AN ANALYSIS OF PRODUCTION, CONSUMPTION AND BORROWING BEHAVIOUR IN THE NORTH ISLAND HILL COUNTRY PASTORAL SECTOR

A.C. Beck

and

J.B. Dent

Research Report No. 163

November 1984

Agricultural Economics Research Unit
Lincoln College
Canterbury
New Zealand

ISSN 0069-3790

THE AGRICULTURAL ECONOMICS RESEARCH UNIT
Lincoln College, Canterbury, N.Z.

The Agricultural Economics Research Unit (AERU) was established in 1962 at Lincoln College, University of Canterbury. The aims of the Unit are to assist by way of economic research those groups involved in the many aspects of New Zealand primary production and product processing, distribution and marketing.
Major sources of funding have been annual grants from the Department of Scientific and Industrial Research and the College. However, a substantial proportion of the Unit's budget is derived from specific project research under contract to government departments, producer boards, farmer organisations and to commercial and industrial groups.
The Unit is involved in a wide spectrum of agricultural economics and management research, with some concentration on production economics, natural resource economics, marketing, processing and transportation. The results of research projects are published as Research Reports or Discussion Papers. (For further information regarding the Unit's publications see the inside back cover). The Unit also sponsors periodic conferences and seminars on topics of regional and national interest, often in conjunction with other organisations.
The Unit is guided in policy formation by an Advisory Committee first established in 1982.
The AERU, the Department of Agricultural Economics and Marketing, and the Department of Farm Management and Rural Valuation maintain a close working relationship on research and associated matters. The heads of these two Departments are represented on the Advisory Committee, and together with the Director, constitute an AERU Policy Committee.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

PREFACE

One of the principle objectives of the Agricultural Economics Research Unit (AERU) is to produce a practical means of evaluating the impact of new technology, market forces and policy change on agricultural and horticultural farm units. Such evaluation frameworks (or models) are often useful to farm organisations, private firms and government departments in improving decision making at the industry level.

This research report is a major step forward in this respect. Mr A.C. Beck has developed a flexible simulation model of North Island Hill Country farms as part of his doctoral dissertation research. The framework encompasses both the technical, biological and managerial responses of this class of farmer to outside influences of various types. The AERU will extend this model in future to enable it to be used on other major farm types.

The work was undertaken with the financial assistance, encouragement and advice of the Economics Division of the Ministry of Agriculture and Fisheries.

R.G. Lattimore
Director

ACKNOWLEDGEMENTS

An important contribution was made to the study by the New Zealand Meat and Wool Boards' Economic Service (and their Chief Economist, Rob Davison), who provided unpublished data for the consumption and credit analyses. In this respect a special acknowledgement is also due to Mrs Janet Gough for the preparation of this data and for the preliminary estimation of some consumption functions described in Chapter 3 of this Report.

The project was financed jointly by the N.Z. Ministry of Agriculture and Fisheries (who commissioned the study) and the Agricultural Economics Research Unit at Lincoln College. This support is gratefully acknowledged.

SUMMARY

The objective of this study was to investigate and analyse some important aspects of the North Island hill country farming system, particularly with regard to financial decision making. The resulting information should provide a better basis for predicting the effect of economic and environmental factors, and government policies, on this important part of New Zealand's pastoral sector.

The report is based on four main areas of description and analysis:

(i) A review of physical and financial features.

In this section farm survey data (Class 4) from the Meat and Wool Boards' Economic Service (MWBES) Farm Survey is reviewed and some important features highlighted. North Island hill country is clearly an area which accounts for a significant proportion (around 40 per cent) of New Zealand's pastoral production and which has considerable physical potential for further development. However, topographical and environmental factors impose severe constraints on the range of production activities possible and make the area vulnerable to adverse environmental and economic conditions. There is a predominance of livestock production activities, especially sheep and cattle breeding. The capital assets of the average farm tend to comprise mainly land and improvements, and livestock; off-farm assets appear to be minimal compared with the value of farm assets. Average equity levels are high at around 87 per cent.

(ii) An analysis of consumption behaviour.

The objective of this consumption analysis was to investigate factors affecting the consumption behaviour of North Island hill country farm households, and to derive some consumption functions to describe this behaviour.

Various general theories of consumption behaviour are discussed and associated functions tested with MWBES farm survey (Class 4) data. The data used took two forms; first published annual average data for the period 1958/59 to 1979/80; and secondly, an unpublished "panel" of data for 46 individual farms for the period 1969/70 to 1978/79. Despite shortcomings in the data and some statistical problems a reasonably consistent picture emerges for consumption behaviour in North Island hill country. Estimates of the marginal propensity to consume, based on the full time-series and a range of function specifications are in the range 0.18 to 0.24 for the short-term and 0.26 to 0.33 for the long-term.

With respect to alternative behavioural hypotheses, no one hypothesis was clearly superior. The formulation which gave the best and most consistent results is one where current consumption was a function of current income and lagged consumption; this function can be justified from a number of behavioural hypotheses.

(iii) An analysis of the use of credit.

In this analysis various aspects of borrowing behaviour are explored by reviewing past credit surveys and studies, and by undertaking some statistical analyses using MWBES survey data. Some additional primary data was collected related to borrowing behaviour.

The results would suggest that farmers are not averse to borrowing per se; rather they may be averse to incurring significant increases in their real level of debt. In times of inflation the difference in these two attitudes can be substantial. Because inflation reduces the real value of outstanding liabilities many farmers can actively borrow funds while at the same time enjoy an upward trend in their equity ratios.

The nominal level of long-term liabilities was found to be highly correlated with the nominal value of farm land and improvements, yet no direct causal link between increases in land values and new borrowing could be established. Rather, new long-term borrowing appears to be prompted mainly by lagged income. While increasing land values provides the capacity to borrow, it appears that this capacity is not utilised until a period of high income improves expectations of future profitability and capacity to repay.

No relationship could be established between interest rate and new long-term borrowing. This result is not surprising given that, in times of high inflation, nominal interest rates can be high while real interest rates can be low or even negative. Since both nominal and real rates are likely to have an effect on borrowing behaviour the lack of a clear relationship is understandable.

With respect to the short-term borrowing, the amount of short-term credit used was shown to be relatively stable and related to the levels of both working expenses and cash reserves. The rationale for this result seems clear; farmers need funds to finance working expenses during the course of the year and, while some short-term credit will usually be used for this purpose, less appears to be used when the farmer has significant liquid reserves available. The hypothesis that farmers deliberately borrow to offset short-term slumps in income had to be rejected. It appears that, where possible, farmers use their own liquid reserves to augment low income.

(iv) An analysis of economic and environmental factors affecting supply response.

Past studies of the New Zealand pastoral sector are reviewed and some additional analysis is undertaken with respect to the North Island hill country situation.

The apparent lack of short-term response to economic variables is confirmed but some short-term stocking rate response to environmental conditions is indicated. With respect to longer term responses it would appear that farmers are unwilling to increase "long-run" stock numbers until feed production capacity is similarly increased, mainly through investment in land improvement. Such investment takes place largely out of residual funds which remain from high income years after other operating, debt servicing and consumption expenditure has been undertaken. Investment funds may initially be retained as savings or liquid reserves. The rate at which stock numbers are increased to utilise newly developed pasture is dependent on climatic conditions. In this respect it would appear that a "ratchet" effect operates; farmers wait for good seasonal conditions before increasing stocking rate to utilise recently developed pasture. Once attained the new stocking rate is relatively insensitive to (moderately) adverse climatic conditions.

The Report concludes with some suggestions about areas where additional economic research may be justified in relation to North Island hill country. Two problems are highlighted; first, there is a need for further research on farm expenditure patterns in order more clearly to separate investment expenditure from general operating expenditure and farm maintenance. Such basic research is necessary if a better understanding of investment and disinvestment behaviour is to be gained.

Secondly, more information is needed on the role of savings and liquid reserves in the financial operation of pastoral sector farms; understanding the role of these reserves would aid in understanding the impact of stabilisation and other policies on farming operations.

CHAPTER 1

INTRODUCTION

1.1 Study Objective

The objective of this study was to analyse some key aspects of the North Island hill country farming system in order to provide a better basis for understanding the impact of political, economic and environmental factors on the area. The "key" aspects considered in this study include the financial structure of the farming operation, the consumption and credit using behaviour of farmers, and factors affecting investment and supply response.

The focus on North Island hill country is justified because of the importance of this area to the New Zealand export economy. In 1982 hill country land mainly in the North Island supported approximately 42 per cent of New Zealand's total stock units and generated around $1,000 million in overseas earnings (Rattray, 1982). These earnings represented approximately 17 per cent of total export receipts (New Zealand Dept. of Statistics, 1982).

While substantial production is obtained from hill country, it is the future of the area, particularly North Island hill country, that makes it of particular interest to agricultural policy makers. On the one hand a number of authors (Brougham, 1973; Yeoman, 1973; Hight, 1976; Mauger, 1977; Parker et al, 1977 and the National Research Advisory Council, 1978) have estimated that potential production increases of 50 to 200 per cent are possible, based on further land development and increased stocking rates. On the other hand, due mainly to the lack of alternatives to pastoral production, the area is notably vulnerable to the effects of adverse economic and environmental conditions.

1.2 Hill Country Defined

Although the term "hill country" is often used in discussions and studies of the New Zealand pastoral sector (see, for example, Brougham, 1973; Hight, 1976, 1979; Mauger, 1977, 1981; Parker, 1981; Rattray, 1982b) the definition of the term remains arbitrary. For many purposes hill country can be simply defined as "predominantly non-ploughable land, excluding South Island high country". This is the definition adopted by the National Research Advisory Council in a study of hill country research requirements (NRAC, 1978). For other purposes more specific classification and definitions are necessary to account for the diversity which is inherent in "hill country". This diversity is associated with differences in geographical location, slope, rainfall, soil type and farming system. For example, the Meat and Wool Boards' Economic Service (MWBES) in their Survey of Sheep and Beef Farms define three hill country farm classes based on a combination of farming system and geographical factors. These are:

(i) Hill Country, South Island (Class 2): farms running mainly fine wool sheep and with a carrying capacity of approaching three stock units per hectare. Wool and sales of cast-for-age ewes are a major source of income. These farms are mainly in Canterbury.

(ii) Hard Hill Country, North Island (Class 3): farms running mainly Romney sheep and carrying around eight stock units per hectare (with approximately one cattle beast to ten sheep). Cattle provide approximately one quarter of the revenue, the balance being derived from the sale of store sheep and lambs, plus wool income. These farms are mainly located on the east and west coasts and central plateau of the North Island.

(iii)Hill Country, North Island (Class 4): farms located on easier hill country and tending to be smaller holdings than Class 3. Mainly Romney sheep are stocked at over ten stock units per hectare (with approximately one cattle beast to 12 sheep). A high proportion of sale stock are sold in forward store or prime condition. These farms are located throughout the North Island.

In other cases, hill country has been classified into wet and dry (Brougham, 1973), on the basis of geographical location (Fitzharris and Wright, 1980), and on the basis of soil type, vegetation and slope (Scott, 1981). Classification and definition can be pursued further on the basis of a number of criteria such as geological history, soil types, vegetation, altitude etc. (see DSIR, (1980) for example).

Notwithstanding the diversity inherent in "hill country", it would appear that this class of land has sufficient unique and common features to justify the use of a broad definition in many studies. The National Research Advisory Council (1978) describe these features:

> "Principal of these (features) is its steeply sloping nature which restricts land use to grazing pasture and forestry; limits management flexibility because the area suitable for growing supplementary crops or conserving grass is often little or nothing; and dramatically increases the costs and difficulty of fertiliser spreading, fencing, weed control, pasture renovation and other operations. In addition social problems (such as inadequate access, schooling, cultural and recreational facilities) resulting from the remoteness of much hill country, increase the difficulties of maintaining a farming population and labour force."

Given these common features and the purpose of this study, which is concerned with aspects of general relevance to the operation of North Island hill country farms, a broad definition has been adopted here. Thus, in the first instance this introductory discussion will relate to hill country defined as "predominantly non-ploughable land, excluding South Island hill country". Attention will then be focussed on "North Island hill country" (Class 4 as defined by the MWBES) which is an important sub-set of all hill country, and which represents the main area of interest in this study.

1.3 General Background

New Zealand has about 13 million hectares of pastoral land of which approximately 4.5 million hectares is hill country.[1] Despite the physical and socio-economic difficulties of hill country farming, hill country land supports about 40 per cent of New Zealand's total stock units (NRAC, 1978; Hight, 1979), representing about 34 million stock units in 1982 (MWBES, 1982). In 1978 the NRAC reported that pastoral farming on all hill country earned "... more than $600 million a year in foreign exchange which is about 50 per cent greater than the value of receipts from "manufacturing exports". They went on to point out that "if allowance is made for the relatively low import content of hill country farming (9 per cent against manufacturing's 27 per cent), its net foreign exchange contribution compared with manufacturing is higher still".

There are about 8,000 hill country farms which provide direct employment for more than 15,000 people as well as having a significant effect on employment opportunities in other sectors. In addition, hill country farms are a major source of breeding ewes, and store lambs and cattle for lowland farms (NRAC, 1978; Hight, 1979).

The average carrying capacity of hill country farms is about 7 stock units per hectare (s.u./ha), with about 3 s.u./ha being supported on South Island hill country and about 10 s.u./ha on easier wetter land in the North Island (MWBES, 1982).

These figures indicate the superior productivity of North Island hill country which tends to be less affected by the temperature and rainfall constraints that limit South Island hill country production. As a result of this difference in productivity and the relative areas involved (1.8 million hectares in South Island and 2.7 million hectares in North Island), North Island hill country is of greater economic importance than the South. Approximately 85 per cent of hill country stock carrying capacity is in the North Island. The harsher in farming systems which tend to differ markedly from North Island hill country systems. As indicated by MWBES description of Class 2 farms, emphasis in the South Island is on fine wool production while in the North Island meat and coarse wool production predominate (see MWBES Class 3 and 4 farms).

The MWBES defines two hill country farm classes (3 and 4) within the North Island which differ mainly on the basis of the difficulty of the physical environment involved. There are approximately 1 million hectares of "hard North Island hill country" (Class 3) carrying about 8.6 stock units per hectare on average, and there are approximately 1.7 million hectares of (easier) "North Island hill country" (Class 4) carrying about 10.8 stock units per hectare on average.

---

1 Based on MWBES classification and comprising approximately 1.8m hectares South Island hill country (Class 2), 1.0m hectares North Island hard hill country (Class 3) and 1.7m hectares North Island hill country (Class 4) (NRAC, 1978).

While there is no doubting the importance hill country production in New Zealand, surprisingly little research has been done in the past on biological aspects of the hill country farming system or to determine optimal hill country management systems. This fact has been highlighted by a number of authors (see, for example, Hight, 1976, 1979; NRAC, 1978; Gillingham, 1980; and Scott, 1981). Hight (1976) for example, stated that ". Few selfcontained management trials have been conducted in New Zealand hill country to define the effects of class and genetic merit of stock, aspect (shady or sunny), grazing method, grazing intensity (continuous/ infrequent and lax/hard), fertiliser requirements, or of supplementary feed on pasture and animal production..."[2] More hill country research seems likely in the future, following a review of research priorities undertaken by a Hill/High Country Research Committee of the DSIR in 1981.

1.4 Structure of Report

The analyses conducted in this study are described in the following four, largely self-contained, chapters. In Chapter 2 a detailed overview of the physical and financial features of North Island hill country production systems is provided. In Chapter 3 an analysis of consumption behaviour is described based on a number of theories of consumption behaviour with associated empirical estimation of some consumption functions.

Chapter 4 describes an analysis of the use of credit by North Island hill country farmers. Various aspects of credit use are explored including uses of borrowed funds and frequency of borrowing. A number of factors are hypothesised as having an influence on short and long-term borrowing behaviour; some functions are estimated to test these hypotheses.

In Chapter 5, the economic and environmental factors affecting investment and supply response are investigated. To this end, past econometric studies of the pastoral sector are reviewed and some additional functions which explore the role of climatic conditions and other factors on North Island hill country stock numbers, are estimated with empirical data.

The Report concludes with a brief Chapter outlining some areas where further economic research would appear to be justified to illuminate further the financial structure and operation of the North Island hill country farming system.

----

2 Some relevant biological and management research includes Inglis, 1965; Kissock, 1966; Hight and Wright, 1972; Suckling, 1975; Smith et al., 1976.

CHAPTER 2

THE NORTH ISLAND HILL COUNTRY PRODUCTION SYSTEM

2.1 Physical and Production Features

A sketch of the typical or average easier North Island hill country farm can be gained by reviewing the results of the MWBES Sheep and Beef Farm Survey for Class 4 farms. Based on survey results for the period 1976/77 to 1980/81 the following picture emerges:

The average size of Class 4 farms is between 370 and 400 hectares of which approximately 90 per cent is effective. Average carrying capacity is 10.5 stock units per effective hectare, of which 30 to 35 per cent are cattle. Hill country farming is still strongly based on family farming units with the average labour used being about 1.7 labour units per farm.

