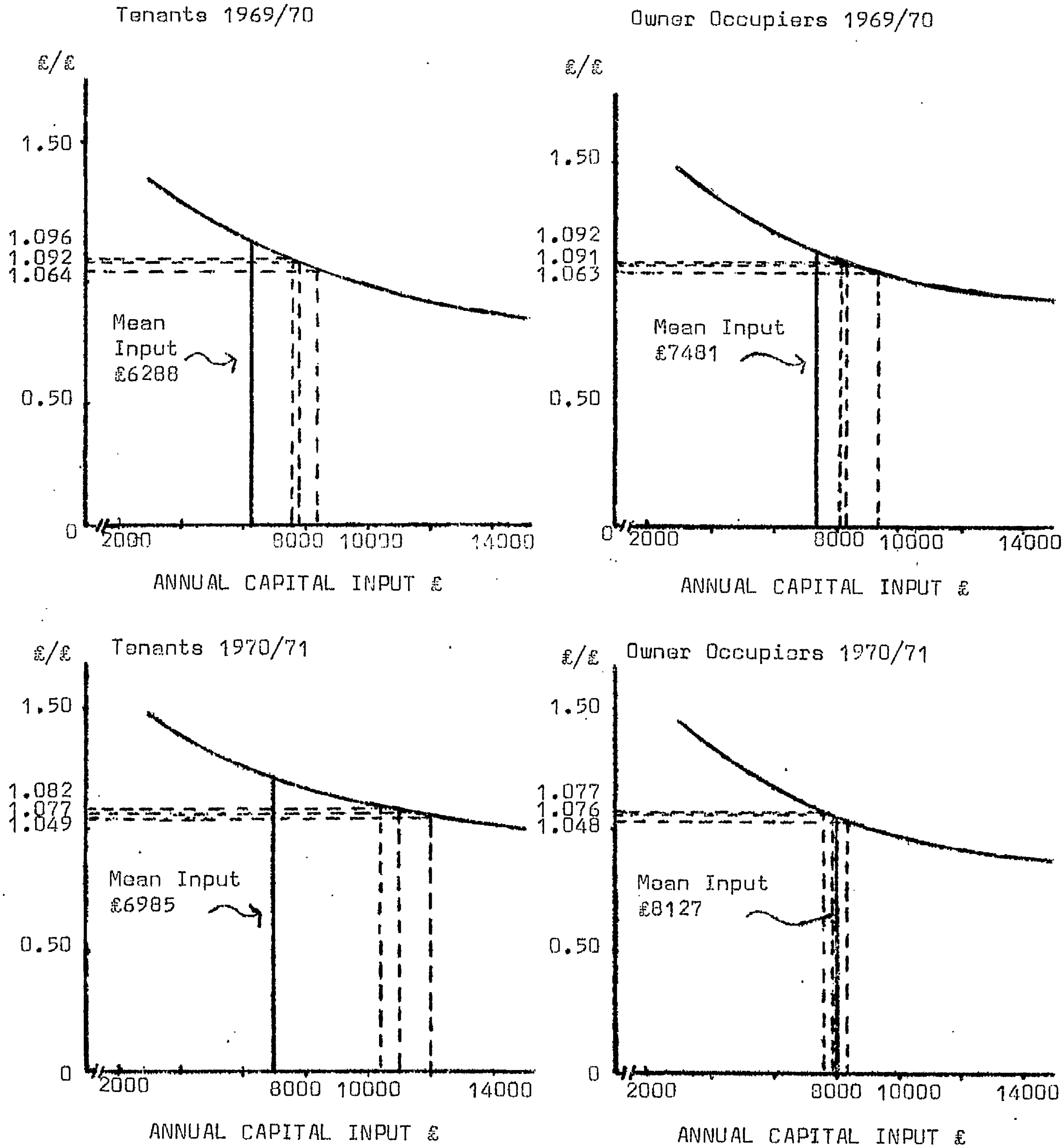
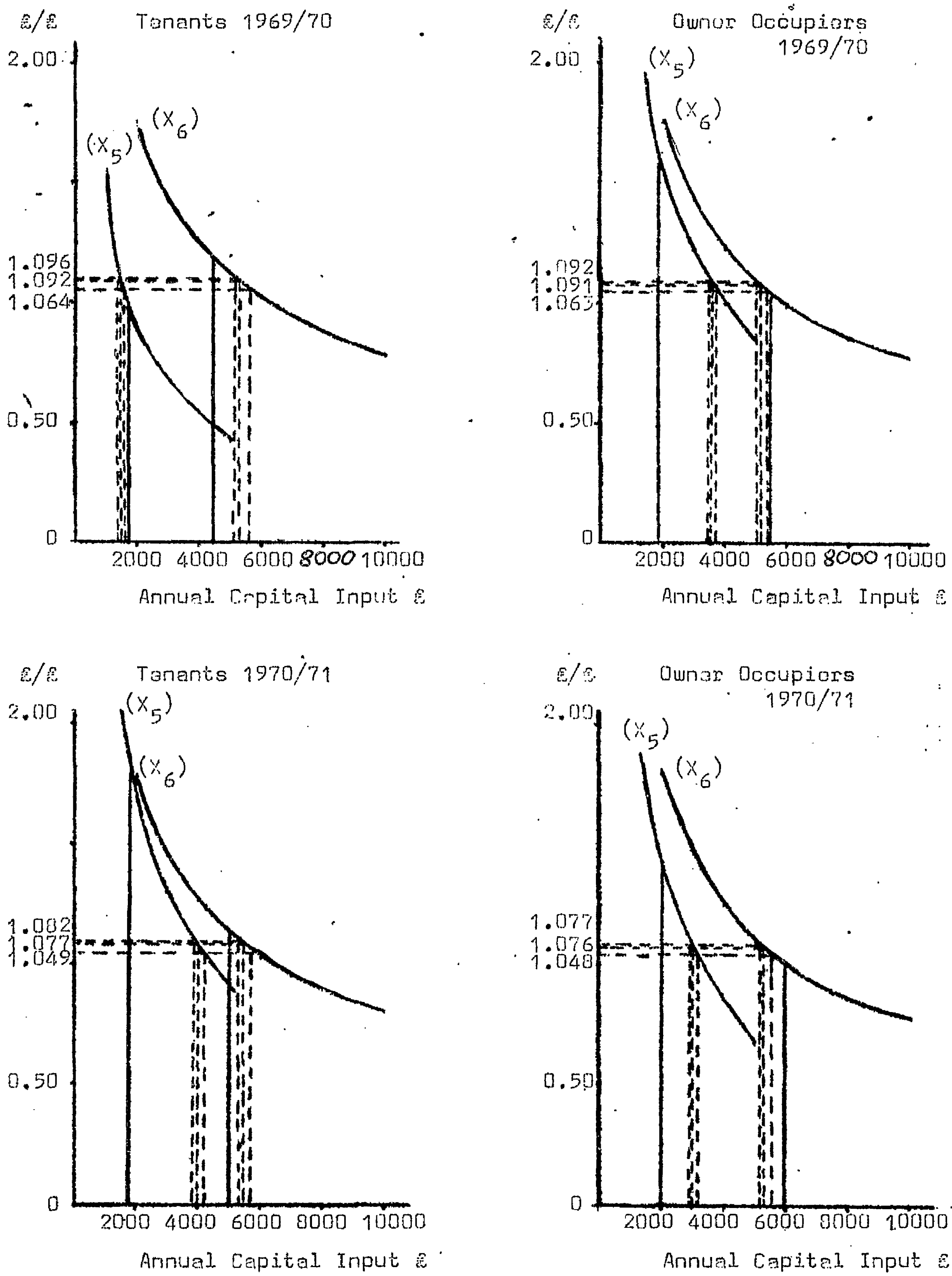


Figure 5.6.2. Marginal Productivity Curves of Livestock (X_6) and Machinery (X_5) Capital



Examination of Figure 5.6.1. indicated that the owner occupier group in 1970/71 operated near to the optimum input of tenants capital. The capital input of the other three groups varied to a greater or lesser extent around the optimum annual input. The tenanted farm group in the second year under study deviated most from the optimum. The owner occupied farms operated closer to their optimum capital input than did the tenanted farms. This suggested that the average tenanted farm was under-capitalised to a greater extent than the owner occupied farm, resulting in a higher marginal productivity for the tenanted farms, at the average capital input level. If the tenanted farm group invested the higher average inputs of the owner occupied farm groups then the tenanted farm groups would be near to their optimum capital input. The problem was therefore largely one of intensity of capital use and not one of productivity difference between the owner occupied and tenanted farm groups, arising from the effect of management or other exogenous factors affecting the relative positions of the marginal productivity curves. In 1970/71, the tenanted farm group would still have a higher marginal product than the equivalent owner occupied group, if the average input of the owner occupied group was applied to the tenanted group. It can be seen from Figure 5.6.1. that this was because the tenanted farm group marginal productivity curve in 1970/71 was on a higher plane than the owner occupied farm group curve, especially at the higher levels of capital input. This was not the case in 1969/70 but the evidence considered earlier in this chapter suggested that the 1970/71 estimates were more reliable than those for 1969/70. Because the tenanted farm group marginal productivity was on a higher plane than the owner occupied farm group, the problem of differing marginal products between the two groups was not completely restricted to differences in intensity of capital use. Differences in productivity, however, were slight, and reference to Appendix II Tables 9a and 9b will confirm that they were not statistically significant.

Reference to Figure 5.6.2. showed the effect of the low level of significance of the β coefficient of the machinery (X_5) variable on the estimated marginal productivity curves. It was for this reason that the marginal productivity curve for tenants in 1970/71 was deemed to be more reliable, since the machinery component of the aggregated capital variable was probably introducing some degree of bias into the 1969/70 estimate.

The effect of the marginal cost of the capital inputs on the optimum capital input can be seen from Figure 5.6.1. If all the capital invested had to be borrowed at market rates of interest, only the owner occupied farm group in 1970/71 would not be able to increase the annual capital input profitably. This group could only increase its average capital input profitably if case 3 capital costs were adopted.

The marginal productivity curves for the annual input of machinery and livestock capital were depicted in Figure 5.6.2. The marginal productivity curves for livestock capital (X_6) were virtually identical for all the farming groups, which was additional proof that differences in the marginal productivity curves in Figure 5.6.1, in particular for the tenanted farm groups between the two years, was probably due to the influence of the machinery capital component.

The general situation regarding investment in machinery capital was that the average farm was under-capitalised in its machinery use. This was not substantiated for the 1969/70 tenanted farm group, but the low reliability of that particular curve has been noted several times. Future comments regarding machinery investment will therefore relate to the 1970/71 situation.

The tenanted farm group were under-capitalised in terms of their livestock capital input, when this was related to the cost of capital in that period. The under-capitalisation, however, did fall from 15 per cent to 6 per cent between 1969/70 and 1970/71. The average owner occupied farm was operating at approximately 6 per cent over the optimum capital input in 1969/70 which rose to 11 per cent in the following year, when case 3 capital costs were assumed.

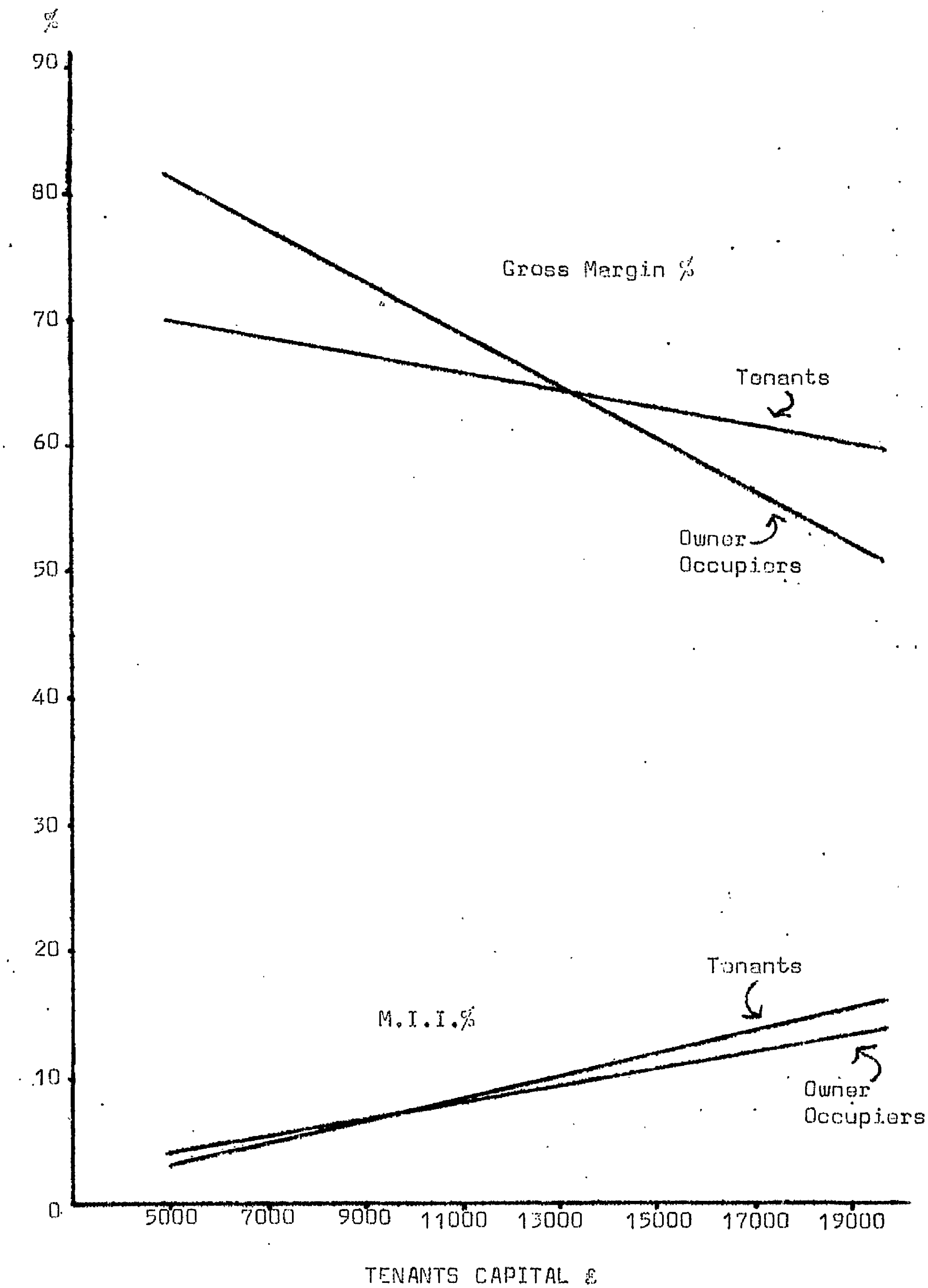
In this section it was found possible to determine the marginal productivity of the capital inputs to dairy farms in West Scotland using a Cobb-Douglas function. By making assumptions regarding the marginal cost of the capital input, it was possible to establish the optimum capital inputs. The scope for improvement in the efficiency of capital use is discussed in the following section.

5.7. Discussion/Conclusions

One of the findings of the previous chapter was that the gross margin/tenants capital ratio (%) fell as the level of tenants capital used on the sample farms increased. This result suggested lower levels of tenants capital utilisation, as the input of capital was increased. The gross margin of a farm, however, does not include the fixed costs associated with the farm operation. The return on tenants capital was therefore measured at the M.I.I. level in order to assess whether the allocation of the fixed costs of a farm affected the effective utilisation of tenants capital.

The graphs in Figure 5.7.1. p.167 demonstrated that although the gross margin percentage return fell as the tenants capital inputs were increased, the return in terms of M.I.I. percentage increased with the use of additional capital. The effect of fixed cost allocation was therefore proportionately greater at the lower levels of capital input. It is known that the fixed costs per acre of the farms fell as acreage increased and also that the intensity of capital use was less on the larger acreage farms (measured in terms of capital per acre). This was due in part to the indivisibility of large capital input factors e.g. tractors, but the absolute amount of capital used on the large acreage farms was greater than on the smaller acreage farms. The result was that the higher returns on capital (M.I.I.%) tended to be associated with the higher acreage farms, but where two farms had identical acreage, the return on capital would be expected to be greater on the more highly capitalised farm. Capital utilisation was hence more effective on the larger farm. The agricultural policy implication of the previous conclusion was that production on higher acreage and more highly capitalised farms should be encouraged.

Figure 5.7.1. Gross Margin % and M.I.I.% Return on Tenants Capital (2 year mean values)



The graphs in Figure 5.7.1. also indicated that gross margin percentage would be a misleading measure of capital utilisation since the impression given was that the lower capital input farms utilise capital more fully than the higher capital input farms, a fact which was not tenable after the allocation of fixed costs. Gross margin percentage return estimates should therefore be considered to indicate the efficiency of variable cost allocation but not the overall efficiency of capital utilisation. The return on capital lines (M.I.I.%) were found to intersect at a capital input of approximately £9000, thus the small owner occupier was more efficient than the small tenant farmer, but at tenants capital input levels above £9000 the tenant farmer used his capital investment more efficiently than the owner occupier. Tenant farmers in general appear to be able to minimise their fixed costs more effectively than owner occupiers since at the gross margin percentage return level, the tenanted farm group did not become more efficient than the owner occupied farm group till a tenants capital input of approximately £14,000 was attained. It could be concluded that not only should larger farms and higher levels of capital usage be encouraged, but also that these farms should be tenanted, on an efficiency of capital utilisation criterion. A move towards a tenanted farm system of land holding would of course be contrary to the recent national trend which has been towards owner-occupancy. It should be stressed that the difference in efficiency of capital use by the tenant and owner occupier was not great in terms of M.I.I.% but none-the-less differences should be recognised.

The adequacy of the return on tenants capital can only be ascertained by comparing the return on capital with the cost of the capital inputs and to the return available on capital invested outside agriculture. In 1969/70 and 1970/71 the cost of tenants type capital was estimated at approximately 9.4 and 9.7 per cent (Table 5.6.4.3. - the average of case 3 estimates). If it is assumed that farmers who did not attain this level of return on their capital were not obtaining an adequate return, then tenanted farms with a capital input of up to approximately £11,000 and £13,000 and owner occupiers with up to £14,000 and £12,000 respectively, in 1969/70 and 1970/71 (Table 5.2.2.2.), were not obtaining an adequate reward on their capital investment. Comparing the return on capital on the sample farms to the return available outwith farming in a period when even long-term Government loans attracted at least 9 per cent interest, it became clear that many farmers would be able to obtain better returns on their capital by investing outwith agriculture, even allowing for the fact that investment income is taxed at a higher rate than earned income.

The indications were that the future of the smaller farmer, judged purely in terms of tenants capital input, (to a large extent low capital input was synonomous with low acreage), was not good. Those farms with a tenants capital input below £11,000 - £14,000 might well consider opting out of dairy farming, unless a non-financial factor induces them to stay, or if they can find a method to reduce costs and increase output.

The efficiency of utilisation of landlords type capital is not reflected in the return on landlords capital, as normally computed, but this aspect is an integral part of the return on tenants type capital on the owner occupied farm. e.g. If a farmer increases the number of cows, housed in a building suitable for forty cows, from thirty to forty cows, then the increased return from the ten extra cows is derived partly from the increase in tenants capital (cows) and partly from the more efficient use of the landlords type capital (the building).

Distortions of the market for land, which tend to inflate land values make it difficult to estimate whether the computed return was an adequate reward for land used as part of the agricultural process. The distortions in the land market arise, due primarily to the use of land as a hedge against inflation and due to estate duty concessions on agricultural land. The low return obtained on landlords capital, 3.06 per cent, was clearly not adequate to cover the cost of borrowing capital in 1970/71. It is frequently argued that a low rate of return on landlords capital (mainly land) is accepted by farmers due to the ability of land to accumulate capital value i.e. land appreciates in value. Table 5.7.1. shows the recent increases in land values at constant

1967-68 prices.

Table 5.7.1. Price Index of Dairy Farm Land Values

	Sales by O. occupier to O. occupier	Sales by Landlord to Sitting Tenant
1967-68	100	100
1968-69	103	102
1969-70	105	122
1970-71	107	118

Source: Scottish Agricultural Economics Vol. XXIII - 1973, Table 131 p.232.

The real value of land has increased in most of the years covered by Table 5.7.1. If farmers accept that the total return on landlords capital - defined as the real increase in land values together with the annual return - is a true indication of the return on landlords capital, then the total return would be adequate to cover the cost of borrowing funds to invest in landlords capital. There are, however, inherent dangers in accepting increases in land values, attributable to the speculative elements of the land market, as part of the return due to land. If the confidence in land as a hedge against inflation were to be weakened there would be a reduction and possibly a reversal in the trend in land values. Such a trend would be likely to make the former levels of investment in land unjustifiable.

The return on total owner occupiers capital would be a useful measure as it would avoid the necessity of making an arbitrary division between the return on landlords capital and the return on tenants capital, and it provides the owner occupier with a guide to the overall performance of his capital investment. The idea of a measure based on the total return to owner occupiers capital is perhaps not realistic due to the existence of two capital markets for land - one speculative and one for farming capital. The measure was used in this study, but it must be stressed that any speculative or inflationary return on the landlords capital component of the total owner occupiers capital was excluded.

Only five farms had negative returns on owner occupiers capital. This number was lower than in the case of return on tenants capital alone and illustrated one of the advantages of the owner occupier over the tenant in cases of adversity. This situation pertains because the charge made for rent on owner occupied farms is a nominal charge instead of a cash expense, as in a tenanted farm. The value of the nominal rent is hence available to the owner occupier when difficulties arise.

Estimates of the percentage return on owner occupiers capital showed the existence of increasing returns to scale. The return varied from about 2 per cent per annum on a 50 acre farm to 7 per cent on a 300 acre farm (Table 5.2.4.2.). The available evidence was clearly in favour of production based on larger farm sizes. Overall, the return on owner occupiers capital was not satisfactory when compared to the cost of borrowing, which ranged from 9 per cent to 7.5 per cent in the period 1969/70 to 1970/71. Neither did it appear adequate remuneration in terms of the effort involved in farming, especially when higher returns on capital were available in many cases if the farmer cared to invest outwith farming.

Many reasons exist to account for the fact that owner occupiers do not cease farming, that is, apart from the reason that farming is their "way of life". The main reason is due to the nature of their primary asset, land. In the case of the majority of owner occupiers the present value of their farm is much higher than the value when it was purchased. The effect of inflation and speculation in land therefore accounts for a large part of the apparently low levels of return on owner-occupiers capital. The rate of increase in land values has, in effect, outstripped the rate of increase in income from the land. In addition, because owner occupiers own an average 80 per cent of their farm the low level of return on the total owner occupiers capital was more than adequate to cover the cost of borrowing the remaining 20 per cent of farm capital

Variation in the efficiency of tenants capital utilisation has been demonstrated to be largely attributable to the ability of the farmers to control the variable and fixed costs associated with the use of tenants capital. Evidence in Section 4.3.4. also suggested the possibility that differences in the gross margin obtained on a farm were a result of the particular mix of categories of capital on the farm.

An index of the ratio of dairy cow assets to total assets was prepared to test the hypothesis that the higher the ratio of Dairy Cows/Total Assets, (D.C./T.A.,) the higher would be the expected return or profit from the capital used. Attempts to associate the D.C./T.A. ratio with farm profit (N.F.I. and N.F.I./acre) proved unsuccessful. Hence it was concluded that the D.C./T.A. ratio was not an adequate measure of the efficiency of capital utilisation and that the proportion of dairy cows to other forms of tenants capital was of lesser importance than the costs associated with the use of tenants capital in determining the overall efficiency of tenants capital use.

Farm output is known to vary at different levels of tenants capital usage (Section 4.3.4.). It was therefore possible that the rate of turnover of capital would have a bearing on the efficiency of capital utilisation. Rate of turnover, however, has been neglected as a measure of farm business performance in agriculture, in contrast to other industries. The possibility that a high rate of turnover of the farm assets could be used as an indicator of farm profitability was therefore examined, but the rate of turnover of farm assets did not appear to have any significant measurable effect on farm profitability. This conclusion indicated that the level of profitability of a farm was not only dependent on the level of turnover but also on the variation of the costs associated with the production of output. These costs will tend to vary according to management practices and exogenous factors e.g. weather, disease. The average rates of turnover on total assets were 0.33 and 1.08 for the owner occupied and tenanted farm groups respectively. The rate of turnover on tenants capital alone, in the case of the owner occupied farms, was slightly lower at 1.04 than for the tenanted farm group. The effect of including heritable property (landlords type capital) within the total assets of the owner occupied farm group was quite considerable. The 4 per cent difference in rate of turnover of tenants capital between the two groups may have arisen through the need of the owner occupier to divide his available management time between farm and estate type management functions, which could result in a lower rate of turnover on tenants capital. Typical rates of turnover for other types of business during the period under study were: Marks and Spencer 1.5, F.M.C. 6.5 and Unigate 3.5. Compared with other businesses, dairy farms were seen to have a low level of turnover of assets and based on this criterion they appear as relatively inefficient utilisers of capital. The low levels of turnover on dairy farms are, however, largely attributable to the seasonal, biological and spatial limitations imposed on capital used on dairy farms.

Until now the attempts made to measure the efficiency of capital utilisation on dairy farms in W. Scotland have been concerned with all the capital invested on the farm, irrespective of whether the capital was owned by the farmer or not. It was therefore necessary to investigate the efficiency of the use of borrowed capital.

The proportion of the farm business which was owned was first demonstrated to be independent of farm size, measured either in terms of acreage or total capital investment in the business. The proportion of a business funded from owned capital (equity percentage) was then shown to be a non-significant factor in determining the ultimate profitability of a farm business. The hypothesis that a low equity percentage indicated a willingness to increase the level of farm indebtedness in order to grasp investment opportunities, resulting in higher profits, must be rejected as not substantiated for dairy farms in West Scotland.

The total amount of capital borrowed was functionally related to the total assets of the farm. (Total assets refers to tenants type capital in the tenanted farm group and to both tenants and landlords type capital in the case of the owner occupied farm group.) Total capital on the owner occupied farms was not separated into tenants and landlords categories since it is an integral part of the owner occupied farm that borrowings of both types of capital require to be funded simultaneously by the farmer. The estimated credit requirement per £100 increase in total assets was £33.1 for the tenanted farm group and £11.5 (2 year averages) for the owner occupied farm group. The results showed that when expansion was undertaken, tenant farmers relied more heavily on obtaining credit than did owner occupiers. This tendency was also reflected in the proportion of existing capital which was owned by the respective farm groups (Table 4.2.5. - Equity percentages). In absolute terms, the amount of capital borrowed by the owner occupier farmer was, of course, greater than the tenant farmer, due to the necessity to fund landlords type capital in addition to tenants capital.

The larger amounts of borrowed capital required by the owner occupied farm group had two main effects on the level of N.F.I.[14] generated by the two sample groups of farms. Firstly, the amount of N.F.I. produced was more sensitive to the amount of borrowed capital on the tenanted farms than on the owner occupied farms, i.e. more of the variation in N.F.I. was explained by changes in the amount of borrowed capital on the tenanted farms. Secondly, the increase in N.F.I. per £100 increase in borrowed capital was higher for the tenanted farm group than for the owner occupied farm group. This situation would fit the hypothesis that tenant farmers were able to concentrate on the "more productive" forms of assets and on farm management whereas the owner occupier had also to contend with estate management and a requirement to borrow long-term capital, which has been shown (Section 5.2.3.) to be lower yielding in terms of disposable income.

The return on additional borrowed capital was considered adequate for the tenanted farm group, in both years, when compared with the cost of capital. Return on additional capital borrowed by the owner occupied group was not adequate in 1969/70, but in the

[14] See earlier footnote number 6 p.144.

following year the margin over cost was approximately 4 per cent. The owner occupier therefore requires to exercise more caution before contemplating additional investment which includes long-term capital.

In an earlier chapter of this study, capital input/output relationships were determined using capital stock values to represent capital inputs. Since the capital input to a production process is not completely consumed in the process, unlike feeds, fuel etc., it can be argued that the capital input to the production process should be represented as a flow over time i.e. an annual input of capital services. In order to calculate the marginal productivity of the tenants capital used on the sample dairy farms in West Scotland, capital was represented as the estimated annual input of capital resources. This facilitated a production function approach to the problem of calculating the marginal productivity of the tenants capital inputs. It was decided to calculate the marginal products in the first instance because they probably give the best guide to the efficiency of capital utilisation. If the capital input is paid its marginal product, the total output attributable to capital will be just exhausted. Under profit maximising conditions, the marginal cost is equated to the marginal revenue product of the capital. It is then possible to determine the extent of the deviation of any given level of capital input from the profit maximising level of input, thus supplying a measure of capital efficiency.

The use of a production function, in this instance a Cobb-Douglas production function, has itself attendant problems, largely of a statistical nature (Section 5.6.2.). These problems are not insurmountable and it was felt that on balance the results obtained supplied reliable estimates of the marginal productivity of tenants capital.

The production functions used included land and labour in addition to capital, as input variables, in order to minimise the unexplained variation in output through the omission of relevant input variables. The contribution to the explained variation in output by land and labour was less than for capital, which was shown to be the major determinant of farm output. This result was substantiated by the results of Section 4.3.3. which did not reveal acreage as a significant variable in the system at the gross output level.

The estimated values for the marginal productivities of the capital inputs were not high in absolute value; their adequacy, in terms of the efficiency of investment, is discussed later.

The marginal productivities of capital estimated for the owner occupied farm group were lower than those for the tenanted farm groups, except in the case of the machinery capital input in 1969/70. This variable in 1969/70 was statistically less significant than the others. The 1970/71 results should therefore be accepted as portraying the more reliable situation. The lower marginal productivities for the owner occupied farms had been anticipated from the results of Section 4.3.4. p. 106, where it was concluded that tenanted farms could expect a higher marginal return than owner occupied farms in terms of gross margin achieved.

The marginal productivity of machinery capital was found, in general, to be higher than that of livestock capital when measured at the average input of machinery and livestock. This should not be interpreted to mean that machinery was necessarily a more productive form of capital investment than livestock, but rather that machinery investment has been neglected on the sample farms with the result that the farms were under-capitalised, which caused the higher marginal productivities at the average input of machinery capital.

The average amount of tenants capital invested in the sample farms increased between 1969/70 and 1970/71. One would therefore expect the estimated marginal product, at the mean capital input, to be less in the second year. In practice, the marginal productivities for the owner occupied farm group fell but those of the tenanted group tended to rise. Two possibilities exist to account for the rise in marginal productivity of the tenanted farm group. Firstly, the estimate for the machinery marginal product in 1969/70 was probably biased downwards and may have affected the total tenants capital estimate similarly. Secondly, the marginal productivities were measured at current values, which could bias the results through relative movements of costs and prices. Such a bias due to this cause would undoubtedly also affect the owner occupied farm group.

In order to remove the bias in the marginal productivity estimates, arising from increased capital intensity and inflation, the marginal productivities were recalculated by deflating the input of capital by the unit cost change between 1969/70 and 1970/71. Such a recalculation is valid, provided the relative cost of inputs and the price of the output remain stable between the years in question. The recalculated values for the marginal productivities indicated a slight change to have occurred. Since the effect of increases in capital intensity and inflation have been removed from the estimates, the change must be due to actual changes in the productivity of the inputs. The change in marginal products between the two periods was small and was within the random variation in productivity which might be expected due to the exogenous factors which affect agriculture such as, weather and disease. It can therefore be concluded that the marginal productivities were stable over the two years studied.

In order to determine the adequacy of the marginal products of the capital inputs, they were related to the marginal cost of capital in 1969/70 and 1970/71. Three assumptions were made regarding the cost of capital: case 1 - all capital borrowed at market rates; case 2 - part of the capital supplied by farmer at an opportunity cost equal to the deposit rate of interest, the remainder being borrowed at market rates of interest; case 3 - identical to case 2 but including repayment over five years.

The diagrams in Figures 5.6.1. and 5.6.2. showed that the average input of capital of the owner occupied farm group was closer to the profit maximising input than in the case of the tenanted farm group. This partially accounted for the lower marginal productivities of the owner occupied farms. The tenanted farm group was in effect under-capitalised, at the mean capital input, at the ruling cost of capital in 1969/70 and 1970/71. Thus, although the efficiency of the tenanted farm group was high in terms of the marginal product obtained from the capital used, the farm profit was not being maximised. One possible reason for this apparent under-capitalisation by tenant farmers was a shortage of funds for investment, which could arise through a lack of collateral needed to obtain borrowed capital.

Intensity of capital input alone does not determine the marginal product of the capital at the capital input mean. The actual productivity of the tenants capital input differed between the tenanted and owner occupied farm groups i.e. the marginal product curve of the tenanted farms was above that of the owner occupiers, especially at the higher level of capital input(15). If the productivity of the capital input differs between the tenants and owner occupiers, this can only be due to exogenous factors, assuming the capital inputs were of a similar quality. The most likely exogenous factor to cause such variation was standard of management. The division of the owner-occupiers available management time between tenants and landlords type duties has already been suggested as a possible cause of the lower productivity of the owner occupied farms. This difference in productivity was not statistically significant, but the fact that such differences were suggested from the results would merit closer examination of the economic effect of the division of management on owner occupied farms.

If reference is made to the marginal productivity estimates for the livestock capital inputs (Figure 5.6.2.), the plane of the curves was almost identical in all cases, except that the tenanted farm group had slightly higher levels of productivity at the higher capital input levels. Differences in the marginal productivity of the livestock capital inputs between the tenanted and owner occupied farm groups therefore arise, due mainly to

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(15)This was not the situation in 1969/70, but the statistical reliability of the estimated marginal products for the tenanted farm group was less in 1969/70 than in 1970/71.

differences in the intensity of capital use. At the marginal cost of capital (Case 3) ruling in 1969/70 and 1970/71, the tenants were shown to be 15 and 6 per cent respectively, under-capitalised in terms of livestock capital input i.e. to maximise profit, an average increase of 10 per cent in livestock capital input was required. On the other hand, the owner occupied farms were 6-11 per cent over-capitalised in 1969/70 and 1970/71 respectively. Changes in capital utilisation of between 6 to 11 per cent are within the range of capital cost fluctuations. e.g. In 1970/71, if an owner occupier was operating at the optimum livestock capital input when the marginal cost of capital was £1.076 (Case 3 assumption), he would be 8.7 per cent under-capitalised if the marginal cost was £1.048 (Case 2 assumption). In practical terms, the owner occupiers can be said to be operating at the optimum stock capital input.

Reference to the marginal productivity curves for machinery capital inputs (Figure 5.6.2.) showed that the tenanted farm group operated on a higher plane of productivity than the owner occupied group, although this difference did not reach statistically significant levels in the years under study. It can also be noted at this stage that the machinery component of the aggregate marginal productivity curves (Figure 5.6.1.) was largely responsible for the tenanted farm group curves being on a higher plane than those of the owner-occupied farm group.

Remembering the lesser reliability of the marginal productivity of the machinery capital estimate for the tenanted farms in 1969/70, most of the comments on machinery are confined to the second year results. Both the farm groups were operating at less than their optimum input of machinery capital. Annual machinery capital input would need to be increased by approximately 40 and 60 per cent respectively for the owner occupied and tenanted farm groups, before the optimum input of machinery capital was achieved, (Assuming case 3 capital costs). Allowing for seasonal variation in the cost of capital, the increases suggested in practice might be considered in the range 15-30 per cent.

The conclusions from the section on the marginal productivity of capital may be summarised -

Tenants: if the goal of the tenant is to maximise profits from his capital investment, an increase in the annual input of tenants type capital is required. In the first instance priority should be accorded to increasing the input of machinery followed by an increase in livestock capital. In practical terms, the increase advocated is about 30 per cent for machinery capital and 10 per cent for livestock capital. In absolute terms at 1970/71 prices, this represents an annual average increased investment in machinery depreciation and running costs of £2,400, and in stock replacement and feeding costs of £1000.

Owner Occupiers: no increase in livestock capital input is suggested, as this group is already operating at a higher average level of livestock capital intensity than the tenanted farm group and at a point close to the optimum capital input. The annual machinery capital input could be increased advantageously by 15 per cent. At 1970/71 values, this represents an increase of £1200 in annual depreciation and running costs. Limited evidence existed to suggest that the productivity of assets employed by owner occupiers was lower than for tenants, especially at the higher capital input levels. This could only result from exogenous factors affecting the capital input/output ratio. The most likely factor to cause this effect is the level of management applied to the assets. The division of the owner occupiers' available working time between farm and estate type management duties affects the productivity of tenants type capital adversely. Although only restricted evidence is available to substantiate this possibility, it would seem to be an area of thought which would justify more detailed research in the future.

At this point it might be worth speculating as to the form, in qualitative terms, which the suggested additional capital investment should take. It can probably be assumed that most farms carry the basic range of equipment necessary to operate a dairy farm. The suggested investment would then take the form of replacing obsolete machinery, the work capacity of which has declined. New machinery would be able to carry out the work more timeously and efficiently, resulting in a probable yield and quality increase in crops and homegrown feeds, thus reducing the cost of purchased feeds as well as increasing the yield of milk. The application of more powerful tractors and machines would also enable the farmer to undertake more modern methods of conservation.

The intensity of capital use, and to a lesser extent in this case, the plane of productivity of the capital used on dairy farms in West Scotland, have been shown to substantiate many of the findings on the variation in efficiency of capital utilisation in Chapter IV and in previous sections of Chapter V.

Additional capital investment has been shown to be necessary if the optimum output from the capital resources deployed in West Scotland dairy farms is to be achieved. In the following chapter, the sources and availability of funds for the required increase in investment on the average dairy farm[16] are investigated and their adequacy determined. In a subsequent chapter it is intended to enumerate possible reasons for the existing non-optimum use of capital resources.

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[16] It should be appreciated that the estimates of the additional capital required to optimise the input of tenants capital were carried out while holding labour and land inputs at their geometric mean values. Any change in the input of land or labour would cause a variation in the optimum input of capital. The results therefore refer to the average dairy farm.

APPENDIX I

Determination of Rental Value on Owner Occupied Farms

Rents are based on the sale value of the farm at vacant possession. The circumstances of an individual farm will fix the final rental value.

Below are listed the factors which influence individual farm values.

Area	Buildings
Altitude	Number
Slope	Condition
Aspect	Concrete
Rainfall	Amenities
Assessability of Farm	Farm House
Compactness of Fields	Cottages
Soil Types	Fences
Drainage	

APPENDIX II

Tables 1-8 tabulate the Zero Order Correlation Coefficients for the Cobb-Douglas Function.

Table 1 Tenants 1969/70 Relation 1

	X_1	X_2	X_3	X_4
X_1	1.000	0.835	0.861	0.967
X_2		1.000	0.778	0.754
X_3			1.000	0.789
X_4				1.000

Table 2 Tenants 1969/70 Relation 2

	X_1	X_2	X_3	X_5	X_6
X_1	1.000	0.835	0.861	0.931	0.931
X_2		1.000	0.778	0.839	0.685
X_3			1.000	0.892	0.704
X_5				1.000	0.820
X_6					1.000

Table 3 Tenants 1970/71 Relation 3

	X_1	X_2	X_3	X_4
X_1	1.000	0.830	0.835	0.972
X_2		1.000	0.764	0.761
X_3			1.000	0.768
X_4				1.000

Table 4 Tenants 1970/71 Relation 4

	X_1	X_2	X_3	X_5	X_6
X_1	1.000	0.830	0.835	0.928	0.938
X_2		1.000	0.764	0.849	0.699
X_3			1.000	0.882	0.684
X_5				1.000	0.804
X_6					1.000

Table 5 Owner Occupiers 1969/70 Relation 5

	X_1	X_2	X_3	X_4
X_1	1.000	0.786	0.851	0.956
X_2		1.000	0.814	0.702
X_3			1.000	0.760
X_4				1.000

Table 6 Owner Occupiers 1969/70 Relation 6

	X_1	X_2	X_3	X_5	X_6
X_1	1.000	0.786	0.851	0.860	0.901
X_2		1.000	0.814	0.723	0.647
X_3			1.000	0.766	0.094
X_5				1.000	0.710
X_6					1.000

Table 7 Owner Occupiers 1970/71 Relation 7

	X_1	X_2	X_3	X_4
X_1	1.000	0.788	0.870	0.938
X_2		1.000	0.841	0.667
X_3			1.000	0.752
X_4				1.000

Table 8 Owner Occupiers 1970/71 Relation 8

	X_1	X_2	X_3	X_5	X_6
X_1	1.000	0.788	0.870	0.840	0.804
X_2		1.000	0.841	0.714	0.594
X_3			1.000	0.798	0.664
X_5				1.000	0.656
X_6					1.000

Table 9a Comparison of the β Coefficients (Cobb-Douglas Function) for Tenanted Farms 1969/70 and 1970/71

TENANTED FARMS													
1969/70							1970/71						
Variable		df	t at P=0.05	s_β	ts_β	$\beta \pm ts_\beta$	Variable		s_β	ts_β	$\beta \pm ts_\beta$	Sig. of Diff. 1969/70 to 1970/71
Relation 1	X_2	32	2.039	0.0540	0.1101	$0.0678 < \beta_2 < 0.2880$	Relation 5	X_2	0.0578	0.1178	$0.0562 < \beta_2 < 0.2918$	N.S.
	X_3	32	2.039	0.0651	0.1327	$0.0771 < \beta_3 < 0.3425$		X_3	0.0692	0.1410	$0.0601 < \beta_3 < 0.3421$	N.S.
	X_4	32	2.039	0.0522	0.1064	$0.5816 < \beta_4 < 0.7934$		X_4	0.0517	0.1054	$0.6463 < \beta_4 < 0.8571$	N.S.
Relation 2	X_2	31	2.040	0.0591	0.1205	$0.0558 < \beta_2 < 0.2968$	Relation 6	X_2	0.0640	0.1305	$0.0021 < \beta_2 < 0.2589$	N.S.
	X_3	31	2.040	0.0807	0.1646	$0.0667 < \beta_3 < 0.3959$		X_3	0.0849	0.1731	$0.0004 < \beta_2 < 0.3466$	N.S.
	X_5	31	2.040	0.0858	0.1750	$-0.0094 < \beta_5 < 0.3406$		X_5	0.0937	0.1911	$0.1081 < \beta_5 < 0.4903$	N.S.
	X_6	31	2.040	0.0511	0.1042	$0.4002 < \beta_6 < 0.6086$		X_6	0.0462	0.0942	$0.4110 < \beta_6 < 0.5994$	N.S.

Table 9b — Comparison of the β Coefficients (Cobb-Douglas Function) for Owner Occupied Farms 1969/70 and 1970/71

OWNER OCCUPIED FARMS												
1969/70							1970/71					
Variable		df	t at P=0.05	s_β	ts_β	$\beta \pm ts_\beta$	Variable		s_β	ts_β	$\beta \pm ts_\beta$	Sig. of Diff. 1969/70 to 1970/71
Relation 3	X_2	50	2.014	0.0522	0.1051	$0.0147 < \beta_2 < 0.1955$	Relation 7	X_2	0.0559	0.1125	$-0.0065 < \beta_2 < 0.2185$	N.S.
	X_3	50	2.014	0.0747	0.1504	$0.1214 < \beta_3 < 0.4222$		X_3	0.0854	0.1719	$0.1831 < \beta_3 < 0.5269$	N.S.
	X_4	50	2.014	0.0564	0.1135	$0.5169 < \beta_4 < 0.9007$		X_4	0.0524	0.1055	$0.5682 < \beta_4 < 0.7792$	N.S.
Relation 4	X_2	49	2.013	0.0534	0.1074	$-0.0426 < \beta_2 < 0.1722$	Relation 8	X_2	0.0571	0.1149	$-0.0265 < \beta_2 < 0.2033$	N.S.
	X_3	49	2.013	0.0762	0.1533	$0.1135 < \beta_3 < 0.4201$		X_3	0.0913	0.1837	$0.1697 < \beta_3 < 0.5371$	N.S.
	X_5	49	2.013	0.0600	0.1207	$0.1527 < \beta_5 < 0.3941$		X_5	0.0598	0.1203	$0.1061 < \beta_5 < 0.3467$	N.S.
	X_6	49	2.013	0.0509	0.1024	$0.3749 < \beta_6 < 0.5797$		X_6	0.0444	0.0893	$0.3809 < \beta_6 < 0.5595$	N.S.

Table 10 Index Numbers for Increase in Cost of Input Variables used in Cobb-Douglas Function

	1969/70	1970/71
Labour	100	101.8
Total Tenants Capital	100	101.7
Machinery Capital	100	102.4
Stock Capital	100	101.5

The estimates of cost changes are based on Tables 102 and 103. Scottish Agricultural Economics, Vol. XXII-1972 and Tables 158 and 159 Vol. XXIII-1973.

The cost index numbers were adjusted for quantity of input changes. The capital investment indices were then adjusted downwards to account for the proportion of stock and machinery replaced each year. i.e. only 20 per cent of the total capital investment is replaced annually at the increased unit cost. The total tenants capital index is the weighted average of the livestock and machinery capital indices.

CHAPTER VI

THE SOURCE AND DISTRIBUTION OF FUNDS ON DAIRY FARMS

6.1. Introduction

Estimates made in the previous chapter indicated that the average dairy farmer in West Scotland required to undertake additional capital expenditure, if his use of tenants capital was to be optimised. The primary aim of this chapter, therefore, is to establish the capacity of the average dairy farmer to supply his 'incremental capital requirement' (the additional capital required to raise the average farmer from his existing capital input level to his optimum capital input).

The concept of "available cash" on a farm is developed, as this is the key to the farmer attaining his incremental capital requirement (I.C.R.). Regression analysis is used to quantify the functional determinants of the "available cash" which initially were believed to be the net farm income of the farm in previous years and the external sources of farm credit. Past income, however, was found to be the main determinant of the "available cash". It was possible, therefore, to prepare estimates of the increase in net farm income required to provide sufficient "available cash" to satisfy the estimated I.C.R. In most cases the increase in net farm income required was not considered a feasible possibility in the short-term. Hence the existing sources of farm credit and the relative borrowings from ach source are examined and possible constraints on their future contribution to the I.C.R. are considered.

The present distribution of the "available cash" on the farm is important as its competing uses - capital formation and consumption (private living requirements) are mutually exclusive. The cash available for capital formation could, theoretically, be increased if farmers were willing or able to reduce their consumption. These possibilities are examined and it is shown that a capital formation versus consumption cycle exists from which it would be difficult for many farmers to escape, without external assistance.

The past contribution of the Government to the capital requirements of West Scotland dairy farmers is assessed and indications are given of the possible need for future Government intervention to assist farmers to optimise their tenants capital input on their farms.

6.1.1. Definition of Terms

"Available Cash" within the year is the aggregate value of all sources of cash available to the farm business during the year. A detailed list of the items which compose "available cash" is shown in the Source and Distribution of Cash computation sheet, Appendix II.

Capital

Net Capital Formation Represents capital in addition to that required to maintain the present work capacity of the existing capital stock.

Capital Grant Any grant made by the Government to farmers under the terms of the Farm Capital Grants Scheme.

Capital Withdrawn Is the value of cash withdrawn from the business, which would not normally be used for current consumption.

Incremental Capital Requirement The incremental capital requirement is that amount of capital required by the average farmer to raise the existing capital input to the optimum capital input.

Replacement Capital Formation Represents that part of the gross capital formation which is required to maintain the present work capacity of the existing capital.

Net Capital Consumption Is indicated when the gross capital formation is less than the estimated replacement capital formation.

External Credit The sum of off-farm liabilities.

Investment

Off-farm Investment Cash withdrawn from the farm business and invested in non-farming activities.

On-farm Investment Additional cash invested in the farm business which may be internally generated or have an external source.

Net Profit The difference between the gross output and costs of the farm. This is the surplus before imputing any notional charges such as rental value (on owner occupied farms) or unpaid labour.

Consumption

(Personal Drawings) Cash withdrawn from the farm business which is used for private living expenses.

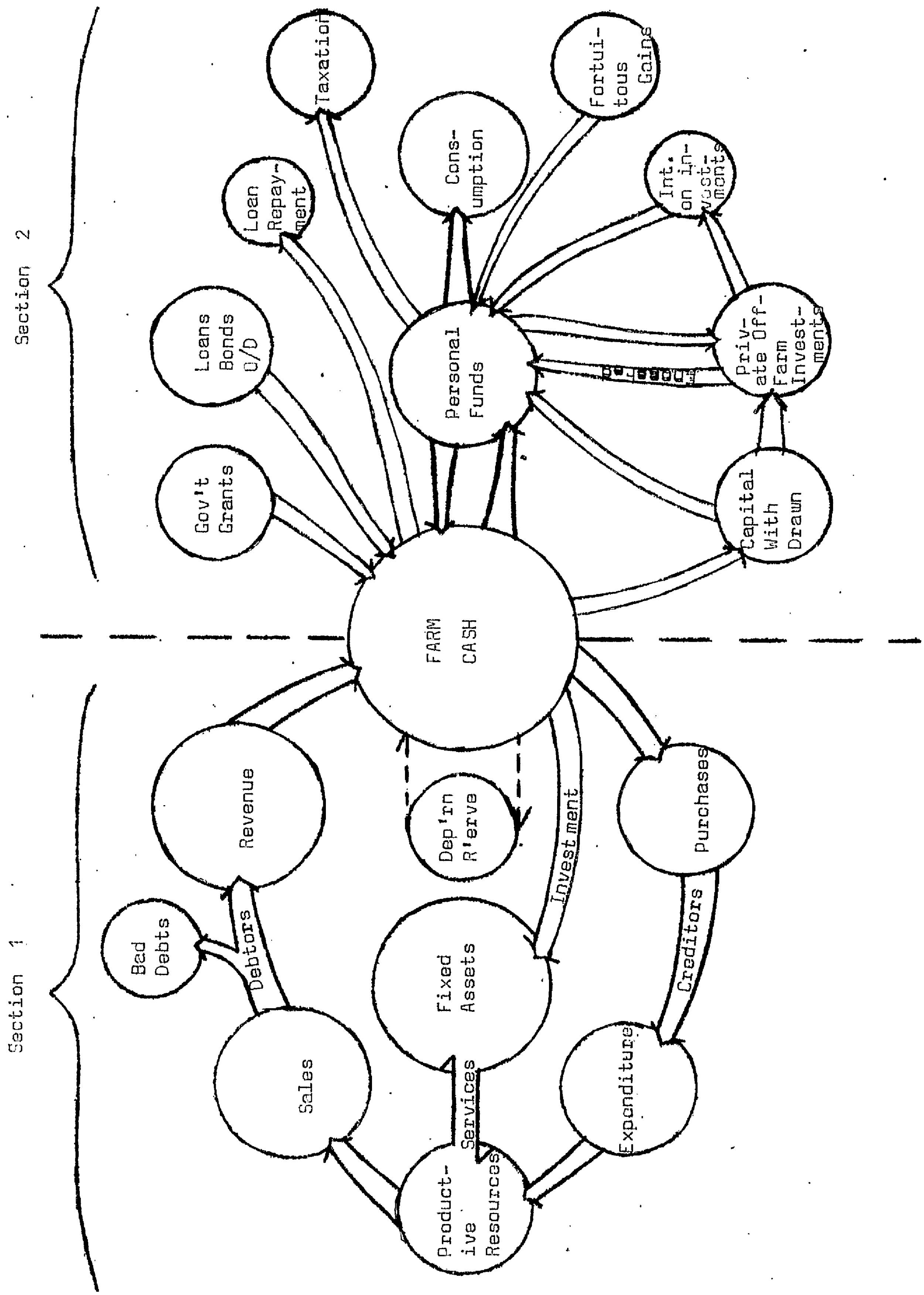
Statistical Notation

In the following statistical analyses, it may be assumed that b will refer to parameters in linear relations and that β will refer to parameters in log-linear relations.

6.1.2. The Cash Flows of a Farm Business

The financial details of a farm business are contained principally in two documents: the profit and loss account and the balance sheet. In order to interpret the financing of a farm business, the information contained in the profit and loss account and the balance sheet must be combined to enable the derivation of the flows of cash into and out of the business. Any business consists of many complex flows of cash and resources between the various constituent parts of the business. In the farm business, there are additional complications which arise from the close association of farm finance with the personal finances of the farmer. The flow diagram in Figure 6.1.1. (p. 193) was prepared, therefore, to demonstrate the cash flows affecting the farm business.

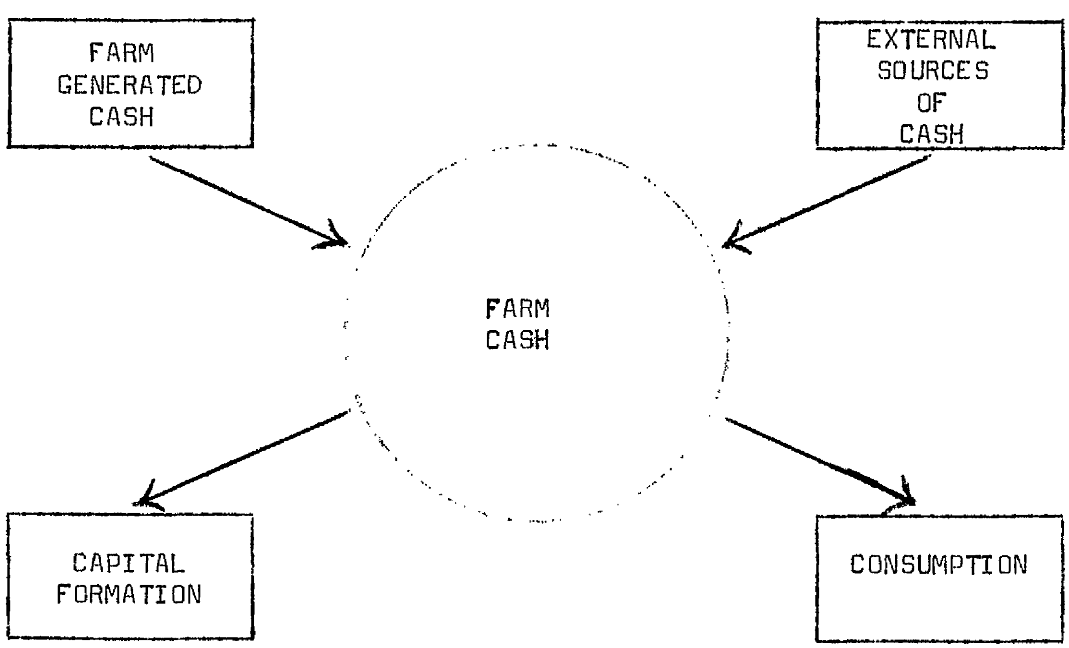
Figure 6.1.1. Diagramatic Representation of the Cash Flows in the Farm Business



Section 1 of the diagram shows the productive process and the generation of capital (cash) from within the farm business. Section 2 shows the external sources of finance for the productive process and the possible destination of the cash flows out of the farm business. In practice, there may arise acute problems of definition when attempting to classify the flows of cash off the farm. Capital withdrawn could conceivably become additional funds for consumption rather than for investment off-farm. Equally, personal cash drawings could easily be invested externally in, say, an assurance policy which could be used later to finance the farm. This would appear as external capital introduced, although the premiums were financed from farm cash.

The hub of all the cash flows into and out of the farm business is the farm cash balance - on this depends the level of possible future investment and personal drawings. The remainder of this chapter is mainly concerned, therefore, with the quantification and analysis of changes in the sources and distribution of the farm cash. Due to the complex inter-relationships of the cash flows depicted in Figure 6.1.1. it was not possible to analyse them fully in their present form. Hence the individual cash flows were aggregated to form the four primary flows of cash of the farm business shown in Figure 6.1.2.

Figure 6.1.2. Simplified Cash Flows of the Farm Business



It can be seen from the above diagram that the main determinants of the "available cash" on a farm are likely to be farm income and the amount of external borrowing. In the following sections, therefore, attempts are made to establish the functional relationship between farm income, external credit sources, and the "available cash" of the farm. If such a relationship can be established, it would be possible to estimate the cash available for capital formation and consumption in a future period. Since the level of farm income has already been demonstrated as being dependent on the existing levels of capital invested in the business (Chapter V), the size of a farm business in terms of acreage and capital invested would then assume considerable importance in relation to the possible future levels of capital formation and consumption on farms. The use of cash for capital formation and consumption is mutually exclusive: hence it is important to investigate the relationship between "available cash", capital formation, and consumption, since a variation in the cash allocated to consumption would affect the potential for capital formation. Finally, any constraint on the sources of external funds would affect the "available" farm cash. It is therefore proposed to commence the analysis of the cash flows in Figure 6.1.2. by examining the existing sources of cash and their relative importance.

6.2. The Sources of Cash and their Relative Importance

The external sources of cash (capital) for farm business are well documented in past literature[1]. It is therefore not proposed to enter into discussion on the type and use of agricultural credit institutions. However, it is proposed to analyse the liability structure of the sample farms to indicate the relative importance of the external sources of finance, before considering the role of Government grants in the farm capital structure. The mechanism for payment of grant aid is such that the farmer normally has to produce a receipted invoice before payment is made. Government grants, therefore, can logically be considered as a source of funds to the farmer but the net effect of the grant is to reduce the cost of the capital. Finally, in Sub-Section 6.2.3., estimates of the "available cash" on farms of various sizes were prepared prior to deriving that part of the "available cash" which could be allocated towards the incremental

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[1] Literature Review Section 2.2. p. 18.

capital requirement of the average dairy farm in West Scotland.

6.2.1. The Non-Equity Liability Structure of the Sample Dairy Farms

The non-equity liability structure of the sample farms can be used, in the first instance, to indicate the credit sources of West Scotland dairy farmers. After establishing the sources of credit, it is possible to indicate the relative amount of credit supplied by the various sources. When this knowledge is available, it may be possible to speculate on reasons for the lack of use of certain categories of credit and on possible constraints on the future use of existing sources.

In Section 4.2 the asset structure of the dairy farms was estimated using a simple regression technique which enabled the amount of the various categories of assets to be related to farm size (acreage). Unfortunately, this technique was not applicable to the estimation of the liability structure of the dairy farms, since some of the liability categories were not represented on all the sample farms e.g. only 22 farms of a possible 54 had obtained overdrafts in the owner occupied 1969/70 group. The liability structure of the two farm groups was therefore presented in terms of the arithmetic means of the liability categories together with the number of farms on which the mean is based. In order to indicate the relative importance of the various categories of liability or sources of credit, the amount of credit was also expressed as a percentage of the total group borrowing. (Tables 6.2.1.1. and 6.2.1.2.)

From Tables 6.2.1.1. and 6.2.1.2. p.197 and p.198 it can be seen that in terms of the number of farms using a particular source of credit, sundry creditors (merchants, auctioneers, etc.) were the most important. The ease of obtaining merchant credit by refraining from the payment of accounts was clearly a much used and necessary facility available to the farmer. If the total credit obtained by the farm groups was proportioned among the five credit sources, the most important source of credit was again sundry creditors in the case of the tenant farmers, was equal in importance to private loans and overdrafts in the case of the owner occupiers, who allocated about $\frac{1}{3}$ of their total borrowings to sundry creditors, overdrafts, and private loans.

Table 6.2.1.1. Liability Structure (Sources of Credit) Owner Occupiers 1969/70 and 1970/71

Source or Credit	1969/70			1970/71		
	No. of Farms	Mean Value Per Farm £	% of Total Group Borrowing	No. of Farms	Mean Value Per Farm £	% of Total Group Borrowing
Insurance Co/ Building Soc.	3	9250	8.5	3	8533	7.6
Family/ Private	28	3709	31.9	29	3647	31.6
Overdraft	22	4575	30.9	23	4514	31.1
H.P.	10	460	1.5	10	454	1.4
S. Creditors	54	1640	27.2	54	1751	28.3

Table 6.2.1.2. Liability Structure (Sources of Credit) Tenants 1969/70 and 1970/71

Source or Credit	1969/70			1970/71		
	No. of Farms	Mean Value Per Farm £	% of Total Group Borrowed	No. of Farms	Mean Value Per Farm £	% of Total Group Borrowed
Insurance Co/ Building Soc.	1	250	0.3	1	125	0.1
Family/ Private	10	1557	15.8	9	2251	19.3
Overdraft	10	2630	26.7	14	1876	25.0
H.P.	8	547	4.4	6	577	3.3
S. Creditors	36	1445	52.8	36	1521	52.3

Insurance companies and building societies were not important sources of credit to the tenant farmer but naturally due to the need for long term finance on the owner occupied farms, they were relatively more important to the owner occupier. Hire purchase credit was the only source of funds where the average amount borrowed per farm was greater for the tenant than for the owner occupier. This probably reflected the fundamental nature of the two business forms: the lack of security which the tenant farmer can offer, to obtain credit, restricts the available credit from banks and other lending institutions and thus forces him to use more expensive sources of credit in the form of hire purchase and merchants (52 per cent of total tenants borrowings were from sundry creditors). The significance of the differences between the borrowing pattern of the owner occupied and tenanted farms is discussed later.

Comparison of the average amount borrowed per farm by the owner occupiers and tenants showed that, except for hire purchase, the amount borrowed from each source was greater for the owner occupiers. This observation only indicated the larger financial size of the owner occupied farms, in terms of capital invested: reference to Table 4.2.5. p. 96 will show that, on average, the owner occupier, in fact, owns a higher proportion of his farm business than the tenant. The change in total borrowing between 1969/70 and 1970/71 was very slight, indicating a stable situation with regard to the funding of the farming businesses under study.

6.2.2. Capital Grants on Dairy Farms

One aspect of Government policy towards agriculture takes the form of capital grants. It is not the function of this study to enter into a discussion of the non-economic philosophy of capital grant payments to agriculture. The economic justification for this type of Government intervention in the capital market, is to attempt to rectify market imperfections which prevent the flow of adequate capital into agriculture at the ruling interest rates. Imperfections may arise from several causes but are due, primarily, to the lower relative profitability of agriculture, compared to many other industries, which arises from yield variation due to disease, weather, inadequate management, obsolete capital investment, etc. Furthermore, investment decisions in agriculture often have to be made on superficial judgement of probability e.g. the irregularity of the supply/demand situation in agriculture. The provision of capital grants reduces the marginal cost of capital investment to the farmer, thus enabling the farmer to consider levels of capital investment hitherto unlikely, if not impossible. By this means, the Government hopes to make an effective contribution towards lowering production costs and that "by providing a lasting increase in efficiency, it will in due course permit of reduction in the support afforded to the industry through price guarantee"[2]. A system of direct grants will also be advantageous to owners with limited resources who do not benefit to any great extent from tax allowances on capital improvements.

Clearly, it is important to establish the extent of capital grants to dairy farmers in West Scotland and to assess whether or not the purpose of these grants was being achieved.

A preliminary appraisal of the data available on capital grant aid to the sample of dairy farmers showed that not all the farmers received grant aid. It was decided, therefore, that regression techniques could not be used to estimate the average amount of capital grant supplied to each farmer. Accordingly, a distribution of grant uptake, by farm size, is shown in Tables 6.2.2.1. and 6.2.2.2. p. 201 and 202.

From Tables 6.2.2.1. and 6.2.2.2. it can be seen that approximately one third of the sample tenanted farms received grants in both 1969/70 and 1970/71 (13-14 farms). The number of owner occupied farms receiving grants was more variable ranging from 13 farms (24%) in 1969/70 to 25 farms (46%) in 1970/71. In this period, only 7 tenanted and 10 owner occupied farms received grants in both years. This meant that, in the period, about two thirds of the sample farms received grants in either 1969/70 an 1970/71. Farmers therefore appeared to be willing to use Government grants when these were available. However, there was a tendency for the smaller farm to have no grant aid. With the larger farm sizes grants were usually taken in one or other of the years under study. The smaller farms were most likely to have no grants in either year. The amount of cash received in grants was not high on a per farm basis, usually

[2] Long Term Assurances for Agriculture Cmnd. 23, Nov. 1956 p. 9

Table 6.2.2.1. Capital Grants - Distribution by Farm Size, Tenants 1969/70 and 1970/71

Acreage	1969/70					1970/71				
	Grant Range £					Grant Range £				
	None	1-200	201-400	401-600	600+	None	1-200	201-400	401-600	600+
40-125	9	0	0	0	0	6	1	1	0	0
125.1-200	7	1	3	1	4	8	3	1	1	3
200.1-450	6	2	2	1	0	9	0	1	2	0
All Farms	22	3	5	2	4	23	4	3	3	3

Table 6.2.2.2. Capital Grants - Distribution by Farm Size, Owner Occupiers 1969/70 and 1970/71

Acreage	1969/70					1970/71				
	Grant Range £					Grant Range £				
	None	1-200	201-400	401-600	600+	None	1-200	201-400	401-600	600+
40-125	12	1	0	0	1	15	0	3	1	2
125.1-200	6	1	1	1	1	6	2	3	1	2
200.1-450	13	1	5	0	1	8	1	2	2	6
All Farms	41	3	6	1	3	29	3	8	4	10

under £600, the exception being the owner occupied farms in 1970/71 when ten of the 25 grants received were valued at over £600. From the limited data available there was no evidence of the amount of grant received being related to farm size.

Although the amount of grant received did not appear high in absolute terms, it may never-the-less represent considerable investment by the farmer. Reference to the regulations covering capital grants in 1969 showed that grant aid may vary from 10 per cent of the total cost (Investment grants) to 50 per cent (Farm Structure Grant). A grant of £100 in Tables 6.2.2.1. and 6.2.2.2. could therefore represent capital formation of between £200 and £1000. Possible constraints on the present and future use of external credit sources, including capital grants, are developed in a later discussion.