The lack of ploughable land and difficulties with pasture production and utilisation in much of the North Island hill country mean that extensive stock breeding and rearing are the main activities. The predominance of stock breeding activities is illustrated by data from the MWBES Survey of Sheep and Beef Farms (1982b) which show that, on average, for Class 4 farms, purchases as a percentage of stock wintered was only 3.5 per cent for sheep and 11 per cent for cattle. Average lambing percentages typically vary between 90 and 100 per cent, with average calving percentages varying between 80 and 85 per cent. On a kilogram per hectare basis, average annual meat production is typically between 110 and 130. Average wool sales per sheep stock unit vary between 5 and 6 kilograms. On a kilogram per hectare basis, this represents average annual production of between 40 and 50 kilograms per hectare.

In comparison with other farm classes, Class 4 farms tend to be the most productive (and smallest) of the more extensive classes of pastoral farm in New Zealand. On the other hand they tend to be larger and less productive than farms on flatter country.

2.2 Capital Structure

The average capital structure of Class 4 farm is most conveniently described using the MWBES Survey results for 1980/81, reproduced in Table 2.1. A number of features are worthy of note. Firstly, the combined value of land, buildings and improvements (separate valuations are not available) dominate the asset structure, accounting for nearly 70 per cent of total assets. The next most significant category of assets is livestock representing 18 per cent of total assets. Other items are relatively insignificant.

Secondly, the value of non-farm assets appears very low; probably less than 4 per cent of total assets if the homestead and car are not counted, and some allowance is made for liquid reserves. While the value of off-farm assets is underestimated in the survey (because investments outside the farm are valued at book value and not at current market value) the MWBES, in their discussion of survey results, confirm that, in most farms surveyed, non-farm investments are few (MWBES, 1982). This fact has important implications for modelling the farm business system; it means that the investment options that must be handled by the model can be restricted to on-farm investments.

TABLE 2.1

Capital Structure of Average North Island Hill Country (Class 4) Farm 1980/81

	$	%
ASSETS		
Capital Value (land, buildings and improvements, excluding homestead)	516,721	68.8
Truck and Tractor	8,519	1.1
Other Plant and Machinery	3,646	0.5
Livestock: Sheep	72,738	9.7
Cattle	62,217	8.3
Other	441	0.1
FARM CAPITAL	664,282	88.4
Cash at Bank or Firm	7,209	1.0
Income Equalisation Balance	4,488	0.6
Homestead	37,419	5.0
Other Assets (including car)	16,138	2.1
Investments and Deposits	21,561	2.9
TOTAL	751,097	100.0
LIABILITIES		
Fixed Liabilities	74,766	10.0
Current Liabilities	18,208	2.4
Sub-Total Liabilities	92,974	12.4
Specific Reserves	4,048	0.5
CAPITAL (NET WORTH)	654,075	87.1
TOTAL	751,097	100.0

Source: MWBES Sheep and Beef Farm Survey, 1980/81

A detailed analysis of farmer use of credit is provided in Chapter 4. At this stage, therefore, it suffices to note that average level of fixed and current liabilities for Class 4 farms in 1980/81 was equivalent to 10 and 2.4 per cent of total assets, respectively. The average farmer equity ratio, therefore, is high at about 87 per cent.

2.3 Expenditure and Income

A summary of average Class 4 farm expenditure for 1980/81 is presented in Table 2.2. Major items of cash expenditure are fertiliser, lime and seeds, interest, repairs and maintenance, and shearing expenses. With minor variations, the pattern of expenditure shown in Table 2.2 has remained similar in recent years. It should be noted that the MWBES Survey does not differentiate between operating (and maintenance) expenditure, and development expenditure. This is because expenditure data in the Survey are based on farm accounts, and most development expenditure, being tax deductible, is rarely noted in farm accounts as a separate expenditure item. This makes the important issue of investment behaviour difficult to investigate. A review of studies of investment and supply response behaviour is presented in Chapter 7.
5.

The sources and disposition of farm income in 1980/81 is shown in Table 2.3. The proportion of income shown from each source is typical of the pattern that has occurred in recent years. Over the period 1976/77 to 1980/81 gross income from wool has varied between 41 and 48 per cent of total gross farm income; gross income from sheep between 30 and 33 per cent; and cattle between 19 and 24 per cent. Income from other farm sources is typically low at about 1 per cent.

Expenditure and depreciation as a proportion of total gross farm income has fluctuated widely over the period 1976/77 to 1980/81, from 54 per cent to 70 per cent, with a generally upward trend reflecting the deteriorating terms of trade suffered by the pastoral sector as a whole. The proportions tended to be highest in low income years and vice versa reflecting the fact that expenditure levels in absolute terms remain relatively stable compared with the fluctuations in gross income.

2.4 Disposition of Net Income

The relative disposition of available net income between drawings, taxation and savings also fluctuates widely. Drawings, for example, varied between 42 and 64 per cent over the period 1976/77 to 1980/81. As with farm expenditure, drawings, which reflect farmers' consumption levels, remain relatively stable in absolute terms. This results in drawings accounting for a high proportion of available net income in low income years, and vice versa. A detailed analysis of farmers' consumption behaviour is presented in Chapter 3.

TABLE 2.2

Farm Expenditure for Average North Island Hill Country (Class 4) Farm - 1980/81

	$	%
WORKING EXPENSES		
Wages	5,633	9.5
Animal Health, Weed and Pest Control	2,533	4.3
Shearing Expenses	6,129	10.3
Fertiliser, Lime and Seeds	9,305	15.7
Vehicles, Fuel and Power	5,439	9.2
Feed and Grazing	867	1.5
Contract	3,731	6.3
Repairs and Maintenance	6,742	11.3
Railage and Cartage	1,435	2.4
Administration Expenses	2,002	3.4
SUB-TOTAL WORKING EXPENSES	43,816	73.8
STANDING CHARGES		
Insurance	1,127	1.9
Rates	1,861	3.1
Managerial Salaries	597	1.0
Interest	7,383	12.4
Rent	552	0.9
SUB-TOTAL STANDING CHARGES	11,520	19.4
TOTAL CASH EXPENDITURE	55,336	93.1
Book Depreciation	4,075	6.9
TOTAL CASH EXPENDITURE PLUS DEPRECIATION	59,411	100.00

Source: MWBES Sheep and Beef Farm Survey, 1980/81

TABLE 2.3

Farm Income for Average North Island Hill Country (Class 4) Farm - 1980/81

		$	%
Gross Farm Income:	Wool A/c	35,831	42.3
	Sheep A/c	27,473	32.4
	Cattle A/c	20,670	24.0
	Other A/cs	729	0.9
TOTAL GROSS FARM INCOME		84,703	100.0
Less Total Expenditure and Depreciation		-59,411	-70.1
NET FARM INCOME		25,292	29.9
Income Equalisation Account Deposit		- 789	- 0.9
AVAILABLE NET FARM INCOME		24,503	29.0
DISPOSITION OF AVAILABLE NET FARM INCOME			
Drawings		13,768	56.2
Taxation		10,088	41.2
Savings		647	2.6
		24,503	100.0

Source: MWBES Sheep and Beef Farm Survey, 1980/81

Taxation payments are primarily related to income and current tax scales but the relationship is not simple. The figure shown for taxation in Table 2.3 is the amount of tax paid in the financial year. This consists of both terminal and provisional tax payments thus the previous years' income is a major influence on current years tax payment. The estimated relationship, based on MWBES Survey data for the period 1961/62 to 1980/81, is as follows:

$$TAX_t = -643 + \underset{(0.023)}{0.164}\, ANFY_t + \underset{(0.025)}{0.229}\, ANFY_{t-1}$$

$$R^2 = 0.98 \qquad D.W. = 1.96$$

where TAX is tax paid in Year t
and ANFY is net income adjusted for income equalisation deposits and wool income retention deposits.
(Figures in parentheses are standard errors of the coefficients.)

This estimated relationship shows that both current and lagged "adjusted net farm income" are significant determinants of tax paid, accounting for 98 per cent of the variation in tax paid.

Savings as recorded in the Survey represent, theoretically, the amount of money left after meeting current farm expenses including depreciation, personal living expenses and taxation commitments. (In some years savings may be negative if reserves are liquidated to meet these commitments). In notes on aspects of the Survey the MWBES (1982) point out that, while few farmers actually run a depreciation reserve fund, replacement of existing capital equipment will generally be met out of the depreciation allowance figure shown in the accounts. Amounts required over and above the depreciation allowance, as well as any repayment of borrowed capital, will be met out of savings. As might be expected for a residual item, the level of average annual savings tends to be volatile, varying significantly as incomes fluctuate. Over the period 1976/77 to 1980/81 for example, savings varied from 31.5 per cent of available net farm income (1978/79) to dissavings equivalent to 11.2 per cent of available net farm income (1977/78).

2.5 Economics of Hill Country Development

As well as a lack of biological research relevant to hill country, there has also been a dearth of research on the economics of hill country development, particularly from the national point of view. This situation is probably partly due to the lack of biological data. It may also be a result of the widely held belief that increased export earnings resulting from increased hill country development must be beneficial to New Zealand. The NRAC (1978) for example concluded that hill country potential for increased stock carrying "... represents an additional 40 million stock units. With the nation facing a serious shortage of overseas funds, the $18.4 per stock unit at f.o.b. at current prices could yield an additional $736 million annually. This figure shows the real economic significance of at least approaching hill country potential".

2.5.1 National level analysis.

In an attempt to quantify and evaluate North Island hill country potential more objectively, Scott (1981) undertook a systematic assessment of the potential stock unit increases attainable and the possible costs and benefits of achieving those increases. The study used the National Water and Soil Conservation Authority's Land Resource Inventory to divide North Island hill country into nearly 24,000 land units. Each unit was described by five physical factors i.e. rock type, soil type, vegetation, slope and erodability. With the assistance of MAF Farm Advisory Officers, each land unit was assessed in terms of its capacity for sustained productive use, expressed in terms of stock carrying capacities (stock units per hectare). Three levels of utilisation were defined. The first was the current actual stocking rate, which allowed for land not in pasture; the second was the current average stocking rate if a unit of land was completely in pasture; and the third was the carrying capacity currently being achieved by the "top farmer" on a particular type of land. Potential stock unit increases were obtained by calculating the differences in total stock units between these three levels.

Results from Scott's study indicated that if undeveloped hill country was developed and stocked at the current average rates then total stock carried would increase by 82 per cent or approximately 22 million stock units. If, in addition to this, carrying capacity was increased to top farmer levels then a further increase of 46 per cent of the base level (or 12 million stock units) would be achieved.

In analysing the economic consequences of achieving these increases in stock carrying capacity Scott divided the development process into two stages:

(1) Development of scrub or bush to pasture - a relatively high cost step involved in moving from current actual to current average stocking rate.

(2) Intensification - a relatively low cost step usually involving such techniques as oversowing, subdivision and improved water supply. This is the step assumed to be involved in moving from current average to "top farmer" stocking rates.

A standard cost-benefit evaluation technique was used in which all transfer payments such as taxes, subsidies and interest were ignored. Hence the investment in hill country development was evaluated from the national, rather than the individual's, point of view. Using 1981 costs and prices Scott found that only about 12 per cent of the total undeveloped North Island hill country area would have an IRR for development of greater than 10 per cent if developed to current average stocking rate levels. However, if further intensification were to occur and stocking rates could be raised from existing levels to top farmer levels then about 65 per cent of the area would have an IRR greater than 10 per cent. On a regional basis, Eastern Bay of Plenty, Wellington and Gisborne-East Coast were found to be relatively "unprofitable" regions, while other regions, particularly Northland, were found to have good economic potential for development. Sensitivity analysis indicated that profitability was sensitive to costs and prices used in the study. Scott also investigated the erosion problem that could result from development and found erosion to be potentially a major problem in Gisborne - East Coast and Eastern Bay of Plenty.

2.5.2 Farm level analysis.

A study of the economics of hill country development from the farmer's point of view was published by Parker (1981). He assessed the profitability of development, both with and without assistance from the Livestock Incentive Scheme (L.I.S.) and the Land Development Encouragement Loan Scheme (L.D.E.L.) (see M.A.F. (1980) for a description of these schemes). He also assessed the effect of marginal tax rate. As did Scott (1981), Parker evaluated the two main forms of development: expansion, where new land is bought into production, and intensification, where production is increased on existing grassland. Cash flow budgeting was used in the analysis which was carried out under 1980/81 price levels assuming a constant relationship between output and input prices.

For the evaluation of expansion development, Parker assumed that, because development in the past has occurred on relatively easy land, future development would occur on comparatively steeper country with a heavier scrub cover. He concluded that development of such "store" hill country from scrub, without recourse to grants and incentives, was likely to be unprofitable. With L.D.E.L. and L.I.S. assistance he found that profitability improved but remained marginal if tax savings were not possible on development deficits. If, however, the farmer had a marginal tax rate of 60 per cent, then development became attractive with an IRR of 28 per cent and a payback period of only 5 years.

With respect to the evaluation of intensification, Parker assumed that it would take the form of extra subdivision, some capital and maintenance fertilising and oversowing, leading to a stocking rate increase of 2.5 stock units per hectare. This form of development was found likely to be profitable, with or without assistance from the Livestock Incentive Scheme grant. Measures of profitability ranged from 12.1 per cent IRR and 9 years payback period with zero marginal tax rate and no L.I.S. grant, to 21 per cent IRR and 5 years payback period with 60 per cent marginal tax rate, and L.I.S. grant.

2.6 Conclusion

North Island hill country is an area which accounts for a significant proportion of New Zealand's pastoral production and which has considerable physical potential for further development. As such it has attracted the particular attention from politicians and farming interests and, more recently, researchers and economists. Although "North Island hill country" involves some diversity of characteristics, it would appear to be sufficiently unique to justify being regarded, for analytical purposes, as a relatively homogeneous sub-sector of the pastoral sector.

A number of features of North Island hill country farms are revealed which have implications for understanding the farm/firm system. Firstly, the topographical features of hill country impose severe constraints on both the range of production activities possible and the nature of farm investment. There is an almost complete predominance of livestock production activities, especially sheep and beef breeding, in the area. Wool sales contribute most to gross revenue, followed by sheep sales, then cattle sales. The relative proportion of gross revenue contributed by each has remained relatively stable over recent years. Secondly, the capital assets of the average farm tend to involve mainly land and improvements, and livestock; off-farm assets appear to be minimal compared with the value of farm assets. Average equity levels are high (around 87 per cent). With regard to other aspects of the system, expenditure and consumption levels appear to remain relatively stable compared with the fluctuations in gross income levels while taxation payments are largely determined by current and lagged net income levels.

With respect to hill country development, two general categories tend to be recognised; pasture establishment from scrub, and intensification of existing established pasture. Based on published analyses undertaken in 1981, some scope for further profitable development appeared to exist; however, the profitability of such investment will vary from farm to farm and appears sensitive to the costs and prices involved.

Following the general overview of the hill country and associated farming system, a number of aspects of the system were selected as being of key importance in the decision framework of the system. Farmers' decisions relating to the allocation of farm income between farm expenditure, consumption and investment, and their attitude to borrowing, determine the level of investment or disinvestment in the industry and consequently the future production and growth of the sector. Similarly, farmers' response to changing economic circumstances is likely to involve changes in consumption, investment and borrowing behaviour, yet very little is known about the nature of this behaviour. The following three Chapters describe analyses of behaviour related to consumption, borrowing and investment.

CHAPTER 3

CONSUMPTION ANALYSIS

3.1 Introduction

The objective of this analysis was to investigate factors affecting the consumption behaviour of New Zealand farm households, with special reference to North Island hill country farms, and to derive a consumption function to represent this behaviour. The approach taken was to examine the general theory of consumption behaviour, review some studies that have specifically considered farm household consumption behaviour, and then estimate consumption functions for the New Zealand hill country situation.

Consumption is a major element in farm household decision making, and is of particular interest in farm production and growth studies in as far as it affects funds available for investment. A relationship between consumption and investment in farming is recognised in the Residual Funds hypothesis suggested by Campbell (1958) and others.

Most research into factors affecting consumption has involved groups whose main source of income is from wages and salaries. While there are likely to be important differences in the consumption behaviour of wage and salary earners and farmers, the traditional consumption function theories can still provide a useful basis for farmer consumption studies. The most widely accepted hypothesis regarding the consumption function is that its main determinant is the level of disposable income. Other hypothesised influences are generally more difficult to interpret and predict, and include price and income expectations, holdings of liquid assets, availability of credit, demographic and life cycle factors (Keiser, 1970).

3.2 General Theories of Consumption Behaviour

Three general theories have been postulated to explain household consumption behaviour: the absolute income hypothesis suggested by Keynes, the relative income hypothesis expounded by Duesenberry and others, and the permanent income hypothesis favoured by Friedman. Although significantly different in their implications they nevertheless have important properties in common. Each postulates a relationship between consumption and income, although the concepts underlying these terms may differ. Other possibly relevant factors such as age, family status, education, etc., are generally assumed constant.

Also, all theories are supposedly of general relevance; each has been used on time-series as well as cross-section data and to derive macro as well as micro-relationships. Each was advanced originally in terms of individual behaviour and then generalised to aggregate behaviour. It should be noted that none of the theories has found unqualified support despite extensive empirical research - each is subject to wide controversy receiving support from some empirical studies but not from others. Even proponents of the same theory often disagree with each other on appropriate definitions and approaches (Ferber, 1970).