6.2.3. The "Available Cash" on Dairy Farms

The concept of "available cash" during a farming year is not new. It was developed originally in industry under the title of 'Source and Distribution of Funds Statements'. The application of the concept to agriculture occurred in the late 1950's and has continued till the present time,[3] but its use in Scottish agriculture has been slow and limited. Hence it is proposed to prepare estimates of the "available cash" during the year for the sample dairy farms in West Scotland, and thereafter, to derive that part of the "available cash" which could be used, potentially, for net capital formation. By using the results from Chapter V, regarding the amount of investment required to optimise the tenants capital input, it is possible to determine whether the average dairy farm has the capacity to generate sufficient cash to enable the optimum capital input to be adopted.

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[3] Literature review Section 2.3.4. p.30.

In the preparation of farm accounts, certain accounts are introduced which are nominal in nature e.g. depreciation and rent accounts. These accounts are one reason why the amount of cash flowing through a farm business is obscured. Hence it becomes necessary to combine profit and loss account data with balance sheet data in order to assess the funds available for investment and/or consumption during the year. The "available cash" during the year can be simply and conveniently calculated, using a Source and Distribution of funds Statement of the type illustrated in Appendix II. The "available cash" was therefore calculated for each of the sample farms. The "available cash" concept also permitted the aggregation of data e.g. increase in loans, overdrafts, etc. into an analyseable form. Earlier it was shown, in Section 6.2.1., that analysis of such data was difficult in a disaggregated form. In order to estimate values for the "available cash" based on farm size (acres), regression analysis was used, as in Section 4.2. p. 82 . Two forms of estimating equations were used (linear and log-linear) in determining the direct relationship between "available cash" and Farm size. The best fit equation was found to be log-linear in each case, although the justification for the use of this form of equation was strongest for the tenanted farms. (see Table 1. Appendix I p.267 to 268). The selected equations in Table 6.2.3.1. were all statistically significant at the P=0.001 level as were the regression coefficients.

The relationships in Table 6.2.3.1. indicate a good correlation between "available cash" and farm acreage. Estimates of "available cash", based on the equations, will be reasonably accurate. In all cases, the regression coefficient was less than 1.0, indicating a less than proportionate increase in "available cash" per farm, as farm size increases.

Results

Using the equations in Table 6.2.3.1. the "available cash" during the year can be estimated for given farm sizes (adjusted acreage). Such estimates are tabulated in Table 6.2.3.2. p.206.

Table 6.2.3.1. Relation between "Available Cash" and Farm Size 1969/70 and 1970/71

	1969/70									
	Tenanted Farms					Owner Occupied Farms				
Dependent Variable	Relation No.	Constant	β	S.E.of β	% Variation Explained	Relation No.	Constant	β	S.E.of β	% Variation Explained
"Available Cash" (X9)	1	1.5155	0.9800	0.1482	56	2	2.2485	0.6531	0.1123	39
	1970/71									
	Tenanted Farms					Owner Occupied Farms				
"Available Cash" (X9)	3	1.6989	0.8972	0.1375	56	4	1.9504	0.8307	0.1282	45

Note: All relationships are log-linear and have adjusted farm acres as the independent variable, (X_1). All regressions were statistically significant at the P=0.001 level.

Table 6.2.3.2. The "Available Cash" on Dairy Farms in West Scotland 1969/70 and 1970/71 £

	1969/70		1970/71	
Acreage	Tenanted Farms	Owner Occupied Farms	Tenanted Farms	Owner Occupied Farms
50	1516	2281	1672	2300
100	2988	3587	3114	4091
150	4447	4674	4480	5729
200	5895	5640	5799	7274
250	7335	6525	7084	8756
300	8772	7350	8345	10190

As expected, the amount of "available cash" on a farm increased as farm acreage increased. The absolute levels of "available cash" were not high on the sample farms, considering the values represent the total funds available during the year from all sources, including farm profit, borrowing, and private capital injection. Since the "available cash", as calculated, has to be allocated between investment, consumption (private living expenses), and any existing loan repayment, farms below 100 acres in size would only have limited scope for investment or farm improvement, after living expenses were deducted.

The owner occupier farmers tended to have higher levels of "available cash" than tenant farmers, although this was not the case in 1969/70 on farms larger than 200 acres. The tendency was for an increase in the "available cash" between 1969/70 and 1970/71, but the size of the increase was limited and was not statistically significant.

As was concluded in Chapter V, the average dairy farm in West Scotland was under-capitalised. The remainder of this section is devoted, therefore, to determining the adequacy of the "available cash", on the sample farms, to supply the required capital formation.

As stated previously, not all the "available cash" of a farmer may be allocated to the incremental capital requirement (I.C.R.)[4] of a farm. From the "available cash" computation sheet illustrated in Appendix II it is clear that any allocation of cash to the I.C.R. would have to be derived from that part of the "available cash" currently allocated under the consumption (private drawings) and capital withdrawn headings. Accordingly, estimates were prepared for the average capital withdrawn and private drawings of the sample farmers i.e. the potential capital available. (See Appendix I Table 2 for estimating regression equations). The actual capital available towards the I.C.R. was then estimated.

Below are shown values for the potential and actual capital which could be made available towards the I.C.R. at the mean farm acreages.

Table 6.2.3.3. Estimated Potential and Actual Capital Available, at Acreage Means, to Fulfill the Incremental Capital Requirement; 1969/70 and 1970/71 £

	1969/70		1970/71	
	Tenanted Farms	Owner Occupied Farms	Tenanted Farms	Owner Occupied Farms
Potential Capital Available (capital withdrawn +private drawings)	2135	1946	1938	2343
Av. Imputed Earnings	1291	1291	1458	1458
Actual Capital Available	844	655	480	885

Note: Average imputed earnings are based on Manufacturing Wages. Annual Abstract of Statistics No. 109 C.S.O. 1972.

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(4) Incremental capital requirement (I.C.R.) is the increase in capital formation required to raise a farm from its present capital input level to the optimum capital input level.

The maximum potential capital available from farm sources in 1969/70, 1970/71 was estimated as approximately £2,000. Farmers like any other person, incur private consumption which reduces the potential capital which can be made available towards the I.C.R. Within limits, by making greater or lesser sacrifices in living standards it would be possible to increase or decrease the amount of potential capital available towards the I.C.R. It was assumed that the average wages paid to manufacturing industry workers represent a reasonable standard of living, hence they were imputed in Table 6.2.3.3. p.207. The estimated actual capital which could be made available from farm sources towards the I.C.R. was then derived and was shown to be rather limited in absolute amount, varying from approximately £500 to £900 per annum on the average size farm.

In Section 5.6.4. the annual increase in capital investment required to optimise the annual capital input on the average dairy farm was estimated[5]. The estimated annual increases in capital input are shown in Table 6.2.3.4. together with the I.C.R. which was estimated by converting the annual increases required, to the lump sum required, if the optimum position was to be attained within one year.

Table 6.2.3.4. Incremental Capital Requirement (I.C.R.) to Optimise Output within One Year £

		Tenanted Farms		Owner Occupied Farms	
		£ Livestock	£ Machinery	£ Livestock	£ Machinery
Increase in Annual Capital Input required		1000	2400	-	1200
Absolute Capital Expenditure in one Year (I.C.R.)	Working Capital	774	1246	-	632
	"Permanent" Capital	1130	5676	-	2838
	Total Capital	1904	6940	-	3470

(5) Those estimates were calculated for the dairy farm operating at the mean input of tenants capital, labour and land i.e. the average dairy farm.

The table on p. 208 shows that the increase in capital expenditure required on the average dairy farm, in order to achieve the I.C.R. was £8844 for the average tenanted farm and £3470 for the equivalent owner occupied farm, if the farms were to be operating at their optimum capital inputs within one year.

In Table 6.2.3.3. it was estimated that only £622 and £770 (2 year averages) capital was available towards the I.C.R. in the case of the tenanted and owner occupied farms respectively. The estimated shortfall in the available capital was therefore £8182 for the average tenanted farm and £2700 for the average owner occupied farm. It is shown, therefore, that it was not possible for the farmers to move directly to their optimum capital inputs within one year. Movement towards the optimum capital input situation would therefore require to be over a period of time in addition to finding methods of increasing the funds available for capital formation from farm and non-farm sources. It is important, therefore, to consider the possibilities open to the dairy farmer of increasing the "available cash" on his farm.

6.3. <u>Some Determinants of "Available Cash" on the Dairy Farm</u>

Quantitative studies involving the use of "available cash" as a variable are practically non-existent in the United Kingdom. The only study reported was by Black[6] who was successful in relating the level of capital investment, on a sample of farms, to the disposable income on the farms (Disposable income was a concept similar to "available cash" in the present study). Black, however, used disposable income as the independent variable whereas in this study it is proposed to examine the functional relationship between "available cash" and possible determinants of the level of "available cash", taking "available cash" as the endogenous variable. By reference to Figure 6.1.2. (The Simplified Cash Flows of the Farm Business), it can be seen that the likely determinants of "available cash" on a farm are the net farm income and the external sources of funds. The importance of N.F.I. as a determinant of on-farm investment has been endorsed by many writers. The diagram in Figure 6.3.1. shows, in simplified form, the probable sequence of causation.

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[6] Literature review Section 2.3.4. p. 30.

Figure 6.3.1. Investment, Income Cycle

$$\begin{tikzcd}
 & \text{"Available Cash"} \arrow[dl] \arrow[dr] & & \text{Year (t-n)} \\
\text{Investment} \arrow[d] & & \text{Consumption} \arrow[d] & \text{Year (t-n)} \\
\text{N.F.I.} \arrow[dr] & & \text{External Credit} \arrow[dl] & \text{Year (t)} \\
 & \text{"Available Cash"} & & \text{Year (t)}
\end{tikzcd}$$

The above diagram illustrates that the "available cash" in year (t-n) is distributed between investment and consumption in that year. The investment in year (t-n) then generates the NFI in a subsequent year (t) which, together with the external credit available in year (t), will constitute the major part of the "available cash" in year (t).

A problem arises when values are ascribed to 't' and 't-n', the years in which investment occurs and income is generated. Clearly a time-lag will exist between investment and the associated income generated and also between income and future investment. In order to investigate this problem, a series of single equation multivariate linear regressions were prepared. The equations are shown below in notational form.

X_3: Adjusted Acreage

X_7: "Available Cash"

X_8: $N.F.I._{t-1}$

X_9: $N.F.I._{t-2}$

X_{10}: $N.F.I._{t-3}$

X_{11}: External Credit

Equation 1 X_7: $f(X_8, X_9, X_{10}, X_{11})$

Equation 2 X_7: $f(X_3, X_8, X_9, X_{10}, X_{11})$

Equation 3 X_7: $f(X_8, X_{11})$

Equation 4 X_7: $f(X_{10}, X_{11})$

In equation 1, the "available cash" was related to the farm income in the previous three years and to the supply of external credit. In this equation, an attempt was made to take into account the effect of the level of previous years income on the current level of "available cash" i.e. allow for the lag expected between the generation of farm income, its subsequent investment in the farm, and the manifestation of the additional investment in the cash flow of the farm. Farm incomes previous to the year (t-3) were not included, as the production lag on a dairy farm was not considered to be in excess of three years.

Equation 2 was identical to equation 1 but for the addition of farm size as an exogenous variable. In earlier chapters, the models prepared indicated that farm size exerted little influence as a determinant of gross output or gross margin. It was decided to include acreage again, to assess the influence of farm size on the level of "available cash" on a farm.

Equations 3 and 4 were presented to overcome statistical problems which arose with equations 1 and 2. These problems are discussed in Section 6.3.1.

6.3.1. The Equations of the "Available Cash" Model

Relations one to eight which correspond to the application of equations 1 and 2 to the tenanted and owner occupied farms in 1969/70 and 1970/71 are shown in Appendix I, Tables 3-10.

Equation 1, relations 1-4 (Tables 3-6, Appendix I) can be seen to be multi collinear due largely to the high levels of correlation between variable X_8 and X_9, X_{10} in the case of relations 3 and 4 (owner occupied farms) and X_8 and X_9 in the relations 1 and 2 (tenanted farms). The values for R^2 are variable, but are generally reasonably high, suggesting that the equations could be accepted for prediction purposes. The regression coefficients of the input variables were, however, largely non-significant, probably as a result of the multicollinearity within equation 1. It should be noted that the only variables significant in both years were X_{10} in the case of the tenanted farms (relations 1 and 2) and X_8 in the case of the owner occupied farms (relations 3 and 4).

The addition of acreage as an input variable (Equation 2, relations 5-8, Appendix I) increased the precision of the equation for estimation purposes by raising the value of R^2 compared to equation 1. The X_3 variable (acreage) was, however, statistically non-significant in the case of relations 5 and 6 (tenanted farms) but attained statistical significance in relations 7 and 8 (owner occupied farms). The addition of acreage as an input variable did not help to break down the multicollinearity between the NFI input variables, as relations 5-8 were still multicollinear.

The multicollinearity in both equation 1 and equation 2 was clearly due to the lagged income variables. In order to eliminate the effect of multicollinearity on the regression coefficients, the equations were rewritten with the income variables X_8 and X_{10} in separate equations (equations 3 and 4 p. 210). Variable X_3 (acreage) was excluded from equations 3 and 4, as equations 1 and 2 showed little was to be gained from its inclusion.

Variable X_9 (N.F.I.$_{t-2}$) was excluded from the reformulated equations as examination of the zero order correlation matrices for relations 1-8 (Appendix I, Tables 3-10) showed variable X_8 (N.F.I.$_{t-1}$) in the case of the owner occupied group, and X_{10} (N.F.I.$_{t-3}$) in the case of the tenanted farms to have, in the majority of cases, a stronger correlation with "available cash" than did variable X_9. In terms of logic, one would expect the correlation coefficients of the lagged income variables to increase as one approached the present time period. This situation arises though the increase in N.F.I. in absolute terms with the passage of time i.e. the N.F.I. on a given farm is greater at present than three years previously. This logical pattern was not followed by the tenanted farm group (relations 1, 2, 5 and 6) where it was found variable X_{10} (N.F.I.$_{t-3}$) had the highest correlation with "available cash", followed by variable X_8 (N.F.I.$_{t-1}$). The owner occupied farm group (relations 3, 4, 7 and 8) did tend to follow the expected pattern, with variable X_{10} (N.F.I.$_{t-3}$) having the lowest correlation with "available cash" in all cases.

If the level of farm income in period (t-3) can be shown to have a functional relationship with the current level of "available cash" on the farm, the existence of a three year production lag or investment cycle would be confirmed. Income generated in (t-3), and invested in that year in dairy cows and additional working capital, would only be fully reflected in an increased cash flow and "available cash" three years later. This hypothesis would agree with the situation expressed by many farmers, who, in conversation, said it took three years to build up fertility sufficiently to support extra cows, quite apart from the fact that a calf retained for the milking herd this year would only enter full production three years subsequently. It can also be hypothesised that a functional relationship between farm income in year (t-1) and "available cash" can be divided into two effects:

a) A Direct Effect - A good year (high income) stimulates the farmer to invest, initially, in short term working capital e.g. higher fertiliser or feed usage and possibly an increase in machinery use through the purchase of new machinery i.e. an intensification effect. Such an effect would result in a rapid response in the farm cash flow the following year (although the full effect of the fertility build-up would be longer term).

b) An Indirect Effect - This is attributable to the effect on "available cash" of the correlation between N.F.I.$_{t-1}$ and N.F.I. in previous years. If the level of income is high in year (t-3), a high level of investment will be stimulated which results in an increased flow of cash in subsequent time periods i.e. a high level of income in year (t-3) would lead to an expectation of a high level of income in year (t-1), although the full effects of the investment in year (t-3) are experienced in year (t). In practical terms, a high-yielding herd of cows in year (t-3), if not depleted, is likely to be high-yielding two to three years later.

The amount of external credit used by the farmer was retained in the equations, as it was considered likely that the "available cash" would bear a relationship to this input variable.

The rewritten equations required to test the above hypotheses are tabulated in Tables 6.3.1.1. and 6.3.1.2. p. 214 and p. 215.

Table 6.3.1.1. Relation between "Available Cash", $N.F.I._{t-1}$ and External Credit

Equation 3 - Tenanted Farms

Year	Relation No.	Dependent Variable	Constant	Regression Coefficients b		Standard Error of b		% Variation Explained
				X_8	X_{11}	X_8	X_{11}	
1969/70	9	X_7	2749.11	1.0959 *	0.1623 NS	0.4800	0.2007	30
1970/71	10	X_7	2212.04	0.8628 ***	0.2742 *	0.2165	0.1133	68

Equation 3 - Owner Occupied Farms

Year	Relation No.	Dependent Variable	Constant	Regression Coefficients b		Standard Error of b		% Variation Explained
				X_8	X_{11}	X_8	X_{11}	
1969/70	11	X_7	1620.52	1.8214 ***	-0.0447 NS	0.1989	0.0563	67
1970/71	12	X_7	986.25	2.3870 ***	-0.0110 NS	0.3298	0.0889	57

Table 6.3.1.2. Relation between "Available Cash", N.F.I.$_{t-3}$ and External Credit

Equation 4 - Tenanted Farms

Year	Relation No.	Dependent Variable	Constant	Regression Coefficients b		Standard Error of b		% Variation Explained
				X_{10}	X_{11}	X_{10}	X_{11}	
1969/70	13	X_7	1049.29	2.3474 ***	0.1688 NS	0.6759	0.1679	43
1970/71	14	X_7	2229.10	0.9912 ***	0.2464 *	0.2404	0.1152	69

Equation 4 - Owner Occupied Farms

Year	Relation No.	Dependent Variable	Constant	Regression Coefficients b		Standard Error of b		% Variation Explained
				X_{10}	X_{11}	X_{10}	X_{11}	
1969/70	15	X_7	1883.68	2.2770 ***	0.0019 NS	0.3848	0.0713	46
1970/71	16	X_7	2200.10	2.2688 ***	0.0991 NS	0.4034	0.0986	45

The values for R^2 in these relations were not particularly high but were adequate to supply reasonably precise estimates of the "available cash" from the inputed variables. The R^2 values for equations 3 and 4, Tables 6.3.1.1. and 6.3.1.2., (relations 9-16) were lower than for relations 1-8 (Appendix I, Tables 3-10): this was to be expected, due to the reduction in the number of predetermined variables included in equations 3 and 4. The general improvement in the level of significance of the income variables in equations 3 and 4 indicated a preference for these two equations, although the precision of the equations was less than in equations 1 and 2.

Comparison of the R^2 values of equations 3 and 4 for the tenanted and owner occupied farm groups, suggested that variable X_8 (N.F.I.$_{t-1}$) had more influence on the owner occupied farm "available cash" than did variable X_{10} (N.F.I.$_{t-3}$). In the case of the tenanted group, little difference was apparent between X_8 and X_{10}. A test for significant difference between the values of the regression coefficients of variables X_8 and X_{10} proved negative. The results of the test are shown in Appendix I, Table 2.

The values for the regression coefficients of variables X_8 and X_{10} were statistically significant at the P=0.001 (*** level) except X_8 in relation 9 (tenants 1969/70) which was statistically significant at the P=0.05 (* level). A functional relationship occurred, therefore, between X_8 and "available cash" and X_{10} and "available cash". Hence evidence did exist to support the hypothesised relation between income, investment and "available cash".

The regression coefficients of the X_{11} variable (external credit), were only statistically significant at (* level) in relations 10 and 14 - tenants 1970/71. The X_{11} variable appeared to have no modifying influence on the "available cash" in the case of the owner occupied farm group.

The relations determined for equations 3 and 4 (Tables 6.3.1.1. and 6.3.1.2.) were used to estimate the increase in "available cash" attributable to a £100 increase in net farm income one and three years previously.

Table 6.3.1.3. Increase in Expected "Available Cash" in 1969/70 and 1970/71 Attributable to a £100 Increase in NFI in years (t-1) and (t-3) £

		Tenanted Farms	Owner Occupied Farms
		Increase in "Available Cash" in 1969/70 (t)	Increase in "Available Cash" in 1969/70 (t)
£100 Increase in N.F.I.	N.F.I.$_{t-3}$ 1966/67	239	228
	N.F.I.$_{t-1}$ 1968/69	109	182
		Increase in "Available Cash" in 1970/71 (t)	Increase in "Available Cash" in 1969/70 (t)
	N.F.I.$_{t-3}$ 1967/68	99	227
	N.F.I.$_{t-1}$ 1969/70	86	239

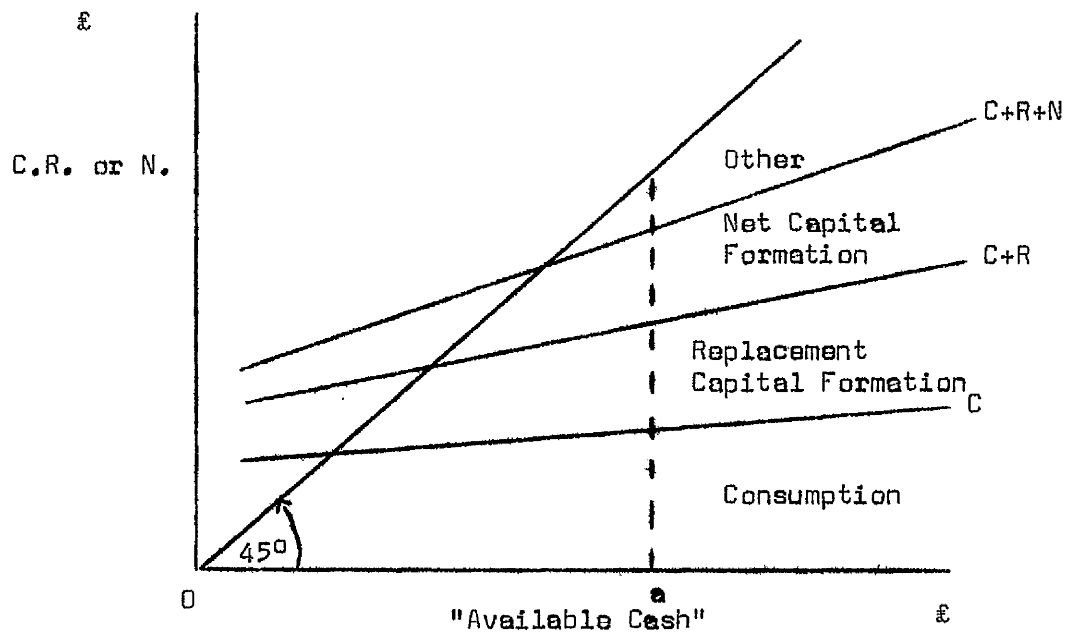
In general, the increase in "available cash" was greater for the owner occupied farm group than for the tenanted group, but it is known from the test of regression coefficients in Table 2, Appendix I that the differences were not statistically significant.

The values for the increase in "available cash" attributable to farm income fell for the tenanted farm group in 1970/71. This was a reflection of the fact that the absolute level of "available cash" fell on average by £492 per farm for this group between 1969/70 and 1970/71. The implications of the relationships shown to exist between past farm income level and "available cash" in the present period, are discussed fully in a subsequent section.

6.4. The Distribution of Cash on the Dairy Farm

The distribution of the "available cash" on a farm may be divided into two fundamental components, (Figure 6.1.2. p. 194). The cash may be consumed - used for private living purposes - or it may be invested - either on or off the farm. Investment on the farm cannot be considered as just the accumulation of capital assets within the farm business, but must include an element of capital replacement as well as any net capital formation. The hypothetical relationships between consumption, replacement capital formation, net capital formation and other cash disbursement are shown in Figure 6.4.1.

Figure 6.4.1. Hypothesised Distribution of the "Available Cash" on West Scotland Dairy Farms



Key C = Consumption of "Available Cash"

R = Replacement Capital Formation from the "Available Cash"

N = Net Capital Formation from the "Available Cash"

In the above diagram, the 45^{0} line indicates the points where the "available cash" of the farms is in equilibrium with the distribution of the "available cash" between consumption, replacement capital formation, net capital formation, and other expenditure (repayment of loans, off-farm investment etc.). Any point which falls on a line to the left of the 45^{0} line indicates that the "available cash" is inadequate to meet the theoretical minimum requirements of consumption, capital formation, etc., of the farm. If an amount of "available cash", equal to oa in the diagram, is assumed for a farm, it is possible to illustrate the division of the "available cash" of that farm between consumption, replacement capital formation, net capital formation, and other expenditure. It was originally intended to quantify the above relationships using regression equations. However, this was found to be unrealistic, due to the variation which occurred within the basic data. Simple averages were adopted, therefore, to determine the distribution of the "available cash" between consumption and on-farm investment (Table 6.4.1.).

Table 6.4.1. Distribution of "Available Cash" between Consumption and On-Farm Investment 1969/70 and 1970/71 - Mean Values %

	Tenanted Farms		Owner Occupied Farms	
	% CONSUMED	% INVESTED	% CONSUMED	% INVESTED
1969/70	42.5	30.4	39.8	27.6
1970/71	44.1	28.8	38.2	32.4

Note: The % values do not sum to 100, as the "available cash" during a year has to allow for any allocation to Capital Withdrawn (Off-farm Investment), increase in cash/bank balances, increase in debtors, loan repayment, etc.

The above table shows that the sums allocated to consumption are well under 50 per cent in all cases, with on-farm investment accounting for over 25 per cent of the funds available. These results confirm, for West Scotland dairy farmers, the findings of other authors[7], that farmers are willing, if required, to sacrifice their living standards in order to invest in their farms.

[7] For authors involved in this type of study see Literature review Section 2.2.3, p. 22.

A conflict inevitably arises between the demands on cash for private living and for capital investment. Solution of this problem depends partly on the economic soundness of the business - does it require additional capital formation? - and partly on the private circumstances of the farmer: age, number of children, attitude to risk, uncertainty, etc. In the following sections, estimates of the farmers' consumption are made prior to assessing whether or not these are adequate and, if necessary, how consumption may be increased. Secondly, since the growth of a farm business (i.e. increase in income-earning capacity) often depends on the extent of net capital formation, it is desirable to isolate the net capital formation component of the total or gross capital formation. Theoretical concepts of capital formation are therefore considered, together with an examination of the problems associated with the practical application of the theory at the farm level.

6.4.1. Consumption of Cash

One of the primary functions of a farm business is the provision of sufficient income to permit the survival of the farmer, both in the short and long term. Survival in the short term depends on sufficient funds being available to meet the farmer's private living requirements. In the long term, the business must be able to generate enough income to cover consumption requirements as well as the maintenance of, and addition to, the capital stock of the business.

It is proposed to assess the adequacy of the present levels of consumption on the dairy farms under study, by comparison with the average earnings in other industries. Estimates of the current levels of consumption on the dairy farms were prepared from linear regressions of consumption (£) on acreage. The equations are shown in Table 6.4.1.1. on p. 221.

Table 6.4.1.1. Relation between Consumption of Cash and Farm Size 1969/70 and 1970/71

1969/70				
Tenanted Farms				
Relation Number	Constant	b	S.E. of b	% Variation Explained
1	139.62	9.9384	3.6126	18
Owner Ocpupied Farms				
2	988.88	3.7618	1.4690	11
1970/71				
Tenanted Farms				
3	626.68	6.9731	1.6677	34
Owner Occupied Farms				
4	1205.64	4.3503	2.6415	5

Note: The regression coefficients had the following levels of statistical significance

Relation 1	**	(P=0.01)
Relation 2	*	(P=0.05)
Relation 3	***	(P=0.001)
Relation 4	N.S.	

The levels of explained variation were not high in the above relations, with the result that estimates of consumption based on the equations suffered from loss of accuracy. Relation 4 was not used to estimate the level of consumption on owner occupied farms in 1970/71, as the regression coefficient was non-significant. The low level of association between farm size and consumption for the tenure groups was, in itself, revealing. It indicated that, irrespective of farm size, a basic requirement of funds for consumption existed and that factors other than farm size e.g. age of farmer and family size were probably more important determinants of the level of consumption. Since, in this instance, the purpose of the regressions was not to establish the determinants of consumption but to prepare estimates of consumption levels in the farm sample, the relations 1 - 3 were used to estimate the consumption of cash for the two groups of farms.

Table 6.4.1.2. Estimated Consumption of Cash 1969/70 and 1970/71 £

Farm Size (Acre)	Tenanted Farms		Owner Occupied Farms
	1969/70	1970/71	1969/70
50	636	975	1177
100	1133	1324	1365
150	1510	1672	1553
200	2127	2021	1741
250	2624	2370	1929
300	3121	2718	2117

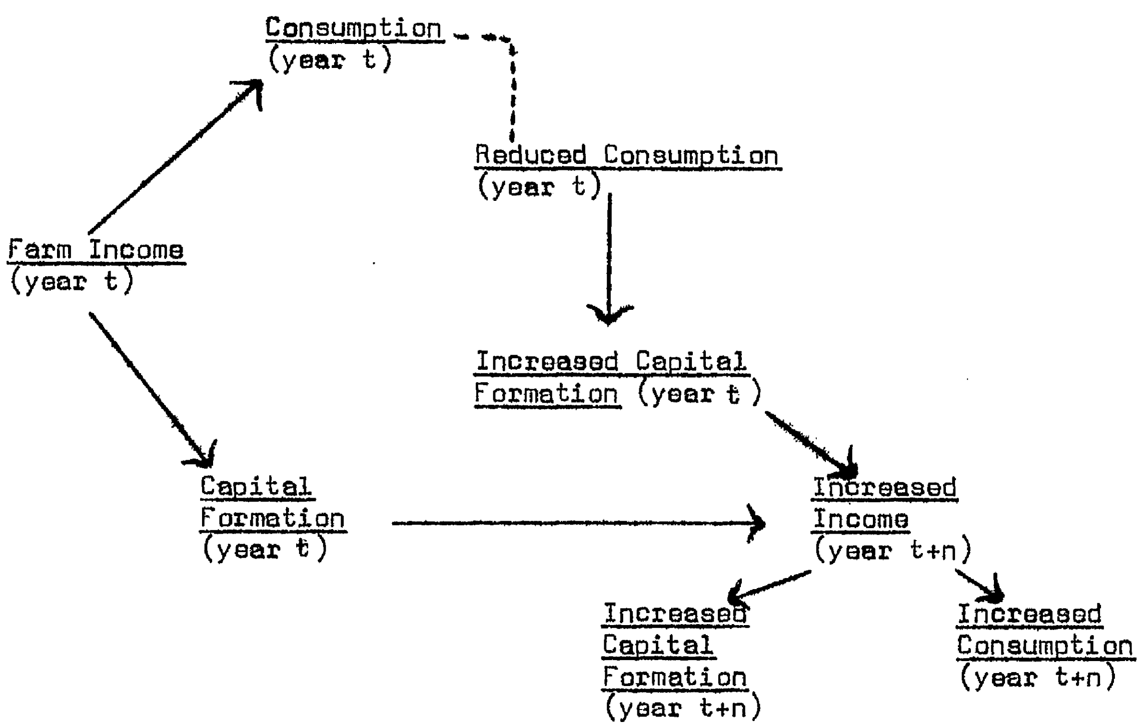
In the above Table, the tenanted farm estimates for 1970/71 were the most accurate. The estimates for the other two groups did, in fact, vary around those for the tenanted farms in 1970/71. Due to the low reliability of the estimates based on relations 1 and 2 in Table 6.4.1.1., it is proposed to base most further comments on the levels of cash consumption on the estimates derived from relation 3 i.e. the tenanted farms in 1970/71

As the consumption of cash on a farm represents the funds used for private living purposes, the values in the table could be said to represent the standard of living of the farmer. The question can therefore be posed - how does the standard of living of a farmer compare with that of non-agricultural workers? In Section 6.2.3. - Table 6.2.3.3. p. 207, the average earnings of a worker in manufacturing industry were seen to be £1291 and £1458 in 1969/70 and 1970/71 respectively. Reference to Table 6.4.1.2. shows that farmers operating farms of less than 100 acres in 1969/70, and 150 acres in 1970/71, can be expected to have a standard of living (in terms of cash consumption) of less than that of the average worker in manufacturing industry. Twenty two per cent and forty eight per cent of the farmers under study did not have parity with manufacturing workers in 1969/70 and 1970/71 respectively.

The amount of cash which is available for consumption is largely dependent on the amount of income generated by the farm. The level of consumption could therefore be raised if the income generated by the farm was increased. Increases in farm income usually result from more intensive use of capital, or increased productivity of the existing capital. Since it has been shown in earlier sections that farm income was the main determinant of the "available cash" for capital formation, a conflict exists between the use of "available cash" for investment or consumption - an increase in capital formation will result in reduced consumption in a closed system with no access to external finance. Even when external borrowed funds are available for capital formation, a reduction in current consumption could result, as loan capital has to be serviced from current income.

The situation for a closed system is depicted diagramatically below.