3.2.1 The absolute income hypothesis.

Keynes (1936) observed that... "Men are disposed, as a rule and on the average, to increase their consumption as their income increases, but not by as much as the increase in their income." In its simplest form, the absolute income hypothesis usually takes the form:

$$C_t = a + bY_t$$

where C represents consumption expenditure in period t, and Y is income in period t. Under this formulation 'a' is a minimum required level of consumption and 'b' is the "marginal propensity to consume (m.p.c.)".

This Keynesian consumption function in its simplest form implies that consumption in period 't' depends only on income in that period; however, adjustment of consumption to new levels of income is not likely to be instantaneous so that previous income also seems likely to have an effect on current consumption. This suggests a model of the form:

$$C_t = a + b_o Y_t + b_1 Y_t \quad + \dots \quad b_n Y_{t-n}$$

where $b = b_o + b_1 + \dots + b_n$ becomes the long-term marginal propensity to consume, and 'b' must be greater than 'b_o' (the short-term m.p.c.). A slightly different formulation which proposes that current consumption is not only dependent on current income but also on habits of consumption (which, in turn, were influenced by previous levels of income) is:

$$C_t = a + bY_t + c_1 C_{t-1} + c_2 C_{2-2} + \dots + c_n \, C_{t-n}$$

which can be reduced to:

$$C = a + bY_t + cC_{t-1}$$

In this case the short-term m.p.c. is 'b' and the long-term m.p.c. is b/1-c i.e. the increase in consumption C which follows a unit increase in all previous income Y_t , Y_{t-1}.. (Malinvaud, 1970). This latter formulation is often preferred for estimation purposes because it accounts for the important "inertia" effect of previous consumption. An alternative interpretation of this specification is that the C_{t-1} term acts as a suitable proxy to account for changes in wealth and income distribution. If these factors affect consumption levels for a given income, then it would be expected that different levels of consumption would be associated with different levels of lagged consumption, even when current disposable income is constant between periods.

3.2.2 The relative income hypothesis.

Empirical work undertaken in the 1940's by Kuznets and others to test the Keynesian hypothesis found that it conformed with the evidence from cross-section household data, and from short-term periods of aggregate data, but that the long-term implication of a decline in the average propensity to consume as a community became richer was not upheld.

To explain this, Duesenberry (1952) and others propounded the Relative Income Hypothesis. They suggested that the consumption rate depends, not on the level of income, but on the relative position of the individual on the income scale. Duesenberry supplied the psychological support for this hypothesis, noting that a strong tendency exists in our social system for people to emulate their neighbours and, at the same time, to strive for a higher standard of living. Given this basis for the long-term proportionality of consumption and income, Duesenberry then proceeded to explain the short-term non-proportionality in terms consistent with it. He suggested that once a new, higher standard of living is achieved, say, as a cyclic peak, people are reluctant to return to a lower level when incomes go down. This hypothesis, incorporating the notion of habit persistence, thus suggests that people seek to maintain at least the highest standard of living attained in the past (Ferber, 1970).

On the basis of this reasoning Duesenberry argued that the relative income hypothesis could be transformed into one expressing consumption as a function of the ratio of current income to the highest level previously achieved:

$$C_t / Y_t = a + bY_t / Y^o$$

where Y^o is the previous highest recorded income. This can be estimated as:

$$C_t = aY_t + bY_t^2 / Y^o$$

An alternative specification suggested by Guise and used by Mullen, Powell and Reece (1980) is:

$$C_t = a + bY_t + c(Y_t - Y^o)$$

where 'b' gives the long-run m.p.c. and 'c' the short-run m.p.c.

Another formulation was suggested by Brown (1952) who modified Duesenberry's hypothesis by introducing the lagged consumption variable C_{t-1} instead of the variable for the previous highest income. (The inclusion of lagged consumption has thus been justified from both an absolute income and a relative income point of view.) Also Brown split income into wage income Y^w and non-wage income Y^n to facilitate the hypothesis that changes in these income components would have a differential effect on the m.p.c. His formulation is given by:

$$C_t = a + bY_t^w + cY_t^n + dC_{t-1}$$

Further development along these lines came with Zellner (1957) who allowed for the observation that, for the same level of income, consumption will vary in accordance with the liquid assets of each household. He thus proposed the following formula to explain consumption:

$$C_t = a + bY_t + cC_{t-1} + dL_{t-1}$$

where L_t denotes liquid assets at the start of period t.

The relative income hypothesis would appear to have particular relevance to agriculture where consumption, and therefore investment behaviour, under conditions of fluctuating income, is of particular interest.

3.2.3 The permanent income hypothesis.

A more recent hypothesis on consumer behaviour grew out of the rising concern regarding the adequacy of current income as the most appropriate determinant of consumption. Particularly among non-wage-earner families, income receipts vary substantially from period to period while consumption outlay usually exhibits much greater stability. To account for this observation the permanent income hypothesis, developed by Friedman (1957), postulates that the reaction of current consumption to a change in current income depends on the individual's expectation about whether the change is likely to be permanent. Permanent changes in income are assumed to directly affect expected consumption whereas transitory changes are assumed to have no effect on expected consumption. Income and consumption in a particular period are assumed to be made up of "transitory" and "permanent" components:

$$Y_t = Y_t^P + Y_t^T$$

$$C_t = C_t^P + C_t^T$$

where the superscripts indicate "permanent" or "transitory". The basic permanent income relationship can then be specified as:

$$C_t^P = a + bY_t^P \text{ or } C_t = a + bY_t^P + C_t^T$$

Also, transitory and permanent income are assumed to be uncorrelated, as are transitory and permanent consumption, and transitory consumption and transitory income.

The main problem with applying this function is to find a suitable measure for the permanent income variable since the only income series usually available is that for actual income. One possible way of linking the two concepts, given the hypothesised importance of expectations in changing an individual's evaluation of permanent income, is by way of an adaptive expectations or distributed lag formulation. For example, Y^P can be approximated by weighting current and lagged actual income by specific discrete weights. Alternatively, a continuous distributed lag process can be tested by estimating a function with a lagged dependent variable. This latter procedure implies the model structure: $C_t = a + bY_t + cC_{t-1}$. As noted above this formulation can also be justified from the absolute and relative income hypotheses.

3.2.4 Influence of variables other than income.

The consumption functions described above all imply *ceteris paribus* assumptions with respect to factors other than income. In recent years studies have focused on three sets of these other factors: socio-economic characteristics of the household, particularly age and life cycle; financial characteristics; and attitudes and expectations (Ferber, 1970). Of these, the life cycle factors have been found to be important in some studies and this has led to the "Life Cycle Hypothesis of Consumption and Savings" (see Ando and Modigliani, 1963). In its most general form this hypothesis suggests that age and family status of the consuming household are major factors in determining consumption behaviour.

3.3 Application to Agriculture and New Zealand

3.3.1 Review of studies.

The generalised consumption functions described above can be regarded as micro-economic relationships used to describe aggregate (macro-economic) behaviour. Malinvaud (1970) suggests that the aggregate model is only really valid if all households have the same marginal propensity to consume and if the distribution of incomes is described by a stable linear stochastic model. Although these are very restrictive conditions, studies of the specific consumption behaviour of relatively homogeneous sub-sections of the population may still be justified as it could reasonably be expected that similar households would have similar marginal propensities to consume.

With respect to agriculture Klein and Goldberger (1955) built a model of the U.S. economy in which the consumption function took account of the differences in types of income by splitting it into three groups; disposable wage income, disposable agricultural income and other classes of disposable income. This was early recognition of the special nature of the agricultural sector. Since that time, however, there appears to have been only a few studies which have specifically analysed the consumption behaviour of farm households despite the policy implications for countries such as Australia and New Zealand where the agricultural sector forms a significant portion of the economy. These studies include Macmillan and Loyns (1969) (Canada), Girao, Tomek and Mount (1974) (U.S.A.), and Mullen *et al.* (1980) (Australia). Also, a simple consumption function for New Zealand pastoral farmers has been estimated by Johnson (1980).

Macmillan and Loyns (1969) in a cross-section study of Canadian farm household expenditure tested for factors affecting different types of expenditure as well as total consumption expenditure. Dependent variables included expenditure on food, household operations, clothing, health, etc. while explanatory variables included total income, age of head of household, number of persons in the household, change in net worth and the annuity value of total assets. Total consumption expenditure proved inelastic with respect to changes in each of these explanatory variables, and close to zero for changes in age of head and net worth. For total expenditure, values of 0.236 and 0.593 were estimated for marginal and average propensity to consume respectively.

Girao et al. (1974) investigated the effect of income instability on farmers' consumption and investment using two samples of Minnesota farmers with contrasting degrees of income stability. Based on their favoured model (a life cycle model which included farmer's age as an explanatory variable) they found that for the unstable group short-run and long-run marginal propensity to consume (m.p.c.) was 0.14 and 0.46 respectively, with an a.p.c. of 0.53. For the stable group short-run and long-run m.p.c. was 0.16 and 0.48 respectively, with an a.p.c. of 0.54. Based on these and other results they concluded that income stability has little effect on consumption behaviour.

Mullen et al. (1980) in a study of the consumption behaviour of 16 farm families in New South Wales over an eight year period came to a similar conclusion. Their best estimates of short-run m.p.c. ranged from 0.13 to 0.16 while long-run m.p.c. estimates were in the range 0.19 to 0.25. (Average propensity to consume was 0.75). These low estimates suggested that, at the farm level, most of any increase in disposable income would be available for either savings or investment. Looking at it another way these results imply that consumption will remain relatively stable as incomes fluctuate.

With respect to New Zealand, Johnson (1980) in a brief appendix to a paper on the financing of agricultural investment in New Zealand, presented a consumption function calculated as:

$$C_t = 201.1 + 0.2182\ Y_t + 0.5879\ C_{t-1}$$

This function was estimated using MWBES Sheep and Beef Farm Survey data for 1970/71 to 1977/78. This model specification gives a short-run m.p.c. of 0.22 and a long-run m.p.c. of 0.53. A closer investigation of this model is presented below in Section 3.4.2.

Finally, a study by Deane and Giles (1972) of aggregate consumption equations for New Zealand should be mentioned. In this study quarterly time-series data for the New Zealand economy were used to estimate a number of consumption equations based on a range of alternative hypotheses. Attention was centred on the behaviour of real personal disposable income in relation to expenditure on consumption goods, the latter being disaggregated into the durables and non-durables. The permanent income hypothesis was favoured as the model which best explained the consumption behaviour in the New Zealand economy during the period under study (1961 to 1970). Results from this study indicated significant differences between the marginal propensities to consume for salary/wage income and non-salary/wage income. For salary/wage income, short-run m.p.c. was estimated at 0.10 and long-run m.p.c. at 0.30, while for non-salary/wage income, short and long-run m.p.c. were estimated as 0.30 and 0.42 respectively.

3.3.2 New Zealand data.

A number of New Zealand data sources were examined in order to determine the availability of suitable data for consumption functions analysis (Greer, 1981; Stats Dept.; Shepherd and Worsop, 1980; MWBES Sheep and Beef Farm Survey). It was concluded that the MWBES Sheep and Beef Farm Survey results contained the most relevant data for the objective in hand, particularly those data related to North Island hill country (Class 4) farms.

These data were available in two forms; firstly as published annual average data based on a sample of 128 farms[3] for the period 1958/59 to 1979/80, representing a time-series of 22 data points; and secondly, as unpublished "panel" data provided by the MWBES for 46 individual Class 4 farms for the period 1969/70 to 1978/79. The criteria for inclusion in the panel was that the farm had been continuously surveyed by the MWBES over the ten year period. Therefore, the panel data farms cannot be regarded as a random subsample of the published data sample.

From these data the best measure of consumption available was personal "drawings", a figure taken from farm accounts, which represents personal living expenses. One disadvantage of using this measure, particularly in the short-term or for any cross-sectional analysis, is that no distinction is made between consumption of "durables" and "non-durables". Another is that a certain amount of consumption will not be accounted for. Examples of this could include the purchase of consumable items which are entered elsewhere in the farm accounts, or more commonly, the use of food and fuel items produced on the farm. It may be possible to adjust for consumption of farm produce in the same way that the managerial reward calculation includes a percentage of the ruling wage; however, a straight percentage increase is not particularly satisfactory and, in the absence of better information, was not attempted in this study.

Net farm income was readily available, and has been used here in a form adjusted for stabilisation accounts and taxation (see Table 3.1). It was not possible to get a reliable measure for off-farm income, which could include interest from savings accounts, rental from a house on the property and possible share dividends. Although this income may not be significant, it would ideally be included.

Liquid assets were calculated as cash in bank, plus specific reserves. Specific reserves are funds specially designated as reserves in the balance sheet, of which common examples are taxation, income equalisation deposits and development reserves. Some indeterminate proportion of specific reserves may not be backed by actual liquid reserves. For example, the item includes allowance for funds spent but

---

3 Approximately 85 per cent of farms remain in the sample from one year to the next. The other 15 per cent, which drop out of the survey or otherwise become ineligible, are replaced using random sampling techniques. More detail on survey procedures is given in MWBES (1982).

TABLE 3.1

Definitions of Meat and Wool Boards' Economic Service Variables Used to Estimate Consumption Functions

	Variable Used	Description
C_t	Drawings	Personal living expenses.
Y_t	Income	Total gross farm income adjusted for deposits or withdrawals on the 'Wool Income Retention Account' and 'Income Equalisation Account' minus total cash expenditure and depreciation and minus taxation (which includes both terminal and provisional tax payments).
Y^o	Highest previous income	Highest previous value of Y_t.
L_t	Liquid assets	Cash in bank + specific reserves.

TABLE 3.2

Estimated Coefficients for Consumption Functions Based on Absolute Income and Relative Income Hypotheses

Equ. No.	CONST.	Y_t	C_{t-1}	Y_t^2/Y_t^o	Y_t^o	$Y_t-Y_t^o$	L_{t-1}	$\bar{R}^2$	D.W.
1.1	12,994	0.170*						0.154	1.53
		(0.077)							
1.2	9,074	0.347**						0.425	
		(0.019)							
1.3	11,781	0.078**						0.546	
		(0.027)							
2.1	6,228	0.207**	0.361*					0.314	2.47
		(0.068)	(0.178)						
2.1a	3,800	0.237**	0.600+					0.727	
		(0.052)	(0.263)						
2.1b	3,017	0.231**	0.584+					0.752	
		(0.048)	(0.248)						
Johnson (1981)	201	0.218	0.588					0.948	
2.2	3,821	0.179**	0.508**					0.614	
		(0.019)	(0.037)						
2.3	10,388	0.081**	0.093					0.547	
		(0.027)	(0.059)						
3.1	15,723	−0.085		0.155				0.219	2.18
		(0.173)		(0.095)					
3.2	8,644	0.431**		−0.058**				0.448	
		(0.027)		(0.013)					
4.1	16,250				0.057	0.169*		0.255	2.26
					(0.105)	(0.070)			
4.2	6,097				0.379**	0.231**		0.505	
					(0.019)	(0.022)			
5.1	6,900	0.201**	0.240				0.069	0.319	2.041
		(0.068)	(0.210)				(0.065)		
5.2	4,740	0.149**	0.388**				0.057**	0.669	
		(0.021)	(0.048)				(0.012)		

+ significant at the 10 per cent level; * significant at the 5 per cent level; ** significant at the 1 per cent level not all claimed for tax purposes in the current year (R. Davison, MWBES, pers. comm.).

With MWBES survey data no measure of household size nor of the number of households supported by a sample farm is available. The sampling unit for the survey is the farm, and financial data refer to that farm only. Farm ownership may be held by an individual or by multiple owners under Partnerships, Trusts, Estates or Companies or a combination of these alternative forms. While the incidence in the sample of multiple household farms (apart from those associated with paid labour) cannot be measured, the strong tradition of family farming in this area would suggest that it is low. With respect to household size Mullen et al. (1980) did conclude that household size was not a significant factor in explaining consumption, however, here the hypothesis cannot be tested.

A summary of variables used in the analysis, and their description is presented in Table 3.1.

3.3.3 Models selected.

Six models were selected for testing. The absolute income hypothesis was tested with two model forms:

$$C_t = a + bY_t \qquad \text{(Model 1)}$$

$$C_t = a + bY_t + cC_{t-1} \qquad \text{(Model 2)}$$

where C_t and Y_t represent consumption and income respectively. (It should be noted that this Model 2 can be interpreted as an expression of the relative and permanent income hypotheses as well as the absolute income hypothesis.)

Two forms of relative income model were selected. These were:

$$C_t = aY_t + bY_t^2 / Y^o \qquad \text{(Model 3)}$$

where Y^o is the previous highest recorded income (in real terms); and

$$C_t = a + bY^o + c(Y_t - Y^o) \qquad \text{(Model 4)}$$

which is derived from Mullen et al. (1980) and was suggested by Guise (1978, University of New England) in a personal communication to that author. In this model the long-run m.p.c. is given by b and the short-run m.p.c. by 'c'.

Zellner's model (Zellner, 1957) was also used because of the addition of liquid assets (L) to the model:

$$C_t = a + bY_t + cC_{t-1} + dL_{t-1} \qquad \text{(Model 5)}$$

The final model tested was the Friedman permanent income model tested in the form:

$$C_t^P = a + bY_t^P \qquad \text{(Model 6)}$$

where Y^P is an estimate of permanent income.

3.3.4 Estimation.

Despite some shortcomings outlined below, Ordinary Least Squares (OLS) regression was used to estimate all models both with the time-series and the panel data. In both cases all values were expressed in "real" terms, by adjusting to 1980/81 dollars using the consumer price index (CPI). This assumes that people perceive the "real" value of an item when considering consumption, and are not subject to "money illusions". Although this may not be a completely realistic assumption, it was accepted in the absence of any sound reasoning suggesting that the relationship is between nominal or money income and consumption.

Where lagged consumption is introduced as an exogenous variable, statistical problems arise. If the error terms are not serially correlated then OLS estimates will be biased for small samples, but will be consistent and asymptotically efficient for large samples. Also, because of the bias in the estimates the computed standard errors will also be biased. Various alternatives to OLS have been suggested for this situation but none have been shown to be "better" in small samples (Rao and Miller 1971), consequently OLS was used in this study.

With the adaptive expectations structure used in Model 6 the errors are, by definition, serially correlated and there will be non-linearities in the parameters. Under these circumstances the OLS estimates will be inconsistent, however, an alternative technique of estimation with serially dependent errors has not been perfected.

Another problem which occurs when the lagged dependent variable is included in the model is that the Durbin-Watson test for serial correlation is biased towards 2 and thus is no longer valid. A modified "h" statistic was suggested by Durbin (1970) but this test could not be used in this study because the denominator in the mathematical expression was always negative.

For the panel data (i.e. the time-series of cross-sections) the estimation procedures used followed Mullen et al. (1980) who collected data in a similar form. The panel data can be pooled and estimated using OLS regression; however, if this is done, the usual assumptions concerning the error term breakdown, and there is a strong likelihood of serial correlation of the error term and heteroscedasticity. Under these circumstances the estimates of the variance of the coefficients and their associated 't' statistics will be biased although the estimates of the coefficients should be unbiased (Fuller and Battese, 1974). Various techniques have been used to overcome this problem whilst retaining a maximum amount of information. A simple adaptation involves the addition of a dummy variable for each farm in the cross-section. These dummy variables can be attached to the intercept in the model if it is assumed that, although the absolute level of consumption may vary from farm to farm, the marginal impact of the explanatory variables is the same for all farms.

Alternatively the dummy variables could be associated with the regression coefficients implying different marginal responses from farm to farm. This approach has the added advantage of identifying particular farms which show different characteristics over time, and which may be considered outliers. On the other hand, it is difficult to interpret the coefficients of the dummy variables. More complicated procedures include a maximum likelihood function approach discussed by Maddala (1971) and cross-error models which further investigate the composition of the error term (Fuller and Battese, 1974; Wallace and Hussain, 1969). For this analysis the first two simple techniques (OLS and OLS with dummy variables) were used.

3.4 Discussion of Results

The results of the regression analyses undertaken to test the various model specifications are presented in Table 3.2 and discussed in the following sections. With respect to the equation numbers in this Table (for Models 1 to 5), the first number represents the model number as specified above, while the second number represents the mode of estimation as follows:

.1 estimated with published MWBES Class 4 time series data for years 1958/59 to 1979/80, reflated to 1980/81 dollars.

.2 estimated with unpublished MWBES Class 4 panel data comprising 46 farms for years 1969/70 to 1978/79, reflated to 1980/81 dollars.

3. as for 2 above, with a dummy variable included for each farm. Only Models 1 and 2 were tested using this procedure.

3.4.1 Model 1: $C_t = a + bY_t$

This model generally had low explanatory power although in each equation the signs on the coefficients were as expected and all the coefficients for Y_t appear significantly different from zero at the 5 per cent level of significance or better. It must be noted however, that 't' tests applied to coefficients estimated using OLS regression with panel data are likely to be biased. The Durbin-Watson test for serial correlation proved negative at the 5 per cent significance level for the time-series estimations.

Estimates of the marginal propensity to consume (m.p.c.) based on these results varied widely - probably the most reliable estimates come from the time-series (Equation 1.1) indicating a m.p.c. of 0.17, and the panel data estimate (Equation 1.2) of approximately 0.35. (The average propensity to consume was 0.84 for the time-series sample farms, and 0.73 for the farms constituting the panel data.)

3.4.2 Model 2: $C_t = a + bY_t + cC_{t-1}$

This model was estimated by Johnson (1981) using MWBES published "All Class Average" data for the period 1970/71 to 1977/78. Johnson's definition of income differed from that used in this study in that taxation and depreciation payments were included as available income. Also the function was estimated using undeflated data. Johnson's estimated model is included in Table 3.2 together with two additional equations, 2.1a and 2.1b which were estimated for comparison. Equation 2.1a was derived using real values on the same basis as 2.1 except that the time-series was reduced to 8 years (1970/71 to 1977/78). The basis for estimating Equation 2.1b was the same as 2.1a except that depreciation was included as part of disposable income.

In comparison with Model 1, the explanatory power of Model 2 was greater. The Durbin-Watson (d) statistic is presented for Equation 2.1 rather than the more appropriate 'h' because the latter could not be calculated. In any case it is likely that a significant level of serial-correlation exists in these equations making the coefficient estimates and standard errors biased for small samples; however, in the absence of any better estimates, and because the coefficients are consistent and asymptotically unbiased, the estimates were accepted as the best available.

All coefficients showed the expected signs and the coefficients of Y_t all proved to be significantly different from zero at, at least, the 5 per cent significance level. Estimates of the short-run marginal propensities to consume based on the coefficients of Y_t were consistent except for the panel data with dummies estimate (Eq. 2.3). All other equations gave a short-run m.p.c. of between 0.18 and 0.24. This is in line with Johnson's estimate of 0.22.

The coefficients of lagged consumption were also significant in most cases indicating a relationship between current and previous consumption. The coefficient values appeared to vary depending on the time period over which the equation was estimated. For Equation 2.1 estimated over the full time-series, 1958/59 to 1979/80, the coefficients of lagged consumption were relatively low, 0.36 and 0.27 respectively, leading to long-run m.p.c. estimates of 0.32 and 0.29. In contrast, the equations estimated with 1970's data only, be it time-series (Equations 2.1a, 2.1b, and Johnson's) or panel data (Eq. 2.2) gave higher lagged consumption coefficient estimates of between 0.5 and 0.6. These values lead to long-run m.p.c. estimates of 0.36 for panel data (Eq. 2.2) and between 0.53 and 0.59 for the time-series data (Eqs. 2.1a and 2.1b). These latter estimates are close to the value of 0.53 implied by Johnson's equation. These results suggest that long-run m.p.c. may have increased in the 1970's while short-run m.p.c. has remained reasonably stable.

Also of interest is the substantially improved explanatory power of this model for the 1970's compared with the longer time-series 1958/59 to 1979/80. This is evidenced by the fact that for the time-series data R^2 (adjusted) improves from 0.314 (Eq. 2.1) to 0.727 (Eq. 2.1a) for periods 1958/59 to 1979/80 and 1970/71 to 1977/78 respectively. The R^2 value achieved by Johnson's model could not be matched because of the effect of deflating the data.

3.4.3 Model 3: $C_t = a + bY_t^2 + cY_t/Y^o$

Based on R^2, significance of coefficients and sign expectations, this model performed poorly with the time-series data. This was not unexpected because, with a time-series of averages, the important link between previous highest income and current consumption for each household is lost.

For the panel data (Eq. 3.2) the results appeared more satisfactory despite the likelihood of multicollinearity between the explanatory variables. Both the coefficients of Y_t and Y_t^2/Y^o were significant and the negative sign on Y_t^2/Y^o was logical. This model gives a good example of the "ratchet" effect that is implied by the relative income hypothesis. This effect relates to the different behaviour of consumers when income is increasing compared with when it is decreasing, and is apparent when the marginal propensities are calculated using this model. Taking the first partial derivative (w.r.t. Y) of Equation 3.3 gives an equation for m.p.c. as follows:

$$\partial C_t/\partial Y_t = 0.431 - 0.116\ Y_t/Y^o$$

This implies that if income is increasing, i.e. $Y_t = Y^o$, then m.p.c. is 0.315; however, if current income falls below the previous highest income, i.e. $Y^o > Y_t$, then the m.p.c. increases. For example, if previous highest income is $15,000 and current income is $10,000, m.p.c. will be 0.354.

The marginal impact of a change in the level of previous highest income can also be derived by calculating the first partial derivative w.r.t. Y as follows:

$$\partial C_t/\partial Y^o = 0.116\ Y_t^2/Y^{o2}$$

This function will be positive indicating that an increase in Y will increase current consumption; however, the extent of that increase will depend on the relative size of Y^o and Y_t.

3.4.4 Model 4: $C_t = a + bY^o + c(Y_t - Y^o)$

This model, which is based on the relative income hypothesis, performed best for the panel data as might be expected - the time-series data are Class 4 averages so that the link between previous highest income and current consumption for each individual is lost. This problem is further evidenced by the non-significance of the Y_t coefficient in the time-series equation (4.1).

The panel data equation (4.2) gave satisfactory results; the estimated coefficients were significant at the 1 per cent level and have the expected sign and order of magnitude. With this model formulation the coefficient of $(Y_t - Y^o)$ gives the short-run m.p.c. while the coefficient of Y gives the long-run m.p.c. On this basis Equation 4.2 gives a short-run m.p.c. of 0.23 and a long-run m.p.c. of 0.38.

3.4.5 Model 5: $C_t = a + bY_t + cC_{t-1} + dL_{t-1}$

This model is similar to Model 2 except that the lagged liquidity level is also included. In comparison with Model 2, the explanatory power of the model improved slightly in each case, however, the signs, magnitudes and significance of the estimated coefficients were more variable and lacked consistency. For the time-series equation (5.1) the coefficient on Y_t was highly significant and of similar value to the same coefficient in Model 2. The coefficients on C_{t-1} and L_{t-1}, however, lacked significance.

For the panel data (Eq. 5.2) all three estimated coefficients were significant and the explanatory power of the model was reasonable (adjusted R^2 was 0.67). The coefficient of lagged liquidity, 0.06, while significant, indicates a relatively small effect. Thus while there is some indication that liquidity and consumption are related, the strength of this link is unclear. In any case, it is likely that a significant part of the liquidity effect is captured indirectly through lagged consumption.

3.4.6 Model 6: $C_t^P = a + bY_t^P$

Different procedures were used to test the permanent income hypothesis. The permanent income hypothesis states that the consumption C_t of a household in period 't' depends on its permanent income and not on its transitory income. To investigate this hypothesis the model was formulated in the following way:

$$C_t = a + b\,Y_t^P$$

where C_t is period t consumption and Y_t^P is permanent income.

Permanent income cannot be directly observed, however, Friedman (1957) suggested an adaptive expectations formulation could be used to estimate a proxy for permanent income. In this study a range of different lag and weight structures were tested. These structures, and the equation number in which they are tested, are as follows:

6.1 $Y_t^P = Y_t$

6.2 $Y_t^P = 2/3Y_t + 1/3Y_{t-1}$

6.3 $Y_t^P = 3/6Y_t + 2/6Y_{5-1} + 1/6Y_{t-2}$

6.4 $Y_t^P = 4/10Y_t + 3/10Y_{t-1} + 2/10Y_{5-2} + 1/10Y_{t-3}$

6.5 $Y_t^P = 5/15Y_t + 4/15Y_{t-1} + 3/15Y_{5-2} + 2/15Y_{t-3} + 1/15Y_{t-4}$

Results are presented in Table 3.3 where the third digit in each equation number indicates the data used to estimate the equation; for example, 6.11 indicates that the model was estimated using published MWBES time-series data for Class 4 farms over the period 1958/59 to 1979/80, reflated to 1980/81 dollars. Alternatively, the same model labelled 6.12 was estimated using unpublished MWBES Class 4 panel data comprising 46 farms for years 1969/70 to 1978/79, also reflated to

TABLE 3.3

Estimated Coefficients for Consumption Functions Based on the Permanent Income Hypothesis

Equ. No.	CONST.	Y_t^P	$\bar{R}^2$	D.W.
6.11	12994	0.170* (0.077)	0.15	1.53
6.12	9074	0.347** (0.019)	0.43	-
6.21	9720	0.330** (0.082)	0.43	1.55
6.22	7435	0.427** (0.021)	0.52	-
6.31	8922	0.366** (0.115)	0.33	1.71
6.32	6589	0.487** (0.024)	0.55	-
6.41	9946	0.302* (0.128)	0.20	2.01
6.42	6270	0.519** (0.027)	0.54	-
6.51	9132	0.346* (0.146)	0.21	1.94
6.52	6136	0.555** (0.032)	0.54	-

* significant at 5 per cent level
** significant at 1 per cent level

1980/81 dollars.

Notwithstanding the statistical problems described above, the results appear satisfactory with the coefficient of Y_t^P proving to be significant at the 5 per cent level or better in all equations. $\bar{R}^2$ is greatest in Equation 6.21 (where $Y_t^P = 2/3Y_t + 1/3Y_{t-1}$) for the time-series data, and Equation 6.32 (where $Y_t^P = 3/6Y_t + 2/6Y_{t-1} + 1/6_{t-2}$) for the panel data. If these equations are taken to provide estimates of long-run m.p.c., a value of 0.33 is obtained for the time-series and 0.49 for the panel data. Short-run m.p.c. estimates can also be derived by multiplying the Y^P coefficient by the weight given to Y_t in the Y^P formulation. Thus from Equation 6.21 a short-run m.p.c. for the time-series of 0.20 is obtained, and from Equation 6.32 a panel data estimate of 0.24 is obtained. The time-series result is consistent with that obtained from Model 2 (0.21 and 0.32 from Equation 2.10, however, the long-run m.p.c. estimate obtained with the panel data is significantly higher than that obtained from Model 2 (i.e. 0.36 from Equation 2.3).

3.5 Conclusions

Despite shortcomings in the data and some statistical problems associated with the use of panel data and OLS estimation, a reasonably consistent picture emerges of the consumption behaviour of North Island hill country farmers, at least as far as their marginal propensity to consume is concerned. Table 3.4 shows the marginal propensities to consume estimated with selected model specifications. Best estimates of short-run m.p.c., based on a range of model and data specifications, appear to be in the range of 0.18-0.24, while for long-run m.p.c. estimates tend to vary depending on the data and time base. For the full time-series of 1958/59 to 1979/80, long-run m.p.c. estimates ranged from 0.26 to 0.33. For the same time-series truncated to 1970/71 to 1977/78 long-run m.p.c. estimates increased to 0.53-0.59.

This higher long-run m.p.c. for the 1970's is confirmed to some extent by the panel data estimations (based on time period 1969/70 to 1978/79) which range from 0.36 to 0.49 for long-run m.p.c. These results indicate that there may have been a real change in consumption patterns in the 1970's. The real cost of basic consumption items appears to have dropped while at the same time farmers seem more inclined to spend once an increase in income has been found to be more than transitory.

With respect to the alternative behavioural hypotheses tested, no one hypothesis is clearly superior. The model formulation which gives the best and/or most consistent results is Model 2 (i.e. $C_t = a + bY_t + cC_{t-1}$); this formulation can be justified from any one of the three behavioural hypotheses. Looking at the models that are more specifically linked to the behavioural hypotheses the picture still remains unclear although the absolute income hypothesis in its most basic form (Model 1) generally performed poorly. The relative income hypothesis models (Models 3 and 4) both performed satisfactorily providing some evidence of the "ratchet effect" which is a feature of this behavioural hypothesis. Similarly, the permanent income model (Model 6) also performed satisfactorily and the validity of this hypothesis cannot be dismissed.

TABLE 3.4

Estimated Marginal Propensities to Consume

Model No.	Short-Run		Long-Run
1.1	0.17		-
1.2	0.35		-
2.1	0.21		0.32
2.1a	0.24		0.59
2.1b	0.23		0.56
Johnson (1981)	0.22		0.53
2.2	0.18		0.36
3.2		0.32+	
4.2	0.23		0.38
5.1	0.20		0.26
5.2	0.15		0.24
6.21	0.20		0.33
6.32	0.24		0.49

Average propensity to consume: - time series 0.84
- panel data 0.73

CHAPTER 4

ANALYSIS OF THE USE OF CREDIT

4.1 Introduction

Credit is an important source of funds for pastoral farmers and borrowed funds are used for a number of purposes ranging from the payment of day-to-day working expenses on the farm, through to the financing of long term capital development and land purchase. In order to better understand and model the role of credit in farm production and growth, an investigation of farmer borrowing behaviour was carried out. In undertaking this study it was generally assumed that observed borrowing behaviour was primarily a function of farmer attitudes, rather than of external credit rationing. This assumption would appear to be justified given some empirical observations described below, and given government policy. The Minister of Finance, acting through the Reserve Bank, has wide powers to give directions to financial institutions on the policy to be followed in relation to lending priorities. Although details of the guidelines vary from time to time agricultural export industries have always had top priority (Deane and Nicholl, 1979).

Various aspects of borrowing behaviour were explored by reviewing past credit surveys and studies, and by undertaking some statistical analyses using survey data. In addition to past surveys and analyses of credit-use, some additional primary data were sought in order to further investigate credit-use and farmer borrowing behaviour.