Figure 6.4.1.1. Capital Formation v Consumption Cycle

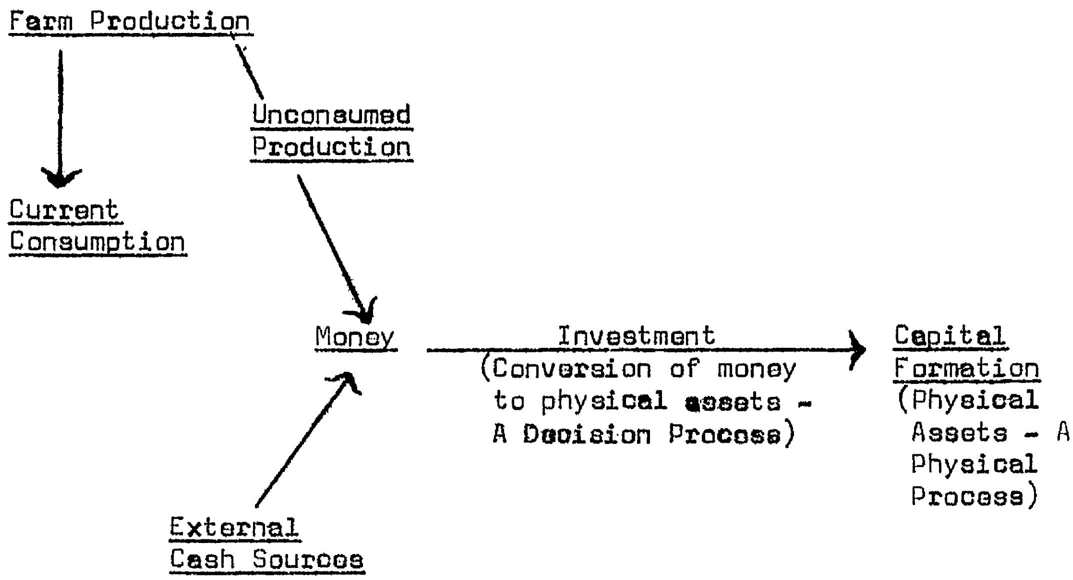


Since the farmers of the smaller farms (below 100-150 acres) were already operating at a personal consumption level below the average for a worker in manufacturing industry, it is difficult to see how this group of farmers could reduce consumption in order to increase their level of capital formation. These farmers will be largely dependent on external funds or grants if improvements are to be made in their standard of living.

6.4.2. A Concept of Capital Formation

In Chapter 1 Section 1.3.2. p. 8, investment was defined as "the process of capital formation which is the creation of capital assets by the conversion of money (store of unconsumed production) into physical assets". Investment can therefore be viewed as a conversion process which has as its raw material, money, and as its end-product, physical capital assets. In the pedantic sense of the term, investment is an abstract interphase between money and physical capital assets - effectively a decision process. In practice, the term investment is applied both to the actual interphase and to the newly formed capital assets. Theoretically, the investment (gross capital formation) should be termed capital and no differentiation made between newly formed capital (investment) and the existing capital assets of a business. Historically, investment has become synonymous with gross capital formation probably because it is convenient to be able to separate the new, from the existing, capital of a business. It would be useful, however, if the difference between investment and capital formation became more widely accepted. This would enable the determinants of investment - the decision making process - to be examined separately from the results of that process - capital formation. The sequence of events in the process of capital formation is shown in Figure 6.4.2.1. p. 225.

Figure 6.4.2.1. The Investment/Capital Formation Process



It is proposed for the remainder of this section to adopt the investment/capital formation concept depicted above, although elsewhere in the study the conventional use of the term investment is retained.

6.4.2.1. Replacement and Net Capital Formation

Capital formation is essential if a business is to continue in the long term since, as was noted in Chapter 1, Section 1.3.1. p. 7, existing capital depreciates over time. Capital formation is necessary, therefore, to maintain the existing productive capacity of the business in real terms, but if increases in output are required, gross capital formation (in real terms), in excess of that required for replacement purposes, is almost certainly unavoidable. However, it is appreciated that real increases in output may arise from higher labour and management productivity, as well as from increases in capital input.

The hypothetical association between replacement and net capital formation and farm output are shown diagramatically in Figure 6.4.2.2. p. 226.

Figure 6.4.2.2. Components of Capital Formation and their Relation to Output Achieved

Gross Capital Formation (Annual)

Replacement Capital Formation → Gross Capital Formation (Annual) ← Net Capital Formation

Replacement + Existing Capital → Maintenance of Present Output

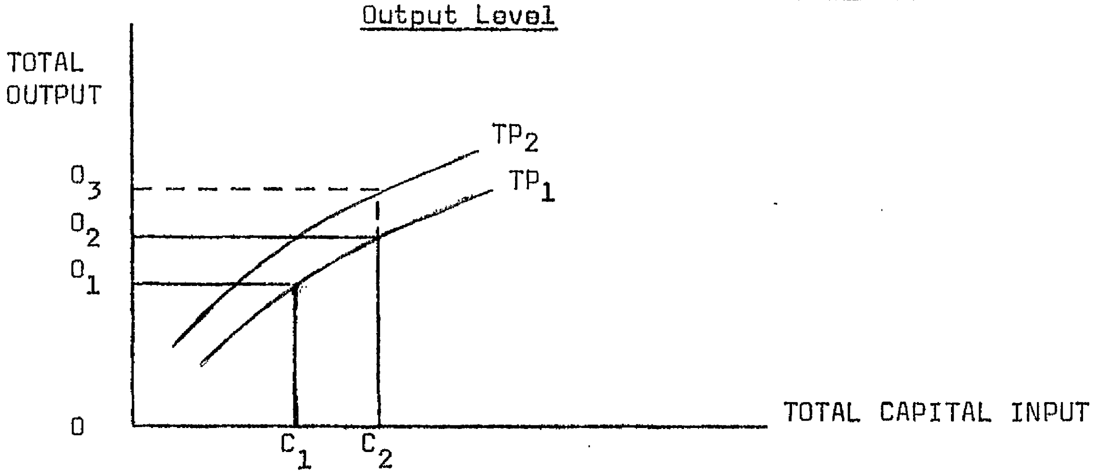
Replacement + Existing Capital - - → Additional Output

Net Capital Formation → Additional Output

The net component of the gross capital formation can now be seen to link with the growth of the farm business in terms of output achieved. (Excluding any growth arising from increases in labour and/or management productivity.)

The net capital formation element of gross capital formation may result in increased levels of output from either or both of two causes. Firstly, the increased intensity of resource use (net capital formation) should result in higher levels of output. Secondly, inherent in net capital formation may be higher levels of potential productivity, e.g. an additional cow could well have a higher yield capacity than existing cows or a machine may incorporate technological improvements. The diagram below illustrates the division of net capital formation into its resource intensity and plane of productivity effects.

Figure 6.4.2.3. Net Capital Formation and its Effects on Output Level



In Figure 6.4.2.3. p.226, Curve TP_1 represents the levels of output possible with the existing productivity of capital in the business. Curve TP_2 represents the higher levels of output attainable if the existing capital were replaced with technologically or scientifically more advanced capital. Assume OC_1 is the original capital input to the business and that OO_1 is the resulting output. OC_2 represents the new level of capital input and it is assumed that the original level of capital input OC_1 has been maintained intact through replacement capital formation. The quantity C_1C_2, therefore, represents the additional element of the capital formation which occurred. Movement in the capital inputed, from OC_1 to OC_2, is in an intensification of capital input which results in an increase in output of O_1O_2 (OO_2 - OO_1). If the additional capital inputed is assumed to have, also, a higher inherent level of productivity than the existing capital, then the increase in capital inputed from OC_1 to OC_2 will result in a total output of OO_3. The effect on output of the additional capital formation can now be apportioned into an intensification effect (increase in output of O_1O_2) and a level of productivity effect (increase in output of O_2O_3). It should be noted that plane of productivity effects may also occur as a result of technological or scientific advances incorporated within the replacement capital formation element (not shown in Figure 6.4.2.3. but hypothesised by the dotted line in Figure 6.4.2.2.).

It is now proposed to evaluate how far it is possible to apply the above analysis to the practical farm situation i.e. without recourse to marginal productivity theory based on a production function approach, as in Chapter V, Section 5.6.

In practice, it is possible to move some way towards the application of an empirical study if certain assumptions are accepted regarding the nature of depreciation and sale value of capital on the farm. Firstly, the calculations will only apply at the aggregate level of capital formation on the individual farm i.e. it is not possible to apply the analysis easily to individual machines or animals. Secondly, the annual amount of depreciation shown in the farm balance sheet must be assumed to equal the actual annual cash value of the services rendered by the capital. Thirdly, it is assumed that there has been annual gross capital formation which is equal to, or greater then, the value of the depreciation charged in any one year; this ensures that there has been compensation for the loss in capital value due to depreciation in previous years. Finally, the sale value of the capital items must be assumed to represent the actual value unexhausted services which could be supplied by the capital.

Under the conditions specified above, it is possible to measure the replacement and net capital formation components of any gross capital formation.

Identity I

Gross Capital Formation - Replacement Capital Formation = Net Capital Formation

where:

Gross Capital Formation = Purchase Price of Capital

Replacement Capital = Depreciation on Existing Capital plus Sale Value of Capital Disposals

In Identity I above, no account has been taken of the effect of inflation. An inflation factor can be used to deflate the purchase price of capital items, thus reducing the otherwise upward bias in the value ascribed to the net capital formation.

In Identity II below, the method of estimating the replacement capital formation is by inflating the original cost of the capital to present day values. This method is not applicable in practice to the farm data available.

Identity II

$$\underbrace{\left[\begin{array}{c}\text{Purchase Price of}\\ \text{New Capital Item}\end{array}\right]}_{\text{Gross Capital Formation}} - \underbrace{\left[\begin{array}{c}\text{Original Cost of Item}\\ \text{+ Inflation Factor}\end{array}\right]}_{\text{Replacement Capital Formation}} = \text{Net Capital Formation}$$

e.g.

$$\underbrace{\text{Price of New Tractor}}_{\text{Gross Capital Formation}} - \underbrace{\left[\begin{array}{c}\text{Cost of Obsolete Tractor}\\ \text{+ Inflation Factor}\end{array}\right]}_{\text{Replacement Capital Formation}} = \text{Net Capital Formation}$$

In Identity II p. 228, the original cost inflated to current value was assumed to equal the replacement capital formation at current values. The inflation factor assumes considerable importance in this instance, since the original cost could deviate considerably from the current cost of a similar capital item, if inflation has been rapid. In order to determine a value for the inflation factor, the time which elapsed between the original purchase of a capital asset and its disposal for replacement purposes, would require to be known for all individual capital items. This method, although possibly preferable, cannot be applied to the available farm data because the age structure of all the capital was not known. Identity I was therefore used to estimate the replacement and net capital formation of the sample farms. The bias introduced through failure to use an inflation factor was not considered serious, as it amounted to only 2.4 per cent between 1969/70 and 1970/71 (Chapter V Appendix II Table 10).

Estimates of replacement capital formation were prepared for the sample farms, by regressing the replacement capital formation values on farm size. This method could not be applied to the net capital formation values, since the relationship derived was statistically non-significant due to random distribution of the net capital formation values.

The estimating equations for replacement capital formation are shown in Table 6.4.2.1. p. 230

The β coefficients of the equations in Table 6.4.2.1. were all significant at the P=0.001 level of statistical significance. The values for r^2 were also high enough to enable reasonable estimates of replacement capital formation to be predicted.

Log-linear estimates were used as the percentage explained variation was higher in all cases for this type of function than for the linear function. The difference in explained variation was statistically significant at the P=0.001 level for the tenanted farm equations. The owner occupied farm linear and log-linear estimates were not statistically different but, as stated, the coefficient of determination was higher for the log-linear than the linear equations. Log-linear

Table 6.4.2.1. Relationship between Replacement Capital Formation and Farm Size 1969/70 and 1970/71

1969/70				
Tenanted Farms				
Relation No.	Constant	β	S.E. of β	% Variation Explained
1	1.0333	0.9821	0.1218	66
Owner Occupied Farms				
2	1.7305	0.6812	0.0977	48
1970/71				
Tenanted Farms				
3	0.8583	1.0642	0.1222	69
Owner Occupied Farms				
4	1.8505	0.6361	0.1072	40

equations were therefore used for the owner occupied farm group as well as the tenanted farm group to maintain logical consistency.

The estimated replacement capital formation required in 1969/70 and 1970/71 for six dairy farm sizes is shown in Table 6.4.2.2.

Table 6.4.2.2. Estimated Replacement Capital Formation Required in 1969/70 and 1970/71 £

	Tenanted Farms		Owner Occupied Farms	
Farm Size (Acres)	Replacement Capital Formation £		Replacement Capital Formation £	
	1969/70	1970/71	1969/70	1970/71
50	503	464	773	854
100	994	969	1239	1326
150	1480	1493	1632	1717
200	1963	2028	1986	2062
250	2445	2571	2312	2375
300	2925	3115	2617	2668

The replacement capital formation values in the above Table include estimates for both livestock and machinery. As expected, the amount of replacement capital formation increased with increased farm size. Comparison of the owner occupied with the tenanted farm groups and the 1969/70 with the 1970/71 results, showed no statistically significant differences in the estimates due to nature of tenure or year.

The values in Table 6.4.4.2. estimate the replacement capital formation required in each of the two years in order to maintain the existing stock of capital. To this extent the values are theoretical, but in practice most individual farms had gross capital formation in excess of the values shown. This situation was expected since gross capital formation = replacement capital formation plus net capital formation. In certain instances, however, the actual gross capital formation on a farm was less than the estimated replacement capital formation (i.e. purchases of capital were less than sales of capital plus depreciation of capital in each of the two years). This resulted in negative values for the estimated net capital formation i.e. net capital consumption occurred. This situation was revealing and has wider implications which are considered in detail in the section which follows on net capital formation.

The estimated net capital formation for each individual farm is tabulated in the frequency distribution shown in Figure 6.4.2.4. and 6.4.2.5. p. 232 and p. 233.

On examination of the frequency distributions in Figures 6.4.2.4. and 6.4.2.5., no systematic pattern emerged between farm size and level of net capital formation. This situation was anticipated, as test regressions between additional capital formation and farm acreage were statistically non-significant. The magnitude of the net capital formation values differed considerably between individual farms, types of tenure groups, and the years under consideration. The performance of the tenanted farms appeared better than the owner occupied farms in 1969/70 whereas the opposite was the case in 1970/71. Closer examination was therefore required to rationalise the apparent random nature of the results.

Figure 6.4.2.4. Net Capital Formation or Consumption - Distribution by Farm Size

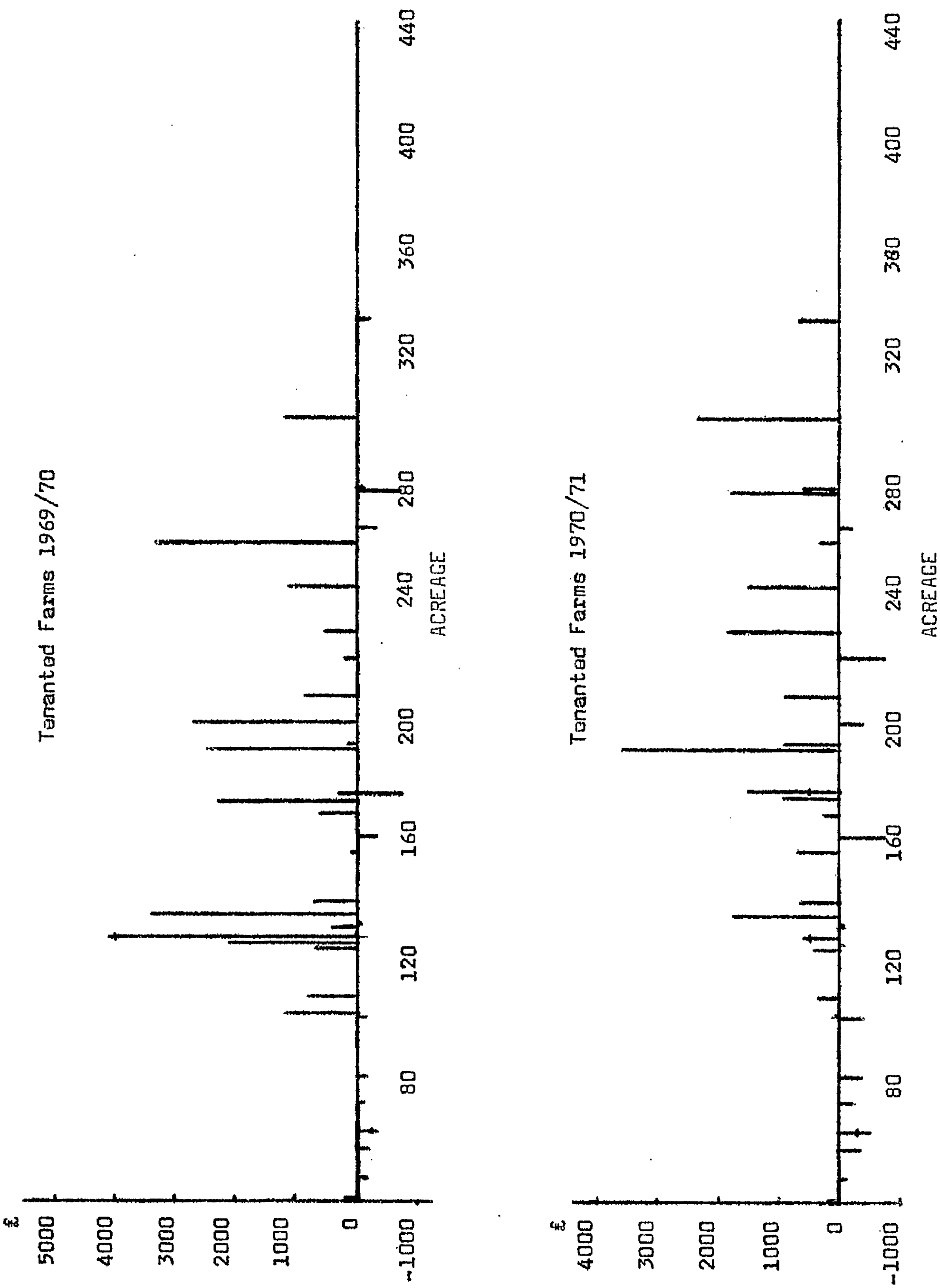
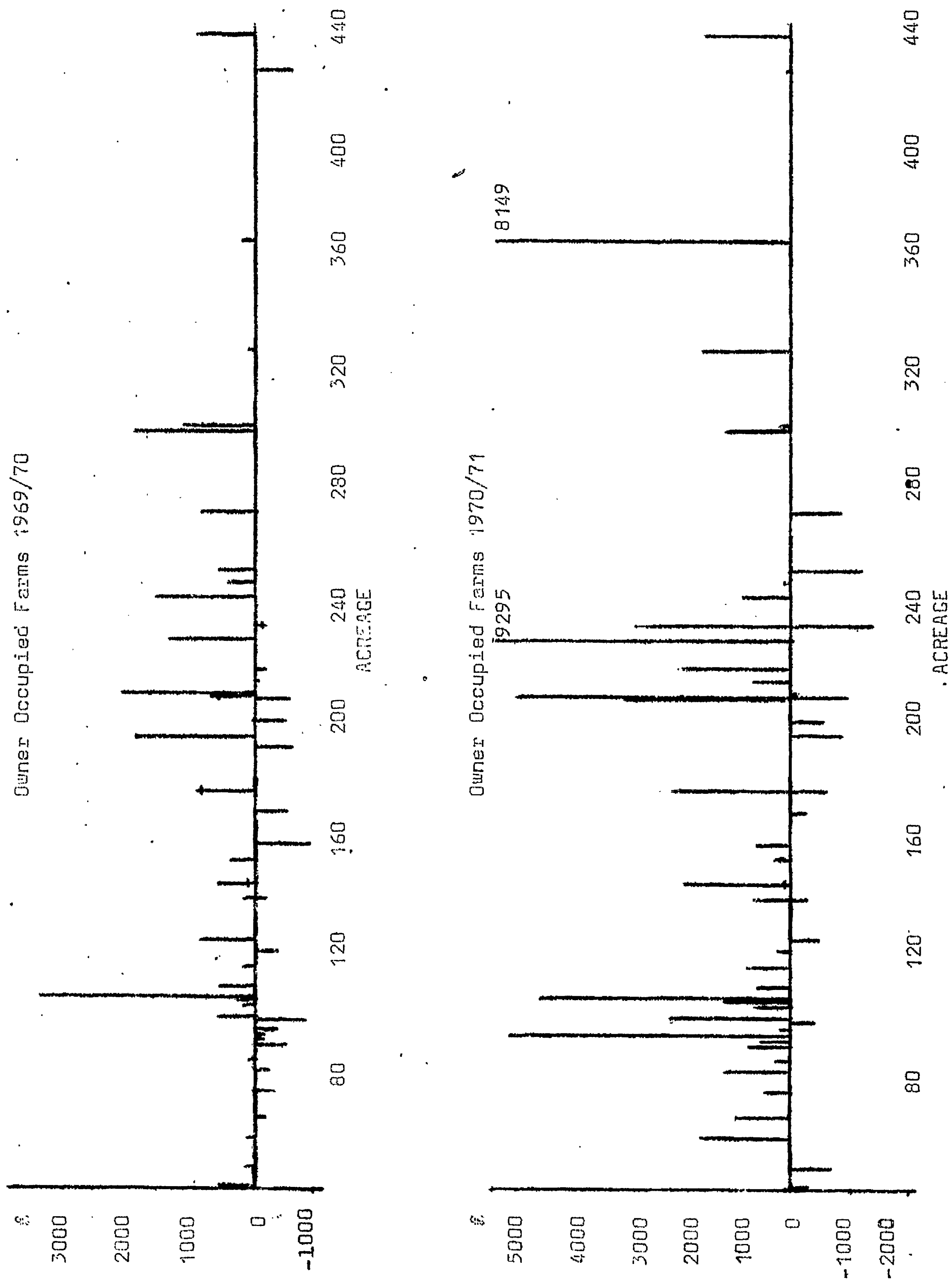


Figure 6.4.2.5. Net Capital Formation or Consumption - Distribution by Farm Size



Net capital consumption was indicated when the actual gross capital formation was less than the theoretical capital replacement estimates prepared previosuly i.e. when estimating replacement and net capital formation (Table 6.4.2.2. and Figures 6.4.2.4. and 6.4.2.5.), the net component of the gross capital formation in any one year was treated as a residual after satisfying the replacement capital formation requirements. The existence of net capital consumption values for certain farms showed that assumption three p.227- "that there is annual capital formation which equals, at least, the value of depreciation charged in any one year" does not hold in all cases. Since the rate of depreciation charged in any one year is an arbitrary figure, the situation of net capital consumption could be remedied by reducing the rate of depreciation charged. However, it is preferable to assume that the rate of depreciation charged (20%) was realistic of the reduction in capital value each year. If this assumption is acceptable, the analysis yields additional information.

An initial study showed that, for the farm sample, more than half the farms exceeded the level of gross capital formation required to maintain their stock of capital intact. In the cases where the gross capital formation was inadequate to meet the estimated replacement capital formation requirements, it could be assumed that these farms were in a serious position, as their stock of capital was diminishing (Net capital consumption). Reference to the 1969/70 data suggested that 34 of the 90 farms constituting the sample were in this situation. When the 1970/71 data was considered, it was found that the number of farms with net capital consumption had fallen to 30. Closer examination showed that only 18 farms had net capital consumption in both years. Capital consumption in one year does not indicate a run-down of the farm business. Capital formation clearly fluctuates on many farms i.e. total capital formation may be insufficient in any given year to replenish the reduction in capital stock in that year, but in a subsequent time period capital formation does occur which is adequate to replace the accumulated depletion of the capital stock. Attention should therefore be focused on those farms recording net capital consumption in two successive years, although it is by no means conclusive that this group of farms is in an irretrievable position regarding the maintenance of an adequate stock of capital since it is possible to have a capital formation cycle (investment phase) in excess of two years. However, it is constructive to note that farms with net capital consumption in two successive years tended to cluster around the smaller tenanted farms. This group seemed most likely, on the data available, to require assistance, if a potentially serious dilution of their capital stock was to be avoided. The considerable variation in the amount of net capital formation might also suggest that much of the capital formation on farms was a random process in that it cannot be predicted. As the attitude of the farmer to capital formation is clearly of the utmost importance it shall be considered in Chapter VII.

6.5 The Monthly Flow of Cash on Selected Dairy Farms - A Digression

In earlier sections of this chapter, the source and distribution of cash on farms was considered on an annual basis. Since the monthly flows of cash are what determine the annual cash position of these farms, it was felt justified to analyse briefly the monthly pattern of payments and receipts for a selected group of the sample farms.

The available monthly data was examined to assess whether dairy farms had a discernable pattern of monthly cash flow and whether or not any differences existed between the flows of cash in the three performance groups with respect to the pattern and size of surpluses or deficits, levels of capital formation, and other factors. Conclusions were then drawn on the possible extent of the influence of the cash flow on investment decision making.

The Sample

The sample was restricted to 18 farms since only the MS type of account described in Chapter IV supplies sufficient detail to permit a monthly analysis of the cash flow on the farm. The analysis was carried out for the years 1968/69 and 1969/70 since, due to the character of the analysis, the lag in data availability prevented analysis of the 1970/71 cash flows.

The 18 farms were divided into three groups of six farms each, intended to represent high, intermediate, and low performance farms. Performance was assessed on the basis of return on capital in 1969/70. Each level of performance group of six farms was balanced to include one farm from each size and nature of tenure group as classified in Chapter IV. The farms were classified according to three performance levels rather than on a nature of tenure/size basis to try and maintain as large a number of farms as possible in each cell. Based on size or tenancy groups, there would only be three farms per cell, whereas using performance levels, this increased to 6 farms per cell.

The method of computation used, was to derive totals for the monthly payments and receipts on the sample farms using the computation sheet illustrated in Figure 6.5.1. p. 237. If the monthly payments and receipts are known, it is possible to calculate the monthly surplus or deficit, and by cumulative addition of each monthly surplus or deficit, thereby derive a cumulative surplus or deficit. To enable analysis of the cash flows, the monthly totals for each of the three groups of six farms were combined and a simple average value obtained for each month. At this juncture it is worth noting that, as always, when averages are used, the results must be interpreted with caution. The sample farms selected did not all have an identical financial year: it was necessary, therefore, to standardise the data and work to a particular financial year. The most frequently occurring year end was March, hence an April to March year was adopted for the analysis and all data was adjusted to this period.

Definition of Terms

Available Cash before Capital Formation

Represents for each month during the year, the cash which is available during each month, for capital formation.

Capital Formation

Includes the aggregate expenditure on farm equipment, vehicles and fixed equipment. Unfortunately it is not possible to include the value of replacement and additional breeding stock in the capital formation values, as breeding stock are included in the farm expenses and it is not possible to isolate the value for breeding stock rearing.

Figure 6.5.1. Format of Cash Flow Analysis Sheet

Cash Flow Analysis - Statistical Year ____________

Y.E. __________ Type __________ County __________ Farm No __________

	Month											
Payments												Total
Farm Exp.												
Capital Formation												
Cap.Inv.Ext.												
Personal												
TOTAL												
Receipts												
Farm Receipts												
Capital Sold												
Cap.Grants												
Investments Cashed												
Private Receipts												
Total												
Surplus												
Deficit												
Cum.S.or D.												
Cum.S.or D. (Incl.Opening Cash and Bank Balance)												

Deficit (Monthly)

The difference between monthly total receipts and total payments where this is negative.

Deficit (Cumulative)

The total of the individual monthly deficits plus any deficit carried forward from the previous year.

Farm Expenses

Includes the expenses incurred in running a farm e.g. seed, labour, fertiliser. It does not include capital formation expenditure or nominal charges e.g. depreciation.

Farm Receipts

Includes receipts from farm produce but excludes private receipts.

Payments

Are the expenses incurred which have actually been paid. They do not include invoiced purchases still unpaid.

Receipts

Are those monies received for goods sold; they do not include invoiced sales for which cash has not been received.

Surplus (Monthly)

Is the difference between the monthly total receipts and total payments where this is positive.

Surplus (Cumulative)

Was the total of the individual monthly surpluses plus any surplus carried forward from the previous year.

Results

Some Characteristics of Monthly Cash Flows on Dairy Farms

A cash flow represents the interaction of the flow of receipts and the flow of payments in a business. In its basic form, the monthly cash surplus or deficit shows the effect on the farm cash balance, resulting from the business operations in any particular month. If the aim is to represent the bank credit requirements resulting from the aggregate decisions each month, then the monthly cumulative surplus or deficit would be more appropriate, as it includes any surplus or deficit carried forward from the previous accounting period. The cumulative surplus or deficit need not represent the total capital or credit requirements each month, as the cash flows calculated for this analysis were prepared from fully paid sales and expenses, not invoiced sales or purchases. Thus it was possible that a farm business could be increasing its trade creditors or debtors, the effect of which would not be recorded in the cash flow. Any decrease in creditors or debtors would, of course, be reflected in the flow of receipts or payments.

Monthly Flow of Receipts

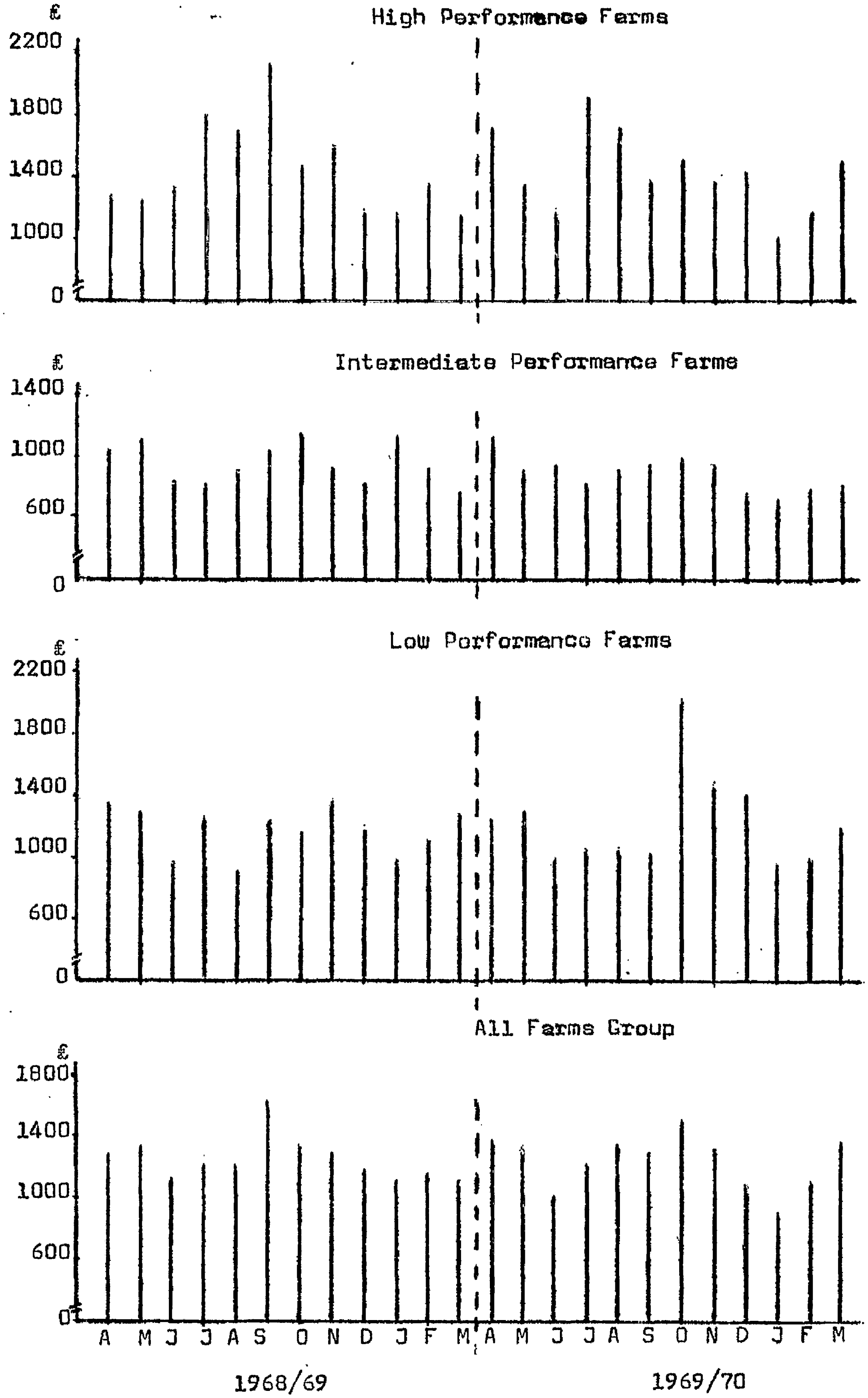
The monthly flow of receipts for the three performance groups and the all groups mean are shown in Figure 6.5.2. p. 240.

The average monthly receipts for the farm groups in Figure 6.5.2. were seasonally variable but this variation did not follow the pattern expected of either a summer or winter milk producer (winter producer of milk - December high, August low production; summer producer of milk - May high, January low production). The absence of the expected pattern of receipts could arise through the aggregation of individual farm receipts to provide a mean value for the group.

Comparison of the three performance groups showed differences in the pattern of the seasonality of receipts. In this case, as price was constant between the groups, the differences must have been due to production variation.

The absolute level of monthly receipts varied between the performance groups. High levels of receipts were clearly associated with high performance, as monthly receipts in the high performance farm group were always greater than the monthly receipts of the intermediate performance farm group. High levels of monthly receipts were not, however, exclusively associated with high performance, as the monthly receipts of the low performance farms were generally higher than those of the intermediate performance farms. The level of farm receipts cannot be used, therefore, as a guide to the ultimate performance of

Figure 6.5.2. Monthly Receipts Flow



the farm. Performance level is determined by the interaction of receipts and payments and it is this interaction which provides the monthly cash surplus or deficit on the farm.

Monthly Cash Surplus or Deficit

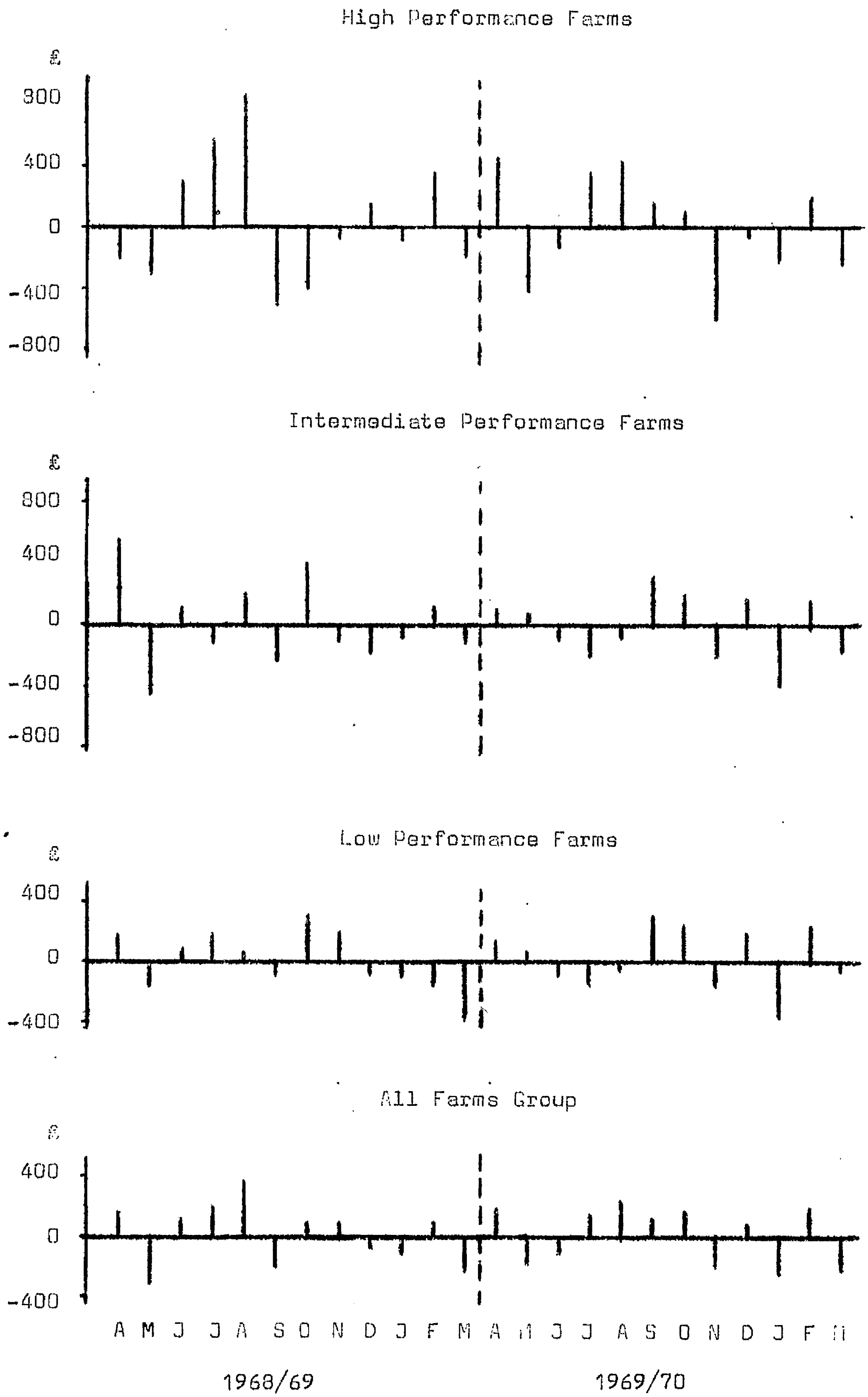
The final cash surplus or deficit in any particular month represented the amount of cash generated in that month, which had not been utilised at the time. It was, in effect, a residual sum of cash which was available to carry forward to subsequent time periods to finance future expenditure. The monthly surplus or deficit of cash is shown for the sample farms in Figure 6.5.3. p. 242.

From the diagrams in Figure 6.5.3. it became clear that the surplus or deficit of a farm could, and did, fluctuate rapidly from one month to the next, irrespective of the farm performance rating.

The absolute size of the surplus or deficit was related to the performance level of the farms: the amount of surplus per month decreased as one moved from the high performance to the low performance farm groups. This was not the case with the monthly receipts for the farm performance groups. The effect of the monthly payments must therefore have been reflected in the monthly surplus or deficit. Hence it was possible to relate the level of payments to the type of production which was practised by the three performance groups. The high performance farms had high levels of receipts associated with intermediate costs of production, resulting in relatively high surpluses. The intermediate performance farms had lower levels of receipts but also low costs of production, resulting in intermediate levels of surplus. Finally, the low performance farms, although achieving intermediate levels of receipts, had high costs of production, resulting in low monthly surpluses.

The general pattern of seasonal fluctuations in the monthly surplus or deficit can be seen from the all farms group diagram in Figure 6.5.3. Deficits tended to occur in late spring or early summer and in the latter part of the year. Surplus months usually occurred in the summer period. The frequency of occurrence of deficits remained fairly constant at approximately six out of the twelve months each

Figure 6.5.3. Monthly Surplus or Deficit



year, although the actual size of the deficits differed.

The monthly surpluses or deficits were residual values, as already stated, resulting from the aggregate effect of all the farmer's decisions during the month, but the pattern of monthly surpluses and deficits was of significance, as these figures determine the rate of cash accumulation for future use. It is proposed, therefore, to illustrate the cumulative monthly surplus or deficit for for the sample farms - this will enable inspection of the accumulated cash in any month prior to the expenditure incurred in future months.

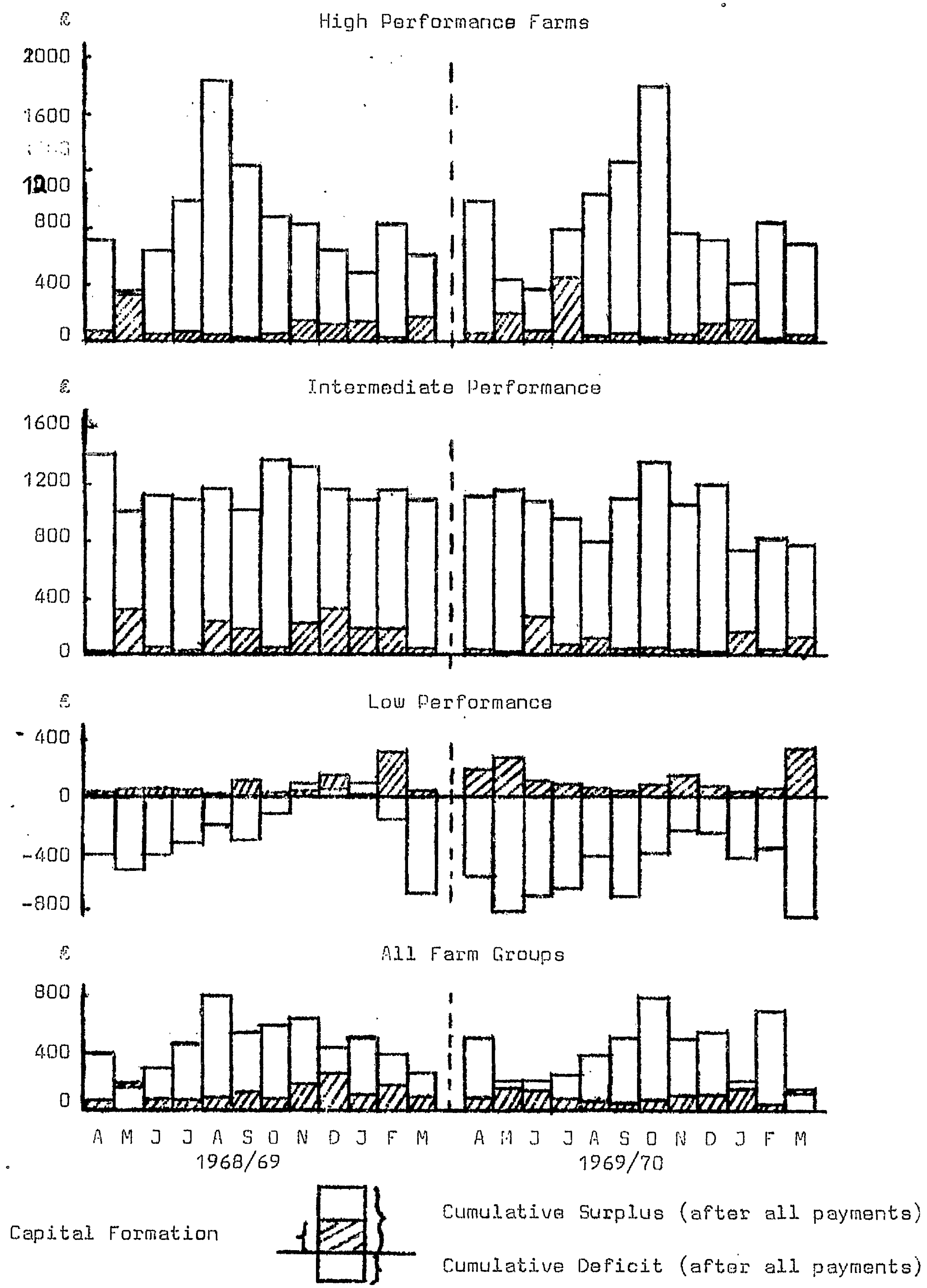
Monthly Cumulative Surplus or Deficit and Capital Formation Payments

The monthly cumulative surplus or deficit diagrams in Figure 6.5.4. p. 244 were prepared by cumulative addition of the monthly surplus or deficit values. The cumulative surplus or deficit in April each year included any surplus or deficit carried forward from the previous year.

The cumulative surplus diagram for the all farm group in Figure 6.5.4. showed a relatively even flow of cash, there being generally only gentle transitions from one month to the following month. The absolute values for the cumulative surplus indicated that the farmers, as a group, did not accumulate large amounts of cash in their bank accounts; they appeared, rather, to attempt to maintain a relatively stable situation throughout the year, thereby utilising cash as it became available. One period in the year when cash tended to accumulate, was between May and October/November - this period coincided with reduced costs, due to lower levels of purchased feedstuffs.

Comparison of the cumulative surplus or deficit diagrams, showed differences in the surplus or deficit pattern which appeared for the various performance level groups. In general, it appeared that the degree of change in the cumulative monthly surplus was greater for the high performance farms than for the other farm groups. Since the monthly values for the cumulative surplus or deficit represented the actual cash in the bank or on hand, at the end of each month, it was worth noting that the intermediate performance group maintained, on average, a higher level of bank balance than the other farm groups.

Figure 6.5.4. Monthly Cumulative Surplus or Deficit and Capital Formation



The cumulative surplus or deficit diagram was also of interest, as in the months in which it was negative, it indicated the amount of overdraft required on the farm, the season of year the overdraft was required, and for what period of time it was necessary. The low performance farm group appeared to be in a serious position regarding overdraft requirements. Although the amount of overdraft was steadily reduced over the summer period in both years, there were only three months in the first year and none in the second when no overdraft was required. In addition, this group ended with a higher overdraft requirement in March of the second year than in the same month in year one.

The bar charts in Figure 6.5.4. p.244 also illustrated the amount of capital formation which occurred each month. The amount of capital expenditure was shown on the same chart as the monthly cumulative surplus or deficit, in order to assess whether a connection existed between the amount of surplus available and the amount of capital expenditure undertaken.

Examination of the patterns of surplus or deficit and the level of capital expenditure each month showed that there was no strong link between the level of surplus and the level of capital expenditure on a month-to-month basis. If one month had a higher cumulative surplus than another, it did not follow that the month with the highest surplus available for capital formation had the highest capital expenditure, nor could a lag between an investment decision based on a high cumulative surplus and actual capital expenditure be deciphered from the two years' results.

There did appear to be some basis for suggesting that expenditure on capital formation was seasonally related. Peaks in capital expenditure appeared in May and in the winter period, even although there was no shortage of funds for capital formation in the summer season. A peak in May could be explained by farmers purchasing equipment prior to the commencement of the new season. The winter peaks could be the result of farmers taking advantage of off-season discounts or paying accounts for machines ordered earlier in the season. Unfortunately, information was not available on the time-lag between the receipt of equipment and the ultimate payment for the equipment.

In view of the lack of any large amount of evidence to support either surplus related or seasonal capital formation, it could be argued that the timing of an investment decision is a random process, which is supported by a similar finding in Section 6.4.2.1. and is investigated further in Chapter VII.

6.6. Discussion/Conclusions

The main analysis in this chapter was based on Source and Distribution of "Available Cash" sheets prepared from the Profit and Loss Account and the Balance Sheet of each farm in the sample. The use of these "available cash" sheets enabled the direct association of the productive process of the farm with the external funding of the farm. The inter-relationships of the information contained in the Source and Distribution of "Available Cash" sheets were shown diagramtically in Figure 6.1.1. This diagram served to demonstrate the complexity of cash flows on a farm. Clearly, it would have been unrealistic to investigate fully all the cash flows depicted in the diagram since some were of relatively minor importance to the majority of farms, although in individual farm cases they might assume considerable importance. In the following discussions the analysis was restricted to the four major cash flows shown in Figure 6.1.2. viz. farm generated cash, external sources of cash, capital formation and domestic consumption.

External Sources of Cash

Sundry credit (auctioneers, merchants, etc.) was the most important single source of cash measured in terms of the number of farmers using a particular type of credit. The facilities offered by merchants help farmers to overcome difficulties which arose from the short term cash flow of their businesses. All the farmers recorded sundry creditors, a situation which was expected since there normally exists a period between submission of an account and its eventual payment. Measuring the importance of credit sources in terms of a percentage of total group borrowing, sundry credit was again the primary source of borrowed funds for the tenanted farm group, followed by bank borrowing. However, the owner occupiers made almost equal use of family or private loans, bank borrowing, and sundry creditors (30% each), as sources of funds. This situation largely reflected the different type of credit required by the owner occupier compared to the tenant. The tenant required short and medium term credit whereas the owner occupier also had to finance his farm, land and buildings.

The considerable dependence on private loans by owner occupiers was very significant since this must partly determine the price which the farmer was prepared to pay for external credit. It also meant that where a private loan carried no, or only low, interest rates, the farmer could consider long term investments, usually yielding a lower return on capital, which would not otherwise have been possible, if competitive interest rates had had to be paid on any borrowed capital used. It could be argued that the large amount of private loans to agriculture represented non-optimum use of part of the nation's scarce capital resources if a high proportion of this capital was lent at interest rates below the market rate of interest. (No information was available on the interest rates being paid). On the other hand, this must be balanced by the social consequences of reducing the capital invested in agriculture and thereby the number of farms and also the opportunity cost of providing alternative employment for farmers and their sons.

The use of hire-purchase did not appear to be very widespread amongst farmers, more than likely due to the high levels of interest payable on this form of credit. Hire-purchase was, however, the only source of credit where the average loan per farm was greater for the tenanted group than for the owner occupied group. The use of hire-purchase and the extensive use of sundry credit (both expensive forms of credit) by the tenant farmer, compared with the owner occupier, again reflected the nature of the two types of businesses.

In view of the under-capitalisation of the average dairy farm which was established in Chapter V, it is relevant to consider possible reasons why farmers do not utilise, more fully, the sources of external funds available to them.

In the case of trade credit, the absolute amount of credit available is governed by the amount of business which a farmer conducts with a particular merchant. Within the limits of credit imposed by the turnover of the farm business, the amount of credit taken by the farmer is constrained by the imposition of penal interest rates by the merchant, usually after an account has been outstanding one month.

Bank loans fall into a different category from trade credit and are therefore subject to another set of constraints. Banks are often reluctant to lend on an unsecured basis - this could present a problem for many farmers, especially tenants, where lack of security could restrict the amount of a bank loan obtained. Loans are sometimes available on an unsecured basis, at higher interest rates: this leads to the more serious problem facing many tenants and owner occupiers - the inadequacy of current farm income to service additional loan capital. This problem of the inability to service loans is discussed in greater detail later.

The constraints on the amount of borrowed capital obtained in the form of private loans are not easy to establish and in the absence of factual data one can only hypothesise on possible reasons. The most likely situation is that capital was not actually lent to the farmer but was left in the business when the business was, for example, transferred from father to son. Where money is actually lent by a relative, the amount is likely to be governed by the closeness of the relationship, interest rate offered, if any, or the "need at the time" of the business. Private loans may often be loans of last resort i.e. residual loans, when the farmer has exhausted all other sources of finance. Frequently a bank or other lending agency may refuse a loan if the relative will not continue with his shareholding, and banks are often reluctant to provide loans to enable a relative to withdraw his shareholding. The farmer himself may impose a constraint on the proportion of his business financed from private sources, owing to the problem of re-financing the business if the private loan is withdrawn.

At the present time, the Government assists the farmer to reduce the amount of credit required to finance capital formation through various capital grants. The economic philosophy behind a capital grant is to reduce the marginal cost of capital formation to the farmer thus, perhaps, permitting capital formation, otherwise impossible due to the lack of security which could be offered by the farmer, or an inability to service the borrowed capital required. It is hoped by the Government that the resulting increase in efficiency of farming will result in increased farm income, through a reduction in production costs and/or increase in output. It is also possible that the increased efficiency will release scarce resources for use in other industries. An increase in farm income should lead to a reduction in income support and price support costs to the exchequer together with an increase in tax revenue to the exchequer. Eventually it is possible that farming might become capable of generating sufficient income to undertake all necessary capital formation without Government assistance.

It was shown in Section 6.3 that a considerable shortfall existed between the capital available for investment and the incremental capital requirement (I.C.R.) of the average farm. It was concluded that the sample farms required as much finance as possible from the sources available yet a preliminary assessment showed that the number of farms receiving grant in any one year could have been greater. Two reasons may account for this apparently paradoxical situation -

Firstly, evidence exists in Tables 6.2.2.1. and 6.2.2.2. to suggest grant uptake fluctuated from one year to the next. In the two year period studied, two thirds of the farmers obtained capital grants but only seven tenants and ten owner occupiers had grants in both years. However, a fluctuating pattern in grant uptake could have been anticipated, as capital formation tends to occur in cycles (Investment phases).

Secondly, the grant aid contribution towards capital expenditure was available for only 10-50 per cent of the total cost. A farmer undertaking capital formation might therefore have to finance up to 90 per cent of the cost. Thus, if the capital which could be supplied by the farmer was limited, it might not be possible for him to continue with the investment. From Figures 6.2.2.1. and 6.2.2.2. it could be seen that, although farms throughout the whole farm size range did not receive capital grants, those farms not receiving grants tended to be concentrated at the lower end of the size scale, especially owner occupied farms. A possible reason for this situation was that already outlined - that the farmer contribution to the total cost made application for a grant financially impossible. The restricted evidence in Section 6.5. on the monthly flow of cash tended to support this theory. In the survey on attitude to investment decisions reported in Chapter VII, a question is asked pertaining to the uptake of capital grants: the replies should supply additional information on the apparent reluctance of the smaller farmer to make use of Government capital grants.

The absence of grants from many of the small farms raised the question: were the available grants reaching the farms most in need of assistance? In terms of purely economic objectives, if the grants were intended to raise the output of agriculture in the most efficient manner through the use of grants, then probably the grants were largely achieving their objective - the larger farms made most use of capital grants and these farms also had the highest return on Capital (Table 5.2.2.2.) If, however, the grants also have a social objective e.g. to support the smaller, possibly less efficient farmer, on the basis of prevention of rural depopulation and/or to provide a minimum income, then the grants were not reaching the farmers most in need of assistance. It is doubtful whether any system of capital grant aid, other than a somewhat unrealistic one hundred per cent grant, would achieve the social objective mentioned, as the small, low capital intensive farm had low returns on capital in the years under study. It is probable that social objectives of the nature outlined could be achieved by the provision of low interest rate loans or through a system of deferred interest and capital repayment. In this way there would be less dis-incentive to carry out necessary capital investment on the less capital intensive farms since capital repayments with interest could be met from the resulting increase in cash flow. Subsidised credit is considered to be a viable alternative or adjunct to capital grants as the capital formation problem identified is one of inadequate cash flow rather than an inadequate return on marginal capital formation.

<u>Farm Generated Cash</u>

In Chapter V it was shown that the average dairy farm was under-capitalised if the criterion of profit maximisation was assumed to apply. It must now be assessed whether or not it is possible for the sample farms to provide their I.C.R. from farm generated funds.

The "available cash" of a farm must supply the farmer with an adequate living in addition to supplying funds for the maintenance and future growth of his business. If an adequate level of renumeration to the farmer is accepted as the average wage earned by a worker in manufacturing industry then the farmer would earn £1291 and £1458 in 1969/70 and 1970/71 respectively. Assuming the above salaries as a first charge on the "available cash" of the business, it can be seen by reference to Table 6.2.3.2., that the "available cash" on the farms was sufficient to meet this charge, However, the residual "available cash" on farms below about 100 acres would barely be adequate to cover the existing depreciation charges on capital, far less permit net capital formation for growth. Some method must therefore be found to increase the "available cash" of the smaller farm assuming it is desired to retain these smaller farms in production.

Since the Source and Distribution of "Available Cash" computation, as illustrated in Appendix II, already includes the capital formation which occurred in 1969/70 and 1970/71, the I.C.R. of the farms would require to be remedied from additional capital investment in these two years. Any immediate increase in capital formation financed by the farm can only be the result of reduced consumption and capital withdrawals. Estimates were therefore prepared of the average consumption and capital withdrawal in 1969/70 and 1970/71. The resulting values (Table 6.2.3.3. p. 207) represented the potential capital available to the average farmer, which amounted to approximately £2000 per farm, but not all of this capital was available to put towards the I.C.R., as the farmer had consumption requirements. The average earnings of a worker in manufacturing industry were deducted, therefore, from the potential extra capital and this resulted in values for the actual capital available on the average farms, of between approximately £500 and £900 per farm (Table 6.2.3.3.). The amount of cash from farm sources which was available as a contribution towards the I.C.R. was therefore small and was dependent on the farmer making greater or lesser sacrifices in terms of living standards and off-farm investment (capital withdrawal). The estimated I.C.R. was £8844 and £3470 (Table 6.2.3.4. p.208) for the average tenanted and owner occupied farm respectively. Taking the two year average of the actual capital available to contribute towards the above I.C.R., it was found the tenant could supply £622 and the owner occupier £770. The shortfall in supply of capital was therefore estimated at £8182 and £2700 for the average tenanted and owner occupied farm respectively. It was clear that shortfalls of this magnitude could not be rectified through adjustments in the consumption or off-farm investment pattern of the farmer. The solution must therefore lie in one or more of three possibilities: increased levels of farm borrowing; distribution of the I.C.R. over more than one year; increased levels of farm income.

Increased Levels of Farm Borrowing

Farmers could increase their debt by reducing their net worth. Table 4.2.5. p. 96 showed the equity percentage of the sample farms to be high: there was therefore likely to be little difficulty, in general, in obtaining extra loans. Increased loans must, however, be financed from current resources until such time as they can be serviced from the increased output generated from the net capital formation. If it was assumed that the £622 and £770 of extra capital, which could be supplied by the tenant and owner occupier respectively, was used to finance interest and loan repayment charges then £2468 and £3055[8] could be raised respectively by the tenant and owner occupier. The average owner occupier could therefore raise sufficient capital to meet the I.C.R. of his farm but the tenant farmer would still have a shortfall of approximately £6000.

Distribution of the I.C.R. over more than one year

The net capital formation required on the farms could be spread over more than one year. In this case, the income benefit gained from the net capital formation in the first and subsequent years could be utilised to achieve the optimum capital input. The average tenanted farm would require a minimum of three years to reach its optimum capital input using this approach.

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[8] It was assumed that the £622 and £770 of the tenants and owner occupiers respectively, was used annually to raise a loan at the ruling average rate of interest (8.4%) in the period 1969-1971 over a five year repayment period including repayment of principal and interest.

Increased Levels of Farm Income

The dependence of capital expenditure on the amount of "available cash" has been shown in previous paragraphs. The "available cash" in a given year will be functionally dependent on the level of farm income in previous years due to the income/investment cycle which exists in all businesses (Figure 6.3.1. p.210). The relationship between the "available cash" of the sample farms, the level of income in the previous three years, and the external supply of capital was examined, and it was found that a functional relationship existed between "available cash" and net farm income in year (t-1) and year (t-3). Firstly, these results supplied the evidence required to support the hypothesised investment cycle, viz. income invested in year (t-3) resulted in increased levels of "available cash" in year (t) due to the normal production lag on a dairy farm. Secondly, the immediate response by a farmer to a good year was reflected in the relationship between "available cash" in year (t) and farm income in year (t-1). This response can be divided into a direct response (intensification effect) and an indirect response (attributable to the relationship between NFI in years (t), (t-2), (t-3)......(t-n)). The level of farm income was therefore an important determinant of subsequent years' "available cash". Conversely, the "available cash" on the farms was not particularly sensitive to changes in the level of external credit.

It is now proposed to estimate the increase in income in the year (t-3) and (t-1) which would have been needed to obtain sufficient "available cash" to achieve the incremental capital requirement of the sample farms. These estimates are tabulated in Table 6.6.1.

Table 6.6.1. Estimated Increase in NFI Required in Year (t-1) or (t-3) to Achieve the Incremental Capital Requirement £

Required Increase in NFI	Tenanted Farms £	Owner Occupied Farms £
$NFI_{(t-3)}$	6348	1524
$NFI_{(t-1)}$	9198	1681

Note: The above values are two year averages based on the results of Table 6.3.1.3. p.217 and an assessed incremental capital requirement of the average tenanted farm of £8844 and of the average owner occupied farm of £3470.

It should be noted that the increase in income required in year (t-1) was greater than in year (t-3). This situation was quite logical since the full effects of income invested in year (t-1) would not be reflected in increased "available cash" for another two years. In addition, an identical "bundle" of farm inputs would cost more in year (t-1) than in year (t-3) due to the effects of inflation, although it is known that the latter effect was limited in the years under study.

The amount of increased income required in year (t-3), or the later (t-1) year, in order to generate sufficient "available cash" to satisfy the I.C.R. of the average owner occupied and tenanted farm was considerable (Table 6.6.1. p.253). The average owner occupied farmer would have required an increase in income in year (t-3) or year (t-1) which was almost equal to the average income earned by the farmers in these two years. Thus a doubling of income would have been required to supply the necessary "available cash". The extra income required by the average tenant farmer was three times his existing income. A four fold increase in income would therefore have been necessary to supply the "available cash" to this group but increases in income of two or four fold within one year are quite unrealistic. A partial solution, already suggested as a possibility, would be an extension of the period during which the farmers could achieve their I.C.R. but on balance, farm income did not appear the most hopeful initial source of funds for the needed capital investment.

The evidence presented suggested that the average dairy farmer, especially the tenanted farmer, was not capable of obtaining optimum capital input levels, in the short term, from internally generated funds (income, reallocation of consumption and capital withdrawal, or increased loans serviced from existing "available cash") or, indeed, from the use of Government grants in their existing form. In terms of the theoretical distribution of "available cash" diagram (Figure 6.4.1. p.218), the above evidence suggested that the average dairy farm in West Scotland was operating on the C+R+N function to the left of the 45^{o} line i.e. the net capital formation from the "available cash" was inadequate.

The average dairy farmer was not in a "self help" situation with regard to his I.C.R. Government action would be required if the average dairy farmer was to increase his input of capital resources quickly, in order to operate under conditions of economic efficiency (maximising profits from the equation of marginal revenue product and marginal factor costs). In order to achieve a smooth transition towards the I.C.R. of the farms, the Government would require to continue the capital grants to agriculture but in a wider context, to include the provision of capital for the purchase of breeding stock. Due to the limited funds available for capital formation on the average dairy farm, the percentage contribution of the grant towards the total cost should be carefully considered and could be placed on a sliding scale according to individual farmer requirements. Alternatively, in the case of many farmers, or deferred repayment of loans and interest, might if this method of financing capital expenditure allowed a lower annual outflow of cash. By taking such action, the Government would hope that farm income would, as time went on contribute more to the future capital requirements of the farm business, thus permitting the option of phasing out the capital grants scheme and/or any low interest rate and deferred repayment loans. It could be argued that the introduction of low interest rate loans (subsidised credit) would represent interference in the price mechanism, thereby causing an imbalance between the supply of funds for investment and the return available on these funds. This could result in depressed marginal returns on capital and non-optimum allocation of the national capital resources. Other objections to credit subsidisation include potential over-commitment or abuse of the system by the farmer, the open-ended nature of any commitment by the Government to such schemes (i.e. the difficulty in assessing the true cost to the exchequer) and the "after care" required to ensure regular repayments of the outstanding loan. "After care", however, need not be a problem, if the method of loan repayment is linked to a "bankers order" type system. Although it may be administratively easier to subsidise agriculture by other means, most forms of direct assistance do not assist the farmer to help himself whereas, Government capital grants and subsidised credit would go some way towards rectifying the fundamental problem of inadequate capital formation.

When the fundamental capital formation problem is one of inadequate cash flow to service the additional capital required to optimise the capital input to dairy farms, credit subsidisation is a viable alternative to Government capital grants. If, however, inadequate capital formation is due to the marginal return on the required capital formation being less than the competitive interest rates Government capital grants are probably more appropriate. This situation could occur if the relative profitability of agriculture, compared to other industries, was imbalanced but, nevertheless, it was deemed in the national interest to encourage investment in agricultural capital. The evidence from the study suggested, however, that the capital formation problem of dairy farmers in West Scotland fell mainly into the former category.

Subsidised credit would make capital formation feasible which, otherwise, would have been impossible due to the inability of many farmers to service the loans required. The improved cash flow generated by the capital formation would increase farming efficiency and, hopefully, would reduce the future need for other forms of farming subsidy. In view of the re-emergence of the balance of payments as a major issue (1975) in the U.K. economy, and the need to reduce payments under the C.A.P. of the E.E.C., it may be easier politically, than in previous years, to justify the provision of "cheap" capital to agriculture.

The distribution of "available cash" on the dairy farm is divisible into two fundamental parts: consumption and capital formation. These two major categories are discussed separately.

Allocation of funds to consumption or capital formation is mutually exclusive. It has already been shown that a conflict existed between funds for capital formation and consumption. Estimates made for the allocation of funds to consumption and capital formation confirmed the findings of other writers, that farmers devote a considerable part of their cash resources to farm development rather than consumption. Approximately one third of the "available cash" was invested on farms and 40 per cent consumed. These relative proportions suggest that farmers were prepared to consider sacrifices in terms of their living standards in order to secure the future existence of their business. This attitude of the farmer to capital formation versus consumption is examined further in Chapter VII.

Consumption

The fundamental purpose of a farm business is that it should provide an adequate standard of living for the farmer. This can be assessed from his consumption of the "available cash" of the business. In general, the higher the level of consumption, the higher was his standard of living.

Estimates of the consumption levels on the sample farms were made using the relationship between consumption and farm size. The result was not as good as desired; indeed, a statistically non-significant relationship existed between consumption and farm size for the owner occupied farm group in 1970/71. The lack of association between consumption level and farm size confirms that a farmer (like any other worker) requires a basic level of income which is more likely to be determined by the size of his family, age, ambition, etc. The best measure of association between consumption and farm size was obtained in the case of the tenanted farms in 1970/71 where 34% of the variation in consumption was explained by farm size. Further comments on the relationship between farmers income and others, are based largely on estimates prepared from this "most reliable" estimating equation. The fact that one third of the variation in consumption could be explained in terms of farm size suggested that, after the basic requirements for consumption were satisfied, the subsequent consumption demands were related to farm size. The larger farm was known to have larger levels of income in absolute terms than the smaller farm. It appeared that as farm size increased, income increased, and the corresponding level of consumption, living standard, increased.