4.1.1 Sources of data

The first source of data used was the annual Sheep and Beef Farm Survey conducted by the Meat and Wool Boards' Economic Service (MWBES). Published data were available from the survey giving the average values for the major asset and liability categories for each farm class over the last 20 years. Also the MWBES recently published the results of a detailed survey of the composition of term liabilities on sheep and beef farms in 1979/80 (MWBES, 1984).

While these data were useful for observing and analysing various aspects of borrowing behaviour, more disaggregated data were required if a clearer understanding of the behaviour of individual farmers was to be gained. To this end the "panel" of data used for the consumption analysis was used again. This comprised individual farm data from the MWBES Survey for a sample of 46 Class 4 farms covering the ten years from 1969/70 to 1978/79. These data included all major financial and production items surveyed. The criterion for selection in the sample was that the farm had been continuously in the MWBES Survey for at least 10 years. This criterion effectively excluded farms that had undergone major changes in size or ownership structure; thus, while borrowing behaviour related to farm and land purchase could not be observed, the data provided a good basis for observing and analysing borrowing behaviour related to normal farming operations and

The other source of primary data used in this study was the Farmer Opinion Survey (Pryde and McCartin, 1983) conducted through the AERU at Lincoln College. A special series of questions on capital structure, investment and borrowing were included in the survey to provide data for this study. The section of the questionnaire related to these aspects is reproduced in Appendix 1. In addition to the published results, more detailed results were tabulated for North Island hill country sheep-beef farmers (258 respondents, excluding farmers on hard hill country).

4.2 Aspects of Credit Using Behaviour

4.2.1 Reasons for borrowing

In a Rural Credit Survey conducted by the MAF (1975) it was found that in 1974/75 the largest proportion of outstanding long-term credit was used for purchase and amalgamation (55 per cent), followed by development (27 per cent), refinancing (14 per cent), and personal reasons (4 per cent). Although a more detailed breakdown of the purposes for borrowing was not available from this Survey, it is likely that a high proportion of finance in the category for "purchase and amalgamation" would constitute large mortgages taken out for the original purchase of the property.

An indication of the reasons for new borrowing was provided by the credit survey conducted by the MWBES (1984). The proportions of the value of new borrowing in 1979/80 classified by reason are shown in Table 4.1 for both Class 4 farms and the All Class average. Of interest for this study is the fact that only 35 per cent (44 per cent if farm purchase borrowing is excluded) of new borrowing on Class 4 farms was for on-farm investment purposes i.e. buildings, stock, plant and vehicles, and land development.

4.2.2 Debt levels

(a) Average debt levels

In nominal terms average debt levels have increased significantly over the last 20 years, and tend to be highly correlated with the value of land. For example, using MWBES Class 4 published data for the period 1961/62 to 1980/81, and regressing the level of fixed liabilities (FXLIAB) as a function of the nominal value of land and improvements (LANDVAL), the following results were obtained:

$$FXLIAB = 15868 + \underset{(0.011)}{0.137}LANDVAL \qquad R^2 = 0.90 \quad D.W. = 0.81$$

Notwithstanding the presence of auto-correlation indicated by the Durbin-Watson statistic, the equation indicates the very high correlation that exists between the two variables.

TABLE 4.1

Reasons for New Long-Term Borrowing - 1979/80

	Percentage of All New Mortgage Value	
Reason	All Class Average	North Island hill country (Class 4)
Initial Farm Purchase	21	19
Additional Land	18	26
New Farm Buildings	11	12
Additional Stock	2	4
New Plant and Vehicles	13	8
Land Development	15	11
Climatic, Other Assistance	2	2
Forestry Development	<1	-
Death Duties	1	<1
Refinancing	15	16
Multi-purpose	1	-
Other	<1	<1
	100	100

Source: MWBES (1984)

With respect to real debt levels, Pryde and Martin (1980) observed that, for the pastoral sector in general, there appeared to be a slight downward trend in the average real level of debt, and a corresponding increase in equity levels, over the period 1971 to 1979. Using MWBES published data in Table 4.2, this trend is shown to be true also for North Island hill country, and to have continued until at least 1980/81.

Using "interest payments as a percentage of gross expenditure" as a measure of debt levels, no such trend is apparent. In Table 4.2 it is shown that, between 1967/68 and 1980/81, the average percentage varied between 10.0 and 13.8 per cent without trend. It appears that increases in interest rates have maintained the interest burden despite a decline in real debt levels.

(b) Individual debt levels

With respect to individual borrowing behaviour, a number of surveys (Miller, 1965; MAF 1975; Pryde, 1978; Pryde and McCartin, 1983) have shown a very wide range of credit use, with considerable variation, not only from farm to farm, but also from district to district and from one farm type to another. To investigate borrowing trends at the individual farm level the MWBES panel data for 46 North Island hill country farms over 10 years was used. The changes in the level of fixed liabilities across the 46 farms showed a wide range. Some farms went from being debt free to having substantial long-term debt at the end of the ten year period, while others went from having substantial debt levels to being debt free. The distribution of percentage changes in nominal and real fixed liability levels over the ten year period is shown in Figures 4.1 and 4.2. Of the 45 farms that had some long-term debt 29 (or 64 per cent) showed an increase in the nominal level of debt over the period, with 16 farms (35 per cent) showing a decline in nominal debt levels. The average nominal debt level increased by 114 per cent over the ten year period.

When debt levels were converted to real terms by reflating to 1980 dollars using the MWBES Farm Price Index it was found that only 12 farms (26 per cent) showed an increase in real debt levels while 33 farms (74 per cent) showed a decline in real debt levels. The average real debt level decreased by 28 per cent. This decline in average real debt levels was also reflected in an analysis of the change in equity levels for the 46 farms. The distribution of equity change is shown in Figure 4.3. Thirty five farms (or 78 per cent) increased equity over the period with 10 farms (22 per cent) having reduced equity.

In summary, it is clear that there is a very wide range of borrowing behaviour amongst farmers and no clear pattern is apparent. Taking the group as a whole, however, two significant observations are possible. Firstly, the majority of farmers have significant levels of debt and are prepared to increase that level of debt in nominal terms. Secondly, while farmers tend to borrow actively, the majority do not do so to the extent of increasing their real level of debt or reducing their equity percentage. It would appear that, while inflation in asset values, particularly land, provides farmers with the capacity for increased borrowing, only part of this capacity is exploited.

TABLE 4.2

Equity Levels, and Interest Payments as a Proportion of Total Expenditure for North Island Hill Country Farms, 1965/66 to 1980/81

	Equity*	Interest as % of Total Expenditure
1965/66	70.8	9.7
1966/67	70.1	11.3
1967/68	68.6	13.1
1968/69	68.6	11.7
1969/70	74.4	11.8
1970/71	72.8	13.4
1971/72	72.3	13.2
1972/73	79.0	10.5
1973/74	80.1	10.0
1974/75	78.7	13.7
1975/76	80.3	12.6
1976/77	81.4	10.6
1977/78	80.9	12.4
1978/79	80.9	12.4
1979/80	85.4	13.0
1980/81	87.1	13.3

* Net Worth/Total Assets

TABLE 4.3

Respondent's Ability to Borrow All the Money Required During 1981/82 Season

	All Sheep/Beef (%)	North Island Hill (%)
Did not apply to borrow funds	47	46
Was able to borrow all funds required	37	37
Was not able to borrow all funds required	10	11
Don't know	6	7
No. of valid observations	874	167

FIGURE 4.1

Percentage Change in Nominal Fixed Liabilities
between 1969/70 and 1978/79

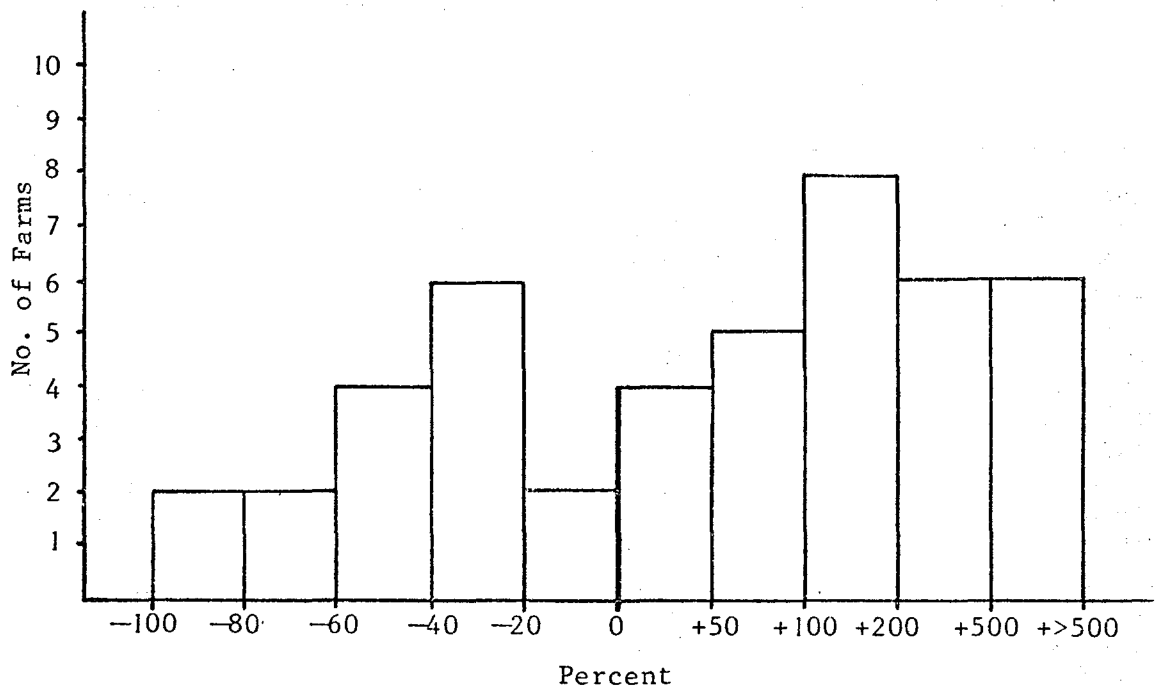


FIGURE 4.2

Percentage Change in Real Fixed Liabilities
between 1969/70 and 1978/79

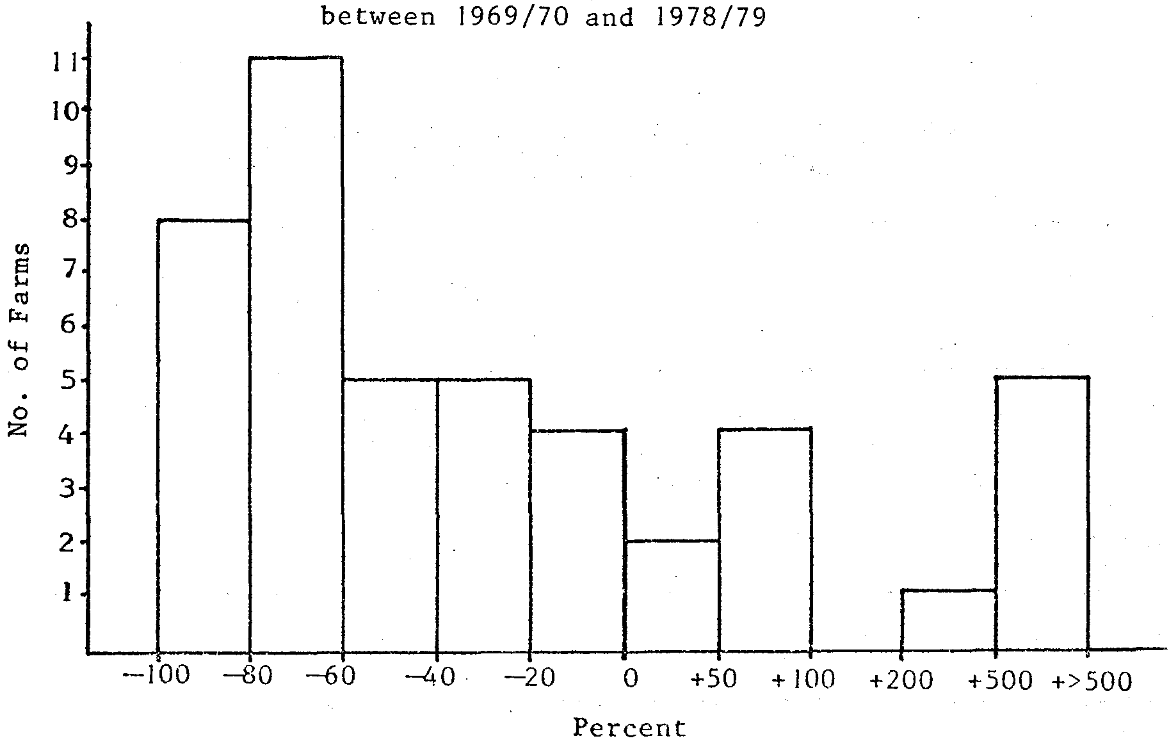


FIGURE 4.3

Changes in Equity Percentage
between 1969/70 and 1978/79

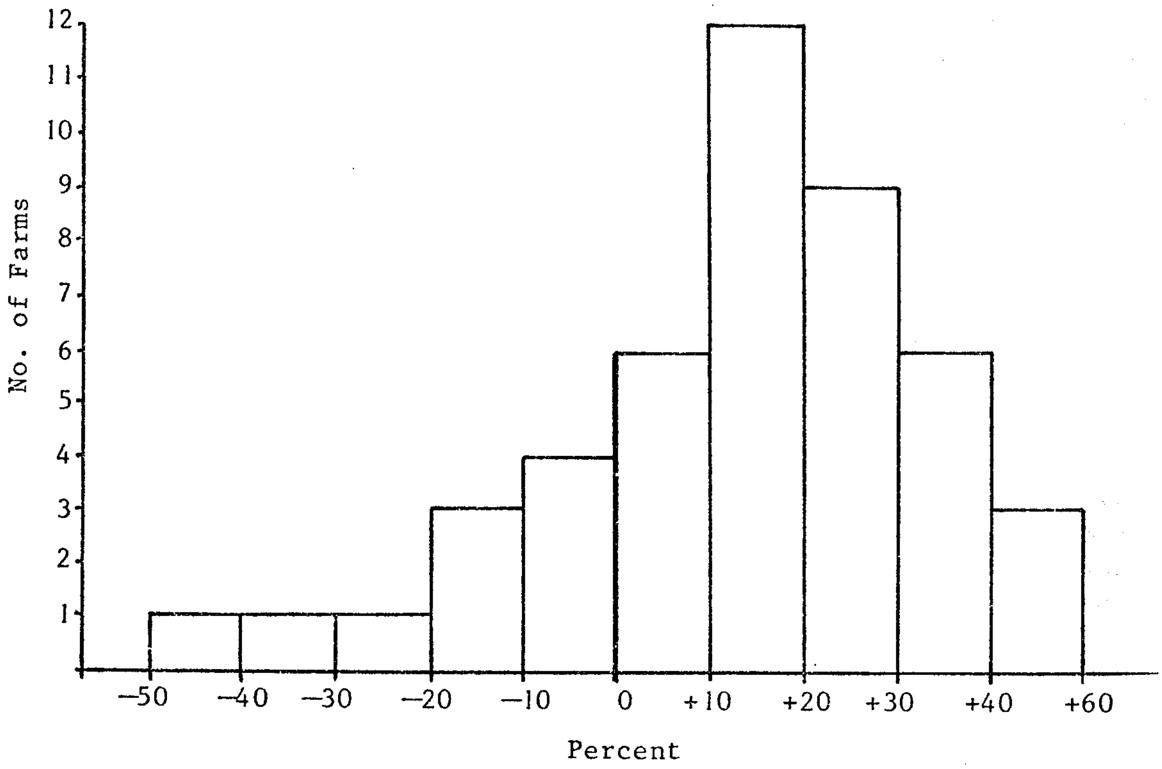
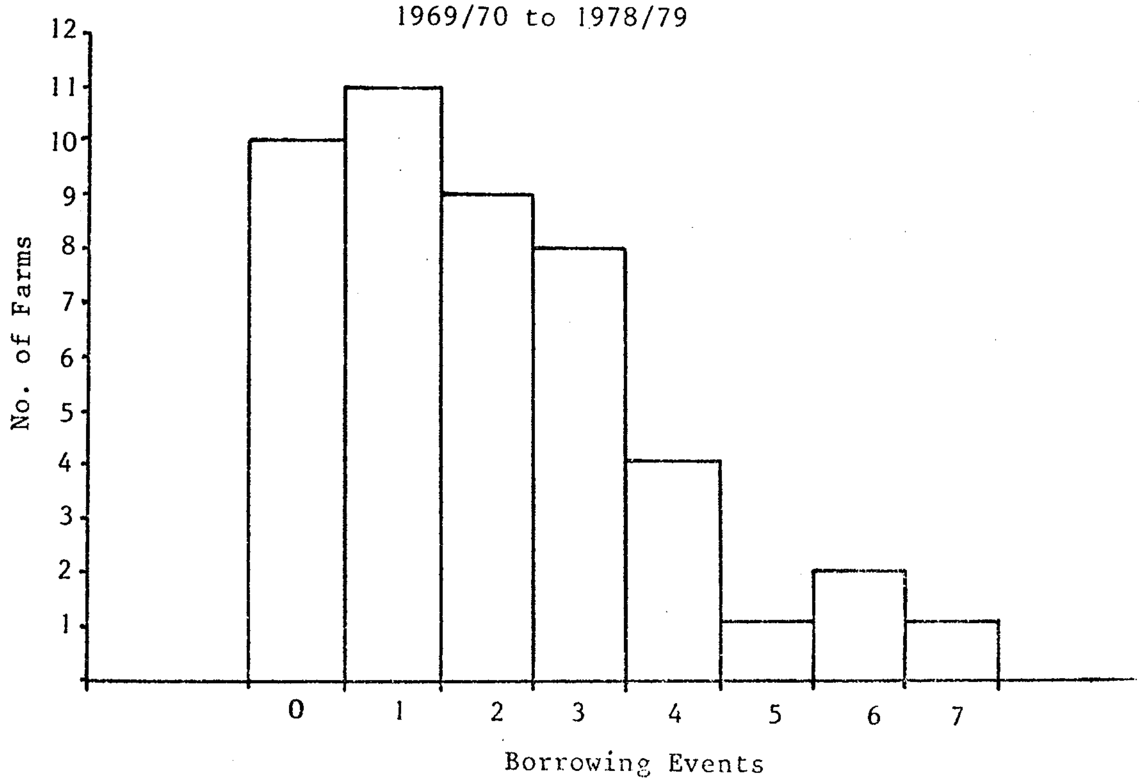


FIGURE 4.4

Frequency of Borrowing over Period
1969/70 to 1978/79



4.2.3 Borrowing frequency

To determine borrowing frequency, each significant borrowing event was noted for each of the 46 farms over the 10 year period. A "significant" borrowing event was defined as an increase of $1000 or more in fixed liabilities compared with the previous year. The frequency of borrowing is shown in Figure 4.4. Only ten farmers out of the 46 (or 20 per cent) did not borrow at any time during the ten year period. Of the 36 farmers who borrowed, 11 (31 per cent) borrowed only once, 9 (25 per cent) twice and 8 (22 per cent) three times. Eight farmers (22 per cent) borrowed between four and seven times in the ten year period. The average time between borrowing was approximately four years.