Comparison of a farmer's consumption level with that of the average manufacturing industry worker showed that those farmers operating with less than 100-150 acres (22-48% of the total sample) had a standard of living below that of the industrial worker, in the period under study. It should be appreciated that this comparison was strictly in terms of money and that certain 'perks' of the farmer e.g. being one's own boss, 'way of life', etc. might to some extent compensate him for a lower money wage. However, considering the responsibility involved in managing and operating a dairy farm, many farmers were not adequately remunerated for their work.

An increase in consumption was dependent on an increase in the "available cash" on the farm, which in turn was determined primarily by an increase in farm income. It can now be seen that pressure to increase the level of farm income arises not only from the need for capital formation but also from the necessity to increase the cash available for consumption: this capital formation-versus-consumption cycle was illustrated in Figure 6.4.1.1. p.223. Since farmers with less than 100-150 acres were already operating at below parity income with the average manufacturing industry worker, it was difficult to see how these farmers could reduce their consumption further in order to release cash for capital formation. In any event, it has already been shown that any such cash released was inadequate to meet the optimum capital requirements of the average business. It can only be concluded that it would be difficult; if not impossible, for the small to average size dairy farmer to break free of the capital formation versus consumption cycle in order to administer 'self help'. Capital, therefore, requires to be provided from sources outwith the farm.

Capital Formation

If investment is viewed as a conversion or decision-making process, then it is possible to differentiate between investment (the decision) and capital formation (the result of the decision - the physical assets). This distinction is useful in the analysis of the "available cash" allocated to capital expenditure, and subsequently, in Chapter VII, it permits the attitude of the farmer to investment to be separated from the actual capital formation. Elsewhere in this study, the term investment was retained in its conventional role to minimise the likelihood of misinterpretation.

Replacement and Net Capital Formation

Capital formation is essential for the long-term existence of the farm business because physical capital assets depreciate over time and would ultimately become completely unproductive (no output generated from their use). Capital formation is not only necessary to maintain the existing productive capacity of the business (replacement capital formation) but also to increase the production from the business (net capital formation). Theoretically, increases in the total output of a business are possible if the plane of productivity of the existing capital is increased, This would result where replacement capital was more productive than the capital which it replaced. Increased output of dairy farms in West Scotland was due less to this cause than to net capital formation. The net formation component of gross capital formation can now be seen to equate with the growth of the farm business in terms of the output achieved. It was therefore relevant to attempt to isolate the net element of the gross capital formation.

Net capital formation may not always result from the desire for growth within the farm business. The situtation frequently arises when a farmer is faced with replacement capital items which are more sophisticated than the existing equipment e.g. extra facilities on a tractor, (more power, etc.). The farmer may not desire or need these facilities which represent additional capital inputs. He is therefore forced into higher levels of capital use which can be costly and may represent non-optimum use of his resources. Net capital formation can therefore result in increased levels of output due to one or both of two effects. Firstly, increases in output may be due to the increase in resource intensity and secondly, output increases may be due to a higher plane of productivity. Increases in the productivity of capital can arise from inherent factors e.g. scientific and technological advances, but also from exogenous factors e.g. improvement in the quality of management applied to the capital resource. These two possibilities were demonstrated conceptually in Figure 6.4.2.3. p.226 but reference to Figure 5.6.1. p.162demonstrated that for West Scotland dairy farmers, any increase in productivity was likely to be slight in the short-term. Increased output attributable to net capital formation would therefore be the result of intensity effects.

It still remained to be determined whether it was possible to estimate the replacement and net capital components of gross capital formation without recourse to the production function techniques applied in Chapter V. In theory, it was possible to isolate the net and replacement components by making certain assumptions regarding the depreciation charged and the sale value of capital items. The method appeared to be satisfactory regarding the estimated value of replacement capital but difficulty was experienced with the estimation of values for net capital formation. Since the net capital formation values, as calculated, were residuals, it was found that several farms had negative estimates for net capital formation i.e. Net Capital Consumption. This situation arose when the gross capital formation on a farm was less than the replacement capital formation i.e. purchases of capital were less than the sales plus depreciation of capital. It could be argued that this represented a breakdown of the methodology employed, but if it is assumed that the rate of annual depreciation charged (20%) was realistic, (if anything it was underestimated) then the existence of net capital consumption, rather than indicating a breakdown of the methodology, demonstrated a deleterious situation on some farms - that the estimated replacement capital required to maintain the existing capital stocks intact was, in practice, not forthcoming.

A relatively good relationship was shown to exist between the level of replacement capital formation and farm size. The evidence suggested that the amount of replacement capital formation fell proportionately with increases in farm size. This reflected the cost economies which exist on larger farms through the spreading of capital costs due to the use of larger machines. No statistically significant difference existed between the amount of replacement capital formation undertaken by the tenant or occupier farmers. It seems realistic, therefore, to assume that both tenants and owner occupiers adopted similar policies regarding capital replacement, this is in fact confirmed in Chapter VII.

No systematic pattern existed between the level of net capital formation and farm size (Figures 6.4.2.5. and 6.4.2.6.) - there was, however, a tendency for net capital consumption to be associated with the smaller farm sizes. The situation was similar with the uptake of Government grants, and was reflected in the poor performance of the small farms, especially the tenants, in terms of percentage return on tenants capital (Figure 5.7.1.p.167). Net capital consumption was not completely restricted to the smaller farm sizes as 34 and 30 farms in 1969/70 and 1970/71 respectively had net capital consumption but only eighteen farms showed net capital consumption in both years and it was this group which was in the most serious position as their capital stock was diminishing. Since capital formation occurs in cycles, it is perhaps premature to conclude that farms with net capital consumption in two successive years were in a situation in which the business was deteriorating. It is quite possible for the accumulated deficit in replacement capital formation to be remedied in a future period. It could be argued that only after three or four consecutive years of net capital consumption is a farm in danger from irretrievable under-capitalisation. In general, the amount of replacement capital formation was adequate on the majority of farms, and a considerable amount of cash was being expended on net capital formation for growth of the farm businesses involved (Figures 6.4.2.4. and 6.4.2.5.).

The method used to seperate the two components of gross capital formation was only considered successful to a limited extent. If the concept were to be developed further, it becomes necessary to determine the farmer's motive behind replacement and net capital formation. Assuming that replacement capital formation occurs when a capital item wears out - and the available evidence in Chapter VII suggests this to be the case - then more accurate measurement of the "wearing out" process is necessary via the depreciation charged. The reliability of estimates of replacement capital formation could be considerably increased if the age structure of all the capital on the farm was known. The reasons motivating net capital formation are different from those for replacement capital formation in that a conscious decision has been made to encourage the growth of the business. Possible motives investigated later are falling income, rising costs and status.

Variation in the estimated level of capital formation between years and tenure groups, both in terms of replacement and net capital formation, tended to suggest that capital formation was a random process. Work by Campbell[9] in Australia lead to a similar conclusion. If capital formation is a random process, it is virtually impossible to construct a quantitative model to predict capital formation on farms, which is quite distinct from the ability, which has been demonstrated, to predict the optimum level of capital formation required.

The Monthly Cash Flow on Dairy Farms

Earlier it was shown that one possibility of achieving the optimum capital input on the average dairy farm was to increase the non-equity capital of the business. If this solution was adopted, the credit worthiness of the farmer would assume considerable importance. It was seen in Table 4.2.5. p.96 that the equity percentage of the sample farms was high - restrictions on further credit were unlikely, therefore, to be due to a high level of existing loans. An important feature of farmer credit worthiness which is becoming more fully appreciated, is the ability to meet the loan repayments regularly. The cash flow on the farm is then seen to be a major determinant of the borrowing capacity of the business. As farm production is seasonal this can place severe restrictions on the cash flow, but dairy farmers are perhaps more fortunate than other types of farmers in that they have a monthly milk revenue. Nonetheless a small pilot survey on the pattern of the cash flow was carried out on a sub-sample of the farms under review.

The monthly receipts varied in absolute amount from month to month and from one performance group to the next. When the monthly receipts were compared with the monthly surplus or deficit on the sample farms (Figures 6.5.2. p.240 and 6.5.3. p.242), it became clear that the level of receipts did not, in itself, determine the performance of the farms. Considering only the receipts, it was seen from Figure 6.5.2. that the high performance farms had

(9) Literature review p. 22.

the highest levels of receipts, in general, followed by the low performance farms, and finally the intermediate performance level farms. If the monthly surplus or deficit was considered, the effect of the interaction of receipts and payments was observable and the amount of surplus or deficit was directly related to farm performance level. Three types of production could therefore be identified: high output, intermediate costs $\longrightarrow$ high performance; low output, low costs $\longrightarrow$ intermediate performance; intermediate output, high costs $\longrightarrow$ low performance. The monthly surpluses or deficits fluctuated considerably from month to month, but evidence of a seasonal pattern did exist. The most likely period for a farm to be in surplus was the summer months.

The cumulative monthly surplus was found to be a relatively even flow. (Figure 6.5.4. p.244-All Groups Result.) Farmers, as a group, did not tend to accumulate cash, but utilised the cash as it became available i.e. allocated it to on or off-farm purposes but did not accumulate it in their bank current accounts. The cumulative surplus also gave an indication of the amount of cash which was available for servicing extra loans. It was clear that the monthly amount was not great, based on the all groups results - about £30 per month was available if it was desired to remain in surplus each month. This amount of cash, together with cash presently invested off-farm did, in fact, equal approximately the amount of extra capital estimated to be available for servicing new loans in Section 6.2.3. The high and intermediate performance farms could make greater amounts of cash available than at present, but the low performance farms were unable to do so. The deficits incurred by the low performance farms represented the amount of overdraft required. Although this amount was reduced at certain periods of the year, these farmers ended the second year with a higher overdraft commitment than at the end of the first year studied. It must be concluded that this farm group was in a serious position and that the individual would find it difficult to remedy the situation from his own resources.

The cumulative surplus in the all groups results was examined with a view to linking the level of surplus with the amount of capital formation undertaken. No association could be established between the amount of the monthly cumulative surplus and the capital expenditure each month, even after allowing for a possible time lag between ordering the capital item and its ultimate payment. Limited evidence did exist to suggest a seasonal pattern of capital formation with peaks in May and early Autumn/Winter. Such a situation could be explained by farmers purchasing capital prior to the start of the new season or taking advantage of off-season discounts. As it is hazardous to interpret farmers' investment decisions from the resultant capital formation, the farmers were asked their motives for capital formation in a survey, the results of which are reported in Chapter VII. The limited evidence to support either available funds or seasonally related motives for the timing of capital formation, would add weight to an earlier hypothesis that investment decisions, and hence capital formation, were a random process.

In the present chapter, the I.C.R. of the average tenanted and owner occupied farm was estimated using results available from Chapter V. It was shown that the average dairy farmer might have difficulty in supplying the capital required. The capital formation problem of West Scotland dairy farmers was established as being one mainly of inadequate cash flow, rather than an inadequate return on marginal investment to justify future capital formation. Solutions, and the constraints on their application to this problem, were considered, including the possibility of capital being made available from reduced personal consumption, farm-generated sources, and reduced equity holding in the farm business. It was concluded that many farmers would be unable to optimise their capital inputs due to the existence of a consumption versus capital formation dilemma. Government action through the provision of capital grants for short-term capital and/or subsidised credit was seen as a means of enabling dairy farmers in West Scotland to undertake the necessary capital formation.

No study of capital investment would be complete without an assessment of the modifying influence of a farmer's view on the economic criteria adopted in this study. Farmers' views on the investment decision and capital formation process, and their goals for the future of their businesses are, therefore, the subject of the penultimate chapter.

Table I

Test of Significant Difference between the "Coefficients of Determination" of the Estimating Equations for "Available Cash" Regressed on Farm Size

Year	Farm Type	Dependent Variable	r^2 of linear est.	r^2 of log-linear est.	Level of Significant Difference of Higher r^2 Over Lower r^2
1969/70	Tenanted	X_9	0.3332	0.5624	***
	Owner Occupier	X_9	0.3144	0.3940	*
1970/71	Tenanted	X_9	0.4134	0.5558	**
	Owner Occupier	X_9	0.4466	0.4718	NS

* Significant at P = 0.05 level

** Significant at P = 0.01 level

*** Significant at P = 0.001 level

NS Not significant

Table 2

Relationship between Capital Withdrawn plus Private Drawings and Farm Size

Dependent Variable	1969/70									
	Tenanted Farms					Owner Occupied Farms				
	Relation Number	Constant	b	S.E. of b	% Var. Exp'nd	Relation Number	Constant	b	S.E. of b	% Var. Exp'nd
Potential Capital available from farm sources	1	584.88	9.4082	3.0250	28	2	727.04	6.9909	2.1320	12
	1970/71									
Potential Capital available from farm sources	3	860.15	6.5401	1.9891	24	4	818.16	8.7450	3.0103	14

Note: Relationships are all linear with adjusted farm acreage as the independent variable (X_1). Relationship 1 was significant at the P = 0.001 level while 2,3, and 4 were statistically significant at the P = 0.01 level.

Table 3 - Equation 1 Relation 1 - Tenanted Farms 1969/70

Zero Order Correlation Matrix					Variable	b	S.E. b	Sign of b	Constant	% Var. Exp'nd
X_7	X_8	X_9	X_{10}	X_{11}						
1.000	0.531	0.521	0.635	0.400	X_7	-	-	-	968.47	43.3
	1.000	0.792	0.682	0.531	X_8	0.2327	0.662	NS		
		1.000	0.676	0.556	X_9	0.1277	0.6800	NS		
			1.000	0.415	X_{10}	2.0174	0.9129	S*		
				1.000	X_{11}	0.1209	0.1940	NS		

Table 4 - Equation 1 Relation 2 - Tenanted Farms 1970/71

Zero Order Correlation Matrix					Variable	b	S.E. b	Sign of b	Constant	% Var. Exp'nd
X_7	X_8	X_9	X_{10}	X_{11}						
1.000	0.782	0.761	0.798	0.700	X_7	-	-	-	1899.30	74.0
	1.000	0.866	0.758	0.630	X_8	0.4814	0.3302	NS		
		1.000	0.792	0.640	X_9	0.0805	0.3771	NS		
			1.000	0.657	X_{10}	0.6188	0.3052	S*		
				1.000	X_{11}	0.1799	0.1152	NS		

Table 5 - Equation 1 Relation 3 - Owner Occupied Farms 1969/70

Zero Order Correlation Matrix					Variable	b	S.E. b	Sign of b	Constant	% Var. Exp'nd
X_7	X_8	X_9	X_{10}	X_{11}						
1.000	0.818	0.831	0.681	0.080	X_7	-	-	-	1375.99	72.8
	1.000	0.876	0.800	0.183	X_8	0.8931	0.4290	S*		
		1.000	0.756	0.108	X_9	1.2146	0.4466	HS**		
			1.000	0.112	X_{10}	-0.0144	0.4757	NS		
				1.000	X_{11}	-0.0287	0.0531	NS		

Table 6 - Equation 1 Relation 4 - Owner Occupied Farms 1970/71

Zero Order Correlation Matrix					Variable	b	S.E. b	Sign of b	Constant	% Var. Exp'nd
X_7	X_8	X_9	X_{10}	X_{11}						
1.000	0.755	0.715	0.659	0.149	X_7	-	-	-	932.49	59.4
	1.000	0.839	0.835	0.214	X_8	1.7840	0.6600	HS**		
		1.000	0.876	0.144	X_9	1.0177	0.6997	NS		
			1.000	0.050	X_{10}	-0.3757	0.8190	NS		
				1.000	X_{11}	-0.0130	0.0916	NS		

Table 7 - Equation 2 Relation 5 - Tenanted Farms 1969/70

	Zero Order Correlation Matrix						b	S.E. b	Sign. of b	Constant	% Var. Exp'nd
	X_7	X_8	X_9	X_{10}	X_{11}	X_3					
X_7	1.000	0.531	0.521	0.635	0.400	0.554	-	-	-		
X_8		1.000	0.792	0.682	0.542	0.444	0.3824	0.6410	NS		
X_9			1.000	0.676	0.556	0.586	-0.2974	0.6893	NS		
X_{10}				1.000	0.415	0.441	1.8589	0.8754	S*	-1090.47	50.6
X_{11}					1.000	0.514	0.0166	0.1937	NS		
X_3						1.000	19.3462	10.5652	NS		

Table 8 - Equation 2 Relation 6 - Tenanted Farms 1970/71

	Zero Order Correlation Matrix						b	S.E. b	Sign. of b	Constant	% Var. Exp'nd
	X_7	X_8	X_9	X_{10}	X_{11}	X_3					
X_7	1.000	0.782	0.761	0.798	0.700	0.610	-	-	-	1382.81	74.8
X_8		1.000	0.866	0.758	0.630	0.553	0.3888	0.3458	NS		
X_9			1.000	0.792	0.640	0.444	0.1821	0.3937	NS		
X_{10}				1.000	0.657	0.586	0.5269	0.3217	NS		
X_{11}					1.000	0.551	0.1501	0.1197	NS		
X_3						1.000	4.8319	5.2078	NS		

Table 9 - Equation 2 Relation 7 - Owner Occupied Farms 1969/70

	Zero Order Correlation Matrix						b	S.E. b	Sign. of b	Constant	% Var. Exp'nd
	X_7	X_8	X_9	X_{10}	X_{11}	X_3					
X_7	1.000	0.818	0.831	0.681	0.080	0.621	-	-	-	24.18	78.5
X_8		1.000	0.876	0.800	0.183	0.588	0.7912	0.3891	S*		
X_9			1.000	0.756	0.108	0.547	1.0406	0.4074	S*		
X_{10}				1.000	0.112	0.560	-0.3533	0.4434	NS		
X_{11}					1.000	0.576	-0.1470	0.0611	S*		
X_3						1.000	18.9388	6.0660	HS**		

Table 10 - Equation 2 Relation 8 - Owner Occupied Farms 1970/71T

	Zero Order Correlation Matrix						b	S.E. b	Sign. of b	Constant	% Var. Exp'nd
	X_7	X_8	X_9	X_{10}	X_{11}	X_3					
X_7	1.000	0.755	0.715	0.659	0.149	0.677	-	-	-	-1124.92	67.2
X_8		1.000	0.839	0.835	0.214	0.679	1.1154	0.6425	NS		
X_9			1.000	0.876	0.144	0.588	0.9252	0.6393	NS		
X_{10}				1.000	0.050	0.547	-0.5268	0.7489	NS		
X_{11}					1.000	0.573	-0.1989	0.1044	NS		
X_3						1.000	32.6159	10.9623	S*		

Table 11a - Test for Significant Difference between b Coefficients of Equations 3 and 4

Tenanted Farms						
1969/70						
Relation	Var.	df	t at P=0.05	s_b	ts_b	$b \pm ts_b$
9	X_8	32	2.04	0.4800	0.9792	$0.1167 < b < 2.0751$
13	X_{10}	32	2.04	0.6759	1.3788	$0.9686 < b < 3.7262$
1970/71						
10	X_8	32	2.04	0.2165	0.4417	$0.4211 < b < 1.3045$
14	X_{10}	32	2.04	0.9912	2.0220	$-1.0308 < b < 3.0132$

No significant difference between b coefficients of X_8 and X_{10}

Table 11b - Test for Significant Difference between b Coefficients of Equations 3 and 4

Owner Occupied Farms						
1969/70						
Relation	Var.	df	t at P=0.05	s_b	ts_b	$b \pm ts_b$
11	X_8	50	2.01	0.1989	0.3998	$1.4216 < b < 2.2212$
15	X_{10}	50	2.01	0.3848	0.7734	$1.9966 < b < 3.0504$
1970/71						
12	X_8	50	2.01	0.3298	0.6629	$1.7241 < b < 3.0499$
16	X_{10}	50	2.01	0.4034	0.8108	$1.4580 < b < 3.0796$

No significant difference between b coefficients of X_8 and X_{10}

Format of Source and Distribution of "Available Cash" computation sheet.

FARM NO. ____________

FARM TYPE ____________

SOURCE and DISTRIBUTION of CASH

STATISTICAL YEAR YEAR END __________

SOURCE OF CASH	£	£	£
Net Profit			
Add Depreciation on Machinery, Equipment and Vehicles			
" " Fixed Capital			
Charge for Board and Lodging of Employees			
Sales of Machinery, Equipment, Vehicles			
" " Buildings and Land			
Grants received on Capital Expenditure			
Personal Cash introduced into the Business			
Decrease in Valuation of Livestock, Crops, Stores			
Decrease in Sundry Debtors			
Decrease in Cash and Bank Balances			
(Increase in Overdraft)			
Increase in Loans and Bonds			
Increase in Sundry Creditors			
Deduct Produce consumed in the House			
Private Share of Expenditure			
TOTAL CASH "AVAILABLE" WITHIN YEAR			
DISTRIBUTION OF CASH			
Purchases of Machinery, Equipment and Vehicles			
" " Buildings and Land			
Increase in Valuation of Livestock, Crops, Stores			
Increase in Sundry Debtors			
Decrease in Overdraft			
Increase in Cash and Bank Balances			
Decrease in Loans and Bonds			
Decrease in Sundry Creditors			
Personal Drawings (including "wife's"wage")			
Taxation			
Capital Withdrawn			
Other Drawings			
TOTAL CASH "DISTRIBUTED" WITHIN YEAR			

CHAPTER VII

THE MOTIVES TO INVEST IN WEST SCOTLAND DAIRY FARMS

7.1 Introduction

Economic analysis of the capital structure of farms, such as has been attempted in earlier chapters, relied on the assumptions of profit maximisation, increased income, and profitability, as the principal aims of economic activity. However, it is undoubtedly true that, in relation to specific decisions, motives other than those of an economic nature are likely to be important. The investment policy and capital structure on a farm will, therefore, be conditioned by the motives of the individual farmer. Although the motives of the farmer, which initiate a response in economic terms, are obviously critical to a fuller understanding of, in this case, capital investment, little published work exists on the question of a farmer's motives. Existing studies showed farmers had a low propensity to borrow funds for investment and, more recently, Harrison [1] indicated career stage to be the primary motivation of a farmer.

As no published work exists on the subject of farmer motivation on West Scotland dairy farms, it was decided to conduct a survey of farmers in the above area. The survey envisaged had two objectives: firstly, to establish the practicality of carrying out an attitude survey and the problems involved; and secondly, to assess the non-economic reasons governing the motivation and attitude of West Scotland dairy farmers to capital investment in their farms. The determination of the important factors which affect the decision to invest should permit modification of the earlier economic analysis of capital formation to take account of the farmer's attitude to investment decisions.

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(1) Literature review Section 2.2.3.p.23

7.2 The Survey

The survey was conducted by personal interviews with farmers during 1973/74 and covered those farmers whose farm results were analysed in the preceding chapters of this study. The response to the survey is shown in Table 7.2.1. below.

Table 7.2.1. Response Rate to Motivation Survey and Reasons for Non-Response

		No. of Farmers In Sample	No. of Farmers Responding	Reason for no Response	% Response
Tenants	LARGE	11	11		100
	MEDIUM	15	15		100
	SMALL	10	9	1 Retiral	90
Owner Occupiers	LARGE	20	19	1 Retiral	95
	MEDIUM	14	13	1 Death	93
	SMALL	20	19	1 Ill Health	90
TOTAL		90	86		93

The response rate to the survey was effectively one hundred per cent. No practising farmer refused to answer the questions asked. Non-response, in all cases, was due to legitimate and unavoidable causes: two farmers had retired, one was ill and one had died.

The number of questions asked was kept to the minimum consistent with obtaining the information required. In this way, it was hoped to encourage the farmer to give reasoned answers to the questions posed. The choice of questions included in the survey was influenced mainly by the preliminary results of the economic data analysed in Chapters IV - VI together with questions designed to establish the applicability, to dairy farmers in W. Scotland, of factors found to be important in motivating farmers in previous published studies. A copy of the survey form used is illustrated in Appendise I p. 308.

At this point it is worth commenting on some of the problems encountered with the survey. In retrospect, it was considered that less help might have been given to the farmers in answering some of the questions e.g. in question 5, a list of possible reasons for investment was suggested. This may have influenced the farmers in their replies, in that they felt obliged to select a suggested reason even although they personally considered a non-specified reason to be more important. While accepting this possible criticism, it must be stated that question 5 and similar questions do supply some indication of a farmer's thinking.

A proportion of the farmers interviewed required some assistance to answer the questions asked due, in the main, to differences in the definition of terms used, between the survey and the farmer e.g. in question one, when asked about plans for investment some farmers replied that they had no plans, even though under the terms of the survey, capital formation was planned. This situation arose due to certain farmers not associating investment with increased cow numbers, but only with purchased machinery, etc. This situation was not serious and was easily remedied through prompting. Some difficulties might have been avoided by rephrasing the questions asked; such instances are dealt with more fully later in the text.

The estimates of the farmers' ages may be subject to error, as it was decided not to request their ages directly. The age of the farmer was therefore based on the judgement of the interviewer.

The results in Section 7.3 are presented in the form of frequency distribution tables of farmer numbers (responses). In certain instances, the low numbers per cell might be criticised as not representing anything constructive about the farmer's attitude to the questions asked. Fortunately, in the majority of tables, there was usually at least one cell containing farmer numbers which were clearly much greater than those in any other cell, thus indicating the importance of that particular factor. In addition, the information available on farmers' attitudes to investment and capital formation was generally limited and, in particular, was non-existent for West Scotland dairy farmers. The analysis was hence considered to yield useful evidence and tentative conclusions on many aspects of the attitude problem which have been surmised in the past, but for which no documentary evidence existed to substantiate the claims.

7.3 Results of Survey

The question asked first was to establish whether or not the farmer being interviewed had any plans for capital formation in the near future. The replies of almost two thirds implied they had no plans. The proportion of tenants with no plans (72 per cent) was higher than for the owner occupiers (58 per cent) but the difference was not statistically significant at the $P = 0.05$ level. This result suggested that the majority of farmers were hesitant in committing further resources to dairy farming. In order to assess possible reasons for this reluctance, all the farmers were asked to place, in order of importance, the most difficult obstacles in planning changes (Question 10). Their replies are shown in Table 7.3.1. on the following page.

Table 7.3.1. Obstacles to Capital Formation - Distribution by Farmer Numbers

Obstacles to Capital Formation	ORDER OF PREFERENCE								
	TENANTS				OWNER OCCUPIERS				
	1	2	3	4	1	2	3	4	5
Sources of Advice	-	-	-	-	-	-	-	-	-
Planning Difficulties	1	1	2	2	5	3	-	-	-
Labour Difficulties	2	2	1	2	4	3	2	2	-
Obtaining Capital	7	6	1	-	9	5	3	-	-
Difficulty in Changing System	4	2	1	1	9	2	4	-	-
Future Uncertainty	3	4	2	-	9	5	2	-	1
Rate of Interest on Borrowed Capital	4	-	2	-	5	8	4	-	-
Other Reasons	14	-	-	-	10	-	1	-	-

Analysis of the above table showed that difficulty in obtaining capital was the primary inhibition among the suggested reasons for tenants not having plans for capital formation. This reason was followed jointly by difficulty in changing the existing farm system and the rate of interest on borrowed capital. Owner occupiers selected obtaining capital, changing system, and future uncertainty, as being jointly most critical. Both the owner occupied and tenanted farmer groups considered reasons other than those suggested, to be important factors affecting capital formation. As might be expected the "other reasons" tended to differ between the two groups. Tenants suggested that lack of co-operation of landlords was a serious disincentive to expansion and technical problems, such as slurry disposal, were also cited as drawbacks.

Owner occupiers considered the difficulty of obtaining a builder to carry out required alterations to be the greatest restriction. Both groups contained farmers who said there were no problems at all and six farmers stated that the reason for their having no plans for the near future, was due to their having recently completed a major capital formation project.

The thirty-one farmers who did have plans for capital formation were asked the detail in which they prepared for their investment decisions (Question 2a), and whether they prepared the details themselves (Question 2b).

Table 7.3.2. Planning Detail - Distribution by Farmer Numbers with Plans

Farm Type	Details With P. & L. Account	Details With Budget	Details With Cash Flow	Brochure Details	Less Detailed	Total Farmers With Plans
Tenanted	-	1	1	-	8	10
Owner Occupied	3	2	1	3	12	21
TOTAL	3	3	2	3	20	31

The dairy farmers under study apparently did not base their investment decisions on detailed economic calculations, as very few plans were prepared with the aid of profit and loss accounts, budgets, or cash flows. Of the farmers (8) preparing details with profit and loss accounts, budgets, or cash flows, only two prepared the details themselves. Most help in preparation was given by bankers and the College Advisory Service.

Since most dairy farmers do not base their investment decisions on some form of budget, it was worth considering how far the existence of Government capital grants influenced the investment decision and also whether or not the farmers expected a rate of return, in the formal sense of the term, from their capital inputs.

Table 7.3.3. Influence of Capital Grants on the Level of Capital Formation; Rate of Return Expected - Distribution by Farmer Numbers

Farm Type	Influence of Cost			Expectation of a % Rate of Return					
	Gross Cost	Net Cost	Neither	A Rate Expected	No Rate Expected	Amount of Rate Expected % 0-5	5.1-15	15.1+	No. Est
Tenanted	-	9	1	6	4	2	-	2	2
Owner Occupied	4	11	6	7	14	-	-	2	5
TOTAL	4	20	7	13	18	2	-	4	7

From the above table it was clear that the large majority of farmers with plans for capital formation took into account the net cost (i.e. gross cost less capital grant) of the proposed capital formation, when formulating a decision to invest.

The majority of farmers had no expectation of a percentage rate of return. This result was biased by the owner occupiers as it can be seen that tenants tended to expect a rate of return on their capital. The farmers who stated that they expected a percentage rate of return were questioned more closely regarding the actual percentage that they anticipated. It was found that seven of the thirteen farmers expecting a rate of return could attach no definite value to their expectations. This was interpreted to mean that farmers do expect something in return (say an increase of x gallons of milk) but do not think in terms of a percentage return. A rephrasing of questions 9a and b might well have elicited more information in this instance.

The motive behind an investment decision will determine the type of capital formation which occurs. The farmers were therefore presented with several possible motives and asked to consider whether they were applicable or not. Table 7.3.4. indicates the number of farmers who selected each factor, whether singly or in a combination of two or more factors. For a more detailed analysis of the combinations selected see Appendix II Tables 1 and 2.

Table 7.3.4. Motives for Capital Formation - Distribution by Farmer Numbers

Motives for Capital Formation	FARM TYPE		
	Tenanted	Owner Occupied	All Farms
Slow Decline in Profits	-	-	-
Maintain Profits	-	3	3
Increase Profits	3	6	9
Improve Working Conditions	6	14	20
Increase Labour Efficiency	3	11	14
Capital Available	4	8	12
Tax Considerations	-	3	3
Other	2	8	10

Improvement of working conditions (workers and farmer) was considered to be the most frequent motive for capital formation, followed by the desire to increase labour efficiency and utilise available capital in the form of Government grants. Reference to the detailed combinations of motives for capital formation, Appendix II Table 2, indicated that only five farmers associated better working conditions or increased labour efficiency with increased levels of profit. This number increased to nine farmers, if all the stated motive combinations which included increased profits as a motive were considered. This situation could be interpreted to suggest that the farmers, when they increased labour efficiency, improved working conditions, etc., forsaw no effect on the level of farm profit. Alternatively, it was more likely that farmers did not see a clear link between an increased profits motive and the other motives. Since the farms analysed above only included the thirty-one farmers intending capital formation, it was perhaps not surprising that none of the farmers considered reducing the rate of declining profits as a motive. The replies under the heading "other" motives again proved a valuable insight into investment decision motives; it was found that, apart from a general wish to reduce costs and increase the efficiency of the existing system, the need for stock accommodation was the most frequent motive.

The timing of capital formation has an important effect on the cash flow of the farm business. Hence the farmers were asked questions to establish what factors influenced the timing of their investment decisions, and whether the capital formation was regarded as replacement or as net capital formation [(2)]. Table 7.3.5 illustrates the distribution of replies to these two questions (Analysis based on replies to questions 3 and 6).

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(2) Rather than using the term net capital formation, the term additional investment was used in the interviews with farmers. The farmers were prompted to try to ensure that they understood the difference between the terms replacement and additional as used in the survey.