4.2.4 Attitude to use of credit

(a) Long-term credit

One of the most important financial decisions that farmers have to make relates to the extent to which they will use borrowed funds to finance farm operations and development. There is considerable evidence to indicate that, in this respect, many pastoral farmers in New Zealand are averse to borrowing in the sense that they borrow less than they could, and apparently, less than would maximise profit. For example, in the 1964 MAF Credit Survey (Miller, 1965), 26 per cent of farms were found to be "virtually free of all forms of debt". The debt-free farms "were by no means fully developed and interviewers commented that although credit could have been obtained for development it was often not sought." On the other hand... "Availability of credit seemed to be limited mostly in cases of already high commitment or poor personal factor." Similarly, Stanbridge (1973) observed a high correlation between investment and net farm income and cited this as evidence of a "preference for internal finance" in New Zealand consistent with that observed in some other countries (Pearce, 1955; Paul, 1963).

Further evidence of farmers' tendency toward internal credit rationing was obtained from the 1982 Farmer Opinion Survey conducted by Pryde and McCartin (1983). With the co-operation of Pryde and McCartin several questions aimed at determining farmers' attitude to borrowing were included in the Survey (see Appendix 1). Unpublished results for North Island hill country farmers are presented in Tables 4.3 to 4.5. Table 4.3 shows that a large majority of farmers either did not attempt to borrow funds during the 1981/82 season (46 per cent), or were able to borrow all the funds they required for the season (37 per cent). Table 4.4 shows that 65 per cent of hill country respondents believed that they could have borrowed more if required, while Table 4.5 indicates that respondents' reasons for not borrowing more in 1981/82 were predominantly "internal" in nature. Only a very small minority of respondents were actually refused finance by a lending institution.

(b) Short-term credit

The above evidence relates mainly to long-term credit. Some interesting insights into farmers' behaviour and attitude toward

TABLE 4.4

Respondent's Attitude to Borrowing

During the 1981/82 Season Did Respondent Either:
Not borrow but believe they could have obtained finance if required

OR

Borrowed finance but believed that if required could have borrowed more.

	All Sheep/Beef (%)	North Island Hill (%)
Yes	68	65
No	14	13
Don't Know	18	22
No. of valid observations	745	142

TABLE 4.5

Why Respondent Did Not Borrow More in 1981/82

	All Sheep/Beef (%)	North Island Hill (%)
Refused by lending institutions	4	1
Didn't want to increase indebtedness	43	43
Repayments too difficult	10	15
No profitable use for additional finance	35	31
Other	8	10
No. of valid observations	765	145

short-term credit can be gained from the 1975 MAF Rural Credit Survey (MAF, 1975). This survey documented farmers' response to the significant fall in farm incomes in 1974/75. It was found that farmers tended to maintain farm operating expenditure at the expense of liquid reserves and capital and development expenditure. Changes in the use of credit were relatively minor and indicated that farmers did not use short-term credit as a means of supplementing income. Between 1973/74 and 1974/75 gross farm income fell by about 27 per cent. This fall was

reflected to a greater extent in net farm income, which decreased by 70 per cent from about $9,250 in 1973/74 to $3,000 in 1974/75. Farm expenditure decreased by only 9 per cent and was thus maintained by drawing on liquid reserves built-up over the previous two years, and by severely limiting capital and development expenditure. Total current assets, comprising such liquid reserves as stock-firm and bank balances, and income equalisation deposits were reduced by 38 per cent relative to the 1973/74 levels. This liquidation offset 45 per cent of the reduction in gross income. Income equalisation deposits provided the largest contribution to liquidity. In 1973/74, they comprised 35 per cent of current assets, and were reduced by 54 per cent in 1974/75.

With respect to capital and development expenditure, the percentage of farms indicating some capital and development expenditure dropped from 85 per cent in 1973/74 to 55 per cent in 1974/75. The average expenditure on those farms with capital and development expenditure dropped by 20 per cent between the two years. The net effect was an average drop in capital and development expenditure of approximately 45 per cent. This "saving" offset a further 23 per cent of the reduction in gross income.

Changes in debt levels were minimal with average total liabilities per farm showing a decrease of 0.9 per cent from 1973/74 to 1974/75. This net effect was the result of current liabilities being 0.7 per cent higher and long-term debt being 1.32 per cent lower in 1974/75.

4.3 Analysis of Factors Affecting Long-Term Borrowing

4.3.1 Hypothesised factors

From the above review of past credit studies (and given government policy) it appears that farmers in the pastoral sector tend to be constrained by internal, rather than external, credit rationing. It was therefore hypothesised that long-term borrowing behaviour is mainly influenced by internal factors affecting expectations, ability to repay and collateral. The main external factor was hypothesised to be interest rate which affects the cost of borrowing. More specifically it was hypothesised that farmers' new long-term borrowing is a function of income, capital and interest rate.

(a) Income

Income, in particular recent income, can be expected to have a significant influence on new borrowing in two ways. Firstly, income in the recent past serves to establish a farmer's expectations about future farm profitability and income levels. As most long-term borrowing is for purposes of farm development or expansion it can reasonably be expected that income levels have a direct positive influence on borrowing behaviour i.e. high income increases a farmer's propensity to borrow and vice versa. Secondly, recent income is a measure of the farmer's capacity to repay a loan. As such, income can be expected to influence both the farmer and the lending agent. Again the direction of influence will be positive.

It is not obvious whether it is nominal income or real income that is likely to have the most influence on borrowing. Arguments can be put forward on both sides. First, in support of real income, it could be argued that real income is the best indicator of future farm profitability and the farmer's ability to repay a loan. Alternatively, nominal income levels may better reflect the effect of inflation on farmers' propensity to borrow. Inflation effectively reduces the real value and cost of outstanding fixed liabilities, because, while incomes may increase, interest rates, and thus debt servicing commitments, remain relatively stable. Debt servicing, as a proportion of total income, thus declines and the farmer's capacity to service further borrowing increases. Nominal income may also be more appropriate than real income if farmers suffer from a degree of money illusion and respond to changes in nominal income that may not be "real".

(b) Capital

Capital assets, especially land assets, can be expected to have an influence on farmer borrowing because such assets represent the collateral for borrowing. While real increases in capital assets may appear to be the most appropriate form of this factor, again, as with income, the real form may fail to capture the important effect of inflation on borrowing behaviour. Because the nominal value of outstanding fixed liabilities resulting from previous borrowing is not affected by inflation, nominal increases in asset values will effectively increase farmer equity. With increasing equity the farmers' capacity and propensity to borrow, and lending institutions willingness to lend, can be expected to increase.

(c) Interest rate

As the measure of the cost of borrowing, interest rate can also be expected to have some influence on borrowing behaviour; however, in times of inflation there may be significant differences between nominal and real (inflation adjusted) interest rates. Nominal interest rates can be thought of as a measure of the short-term cost of borrowing, in particular the impact of borrowing on short-term cash flow. On the other hand, the real interest rate is probably a better measure of the true, long-term cost of borrowing. Borrowing and lending interest rates tend to be highly correlated and thus the interest rate also provides a measure of the opportunity cost of farmer investment and as such, may have an additional influence on borrowing behaviour.

While as a general rule deflated data are usually most appropriate for econometric studies, in this case the situation is not clear. As has been illustrated and observed in previously reviewed studies, there is a strong correlation between the value of capital assets and the level of fixed liabilities; in other words, equity ratios remain relatively stable in times of inflation. Farmers therefore use the nominal increases in asset values as collateral against which to borrow. From a behavioural point of view it is the nominal values that appear most important. This argument extends to the form of the dependent variable. It is clear that many farmers actively borrow in times of inflation and yet they may not increase the real value of their fixed liabilities. Under these circumstances it is the change in the nominal value of fixed liabilities that reflects farmer borrowing behaviour.

4.3.2 Regression analysis.

To test the general hypothesis outlined above, various forms of the basic function were tested using a time-series of MWBES Published data for North Island hill country farms (Class 4) for the years 1961/62 to 1980/81. This Class-average data set was used, rather than the panel of individual farmer data-, because it was felt that the discrete and infrequent nature of borrowing events for individual farmers would make it difficult to construct an effective explanatory model of their behaviour using continuous explanatory variables. On the other hand, changes in average borrowing rates for the whole Class is a measure of changes in borrowing propensities which could reasonably be expected to be related to the hypothesised explanatory variables.

(a) Variables used in the analysis

The following variables were used in the analysis:

(i) Changes in total fixed liabilities - This variable was assumed to be a satisfactory measure of new long-term borrowing, although it is influenced, to some unknown extent, by repayments of previous loans. For each year the change was positive indicating that new borrowing more than offset any reduction in fixed liabilities due to loan repayments.

(ii) Net farm income - This variable was selected as the best measure of farm income and ability to repay a loan.

(iii) Changes in capital value of land and improvements - This was regarded as the most appropriate variable to represent the collateral available to the farmer against which he could borrow.

(iv) Average rate of interest on new mortgages - This variable, published by the New Zealand Department of Statistics (NZDS (various)), was selected as a reasonable measure of interest rates. Although many loans to farmers may be at concessional interest rates, the change in those concessional rates is probably adequately reflected in the variable used. Also, the average rate of interest on new mortgages was thought to be a reasonable measure of the return the off-farm investments.

(v) Inflation in prices paid - Although, for reasons explained above, nominal data appeared most appropriate, one form of the basic

TABLE 4.6

Results of Regressions Related to Fixed Liabilities

EQU. NO.	DEP. VAR.	CONST.	NNY(1)	NNY(2)	RNY(1)	NDLV	NDLV(1)	RDLV(1)	NINT	RINT	INF	$\bar{R}^2$	D.W.
1	NDFLIAB	–13231	0.465* (0.170)				–0.080 (0.037)		2246.8** (567.3)		–624.9** (188.6)	0.63	1.83
2	"	–9059		0.270 (0.133)			–0.038 (0.035)		1577.5 (749.4)		–275.4 (190.8)	0.56	1.79
3	"	–18289	0.386** (0.118)			–0.075** (0.020)			3168.4** (538.7)		–731.1** (153.9)	0.76	1.69
4	RDFLIAB	2823			0.180 (0.168)			–0.038 (0.053)		161.4 (330.0)		–0.12	1.84
5	NDFLIAB	–7280	0.204 (0.197)				–0.080 (0.049)		1192.5 (614.6)			0.37	2.11
6	"	–5503		0.325* (0.133)			–0.058 (0.033)		802.1 (542.3)			0.52	1.61
7	"	–787		0.435** (0.119)			–0.020 (0.037)			56.4 (176.9)		0.45	1.31
8	"	–358	0.404* (0.182)				–0.060 (0.052)					0.25	2.00
9	"	–675		0.432** (0.116)			–0.028 (0.028)					0.48	1.32
10	"	741	0.219* (0.088)									0.23	1.70
11	"	–378		0.355** (0.086)								0.48	1.23
12	"	–554	0.046 (0.097)	0.320 (0.116)								0.46	1.24

For legend, see next page

Legend for Table 4.6

NDFLIAB	- nominal change in fixed liabilities
RDFLIAB	- real change in fixed liabilities
NNY	- nominal net income
RNY	- real net income
NDLV	- nominal change in value of land and improvements
RDLV	- real change in value of land and improvements
NINT	- nominal interest rate
RINT	- real interest rate
INF	- inflation rate
Lags	- numbers in parentheses after variable name represent period of lag
$\bar{R}^2$	- R^2 adjusted for degrees of freedom
D.W.	- Durbin-Watson statistic
Standard errors	- numbers in parentheses below estimated coefficients are standard errors
*	- significant at 5 per cent level
**	- significant at 1 per cent level

function was tested with data in real terms. When this adjustment for inflation was necessary the "Prices Paid Index" published in the MWBES Annual Review of Sheep and Beef Industry (various issues) was used.

(b) Lags in the system

It seems reasonable to expect some lags in farmers' response to factors affecting borrowing behaviour; in particular, response to changes in income levels could be expected to be lagged as farmers wait to see if changes in income are permanent or transitory. Consequently, various lags on the explanatory variables were tested in the estimated functions.

4.3.3 Results of estimation.

Table 4.6 shows a summary of results from estimating various forms of the hypothesised model. Equations 1 to 4 represent an initial round of estimation using functions which included each of the hypothesised explanatory variables in some form. Differences in the functional form related to minor differences in lags, and, in the case of Equation 4, to the use of real instead of nominal data. The use of data in real form (Equation 4) resulted in a very poor statistical fit. In no case were the estimated coefficients significantly different from zero, and the explanatory power of the function was also very low ($R^2 = 0.08$, $\bar{R}^2 = -0.12$).

Equations 1 to 3, estimated using nominal data, gave somewhat better results, although, of the explanatory variables, only "lagged net income" consistently showed a significant coefficient and a logical sign. Both "change in nominal land value" and "nominal interest", while having estimated coefficients which were significantly different from zero, also had illogical signs. There is no apparent reason why a lagged increase in land value should have resulted in reduced borrowing, or why an increase in nominal interest rates should lead to increased borrowing. Also the negative sign on the inflation coefficient defies a logical explanation.

Such perverse results could have been caused by the high degree of multi-collinearity between nominal interest rates and inflation rates. In an attempt to overcome this problem the inflation rate variable was dropped from the function. The results of this formulation, using both nominal interest rates (Equations 5 and 6) and real interest rates (Equation 7), are summarised in Table 4.6. Income lagged twice remained highly significant while "change in land value" and interest rate coefficients became not significantly different from zero. The signs on these coefficients remained illogical. The explanatory power of the models, as measured by the adjusted R^2 was reduced slightly relative to the original formulations.

The effect of dropping interest rate from the function was tested with Equations 8 and 9 in Table 4.6. The coefficients for income lagged once (Equation 8) and income lagged twice (Equation 9) were highly significant but lagged changes in land value remained non-significant. Adjusted R^2 for the functions were reduced slightly compared with Equations 5 and 6 , while Durbin-Watson values continued to indicate either no autocorrelation or an inconclusive test.

The results of Equations 8 and 9 indicated that there was a marked difference in the power of net income as an explanatory variable, depending on the lag used. To clarify this the land value variable was dropped to leave net income lagged once as the sole explanatory variable in Equation 10, and net income lagged twice as the explanatory variable in Equation 11. Although both lagged income variables remained highly significant, it was net income lagged twice that was the more effective explanatory variable with an adjusted R^2 of 0.48, compared with 0.23 for the once lagged variable.

Similarly, using both lagged income variables in the same function (Equation 12) failed to result in improved explanatory power. The coefficient of net income lagged twice remained highly significant but that for net income lagged once became very small and not significantly different from zero. Adjusted R^2 and the D.W. statistic remained very similar to those values for Equation 11 where net income lagged twice was the sole explanatory variable. It would appear that the explanatory power of net income lagged once is effectively accounted for by net income lagged twice.

4.3.4 Discussion

The results indicate that lagged income has the strongest influence on farmers' decision to borrow long term. This is a logical result given the importance of income as a determinant of expectations, and as an indicator of the farmer's capacity to repay a loan. The two period lag may appear surprisingly long but, in fact, may not involve much more than one year. Most income on pastoral farms comes towards the end of the June year. Following this the financial status of the farm is not likely to be clear until well into the next June year when farm accounts are completed. The decision to borrow may then be made and actioned (after administrative delays) at the beginning of the next June year in preparation for development and pasture establishment in the spring of that year.

The lack of a logical sign and/or significance associated with the relationship between borrowing and changes in the capital value of land and improvements is interesting. There is little doubt that increases in the nominal value of assets provide farmers with the capacity to borrow. Also, it is obvious from previously reviewed surveys and analyses that a significant proportion of that borrowing capacity is utilised. The fact that this relationship could not be revealed in the analysis as one of direct cause and effect has a plausible behavioural explanation. While increases in the nominal value of capital assets increases the farmer's capacity to borrow, it does not automatically lead to this capacity being utilised. It would appear that increased borrowing capacity is only utilised periodically, and mainly in response to relatively high income levels in the recent past.

The non-significance of interest rate as a factor determining new borrowing conforms with results reported by Laing and Zwart (1983). While significant increases in nominal interest rates occurred over the time period tested, there was an even greater increase in inflation. As a result, real interest rates tended to fall over the period. Under these circumstances, a farmer's response to interest rates is likely to be ambivalent, if not confused. On the one hand the farmer will be inclined to reduce borrowing in response to high nominal interest rates because of the short-run interest burden that would be incurred. On the other hand, if, due to inflation, the real interest rate is low or even negative, he may be encouraged to borrow. This confusion of responses could well account for the lack of significance and/or logical sign found for interest rate in the analysis.

4.4 Analysis of Factors Affecting Short-Term Borrowing

4.4.1 Hypothesised factors.

The behaviour of farmers toward the use of short-term credit was also of interest in this study. It was considered important because short-term credit, including seasonal finance, plays an important facilitating role in agriculture, bridging the time gaps between expenditure and income. Farmers' behaviour with respect to short-term credit has not been studied in detail in New Zealand, although Pryde and Martin (1980) suggested that short-term credit is used to compensate for short-term falls in income. They stated that "In the short-term, fluctuations in the levels of farm incomes will influence credit demand, with the hypothesised relationship being that short-run falls in rural income are associated with an increased demand for short-term credit". Such a hypothesis is supported by other authors. (See for example, Baker (1968), Barry and Baker (1971), BAE (1977)). Baker (1968) argued that farmers tend to maintain a "reserve" of unused credit "that can be called upon to counter the effect of failure in expectations." The BAE (1977), in a review of credit in the Australian rural sector, reported that, "The uncertainty of income created by instability, influences the (rural) sector's demand for credit and is reflected in turn by the reluctance by many producers to enter fixed payment commitments and a preference for overdraft type finance. The demand for short-term carry-on finance is especially marked in periods of drought and price recession." Some intuitive support for the hypothesis that short-term credit tends to be used (in addition to its production facilitating role) to help "iron-out" short-run fluctuations in income, comes from the study of consumption behaviour described in Chapter 3 of this Report. North Island hill country farmers, in common with other farming communities both in New Zealand and elsewhere, maintain a relatively stable consumption pattern despite significant fluctuations in net income. To achieve this stability of consumption, recourse could be made to short-term credit. Alternatively, the farmer could maintain his own liquidity reserves in the form of liquid assets to be called upon in times of depressed income and restored in times of high income. Some evidence of this type of behaviour was found in the 1975 MAF Rural Credit Survey (MAF, 1975) described above.

4.4.2 Graphical observation and regression analysis.

To test the relationship between income, short-term credit and liquid assets, a series of regression models were tested, in conjunction with some graphical observation. The data used were the 20 year time-series of MWBES published data for North Island hill country (Class 4) farms.[4] Figures 4.5 and 4.6 show net income and current liabilities in both nominal and real form. The data in real terms are in 1980/81 dollars "reflated" by the Index of Prices Paid (MWBES).

(a) "Pot-holing" hypothesis

The first hypothesis tested was that short-term credit is used to compensate for fluctuating incomes. From inspecting the data in graphical form it is clear that the level of current liabilities is relatively stable compared with the instability in net incomes. Current liabilities tend to increase steadily with inflation rather than fluctuate. In real terms current liabilities remained remarkably constant with only slight fluctuations around a mean of approximately $17000 in 1980/81 terms. Furthermore there is no apparent relationship between what variation there is in current liabilities, and the variation in either net farm income or gross farm income. This observation was confirmed by regression Equations 1, 2 and 3 in Table 4.7 where current liabilities was regressed on net farm income, lagged net farm income and gross income respectively. In all cases no significant relationship was discernible and the hypothesis suggesting a direct link between income and the use of short-term credit had to be rejected.

(b) "Facilitating" hypothesis

An alternative hypothesis, associated with the role of short-term credit as a facilitating medium for the day-to-day financial operations of the farm, was then tested. The hypothesis was that current liabilities is directly and positively related to the level of farm expenditure. Although this hypothesis appeared to have a logical foundation, prior expectations were that it would also be rejected, given the close relationship between income and farm working expenses. This relationship is illustrated in regression Equations 4 and 5. Figure 4.7 shows the time-series of working expenses and current liabilities in real terms.

As expected, the hypothesis that there is a direct link between the level of farm working expenditure and the level of current liabilities had to be rejected. The result of testing this hypothesis is given in regression Equation 6, which shows no significant relationship.

From the relationships tested above it seems clear that short-term credit does not play a major role in stabilising farm consumption and expenditure during fluctuations in farm income. Given that this is the case, then farmers must maintain their own reserves, in the form of liquid assets, to moderate the effects of income fluctuations.

---

4 These data are averages based on current liability levels as at the end of the farm accounting year, usually June 30. No data are available on peak seasonal debt levels which would tend to occur earlier in the season.

FIGURE 4.5

Nominal Net Income and Current Liabilities for Years 1961/62 to 1980/81

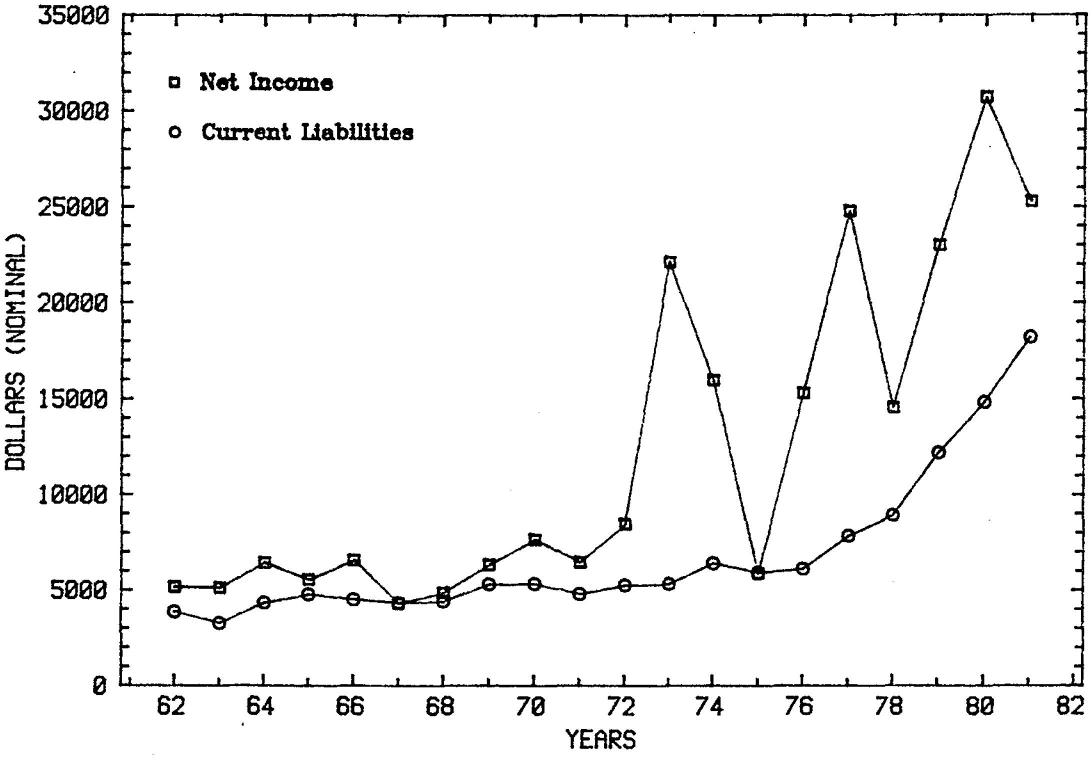


FIGURE 4.6

Real Net Income and Current Liabilities for Years 1961/62 to 1980/81 – (1980/81 dollars)

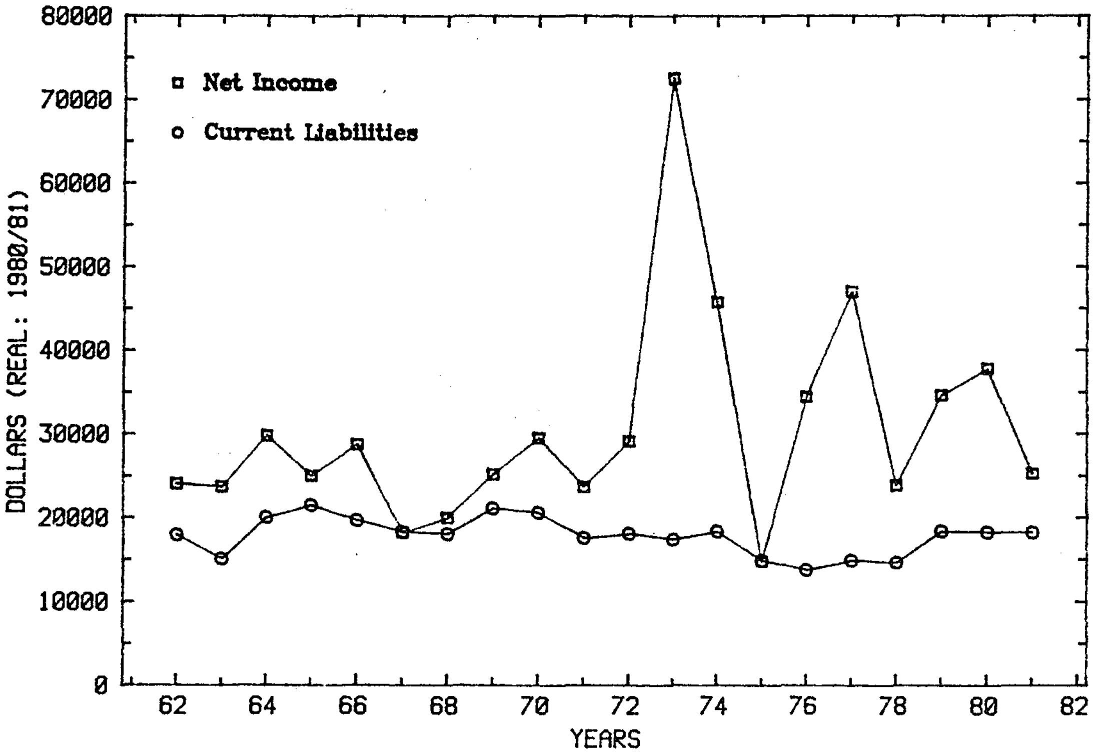


TABLE 4.7

Results of Regression Related to Current Liabilities

EQU. NO.	DEP. VAR.	CONST.	RNY	RNY(1)	RGY	WEXP	RESLVL	$\bar{R}^2$	D.W.
1	RCLIAB	18183	−0.012 (0.041)					−0.05	1.00
2	"	18668		−0.028 (0.041)				−0.03	0.99
3	"	18040			−0.003 (0.029)			−0.06	0.97
4	WEXP	18179			0.253** (0.033)			0.76	1.38
5	"	30423	0.295** (0.063)					0.52	1.20
6	RCLIAB	15028				0.071 (0.101)		−0.03	0.81
7	RESFLO	−16975	0.701** (0.058)					0.89	2.02
8	"	7303		−0.088 (0.180)				−0.04	1.91
9	"	−35216			0.472** (0.061)			0.76	1.95
10	RESLVL	33646	0.689** (0.166)					0.46	0.62
11	"	41968		0.420 (0.217)				0.13	1.11
12	"	12558			0.502** (0.120)			0.47	0.56
13	RCLIAB	15297				0.272** (0.084)	−0.150** (0.034)	0.50	1.63

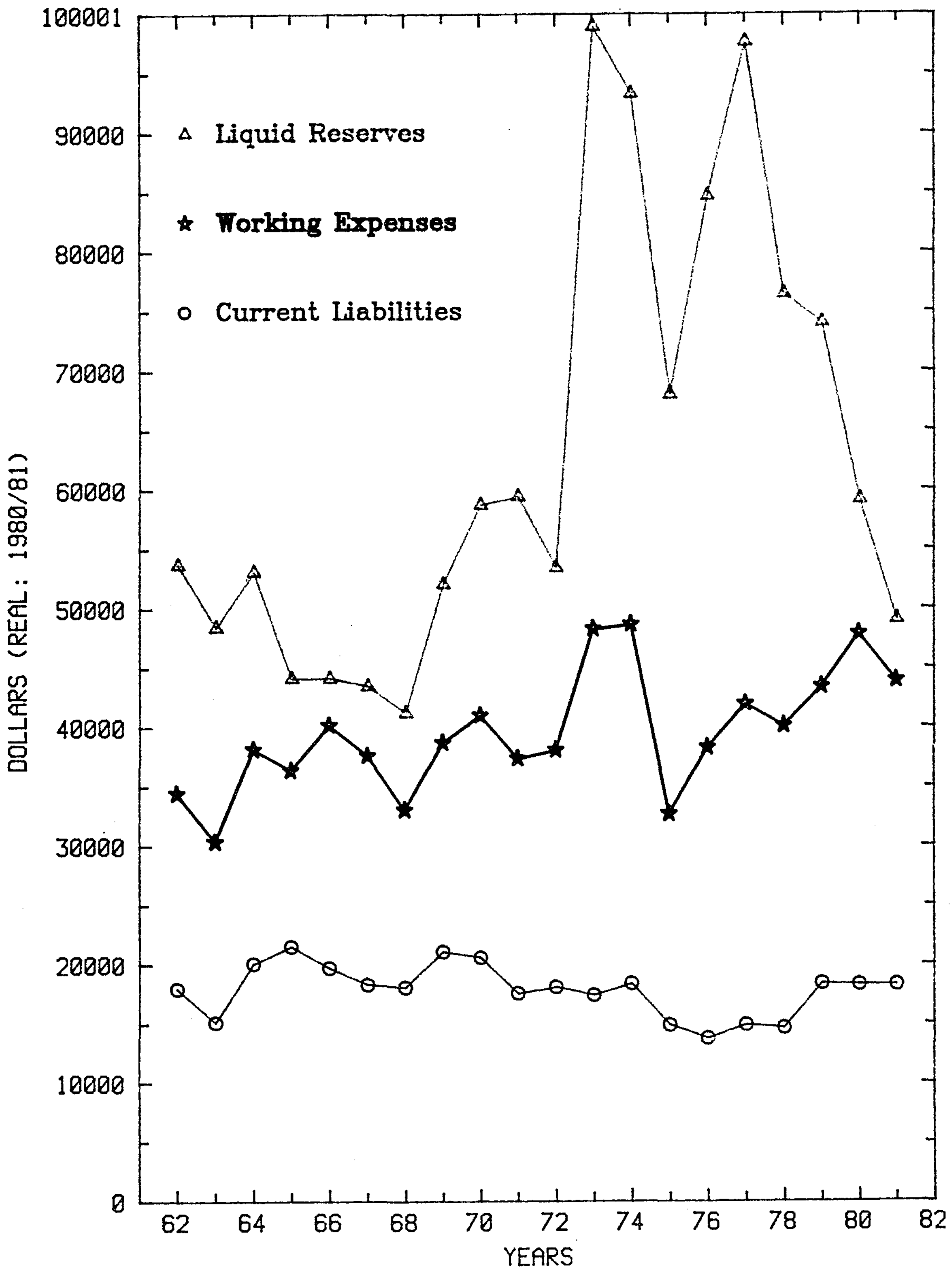
For legend, see next page

Legend for Table 4.7

RCLIAB	- real current liabilities
WEXP	- real working expenses
RESFLO	- flow of funds to reserves
RESLVL	- level of reserves
RNY	- real net income
RGY	- real gross income
Lags	- numbers in parentheses after variable name represent period of lag
$\bar{R}^2$	- R^2 adjusted for degrees of freedom
D.W.	- Durbin-Watson statistic
Standard errors	- numbers in parentheses below estimated coefficients are standard errors
*	- significant at 5 per cent level
**	- significant at 1 per cent level

FIGURE 4.7

Reserves, Working Expenses and Current Liabilities for Years 1961/62 to 1980/81 (Real Terms: 1980/81 dollars)



(c) Modified "facilitating" hypothesis accounting for reserves.

To investigate the role of liquid reserves in the operation of the farm, two composite variables were constructed from the MWBES published survey results; the first, a "flow of reserves" variable consisting of savings and income equalisation deposits; the second, a stock variable "liquid reserves" consisting of cash at bank or stock-firm, investments and deposits, and "other assets". Figure 4.7 shows the time-series of liquid reserves, working expenses and current liabilities.

To test the hypothesis that liquid reserves are used to help stabilise the effects of fluctuations in income, the reserve flow and reserve stock variables were regressed on income. The results are represented as Equations 7 to 12 and show a clear relationship between current income and the flow and level of liquid reserves.