Table 7.3.5. The Type and Timing of Capital Formation - Distribution by Number of Farmers

Farm Type	TYPE OF CAPITAL FORMATION			TIMING OF CAPITAL FORMATION						
	Replacement	Not	Both	Available Cash (A)	Seasonal Requirements (B)	Available Government Grants (C)	No Response	Combinations		Other Reasons
								AB	AC	
Tenanted	-	8	2	-	4	4	1	1	-	-
Owner Occupied	2	14	5	2	8	6	-	2	2	1
TOTAL	2	22	7	2	12	10	1	3	2	1

The farmers interviewed considered that most of their planned capital formation fell into the net formation category. This result was quite unexpected when related to the actual gross capital formation undertaken in previous years, (Section 6.4.2.1.) and when it is considered replacement capital formation is an unavoidable requirement of all businesses.

The replies to the questions on the timing of gross capital formation were interesting because of the low emphasis placed on available funds as a factor influencing its timing. This pattern did, however, fit the earlier replies to type of capital formation proposed, in that net capital formation is more likely to be governed by seasonal and availability of Government grant factors, than would replacement capital formation. The results showed that seasonal considerations were the main determinant of when capital formation occurred.

Associated with the ultimate timing of the planned capital formation was the investment decision-lag i.e. the time which elapsed between first conception of a plan and the execution of a plan. In general, all the farmers conformed to a similar pattern regarding the decision-lag period. In principle, the longer the life of the capital asset, the longer was the decision-lag period. Most decisions to increase stock numbers were taken in under three months, equipment and vehicles in up to six months, whereas the decision-lag in the case of fixed capital was almost always in excess of one year.

The attitude of the farmer towards his farm will inevitably influence his investment decisions. Two questions (12 and 13) were asked with the aim of assessing farmer attitudes.

Table 7.3.6. Propensity to Invest in Farming and Acceptance of Existing Standard of Living - Distribution by Farmer Numbers

FARM TYPE	Investment Preference			Preparedness to Maintain present living standard to allow increased investment.	
	Into Farming	Outside Farming	Both	Yes	No
Tenanted	15	2	18	31	4
Owner Occupied	26	4	21	43	8
TOTAL	41	6	39	74	12

The farmers under study followed the pattern found by other writers,(3) that farmers were prepared to make sacrifices in terms of standard of living to make additional funds available for net capital formation on their farms. The decision not to make sacrifices was found to be age-related. All the tenant farmers answering negatively were estimated to be in the over 50 years old age group. All the owner occupiers answering negatively were in the forty-five plus age group, with one exception, who was under the threat of compulsory purchase of his farm. As in the case of the tenants, the majority of owner occupiers in the over 45 age group were, in fact, over fifty years old.

(3) Literature review Section 2.2.3. p. 22

Very few farmers stated a preference to invest outside farming, showing that their primary interest lay in the success of their farm business. A very high proportion of farmers, however, did indicate that they liked to be able to invest in both farming and other activities thus lessening the dependence on one source of income.

Having assessed the anticipated high propensity to invest in dairy farming by the sample farmers, questions were asked with a view to establishing an order of preference for the possible types of capital formation on farms. In addition, the questions were designed to indicate the effect source of capital (own funds, credit, or Government grant) might have on the order of preference stated by the farmers. (Questions 15 and 16 on Survey Form).

Table 7.3.7. Order of Preference for Various Types of Capital Formation - Distribution by Farmer Numbers

Farm Type	Order of Preference	Bldgs	Stock	Machinery	Vehicles	Other On-Farm	Other Off-Farm
Tenanted	1	12	11	6	-	4	2
	2	6	10	7	-	2	-
	3	2	-	5	-	4	-
	4	-	-	-	4	-	-
Owner Occupied	1	22	9	3	-	10	7
	2	6	12	4	1	1	-
	3	3	-	9	-	1	-
	4	-	-	1	6	-	-

In question 15, a limit of £5,000 was stated as the maximum borrowed capital available, in order to give the farmer a finite limit. This limit could be criticised on the basis that £5,000 may seem a relatively small amount to some farmers, yet be considered a major investment to others. On balance the limit was felt justified as it discouraged farmers suggesting unrealistic plans.

Both the owner occupiers and tenants showed a preference for buildings, the preference being only slight in the case of the tenants but quite marked for the owner occupiers. Stock capital was rated next to buildings as a first choice, with machinery and vehicles third and fourth respectively. The order of preference revealed by the farmers would appear to indicate that many farmers were fully stocked within the limits set by existing buildings and that, if extra capital became available, it would be used to provide buildings so that the stock capital could be increased.

The "other" on-farms group consisted largely of farmers who stated their first choice would be land, although they admitted that £5,000 would not buy much land at current prices. Remarkably, this group of the tenant farmers also stated they would like to purchase land.

The "other" off-farms group comprised, those farmers who would not consider any further deployment of capital in dairying and those who considered no net capital formation was necessary on their particular farms at that time.

The farmers were then asked if the fact that the £5,000 was an interest free loan or their own capital, would alter their order of preference. The source of funds would not affect the choice of tenant farmers, but four owner occupiers would have altered their order of preference. Three farmers would have invested outside farming when faced with this situation, and the fourth would have changed from no on-farm capital formation to machinery purchases as a first choice.

Finally, the farmers were asked to say if a limited capital supply would alter their choice as first stated. Two tenants would have changed their preference from, in one case, buildings to stock and the other from machinery to stock. Two owner occupiers would have changed from off-farm investment and buildings respectively to no off-farm investment and no buildings respectively. A third owner occupier would have altered his preference from buildings to machinery.

In order to investigate the likely future pattern of capital formation in West Scotland dairy farming and assess the present feeling of farmers towards dairy farming, the farmers were asked their long term objectives for their farms.

Table 7.3.8. Long Term Objectives of Farmers - Distribution by Farmer Numbers

Farm Type	Order of Preference	OBJECTIVES				
		Survival	Higher Profits	Higher Return On Capital	Easier Life	Other
Tenanted	1	3	15	7	6	4
	2	-	-	7	5	3
	3	-	1	-	6	-
	4	3	-	-	1	-
Owner Occupied	1	8	17	5	12	9
	2	1	3	6	7	2
	3	-	-	2	4	1
	4	1	-	-	2	-

Most farmers considered higher profits to be their primary long-term objective although this view was more prevalent among the tenants, 42 per cent compared to 33 per cent of the owner occupiers[4]. This response of the farmers was an apparent contradiction to the motives given previously for proceeding with capital formation. The situation could be rationalised if it was assumed that increasing profits was the long term goal whereas improved working conditions, increased labour efficiency, etc., was the immediate requirement on the sample farms. Higher return on capital and on easier life were also favoured by the tenants, whereas the owner occupiers opted for higher profits and an easier life. A relatively small number of tenants were in the position where they considered survival to be their main objective. The number of owner occupiers in this category was higher as a proportion of the total farmers. The number of farmers stating other objectives as their primary aim, differed only slightly between the two tenure groups. These farmers indicated that good husbandry, maintenance of the status quo, and job satisfaction were their goals.

In Chapters IV and VI high dependence on their own resources was noted as a feature of dairy farmers in West Scotland, and also the difficulty which would be faced by the average farmer in optimising his capital input to maximise profit if relying on farm profits as the only source of finance. The sample farmers who had investment plans were asked, therefore, to indicate the proposed method of financing the capital formation. Their replies are tabulated in Table 7.3.9.

Own resources was the main single source of finance for on-farm capital formation, followed by bank overdrafts, and then 'other' loans. Of the nine remaining farmers who planned to invest, six said they would use a combination of own resources and bank overdraft, two would use their own resources and private loans, and the ninth would use own resources, bank overdraft, and 'other' loans. As was found in Chapter VI, the reluctance of farmers to use borrowed funds, and in particular hire purchase, was confirmed. The farmers appeared to have difficulty in suggesting the proportion of each type of finance they would use. In general, the proportion of own resources was usually not less than fifty per cent of the total capital required.

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(4) During questioning it became clear that many farmers had difficulty in making the distinction between higher profits and higher return on capital.

Table 7.3.9. Method of Financing Investment Plans - Number of Farmers Selecting only one Source

Farm Type	Own Resources	Private Loans	Overdraft	Hire Purchase	Other Loans
Tenanted	5	-	2	-	1
Owner Occupied	8	-	5	-	1
TOTAL	13	-	7	-	2

One of the tentative conclusions in Chapter VI was that farmers tried to regulate their bank balances in order to maintain a predetermined balance throughout the year. In order to assess the validity of this conclusion, the farmers were asked if they were restricted on overdraft level and if not, did they consciously regulate their bank balance (Question 14), Table 7.3.10. p.295.

Although the overdraft facilities extended to any individual must of necessity be restricted to some extent, the large majority of farmers with overdrafts considered they were not restricted in any practical way. About one quarter of the farmers interviewed indicated they did not have an overdraft. Of the 64 farmers who were completely free to regulate the amount of their bank balance, 44 (or almost 70 per cent) attempted to maintain a predetermined amount in their bank accounts. This finding supports the similar observation in Chapter VI.

Results in Chapter VI indicated that only about one third of the farmers used capital grants in any one year. This could be due to a cyclical investment pattern but also to the attitude of farmers towards Government assistance. A question (question 11), Table 7.3.11; p.295, was therefore included in the survey to determine the reasons for not using grants.

Table 7.3.10. Regulation of Bank Balances - Distribution by Farmer Numbers

Farm Type	Overdraft Facilities			Regulate Bank Balance		
	Restricted	Not Restricted	No Overdraft	Regulated	Not Regulated	No Res-ponse
Ten-anted	9	13	13	17	6	3
Owner Occ-upied	13	28	10	27	8	3
TOTAL	22	41	23	44	14	6

Table 7.3.11. Proportion of Farmers Utilising Government Capital Grants

Farm Type	USE CAPITAL GRANTS		
	Always %	Sometimes %	Never %
Tenanted	83	17	-
Owner Occupied	58	42	-
TOTAL	68	32	-

It was interesting to record that no farmer said he would never consider the use of capital grants. The number of farmers who always use capital grants differed remarkably between tenants and owner occupiers: the tenants made much more use of the grants available. The most interesting group was, however the farmers who only sometimes took capital grants, since they represented a fair proportion of the whole group. Analysis of the reasons for not using grants should reveal the measures required by the Government, should it desire a better response to any future capital grants scheme. The reasons for non-uptake of grants appeared to differ between the tenants and owner occupiers. The tenants considered the time involved in the administrative procedure to outweigh any benefits, for small jobs at least. The owner occupiers also commented on the time element but, more importantly, on the need to meet DAFS specifications (this aspect was also raised by tenants). The criticism about the specifications lies in what farmers call 'over-elaboration' and they cited as an example the need to use new materials. (The latter situation regarding materials is not strictly true). The net effect was that the cost of a grant-aided programme was higher than otherwise it might be, thus removing a large part of the incentive for the use of grants.

The final question of the survey was the age of the farmer, which had to be estimated by the interviewer. Age estimates were thought necessary to try to construct the age structure of dairy farmers in West Scotland, as this was thought to be an important factor in the farmer's attitude to his business and investment policy.

Table 7.3.12. Age Distribution of the Dairy Farmers

Type of Farmer	AGE GROUPS								
	25-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70
Tenant	5	3	3	8	4	5	7	-	-
Owner Occupier	-	6	10	8	12	9	4	1	1
TOTAL	5	9	13	16	16	14	11	1	1

Table 7.3.12. showed that persons actively farming tended to be centred on the age band forty to fifty-five with particular emphasis on what might be called the early middle age period (40-50). The number of farmers within ten years of the normal retiral age of 65 plus those over 65 years old was less than the number of farmers younger than the central band already referred to above. This fact would seem to indicate an adequate supply of young men coming into farming. It certainly does not suggest an ageing farmer population.

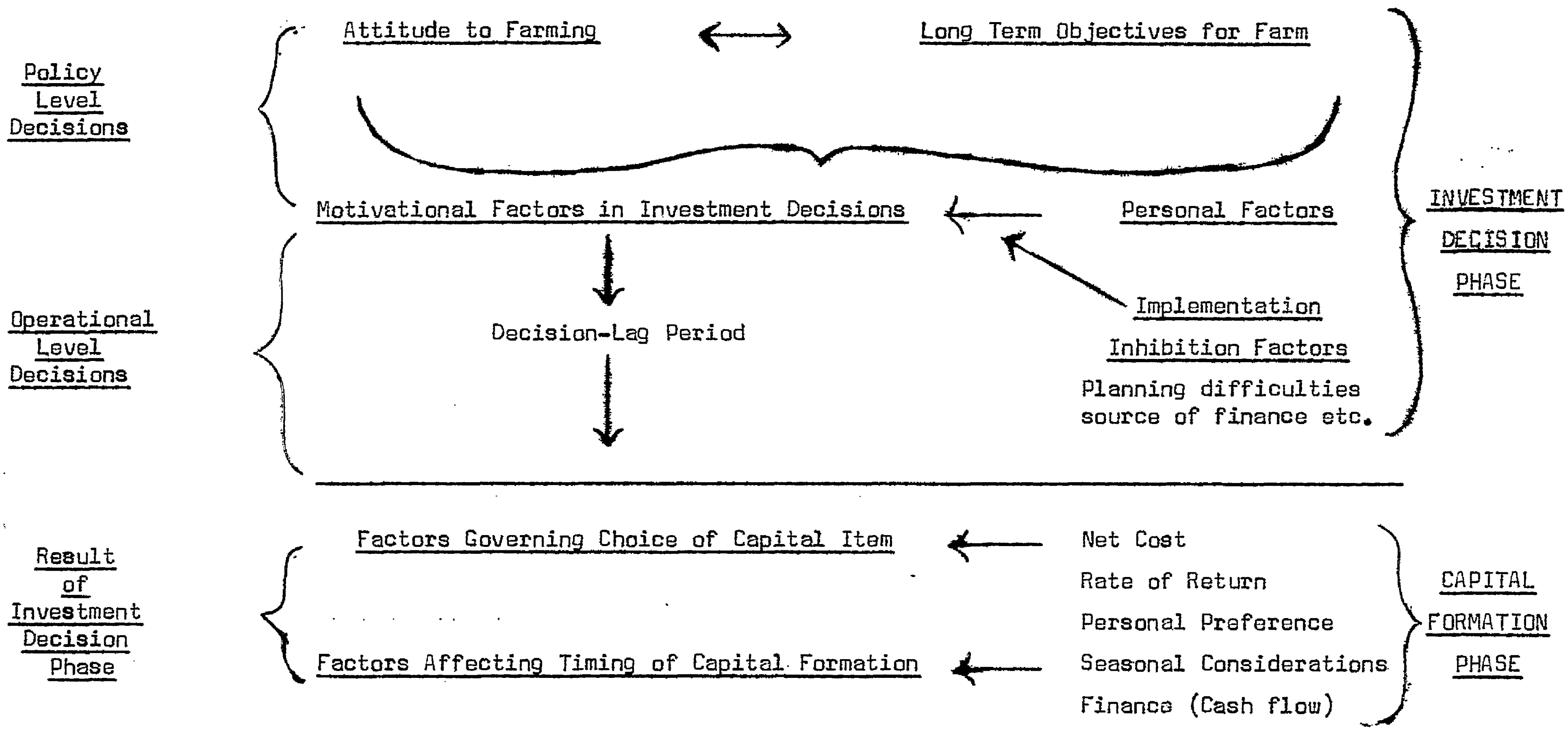
7.4 Discussion/Conclusions

The survey was carried out during the statistical year 1973/74. It was possible, therefore, to build questions, based on the economic analysis of the farm data for 1969/70 and 1970/71, into it. The survey was primarily interested in the objectives and motives of farmers with respect to capital formation and investment decisions, but questions were included of a peripheral nature, with a view to supplying useful background information.

Capital formation on a farm results from two distinct processes: firstly, one has the investment-decision phase, and secondly, one has the actual procedure involved in creating capital assets. Within each of these two distinct phases, various factors are in operation, and these are shown diagrammatically in Figure 7.4.1.

It is convenient to use Figure 7.4.1., on the following page, as the basis of further discussion of the survey results.

Figure 7.4.1. Motives for Capital Investment on Dairy Farms



Within the investment-decision phase, one is primarily occupied with the motivational factors involved in investment decisions. These factors operate largely at what might be called the operational level of decision-taking, but they must, of necessity, be influenced by overall farm policy, which is determined by the individual farmer's attitude to farming and his long term objective for his farm.

Policy Level Decisions:

The attitude of the farmers to their farms was assessed by asking whether they preferred to invest in their farms or outside farming and whether they were prepared to make sacrifices in terms of living standard to benefit the farm business. The answers to the first question indicated that farming and the maintenance of the farm business was a primary aim of the majority of farmers. Opinions on their readiness to make standard of living sacrifices were more varied but the majority of farmers were prepared, withinin reason, to make sacrifices. When a farmer was not prepared to make sacrifices in living standard, it was found he was in the over forty-five year old age group. This situation would appear rational in that if a farmer had worked hard to expand his business a point would be reached when maintenance of an adequate standard of living became more important than the desire for farm growth i.e. farmers may well enter a period of business consolidation in the latter part of their working lives.

Associated, and closely inter-related, with attitude to farming, was the long-term objective for the farm. Higher profits were considered as a primary aim of policy followed by higher return on capital and an easier life. It should be stressed that those farmers opting for non-economic goals, did not mean an easy life, but rather a less strenuous life. Not all farmers considered that the goals suggested in the survey were appropriate. In these cases, the most frequent goals were maintenance of the status quo, job satisfaction, and good husbandry. In particular, it should be noted that the farmers quoting good husbandry were not restricted to older farmers, but also included some younger farmers. The relatively low proportion of farmers who considered that they were in a survival position, lead to the conclusion that investment decisions on West Scotland dairy farms were being taken under a favourable climate i.e. There was a positive sense of optimisim at the overall policy level of decision taking. The importance which farmers attached to the long term policy of increasing farm profits was taken as justifying the assumptions, made in Chapter V, regarding profit maximisation as a goal when optimum capital inputs were being measured. It did, however, become apparent during the survey that, firstly, many farmers were unable to distinguish between higher profits and higher return on capital as a goal. This was not surprising, as many farmers were also unable to estimate the percentage return they expected from their capital inputs. Since optimum capital input demands the knowledge of expected returns and costs it appeared apparent that there was considerable scope for advisory or educational influences. Secondly, it became apparent that farmers appeared to contradict themselves with respect to the objectives of capital formation. The assumption that increasing profits was the long-term goal, and other factors the immediate goal, could partly account for the situation. It was also possible that the farmers were unable to link the aim of improved working conditions etc. with increased profit, or that the question on the reasons for capital investment (question 5) was faulty. It is conceivable that there was a psychological effect implicit in the question: some farmers may have thought that a more sophisticated answer was to make more effective use of labour, etc., rather than to invest to increase profits.

Operational Level Decisions:

The operational level decisions about investment are the personal motivation factors which are governed by, and inter-related with, the policy objectives of the farmer for his farm, which have just been discussed.

From Figure 7.4.1. it was seen that the motivational factors affecting investment decisions were mainly personal factors i.e. what the farmer wanted from his farm business. The survey indicated that improvement of the working conditions of both the farmer and his workers was a primary motive. The importance of this motive revealed the need to attract and retain good workers on the farm at a time when quality labour was increasingly difficult to obtain. It also showed a desire to reduce labour costs by improving farm layout, provision of concrete yards, etc., and through increased labour efficiency, possibly to obtain increased profits. A second important motive was the personal aspiration of running an efficient farm which, apart from the personal stimulus involved, should also result in an improvement in the profit level of the farm.

A non-personal factor in motivating investment decisions was found to be the desire to utilise Government grants when available, but this motive was much less important than the willingness to improve working conditions. The stimulus to capital formation through the availability of assistance in the form of Government grants could be considered as partial success of the Government aim to improve the capital structure of farming. Evidence is presented later which shows that disadvantages associated with grant use probably offset this stimulatory effect. The principal remaining reason given by farmers as a motivating factor, was the need to provide livestock accommodation. This illustrated the influence of the overall objectives for the farm, on the operational level decisions which were taken. i.e. the primary policy objective was to increase profits, which was probably most easily achieved by increased stocking density, but restrictions on available housing were seen to be a constraint at the operational level.

Inhibitions to the implementation of the operational level decisions were also important. They represented what could be called 'negative motivational factors' and were most frequently financial in nature. Both the owner occupiers and tenants considered that obtaining capital was a major difficulty in the execution of their plans, but especially in the case of the tenant farmers. The greater proportion of tenants than owner occupiers experiencing difficulty in obtaining credit, reflected the difference in the capital structure of the two types of business - the owner occupier had greater assets to act as security to obtain a loan. The method of financing proposed capital formation was largely through the use of the farmer's own resources (farm generated funds). This folowed the existing pattern of the asset structure of dairy farming in West Scotland (80 per cent net worth approximately) and indicated little change in the attitude of farmers towards borrowing capital. As was indicated, however, in Chapter VI, farmers had limited potential for net capital formation from farm income sources, even when these resources were used to service loans. Hence a severe inhibition was placed on investment decisions arising from this cause. The remaining financial factors which farmers found inhibited investment decisions were the rate of interest to be paid (tenants) and uncertainty regarding future prices and costs (owner occupiers). It is an interesting point of conjecture to ask whether the rate of interest to be paid on borrowed capital would now be considered of major importance in investment decision making, had the survey been carried out at the present time (summer 1975). Technical factors were also important in investment decision making i.e. many farms were at the optimum herd size within the restrictions imposed by the available buildings. The disposal of additional slurry was also viewed as a technical problem which has yet to be solved in a satisfactory manner.

Apart from financial and technical inhibitions, both groups of farmers had what appeared to be largely unsolvable problems. Some tenants were in the unfortunate position of having unco-operative landlords. This situation could only be remedied by Government legislation which, on balance, is already weighted in favour of the tenant. It is therefore difficult to visualise an acceptable statutory situation being developed. The problem faced by some owner occupiers, of being unable to obtain a builder prepared to undertake building modifications, although acute at the time of the survey, was likely to be of relatively short-term duration.

The need for external funding, was established in Chapter VI, if farms were to be operated at their optimum capital input. It was interesting, therefore, to find from the survey results that, although no farmer admitted to never taking Government capital grants, a large number said they only sometimes accepted assistance. The main reason why the latter group of farmers only sometimes used the grants, was the time involved in the administrative procedure.

Both tenants and owner occupiers agreed that timing was a problem, but the owner occupiers also considered elaborate specifications by D.A.F.S. tended to make a project expensive. It is possible that this effect is illusory and that, in fact if a farmer was to count the true cost of collecting and using second hand materials etc. the cost could be as great as using new materials. D.A.F.S. could however investigate their administrative procedure[5] to evaluate whether capital formation could occur more timeously if the regulations were simplified[6]. It might also be beneficial to reappraise the specifications laid down for the use of grants: in an age when versatility of buildings is desirable, it could well be the case that shorter life, less elaborate buildings are more appropriate than a more sophisticated, more permanent building. A lowering of standards could be justified if the effect was to stimulate and make possible the needed capital formation on West Scotland dairy farms.

The Decision-Lag Phase:

Figure 7.4.1. indicated quite clearly that, towards the end of the Investment Decision phase, there existed a decision-lag period before the commencement of the Capital Formation phase, which was the result of the Investment Decision phase. The length of the decision-lag period was variable but was well-defined in the majority of cases. The principle involved was simple: the longer the life of the capital asset under consideration, the longer was the lag between the investment decision and the ultimate capital formation on the farm. The length of lag was probably due to the cost factor involved, since the longer life capital items were generally more expensive than

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[5] Literature Review Section 2.2.3. p.22

[6] E.E.C. policies for improving farm structures N.F.U. Common Market Publication, 5 New Series, Oct. 1974 p.5. Commenting on the F.H.D.S. "The Government have estimated that about 60,000 British farmers are eligible to benefit ...... but so far only about 400 applications to participate in the Scheme have been made. This poor response may be due, in part, to the complexity of the Scheme ......"

those of shorter life. In general, the decision lag periods were as follows: livestock capital - less the three months lag; equipment etc. - up to six months lag; fixed capital - one year lag plus.

The Choice of Capital Items:

During the Decision-lag phase, the factors governing the choice and timing of the final capital formation became operational. The principal factors governing the choice of capital items were financial and personal preferences. However, it is worthy of comment how little use farmers made of aids to decision-making in the form of budgets, cash flows, or even simple calculations, using the profit and loss account and balance sheet of the farm. There is, therefore, considerable scope for upgrading the methods of investment decision-making, through the education of future young farmers and through advice to present farmers from the farmer Advisory Service.

Regarding the basis of choice of capital item from its financial aspect the concept of net cost of capital (i.e. total cost less Government grants and sales of capital items) was the criterion adopted by most farmers to assess the viability of a capital formation proposal. A minority of farmers were found to disregard cost as a criterion: in their case, the capital investment was undertaken for reasons of status. Very few farmers expected a rate of return in terms of a percentage return on capital, from their capital inputs to their farms. Those farmers who did expect a rate of return, experienced considerable difficulty in stating the return expected. This situation was highly undesirable as it is difficult to optimise the capital input to a business if the actual, or even expected, rate of return is not known. This point reinforces the argument in favour of some form of education and/or advice for farmers to encourage thought about the economic and financial aspects of their businesses.

Personal preference has a considerable influence on the choice of capital, but it is accepted that personal preference is also governed by financial considerations e.g. the return on different forms of capital varies as does the source of capital. In order to establish the order of preference of farmers for various types of farming capital, the farmers were asked how they would invest £5,000 borrowed capital. The first preference of the farmers was for buildings, which was surprising in the case of tenants but showed their desire to expand even if it meant raising buildings with their "own" funds. The second choice was livestock, followed by machinery. In Chapter V it was demonstrated that, in order to maximise profits, the average tenant farmer required to increase his use of livestock and machinery capital and the average owner occupier, mainly his machinery capital. The results of the survey indicated that one reason for the existence of sub-optimum tenants capital inputs, was the need for additional stock accommodation before the stocking density of the farms could be raised. Several farmers, including both owner occupiers and tenants, indicated their preference for land as a priority for available capital investment. These farmers would fall into a similar category as those prefering buildings, as clearly the future expansion of their businesses was dependent on overcoming the restrictions imposed by lack of acres.

The farmers were next asked to state any change in order of preference if the £5,000 was subject to no interest charges. Only four farmers, all owner occupiers, said they would alter their order of preference (3 to investments outside farming, and one from no on-farm investment to machinery investment). The result obtained was surprising in that the fact that the capital was an interest free loan, or the farmers' own capital, did not alter the preference away from "rewarding" forms of capital formation to "less rewarding" forms. Farmers seemed to have a well-defined view of the capital requirements of their farms which, in the period under study, appeared to be unaffected by the interest rate on borrowed funds. Even the limitation on the amount of capital available did not alter the order of preference: in the majority of cases, the farmers preferred less of their selected preference rather than a change to a different type of capital.

The Timing of Capital Formation:

The final stage of the capital formation phase of a decision to invest is the timing of the capital formation. This was important as it could have a critical effect on the cash flow of the farm business. Some prior consideration of timing can obtain preferential discount rates from suppliers as well as, more importantly, avoid unnecessary borrowing to finance the newly acquired asset. It was therefore surprising that the majority of those farmers with plans for capital formation did not consider the availability of cash as an important factor in determining the timing of their purchases of capital items. Seasonal requirements and the existence of Government grants were said to be the main factors influencing their decision. Two possibilities exist to account for this situation: firstly, the majority of farmers considering capital formation said it was net capital, rather than replacement capital formation - it therefore seemed appropriate that the capital would be acquired to meet any seasonal requirement; secondly, the small section in Chapter VI on the cash flow of farmers showed that the flow of cash was seasonal. It was therefore highly probable that seasonal requirements for capital coincide with the availability of cash on many farms, which would account for the farmers stating the importance of seasonality as a determinant of the timing of capital investment.

Summary:

The survey results have shown that the investment/capital formation/decision-making process may be divided into two basic parts in which different factors influence the decisions taken. It was also shown that the two processes did not operate independently but were closely inter-related. The long-term view of the farmers towards on-farm investment was found to be generally optimistic, with most farmers being prepared to make sacrifices, within reason, in their living standards in order to invest in their farms. The main problem facing farmers was that of obtaining capital at a realistic cost which could be borne by the farm business: furthermore, a need for external funds, possibly in the form of Government grants, existed. Finally, a strong case for the further education of practising farmers clearly exists which would enable them to use better investment planning techniques and make more informed investment decisions which, it is hoped, would lead to more optimum capital allocation.

APPENDIX I

SURVEY INTO THE FACTORS AFFECTING CAPITAL INVESTMENT
ON DAIRY FARMS IN W. SCOTLAND
SECTION A TO BE COMPLETED IN ECONOMICS DIVISION

Farm Code No.: ______________ Performance Group: ______________

Size of Farm (adj. Acres): ______________ Nature of Tenure: ______________

Tenant's Capital (Av. O.V. & C.V.): ______________ Valuation Dates: ______________

Date of Survey: ______________

SECTION A
(Completed Prior to Farm Visit)
DETAILS OF PREVIOUS INVESTMENT 1969/70 AND 1970/71

Year	BREEDING STOCK		FARM MACHINERY			VEHICLES			FIXED CAPITAL			
	No.	Value	Purchases	Sales	Net Cost	Purchases	Sales	Net Cost	Purchases	Sales	Gov't Grant	Net Cost
1969/70												
1970/71												

Section B (to be completed on Farm)

Tick where Answer is Yes

(1) Have you definite plans, which are actively being pursued, to buy new machinery, extend buildings, increase cow numbers etc., (i.e. plans to be commenced this year).

Yes --------- Go to question 2

No --------- Go to question 10

(2) (i) How detailed are your plans? --------

(a) In detail with a P. & L. Account --------

(b) In detail with a budget --------

(c) In detail with a cash flow --------

(d) With brochures but no financial details --------

(e) Of less detailed nature --------

(ii) If you use (a to c) above, do you prepare details yourself? YES or NO. (Ring as appropriate). If answer is NO who prepares details? --------

(3) Details of proposed investment this year. i.e. Additional or Replacement Investment.

(4) Method of Financing proposed investment. Tick %

(a) Your own resources: Savings from profit ______ ______
(b) Private loans (e.g. wife, family) ______ ______
(c) Bank Overdraft ______ ______
(d) Hire Purchase, leasing ______ ______
(e) Other Loans ______ ______

(5) Why are you proposing to make the investment?
(One or more may be ticked).

(a) To slow rate of decline of profits ____________
(b) To maintain profits at existing level ____________
(c) To increase profit beyond existing level ____________
(d) To make working conditions easier (Farmer or Workers) ____________
(e) To make more effective use of labour ____________
(f) Because capital is available (e.g. Govt. Grants) ____________
(g) Tax considerations (e.g. need to reduce tax in a good year) ____________
(h) Other reasons (specify) ____________________________

____

(6) What influences the timing of your investments?

(a) Cash availability in a given period (month) ____________
(b) Seasonal requirements e.g. baler for harvest time ____________
(c) Existence of Government grant or beneficial depreciation allowances ____________

(7) Can you give any indication of the period of time which elapses between first planning an investment and actually making the decision to proceed?
(see over)

	Stock	Equipment	Vehicles	Fixed Capital Items
Period				

8) Does the gross cost or net cost (total cost less grants etc.) of an investment influence you most when deciding to invest or does neither influence you. (Ring appropriate case).

9) a) Do you expect a rate of return on your investments? -----
b) If so, what rate of return do you expect? ----------

10) What do you consider the most difficult obstacles in planning major changes? Choose from the following and list in order of importance. (i.e. 1st 2nd 3rd etc.)
a) Where to seek advice ----------
b) Difficulties of planning ----------
c) Difficulties abour labour ----------
d) Difficulties in obtaining capital ----------
e) Difficulties in changing existing system (e.g. already at best herd size) ----------
f) Uncertainty as to future sale prices and markets ----------
g) The rate of interest to be paid on borrowed capital ----------
h) Other reasons (specify) --------------------------------
----

11) a) Do you take Government capital grants when available?
i) Always ii) Sometimes iii) Never (Ring as appropriate)
b) If grants are not taken why not? -----------------------

12) If you have funds available do you prefer to put them back into farming or invest outside farming or both? ------------------

13) Would you be prepared to keep your standard of living at its present level, if necessary, in order to put more cash back into the farm? ----------

14) a) Are you restricted on the level of overdraft balance during a year? (Yes, No). ----------

b) If not restricted do you attempt to maintain a certain cash/bank balance or overdraft over the year? ----------

15) a) If £5000 of borrowed capital was made available to you, list in order of preference the class of investment you would undertake.

a) Building Improvements

b) Stock

c) Machinery

d) Vehicles

e) Other

b) If the £5000 was an interest free loan or your own capital would this alter your order of preference? Yes or No ----- If answer is yes, state new order of preference.

----

16) In the event of capital being limited would you still invest in the order of preference stated in answer to question 15a? ---------- If answer is NO please state new order of preference.

----

17) What is your long term objective for your farm? (State order of importance)

a) Survival ----------

b) Higher Profits ----------

c) Higher return on Capital ----------

d) Easier Life ----------

e) Other (specify) ----------

18) Estimate of farmers age ----------

APPENDIX II

Table 1. Motives for Capital Formation - Number of Farmers Selecting only one Factor

Farm Type	Slow Decline in Profits (A)	Maintain Profits (B)	Increase Profits (C)	Improve Working Condit-ions (D)	Increase Labour Efficiency (E)	Capital Available (F)	Tax Consider-ations (G)	Other (H)
Tenanted	-	-	-	3	1	-	-	1
Owner Occupied	-	-	-	-	-	-	-	4
TOTAL	-	-	-	3	1	-	-	5

Table 2. Motives for Capital Formation - Numbers of Farmers Selecting Various Combinations

	COMBINATIONS OF MOTIVES														
Farm Type	BD	CE	CF	CH	DE	DF	DH	DEF	DEH	DFG	EFH	CD EG	CD FG	BCD EF	CDE FH
Tenanted	-	-	2	-	1	1	-	-	-	-	-	-	-	-	1
Owner Occupied	2	1	1	1	3	-	1	2	1	1	1	1	1	1	0
TOTAL	2	1	3	1	4	1	1	2	1	1	1	1	1	1	1

APPENDIX III

SUMMARY OF CAPITAL GRANT PROCEDURE

I Application to D.A.F.S.

II Inspection of farm and discussion of proposed plan.

III Authorisation of approved works.

IV Claim for payment to account or final payment - evidence of costs incurred must be included.

V Payment of Grant to farmer.

The farmers interviewed were critical of the administrative times involved before work could proceed, and also of the delay between submission of a receipted account and actual reimbursement, which could be anything from 2 to 4 months. It could be argued that the delays are not excessive when due regard is paid to the fact that public money is involved.

CHAPTER VIII

CAPITAL INVESTMENT ON WEST SCOTLAND DAIRY FARMS

CONCLUSIONS

8.1. Introduction

In the present era of high levels of domestic inflation and a depreciating currency, the Government has placed emphasis on the selective expansion of agricultural output as a means of reducing the food import bill. In the normal farm situation, increased production and/or increased efficiency of production often requires additional capital investment. The sources and structure, as well as the level, of existing and additional capital investment, are important aspects therefore, of the development of the agricultural industry at the macro and micro levels.

Previous research on agricultural capital has covered a wide range of descriptive and analytical studies of capital structure, sources of credit, etc. The present study has been restricted to what, in the opinion of the author, were the most salient factors affecting capital investment on West Scotland dairy farms. As stated in Chapter I, the general aim of the study has been to formulate a means to enable the dairy farmer in West Scotland to operate more effectively within the constraints on his capital investment. It is appropriate, at this point, to present a resumé of the main objectives of the study

1) To estimate the aggregate capital invested in Scotland and West Scotland agriculture and in so doing develop a new estimation procedure.

2) To develop methodology in order to analyse farm data on capital structure.

3) To quantify the relationship between capital stock and output, and thus try to establish the expected output from given levels of capital input.

4) To derive optimum capital inputs for the average dairy farm and examine the constraints on the sources of additional capital required to achieve an optimum allocation of capital.

5) To supply information on farmers' personal attitudes to capital investment in West Scotland dairy farms.

The techniques of analysis adopted were governed by the objectives outlined above and the data available, and were subject to the rule that simple but effective methods should be utilised when possible, in the hope that the techniques applied might be of use in certain forms of farm management advisory work. The analysis was therefore centred on simple and multiple regression equations and econometric models, using cross-sectional data.

In the sections which follow, it is proposed, firstly, to consider the capital stock of Scotland and West Scotland dairy farmers (Section 8.2), to follow this by a summary of the factual findings of this study pertaining to the capital situation of dairy farms in West Scotland (Section 8.3) and finally, to present a general discussion of the problems which became apparent and the possible contribution of the farmer, the Government and the educationalist to the amelioration of the problem of capital formation (Section 8.4).

8.2. Aggregate Capital Stock of Scottish and West Scotland Agriculture

The capital stock of West Scotland[1] agriculture was just over one third of the total capital stock of Scottish agriculture in 1972. At current values this represented £1011.10 million of which £204.91 million was tenants type capital. Farmers in West Scotland increased their capital investment in all categories of tenants capital except concentrate feed stocks over the four year period ending in 1972. This increase represented a 60 per cent rise, after adjustment for the effects of inflation, and showed no deviation from the national trend. The importance of the capital invested in dairy farming was demonstrated by the fact that the

[1] See p.63 for a list of the counties included in the West Scotland area.

tenants capital invested in livestock was 8 - 9 per cent higher in the West region than for all Scotland.

In the course of obtaining the estimates of tenants capital investment, it became apparent that in many respects the method of calculating the capital stock using census data had advantages over the raised sample technique. These advantages were fully discussed in Chapter III but are summarised below.

The ease of creating a consistent series of estimates from an existing primary data source which includes all farms in Scotland not just a sample of farms. Census data permits the use of calendar years and allows the average capital involvement over the year to be estimated, which is superior to the valuation of an inventory at an arbitrary and variable period in time. The use of census data also allows the changing age structure of the animal population to be taken into account.

8.3. The Capital Situation of West Scotland Dairy Farms 1969-71

This section summarises the information gained from the study with respect to the existing allocation and sources of capital of the dairy farms. Such economic information, together with knowledge of the modifying effect of farmers'attitudes, is essential in order to help to identify the relationships between capital and output and to determine the factors and constraints which govern the level of capital deployed and the credit sources utilised. Thereafter the information is used in Section 8.4. to formulate the capital formation problems confronting the dairy farmer groups under study, and then to suggest possible means of rectifying the situation.

8.3.1. The Existing Allocation of Capital

In terms of monetary value, the order of importance of tenants assets was livestock, machinery, other capital, and crops, but on owner occupied farms the capital invested in landlords type capital was found to be four times that invested in livestock. Smaller farms, in terms of acreage, were more intensive users of tenants capital (capital/acre), as were owner occupied farms compared to tenant farms. The less intensive use of tenants capital by the tenant farmers was the first indication of possible under-utilisation of tenants capital by that group of farmers.

The net worth of the sample farms expressed as a percentage of total assets - equity percentage, was high - approximately 80 per cent. The proportion of the business owned was found to be independent of farm size in terms of acreage and capital invested, and the proportion of the business owned was not a significant factor in determining the ultimate profitability of the business. The latter finding challenged the view that a low equity percentage indicated that farmers were prepared to borrow to finance profitable opportunities.

A functional relationship was established between the total assets employed on the sample farms and the amount of borrowed capital in use. Tenants relied more heavily on borrowed capital for expansion than did owner occupiers, which was reflected in the equity percentages for the two groups; the owner occupiers net worth percentage was on average 3 per cent higher than that of tenants, which was a considerable difference when the relative volume of the assets of the two groups was taken into account. The higher level of indebtedness of the tenant farmer could be considered as an inducement to utilise the existing capital employed, as fully as possible. In practice, it was demonstrated later that the average owner occupiers' allocation of capital approached closer to the optimum than did that of the tenant. Owner occupiers did, however, use more absolute amounts of borrowed capital than did tenants, which affected the level of net farm income in two ways. Firstly, the amount of net farm income generated was less sensitive to changes in the level of capital borrowed in the case of the owner occupiers and secondly, the increase in net farm income per £100 borrowed capital was greater for the tenants than for the owner occupiers. A possible hypothesis was that tenants can concentrate on the "more productive" types of tenants capital whereas the owner occupiers must also finance the lower yielding landlords type capital. It could also be the case that management resources were less stretched on the tenanted farms as no estate type management was involved. It is suggested that a study of management input would be a rewarding area for further research.

8.3.2. Sources of Capital

Any gross capital formation required on the sample farms can only be derived from the "available cash" on the farms, which was fairly limited on the majority of farms (£1516 - £10,190 depending on size of farm and nature of tenure). The principal functional determinant of the amount of "available cash" was shown to be the level of farm income in previous years. A three year investment cycle existed, in that the level of farm income in year (t-3) exerted a strong influence on the "available cash" in year (t). The amount of farm income in year (t-1) also had a direct but lesser effect on the expected level of "available cash" in year (t). The majority of finance was provided by the farmer from his own sources or farm profit. The existing pattern of finance, largely through farm profits, was likely to continue, as the response by farmers in the survey indicated no change in their attitude towards borrowing.

The principal source of borrowed funds for tenant farmers was merchant credit both in terms of the number of farmers using this source and as a proportion of total group borrowings. The next most important source for the tenant farmers was bank borrowing. However, the lack of security which tenants could offer to obtain loans could have been forcing tenants to use more expensive forms of borrowed capital, which was suggested by the more frequent use of merchant credit and hire purchase by tenants. Owner occupiers made use of merchant credit, bank overdrafts, and family or private loans equally, which largely reflected the different credit needs of the two types of business. The dependence of the owner occupiers on family or private loans could make possible investment which otherwise, would not have earned an adequate return at market rates of interest. The survey results indicated, however, that the majority of farmers did not plan their order of investment according to the source of funds.

Government capital grants formed another source of finance to both groups of farmers but only about one third of the farmers used grants in any one year. The absolute amount of grant uptake per farm was not high and a higher proportion of the larger acreage farms took up capital grants. A partial explanation of this situation could be that grants were only available towards 15-50 per cent of the total cost. The amount of self-financing involved could therefore be prohibitive due to less security being available to obtain loans and the lower return on capital obtainable on the smaller farms (Table 5.2.2.2.).

One further source of funds for capital formation was the re-allocation of part of the funds formerly used for consumption. Although many farmers were prepared to make sacrifices in terms of standard of living in order to invest in their farms, the scope of this means was limited.

8.3.3. Relationships between Capital and Output

The use of an explicit causal chain model permitted the functional relationship between capital stock, acreage, gross output, and gross margin to be established. The model showed that acreage only exerted signficiant influence at the gross margin level and even at this level in the sequence of causation, gross output was the major determinant. The expected increase in gross margin from a £100 increase in gross output was £44 in 1969/71. The Cobb-Douglas functions which were prepared to estimate the marginal productivity of the capital services used, included land and labour as input variables. The results supported the findings from the causal chain model regarding the lesser influence of the land and labour variables as opposed to the capital variable in determining the level of output.

The EDC for agriculture tended to stress factors other than capital as being more important determinants of productivity. Namely

> The main constraint to a more efficient use of resources that have been identified by the study, such as the size of farms, the use of labour, and the retirement age of the farmer, are to some extent outside the control of individual farmers[2].

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[2] Agriculture E.D.C. Farm Productivity HMSO Oct.1973 p.9.

These conclusions were at variance with the findings of the present study but the non-significance of capital as a constraint on productivity in the E.D.C. study could be due to the measure of farm productivity adopted - Productivity = Gross Output £/£ Input. This measure of productivity could be unreliable because the depreciation element within the input costs could have caused peculiar estimates of productivity to be obtained e.g. if a farmer used mainly older equipment, the annual depreciation charge included as an input cost, would be lower than if the equipment were newer. Hence the productivity of a farm using older equipment would appear higher than that of the farm with the newer equipment.

The low dependence of output on farm acreage which was found in the present study demonstrated the ability of the smaller acreage farm to produce, through the more intensive use of capital, a gross output similar to that produced on a larger, less capital intensive farm. However, because of their more intensive use of capital per acre and its associated variable costs, the smaller farm was at a disadvantage in terms of gross margin produced. The effect of farm size at the gross margin level of output measurement was therefore to partly overcome the rising level of variable costs associated with the higher absolute level of capital use on the larger acreage farms. A farmer could, within a limited range, substitute livestock capital for acreage and achieve similar levels of gross margin e.g. £200 and £100 livestock capital could be substituted for one acre by the owner occupiers and tenants respectively, in 1969/70, to obtain equivalent amounts of gross margin. The gross margin per acre of the sample farms decreased as size increased due to the reduced intensity of capital inputs per acre as acreage increased. Hence, although the smaller farms appeared to offer higher performance in terms of gross margin per acre than the larger farms, the smaller farms may not be more effective in the overall efficiency of capital employed. In order to assess the overall efficiency of capital utilisation, the fixed costs attached to the production of output were allocated. It was then shown that, as the level of tenants capital increased, the expected return on that capital increased

(M.I.I.%). The effect of the fixed cost allocation was therefore proportionately greater at the lower capital input levels. Although the fixed costs and capital invested per acre were less as acreage increased, the absolute amount of capital used rose as acreage increased. The higher returns on capital (M.I.I.%) were therefore associated with larger acreages. Where two farms had equivalent acreage, the higher return on capital would be expected on the more highly capitalised farm. This finding has important implications and illustrates the dilemma faced by the Government pursuing more than one policy objective. If the aim is to use capital most economically in terms of percentage return, the larger, more highly capitalised farms should be encouraged. However, if the provision of a minimum income for present farmers is the objective the Government would have to accept a lower return on the capital required to increase farmer incomes, as it was the low acreage, low capital intensive farmers who required most assistance. It is recognised that the above aims may only be two in an extensive list of Government objectives, which might include such other aspects as providing jobs and social income, or increases in self-sufficiency to save imports.

The marginal productivities for the input of capital services were calculated, as already stated, using a Cobb-Douglas function. This technique provided a method of assessing capital utilisation by equating the marginal product with the marginal cost of the capital, assuming profit maximisation as the objective. As was later shown by the farmer attitude survey, this objective was found to be acceptable. The absolute values for the marginal productivities of the capital inputs were not high, ranging from 1.004 to 1.835 in terms of £/£ input. No change in marginal productivity could be established between the first and second year of the study after removal of inflation and increased intensity of capital use effects. Differences in the marginal productivity of livestock capital input between the owner occupiers and tenant farmers were found to be due to differences in intensity of capital use and not plane of productivity. This conclusion agreed with earlier findings that the livestock capital on a tenanted farm increased less than proportionately with farm size and also that, at the gross margin level, tenanted farms with less than approximately £7000 livestock capital required to increase their gross output through the use of additional tenants type capital. Adopting the case 3 assumptions of Chapter V (capital supplied by farmer costed at opportunity cost equal to deposit rate of interest, the remainder being supplied at market rates of interest and repaid over five years), it was shown that the average tenant farmer could advantageously increase his annual input of livestock and machinery capital by 10 and 30 per cent respectively, while the average owner occupier could increase his machinery input by 15 per cent.

8.3.4. The Farmer's Attitude to Investment

The investment policy and capital structure of a farm business are not determined solely by economic influences. Due to the close association between the farmer and his business, the ultimate decisions regarding investment will be in response to both economic and personal motives stimuli.

If a differentiation between investment decisions and capital formation is accepted, it is possible to isolate the decisions and motives followed by the farmers in these two phases. During the investment decision phase, decisions were taken at two levels: firstly, policy decisions were taken which were governed by the farmer's attitude to, and his long-term objectives for, his farm - most farmers appeared to desire to continue farming and to build up their businesses, their long-term goals being higher profits/return on capital and an easier life; secondly, operational level decisions were taken which were governed by personal stimulus and motivation - improved farming efficiency through better working conditions of both the farmer and his workers were found to be an important motive as was the desire, if possible, to make use of Government capital grants, which could be construed as partial success of the Government capital grant schemes. Inhibitions to operational decisions, such as the difficulty in obtaining sufficient capital, were also important, but this aspect is discussed in a subsequent section.

A decision-lag period existed between the time the decision to invest was made by the farmer and the ultimate capital formation occurred. This period was related to the length of life of the asset and its probable cost.

The factors governing the choice of capital items were financial and personal preferences. The farmers made little use of management aids when making investment decisions - there therefore appeared scope for advice to be offered to farmers. Most farmers considered that the timing of their capital formation was mainly determined by seasonal requirements and that their principal problem was to obtain sufficient capital at a cost which could be serviced by the existing farm business, until such time as the benefits obtained from any capital formation undertaken flowed into the business.

8.4. Interpretation of the Capital Investment Position of Dairy Farmers in West Scotland

The previous section summarised the important factors affecting the capital structure of West Scotland dairy farms. In the sections which follow, these factors are interpreted, thus enabling the formulation of the capital investment problems confronting dairy farmers in the above area. Finally, consideration is given to the possible extent to which the farmers themselves, the Government, and the educationalist/adviser may be able to contribute towards the amelioration of the problem.

Effective utilisation of a resource input is critical to any production process, and non-optimum utilisation would indicate the existence of an imperfection in that production process. The study suggested that neither the average owner occupier nor the tenant was optimising their capital inputs, although the average owner occupier did operate closer to the optimum capital input than did the average tenant farmer. The return on tenants capital (1969-71) was such that farmers with less than £11,000 - £14,000 tenants capital invested in their farms would be unable to cover the cost of borrowed capital (9.4 - 9.7%) required to rectify the situation of non-optimum capital use. In addition, the return on capital fell at current values between the two years under study. It was concluded that many farmers, including those up to the average input of tenants capital, required to improve their efficiency of capital utilisation. Where a farmer was unable to obtain 9 per cent return on his tenants capital, it would probably have been easier for him to obtain an equivalent income by investing his capital outside dairy farming. In the event of his wishing to remain in dairying, his main consideration would be to increase his use of tenants capital and, where possible, to reduce his costs of production.

The fundamental problem facing the average dairy farmer in West Scotland, therefore, was the need to increase his tenants capital input in order to attain a more optimum allocation of capital, thereby increasing his return on capital. The incremental capital requirements (I.C.R.) was estimated as £8800 and £3400 for the average tenant and owner occupier respectively.

It seems appropriate at this stage, when considering the capital requirements of the dairy farmers, to comment on certain features of the study. Due to the nature of this study, many of the qualitative aspects of investment/capital formation have, by necessity, been largely ignored. The author is also aware that the study is largely a one factor input study (i.e. capital), although when the optimum levels of capital input were determined, values for the land and labour input variables were included, in order to partly ameliorate this problem. It is accepted, however, that if the results indicated that optimisation of capital input required an extra x thousand pounds capital formation, this was partly dependent on all other factors of production being supplied in adequate quantities. Any suggestion that £x tenants capital was required in order to optimise the tenants capital input then opened the practical question - what form should this capital take? More stock? - but which type of stock? More machinery? - but which type of machine? If it is assumed that farmers are capable of selecting the correct resource mix in qualitative terms, then the problems of considering optimum capital inputs in financial terms are lessened. In any event, possible qualitative deficiencies of the study are not believed to detract from its finding, that capital input was not optimised in all cases.

The I.C.R. estimates of £8800 and £3400 referred only to the net capital formation required; they did not include the capital formation which the farmer already undertook in the form of replacement capital formation. The problem of optimising the capital input to dairy farming can now be translated into the question of how to fund the large increases in tenants capital required. If extra cash was to be made available for capital formation, it must either be derived from a re-allocation of existing "available cash" or from an increase in the "available cash" on the farm. The potential sources of increased "available cash" were: farm income, borrowing, and Government assistance. It is the contribution of, and constraints on, these sources of funds which must now be considered.

8.4.1. The Farmer's Contribution

As was indicated above, the possibility existed that farmers might be able to increase the "available cash" on their farms and hence the amount of capital formation, by the expedient of re-allocating the existing "available cash". The amount of cash which could be made available towards the I.C.R. by reduced consumption and off-farm investment was approximately £500-900 on the average farm. The shortfall in capital required was therefore £8,000 and £2,700 respectively for the average tenanted and owner occupied farm, if the move to the optimum capital input was contemplated in one year. Re-allocation of existing "available cash", therefore, did not offer a solution to the problem of optimising the tenants capital input and the situation was especially acute on those farms less than 100 acres in size. Possible solutions indicated a requirement to increase the amount of "available cash" rather than a re-allocation of the "available cash".

The absolute amount of "available cash" could be increased through an increase in the level of farm borrowing. Although the net worth position of the farm was sound, a major comment by farmers, especially tenant farmers, was their difficulty in obtaining capital. The reason for this was their inability to service loans: the return on marginal capital was adequate to cover the cost of the borrowed capital, but the consumption demands on cash and the lag between the occurrence of capital formation and the resultant flow of cash into the business, caused the loan servicing difficulty, especially among the smaller farmers with a low return on existing capital. There was, however, resistance among certain farmers to borrow capital. If those parts of the existing "available cash" which could be re-allocated through a reduction of consumption and off-farm investment were used to service a loan, the amount of capital which could be raised would be £2500 and £3000 approximately, for tenants and owner occupiers respectively. The average owner occupied farmer could therefore theoretically move to his optimum capital input position through the use of borrowed funds. In practice, it must be stressed that many owner occupiers and tenants considered that obtaining capital was the most serious obstacle to further capital formation and, in particular, tenant farmers saw the rate of interest on borrowed capital as a barrier to potential borrowing, as well as the problem of not being able to supply security of a suitable nature to obtain a loan.

An alternative to the use of borrowed funds to increase the level of "available cash" was to increase the farm income. This method was probably the most acceptable to farmers, as it did not necessitate any increased dependence on borrowed capital or Government grants. The average increase in income in year (t-1) which would have been required to achieve an increase in "available cash" in year (t) sufficient to permit the optimum allocation of capital, was £1600 and £9000 respectively for the average owner occupied and tenanted farm. Increases of this magnitude were unrealistic and offered little towards a solution of the problem of how to increase the "available cash".

It was estimated that farmers farming less than 100-150 acres (22-48% of the sample) had a standard of living in monetary terms of less than the average worker in manufacturing industry. An increased level of consumption was dependent on an increase in the "available cash", which was primarily dependant on increased capital formation. It was difficult, therefore, to foresee how farmers with below parity income could sacrifice current consumption, in order to increase capital formation and hence their future consumption. The capital formation versus personal consumption cycle was an additional problem facing many of the smaller dairy farmers in West Scotland. Although many of these farmers wished to increase their capital formation, and hence their farm income, it was not possible due to their existing low farm income and its inadequacy to service additional loans.

The contribution of the average dairy farmer towards increasing the amount of "available cash" was clearly restricted. It became obvious that the smaller farmers would require external assistance if they were to increase the efficiency of their farms through the optimum allocation of tenants capital. Such financial assistance can only be forthcoming from Government sources.

8.4.2. The Government Contribution

The principal area requiring Government attention was how to supply capital to the dairy farmers in order to achieve an optimum allocation of capital. Any policy recommendations regarding the means of the approach to this problem must necessarily be governed by Government policy towards agriculture. The recent Government white paper, "Food from Our Own Resources"[3], indicated the desirability of increased milk production, to be obtained by creating stability in the industry through reasonable profitability, but concentrating on the areas of most profitable return. Implementation of this policy places the Government in the dilemma of how to obtain economic expansion of milk production while improving the structure of dairy farming and also the farmers' income level.

As was shown by the study the larger dairy farms, in terms of capital input, were found to be the most efficient users of tenants type capital. In pure economic terms, it could be argued that Government policy should be geared towards encouraging net capital formation on such farms (those with an existing tenants capital of £14,000 plus in 1969-71) whilst making it possible, through com-

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[3] Food From Our Own Resources. White Paper, Comnd. 6020. H.M.S.O, April 1975.

pensation measures, for those low income farmers farming less than 100 acres to leave farming. In the view of the author, this extreme policy would not be desirable nor was it Government policy in the period under study. Rather, it was felt that the policy towards dairy farming should be balanced between pure economic efficiency objectives and social ideals. In the current climate of expansion only the farmers of the smaller farms under 100 acres in size should be encouraged to leave the industry whilst encouraging efficiency among those remaining through higher capital intensity and an improved farming structure.

Government measures to directly increase the income of farmers by milk price increases were not seen as the principal means of achieving the above goal. Although increased prices would ensure "reasonable profitability"[(4)] and encourage the net capital formation needed for expansion, they would not necessarily bring about "an expansion of economic agricultural production",[(5)] as it is probable that the output of the more efficient farms would rise faster than that of the less efficient farms. Thus, although all producers might obtain higher incomes, the relative disparity in efficiency (return on capital) would widen. It is suggested therefore, that any income benefit to farmers should derive from measures designed, firstly, to encourage the smaller dairy farmers to leave dairy farming (i.e. those earning under 9 per cent return on capital in 1969-71) and secondly, to increase the capital intensity of the remaining farms.

Assuming that the Government are prepared to improve the efficiency of dairy farmers, by adopting subsidy measures in addition to any pricing policy, then the provision of capital grants is a possible solution to the dilemma faced by dairy farmers attempting to optimise their capital inputs.

The number of West Scotland dairy farmers receiving capital grant aid, and the amount of grant aid, was found to be variable in any

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[(4)] Ibid., p. 16.
[(5)] Ibid., p. 17.

one year. Under the existing grant aid schemes a grant could only be obtained for up to 10-50 per cent of the cost of the scheme. In economic terms, this situation could result in a farmer being unable to undertake a project due to an inability to supply sufficient capital towards his share of the cost (50-90 per cent). The level of capital grant uptake on many farms raised the question of whether or not the existing system of subsidising capital formation was working efficiently. In practice, many of the sample farmers considered that the uptake of capital grants was restricted, due to the need for farmers to follow a "tedious administrative procedure" and to comply with elaborate DAFS specifications. If this claim is in fact true, and it was possible to partially substantiate the claim, from a recent N.F.U.[6] publication using Government statistics, a problem exists of how to make capital grants more attractive to farmers.

In the opinion of the author, the present system of capital grants could be modified to meet the capital requirements of dairy farmers more fully. These requirements were found from the study to be: a supply of short-term capital for the purchase of livestock and machinery, and assistance to service loans obtained to finance the farmer's share of a capital formation project until such time as the revenue from the project flowed into the business.

The Farm and Horticultural Development Scheme, which is legitimate under the terms of EEC directive (72/159/EEC), progresses a considerable way towards supplying the type of credit required by the dairy farmer, as it is now possible for grants to be obtained for the initial purchase of livestock and stores. It is felt by the author, however, that grant aid should not be restricted to 10 per cent of the cost of the animals, but that the percentage contribution by the Government should be based on a sliding scale. It is appreciated that difficulties may arise with the extension of grant aid to easily saleable assets, but regulations could be introduced to minimise possible abuses of the scheme, e.g. in the case of breeding stock purchased with grant aid, a stipulation could be

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made that the stock must be retained on the grant assisted farm for a minimum of four years - alternatively, any gain realised on the premature sale of the stock would be repayable to the Government. The eligibility for grant assistance, whether for short or long-term capital, should be restricted to exclude those dairy farmers whom the Government might desire to encourage to leave dairy farming - possible candidates for exclusion are the smaller farmers (low capital intensity under 100 acres) who were unable, in this study, to obtain a return on capital equal to the then current rate of interest. If such exclusions are not made the capital grant schemes will merely prolong the existence of an inefficient dairy farming structure.

At present, any farm accepting Development aid must, at the termination of the aid period, be capable of supporting all labour employed (including farmer) at what is termed "comparable income" levels. The minimum amount of capital available is £1000 and, when eligible, a farmer receives a grant at a fixed proportion of the cost of the particular type of investment.These restrictions are designed to exclude grossly inefficient farmers from the scheme and prevent abuse of the capital available. However, the possibility does exist that the minimum grant of £1000 will exclude a considerable number of dairy farmers deserving of development aid e.g. the rate of grant for livestock purchase is 10 per cent of the total capital expenditure. A farmer wishing to avail himself of the grant is thus committed to a total outlay of £10,000 of which he has to finance £9,000. The operation of the income rule may also exclude many farmers from eligibility for a development plan, in which case capital grants towards short-term capital would be unavailable, as this class of capital is currently excluded from the alternative source of Government finance - The Capital Grants Scheme.

The provision of grant aid may not in itself lead to an improvement in the input of capital to dairy farms, as in several instances farmers included in the sample were aware of their non-optimum use of tenants capital but were unable to move towards their optimum input of livestock, for example, due to a need to erect new buildings (stock accommodation) prior to increasing their intensity of live-stock capital. Their problem was their inability to invest in new buildings due to unco-operative landlords. A remedy to this situation would require Government legislation. A solution could be achieved if a tenant could appeal to a body similar to a Rent Tribunal whereby, if the tribunal agreed to the need for new buildings, the tenant could proceed, at his expense, to erect buildings even in the face of a landlord's opposition.

One of the main problems regarding existing capital grants which emerged from the study, was the difficulty experienced by farmers in servicing the loans required in association with capital grants in order to undertake specific capital formation projects. Low interest rate loans, or deferred repayment of loans, are therefore suggested as a possible means of overcoming this loan servicing problem. Such loans could be an attractive alternative to farmers as they would not suffer from many of the disadvantages attributed by the farmers to Government capital grants: delayed receipt of grant, elaborate specifications, project vetting, etc. It should be stressed that low interest rate loans are advocated, not because of any inability of eligible farmers to pay the market rate of interest due to a low expected rate of return on marginal capital formation, but to accelerate the movement towards an optimum capital input position. At market rates of interest, the eligible farmers would, in the first instance, due to the time lag between the capital expenditure and the resulting income flow, be unable to service amounts of capital sufficient to optimise their capital input quickly and efficiently. Subsidised credit is permissible under the terms of the Farm and Horticultural Development Scheme which became operational in January 1974. Under this scheme loans would be guaranteed, which is in effect creating lower interest rate loans, as the rate of interest charged by banks for secured lending is less than that for unsecured lending.

The present study did not investigate the mechanism of a system of credit subsidisation but it is envisaged that a Government funded agency would be established to supply low interest, fixed rate, or deferred repayment loans directly to eligible farmers. The loans would not be for long-term development work but for financing shorter life assets, such as breeding animals and purchasing machinery, for a period not exceeding five years. The loans would be on an unsecured basis and would be repaid in the latter stages of the loan from the income generated by the capital. Eligibility for subsidised credit would be identical to that for capital grant purposes and the restricted application of the scheme would minimise any potential distortion of the money/capital market.

The contribution which the Government can make towards improving the capital structure of dairy farming, and hence expand output, is to ensure that a supply of capital for short/medium term investment is available in addition to the existing provision of long-term capital. Irrespective of the method used to supply the necessary capital, the Government must enable the farmer to appreciate whether or not he is eligible for assistance. The scheme should encourage eligible farmers to adjust quickly towards an optimum capital input position whereby dairy farmers would be in a position to supply the future capital requirements of their businesses, without recourse to Government assistance.

8.4.3. The Contribution of the Educationalist/Advisor

In a period of escalating cost to service and replace existing capital and also the need for net capital formation to expand output, it was disconcerting to establish that few farmers prepared any form of budget and that many were quite unaware of the rate of return on an investment - if the optimum output is to be obtained from the allocation of capital, it is necessary that some method of estimating the likely returns should be applied. It is also essential that the farmer Advisory service should be alerted to the finding that, in 1969-71, farmers were not equipped to calculate a return on capital, prepare a budget, etc.

The educational problem involved may be divided into two parts: firstly, how to encourage future farmers to avail themselves of existing facilities - this could perhaps be achieved by making agricultural education courses more attractive to entice farmers' sons to spend two to three years training and by demonstrating tangible results for the time spent off-farm; secondly, how to encourage practising farmers to adopt more sophisticated business analysis techniques - the Advisory service has, in this situation, a fundamental role to play in helping the dairy farmer to expand his output. The provision in the Farm Development Scheme, that a farmer must be capable of operating a farm successfully before a grant is payable, is a movement in the right direction to motivate farmers. This type of legislation may be the only solution to the problem of upgrading business ability.

The contribution which the educationalist/adviser can make to more optimum use of capital resources is to provide information which the farmer can use to aid his decision-making process and to try to ensure that the information made available is adopted by the farmer.

8.5. A Final Comment

Dairy farming in West Scotland was capable, at the time of the study, of generating a return on tenants capital invested in excess of the then current rates of interest on borrowed capital, but this minimum acceptable rate of return was only possible when tenants capital investment was in excess of a minimum value (£14,000 per farm in 1969-71).

The average dairy farm was confronted with a capital shortage situation, if capital input was to be optimised, which was so severe in the case of low capital intensity farms under approximately 100 acres in size, that it would probably be best to advise farmers in this situation to opt out of dairy farming. The capital shortage was not usually due to the poor credit worthiness of the farmers but due, rather, to a cash flow problem (low income) which acted as a constraint on the loan servicing ability of the farmers. Many farmers, especially the small farmers referred to above, found themselves involved in the capital formation versus consumption cycle, liberation from which they found impossible through "self-assistance". Such farmers were therefore completely dependent on Government action to improve the efficiency of capital deployment.

The problems of the dairy farmer in 1969-71 are considered relevant to the recently declared Government agricultural policy which envisages an expansion of milk output. The rapid escalation of capital and its associated costs and the fall in real terms, in United Kingdom agriculture's net income in 1974-75, has not made the loan servicing problem any easier. However, assuming measures are taken to ensure reasonable profitability, dairy farming should be able to yield an adequate return on capital. Large scale milk price increases are not advocated even in the expansionary climate of 1975, as this indiscriminatory approach would not encourage a more efficient capital structure within dairy farming. The selective use of 'wider scope' capital grants and/or subsidised credit is considered to be the most efficient means of inducing the optimum allocation of capital and expansion of milk output on West Scotland dairy farms.

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