Recognition of the importance of liquid reserves in the financial operation of the farm, gave rise to a third hypothesis to explain the use of short-term credit. Farmers' apparent preference for the use of their own funds to finance consumption and farming operations would suggest that farmers may use short-term credit more when the preferred alternative of using own reserves is not available. Similarly, short-term credit might be expected to be used less when large reserves of liquid funds are available. It was therefore hypothesised that the level of current liabilities could be explained as a function of total working expenses and the level of liquid reserves. A positive relationship would be expected for working expenses, and a negative relationship for the level of liquid reserves. Equation 13 shows the result of testing this hypothesis. The estimated coefficients for both working expenses and liquid reserves had the expected sign and were highly significant. A reasonable proportion of the variation in the level of current liabilities was explained by the function (R** = 0.55).

From this analysis a clearer picture of farmers' behaviour with respect to the use of short-term credit can be built up. In real terms the level of outstanding short-term credit has remained quite stable. Clearly farmers have a preference for internal financing to cover short-term shortfalls in income, and to provide some of the funds necessary for the day-to-day operation of the farm, and for consumption.

4.5 Conclusions

From this study certain general and specific conclusions can be drawn. Firstly, farmers do not appear to be averse to borrowing *per se*; rather they may be averse to incurring significant increases in their real level of debt. In times of inflation the difference in these two attitudes can be substantial. Because inflation reduces the real value of outstanding liabilities many farmers can actively borrow funds while at the same time enjoy an upward trend in their equity ratios.

The nominal level of long-term liabilities was found to be highly correlated with the nominal value of farm land and improvements, yet no direct causal link between increases in land values and new borrowing could be established. Rather, new long-term borrowing appears to be prompted mainly by lagged income; more specifically by income lagged two periods. While increasing land values provides the capacity to borrow, it appears that this capacity is not utilised until a period of high income improves expectations of future profitability and capacity to repay.

No relationship could be established between interest rate and new long-term borrowing. This result is not surprising given that, in times of high inflation, nominal interest rates can be high while real interest rates can be low or even negative. Since both nominal and real rates are likely to have an effect on borrowing behaviour the lack of a clear relationship is understandable.

With respect to the short-term borrowing, the amount of short-term credit used was shown to be relatively stable and related to the levels of both working expenses and cash reserves. The rationale for this result seems clear; farmers need funds to finance working expenses during the course of the year and, while some short-term credit will usually be used for this purpose, less appears to be used when the farmer has significant liquid reserves available. The hypothesis that farmers borrow to offset short-term slumps in income had to be rejected. It appears that, where possible, farmers use their own liquid reserves to augment low income.

The apparent general unwillingness of farmers to borrow to offset low incomes does not preclude the possibility that some farmers may be forced into this situation. This can occur when a slump in returns, coupled with limited liquid reserves, makes it impossible for some farmers to repay short-term credit, which had been used to finance working expenses. As a result short-term credit can become "hardcore" debt and refinancing becomes necessary. While some individual farmers have no doubt faced this situation at some time during the last ten years, this study would suggest that it has not been a widespread phenomena during this period.

CHAPTER 5

ECONOMIC AND ENVIRONMENTAL FACTORS

AFFECTING PASTORAL SUPPLY RESPONSE

5.1 Introduction

New Zealand has a long history of research which has attempted to examine and describe the influence of economic and environmental conditions on the operation of the pastoral farming system. Such studies include Johnson (1955), Rowe (1956), Court (1967), Rayner (1968), Woodford and Woods (1978), Tweedie and Spencer (1981) and Laing and Zwart (1983). Recourse is made to this legacy of research work in order to establish a clearer picture of pastoral sector investment behaviour in general and hill country farmer behaviour in particular. Some additional analysis is also undertaken with respect to the North Island hill country situation. Finally, consideration is given to procedures for modelling investment activities.

5.2 A Review of Pastoral Sector Studies

5.2.1 Pre-1970 models.

The studies by Johnson (1955), Rowe (1956), Court (1967) and Rayner (1968) were typical of early attempts to model the pastoral sector and were reviewed in detail by Woodford and Woods (1978). A brief review of these studies is provided here to give an historical context to more recent studies.

Johnson (1955) analysed changes in aggregate agricultural output from 1928/29 to 1949/50 using a single equation model. The dependent variable was defined as the total volume of New Zealand's farm production as computed by the Government Statistician. For use as an explanatory variable Johnson constructed an index of climatic conditions based on total rainfall for the months January to March for each year, as measured at Ruakura Animal Research Station near Hamilton. A secondary explanatory variable was the area of hay and silage on New Zealand farms in the preceding year. Johnson suggested that this variable could be regarded as a measure of the lagged effect of climate. Johnson also attempted to isolate a systematic price response using both current and lagged prices.

The attempt to isolate any price influences in the farm production series failed and Johnson concluded that "We have only a negative indication that the supply function of New Zealand agriculture is highly inelastic. In other words, not only is the supply of farm products independent of the current market situation, but it also tends to be independent even of previous market situations". With respect to the explanatory variables related to climate, however, the coefficients of both variables proved significant at the 5 per cent level. The proportion of variation explained by the multiple regression was 0.46.

Rowe (1956) analysed economic influences on livestock numbers in New Zealand between 1920 and 1950, using a single equation model. The basic hypothesis of this study was that economic factors account for most of the observed variation in livestock numbers while residual variation may be attributed to technological, climatic and other influences. He hypothesised further that climatic factors have relatively little influence on livestock numbers and, consequently, climatic factors were not incorporated in his model. Results were presented for five different classes of sheep and beef cattle numbers and explanatory variables included sheep and beef product price ratios and a time trend. Rowe's study was inconclusive with respect to the importance of economic factors influencing sheep and cattle numbers. He found, for example, that in equations where the time trend was included it provided the majority of the explanation. This result would seem to contradict Rowe's hypothesis that economic variables account for most of the observed variation in stock livestock numbers. Also, the statistical validity of Rowe's analysis can be questioned; in several equations the residuals were highly correlated, possibly leading to spurious results.

Court (1967) estimated supply functions for lamb, mutton and beef using both ordinary least squares and two-stage least squares. He used an adaptive expectations model to estimate short and long-run price elasticities for these three products. For mutton and beef his results were ambiguous and difficult to rationalise, with negative elasticities estimated for both short-run and long-run supply. This suggests model specification problems and Court admitted that the lamb, mutton and beef production data showed fairly strong trends over time which were due to reasons other than income maximising behaviour. Despite this he concluded that "It is almost certain that definite economic influences on the supply of New Zealand meat exist and that these can be obtained from a model taking account of the decision making processes of the New Zealand farmer over time. That these influences cannot be determined very precisely seems to be characteristic of supply models in general".

Rayner (1968) developed a national sheep supply model in which sheep numbers were disaggregated into classes based on age and sex. The explanatory variables used were a combined lamb price and wool price lagged one year, and trend terms to account for technological change. The equations were originally estimated using data for years 1952 to 1965 and were subsequently updated by Woodford and Woods (1978) to cover the period 1952 to 1973. Although the prices index provided significant explanation over the period 1952 to 1965, it performed poorly over the longer period, giving R^2 values of only 0.04 and 0.11 for numbers of breeding ewes and ewe hoggets, respectively.

Of the four early studies reviewed above, only Johnson took explicit account of climatic conditions and, having done so, found strong evidence of climatic influences on aggregate production. On the other hand, all four attempts to isolate economic influences led either to inconclusive or ambiguous results. These results suggested to subsequent researchers that the influence of climatic conditions on the operation of pastoral farming systems was worthy of closer examination, and that the economic influences which were hypothesised to exist may be too complex to be handled in a simple single equation model. The hypothesis that climatic conditions are an important determinant of livestock numbers is supported by other studies linking agricultural output to climatic variability. See for example, Maunder (1974), Thompson and Taylor (1975), and Rich and Taylor (1977).

5.2.2 More recent studies

In response to the apparent shortcomings of earlier studies, researchers in more recent studies such as Woodford and Woods (1978), Tweedie and Spencer (1981) and Laing and Zwart (1983) have attempted to improve the accuracy and validity of model specifications related to climatic and economic influences in the pastoral sector.

(a) Woodford and Woods (1978)

Woodford and Woods (1978) developed a model that explicitly allowed for the influence of climate on both sheep and cattle numbers. The aim of their study was to explain annual changes in total livestock units on sheep and beef farms. The model was developed for the eight classes of farms defined in the New Zealand Meat and Wool Boards' Economic Service Sheep and Beef Farm Survey. Results were presented for four different formulations of the single equation model applied to the period 1963/64 to 1974/75.

As the dependent variable they used an index of total livestock units in which the numbers in each class of livestock were adjusted for their relative feed requirements. Two alternative variables were used to represent climatic and feed supply variability. Firstly, a rainfall index was constructed by grouping the survey farms in each class into geographical areas, and weighting recorded rainfall (October to March) according to the proportion of farms in each area. Secondly, wool weight per head was selected as a proxy index for feed availability per livestock unit over the total growing season.

With respect to economic factors, Woodford and Woods hypothesised four different responses to economic factors. These were:

(i) a positive "price expectations" response where farmers alter livestock numbers in response to a change in the expected level of product prices. In effect, this represents an intensification (or extensification) response where there is a movement along the production curve until the new equilibrium point is reached where expected marginal revenue equals expected marginal cost. (Although not explicitly stated by Woodford and Woods, this response would appear to imply a minimum of additional capital investment (apart from livestock) and could occur quite rapidly, in contrast to the investment response described below.)

(ii) an "investment" response which is a function of gross farm income in preceding years. In this case there is a shift in the production curve and stock numbers only increase or decrease as capital stock is adjusted to handle them.

(iii) a short-run "cashing-in" response where farmers sell more potential breeding stock when meat prices are high, in an attempt to "cash in" on the high prices while they are maintained.

(iv) a short-run "income supplementation" response where liquidity considerations force farmers to sell additional livestock when product prices are low.

To test for the existence of a price expectations response, Woodford and Woods regressed annual changes in livestock numbers against annual changes in deflated gross income per livestock unit, the latter being used as a proxy for changes in product prices. No significant relationship was found. To test for a distributed lagged response they calculated the simple correlation coefficients between annual changes in livestock units (lagged one year) for each farm class. None of the coefficients were significant; the coefficient in the equation related to North island hill country (Class 4) was the largest at only 0.43. Woodford and Woods suggested that this result indicated "...not only that there are no statistically significant distributed lag responses to price expectation effects, but also that there are unlikely to be significant distributed lag responses to other factors."

In testing for an investment response it was hypothesised that there is an investment relationship linking real gross farm income per livestock unit with subsequent changes in livestock numbers. This relationship was postulated as comprising the following components:

(i) Livestock Units = fn (Farm Investment)
(ii) Farm Investment = fn (Cash Farm Expenditure)
(iii) Cash Farm Expenditure = fn (Gross Farm Income)

The third of these postulated components was tested for validity by regressing farm cash expenditure on gross farm income in the same year for each farm class. A close link was established; thus, given the failure to establish any distributed lag effect, and to preserve degrees of freedom, gross income lagged one year was used as the investment proxy. To test for the short-run economic responses ("cashing-in" and "income supplementation"), deflated gross income from meat per stock unit was used as a proxy for meat prices.

Results indicated that wool weights per head were positively correlated with the annual changes in livestock units; livestock units tended to increase at the end of a season when wool weights were high and either decrease or else increase at a lower rate following a season when wool weights were low. For hill country farm classes (i.e. Classes 2 to 4) this wool weight variable was significant at the 1 per cent level and explained an average of 68 per cent of variation in the dependent variable. The rainfall index proved to be a poor indicator of changes in stock numbers possibly because, in some cases, it was not a good measure of the actual rainfall on the sample farms. The economic variables appeared to be weak as factors determining annual changes in stock unit numbers. No statistical evidence was found for the presence of either price expectation or investment responses, nor, for Class 4 farms, could any evidence be found for short-run economic effects.

While these results suggest that fluctuations in the level of investment were not a major cause of annual fluctuations in stock units, they do not necessarily indicate that investment is unimportant in determining the underlying carrying capacity of sheep and beef farms.

(b) Tweedie and Spencer (1981)

Since the Woodford and Woods study, a much improved index of climatic conditions has become available. This index is based on soil moisture deficit days weighted by the sheep population, and is published by the New Zealand Meteorological Services. The use of this index in subsequent econometric studies of supply response (e.g. Tweedie and Spencer, 1981; Laing and Zwart, 1983) has confirmed Woodford and Woods' conclusion that climatic conditions have a major influence on annual fluctuations in stock numbers. Also, use of the index to account for climatic influences in these studies has allowed the true influence of economic factors to be explored more effectively.

Tweedie and Spencer (1981), for example, as part of a study of supply behaviour in New Zealand's export industries, estimated equations to explain changes in disaggregated sheep and beef numbers separately. Both equations were initially specified in a "stock adjustment" framework where lagged stock level was included as a regressor to enable an equilibrium or desired stock level equation to be derived from the estimating equation. Other explanatory variables included soil moisture deficit days, farm expenditure (as a proxy for investment), the terms of exchange facing beef and sheep farmers, and the relative return between beef and sheep. It was found that beef numbers were better explained by the stock adjustment framework than sheep numbers, but in both cases the explanatory variables listed above were found to be significant.

The econometric studies reviewed so far, including the Tweedie and Spencer models, were intuitive in their specification or were specified on the basis of a constrained dynamic profit maximising problem. Also, due to data problems, they were forced to handle investment in a very simplistic way often with farm expenditure used as a simple proxy for investment. This approach was necessary because farm survey data based on farm accounts (such as the MWBES Survey) does not separate investment expenditure from general operating expenses.

(b) Laing and Zwart (1983)

In what is the most comprehensive econometric study of the pastoral sector to date, Laing and Zwart (1983) took a more general view of the decision making process, and, as part of their pastoral sector model, they developed a sub-model to represent the farm investment decision-making process. In this sub-model investment decisions are related through income to current output and prices. Income acts as a constraint on farm investment, either as a direct source of funds or through the ability to service the debt which might be required for investment. A subsequent sub-model then relates investment decisions to livestock numbers and thence to production.

In an effort to overcome farm level data deficiencies with respect to investment, the Laing and Zwart model was estimated using a combination of the MWBES and New Zealand Dairy Board farm survey data, and aggregate investment statistics from the New Zealand Department of Statistics.

In contrast to many other econometric models of pastoral supply response which emphasise livestock as the major form of capital involved (for example, Freebairn (1973), Jarvis (1974), and Reynolds and Gardner (1980)), Laing and Zwart explicitly accounted for other forms of investment which are often prerequisite to increasing livestock numbers. They argued that "...investment in land clearing, fencing, long-term fertilisers such as phosphate and lime, and even managerial skills are a necessary part of increasing livestock numbers and output". The approach they took was to "...view the producer as a portfolio manager who has at his disposal a wide range of potential assets which have considerably different characteristics and yet can be related to one another through the farm production process".

Portfolio choice models have been traditionally used by investors to determine the optimum combination of securities (Markowitz, 1959); however, Laing and Zwart argued that farmers face similar decisions. While this is no doubt true to some extent, it is also true that in practice there are important complementary relationships in investment. Thus, farmers tend to choose between a limited number of investment "packages" each involving a relatively fixed combination of new assets. With respect to land development, for example, Scott (1981) and Parker (1981) each define investment "packages" involving similar combinations of investment in land clearing, seed, fertiliser, fencing and livestock (see Chapter 3 for more detail). Also, land development and the associated increased stock carrying capacity, will lead to the need for investment in some extra plant, machinery and buildings. Laing and Zwart attempted to account for this to some extent by using the land development component of investment as the main determinant of changes in livestock numbers.

Traditional portfolio models also account for risk in determining the optimum combination of investments, but the Laing and Zwart model does not incorporate risk.

Some results from Laing and Zwart's estimated model are reviewed below and provide useful insights into the operation of aspects of the pastoral farming system. It would appear, however, that direct use of some of their estimated relationships in a farm growth simulation model is either not justified or not feasible given, firstly, the more aggregated nature of their study and, secondly, that the relationships are often embedded in a system of equations and cannot readily be isolated.

(i) <u>Expenditure and investment behaviour</u>

With respect to drawings, off-farm investment, and capital investment in buildings, Laing and Zwart found that expenditure in these categories was, in some measure, stabilised around the trend in available income. In contrast, expenditure on land purchase and development, plant and machinery, and debt servicing were found to be relatively sensitive to changes in income levels. With respect to land development, these results indicated that "...a proportion of any sudden increase in available income is directed into land development expenditure. Conversely, sudden reductions will sharply restrict funds directed into land development".

The basic income effects described above can potentially be modified in the Laing and Zwart model by the effects of changing returns to investment in particular assets, and by the dynamic adjustments caused by the opening asset level variables. In practice, the effect of the return to an asset on the level of investment in that asset would appear to be low as in no case did such an explanatory variable prove to be significantly different from zero at the 5 per cent level of significance, and have a logical sign.

These results are generally in line with the residual funds investment hypothesis (Campbell, 1958) which suggests that investment in agriculture is a residual after general farm expenses have been met and an allowance has been made for farm household consumption.

(ii) Livestock numbers and production.

Laing and Zwart used the land investment levels generated by the investment portfolio sub-model, together with other factors, to explain changes in livestock numbers. Other factors included livestock demographic, economic and environmental variables.

As would be expected, livestock demographic variables proved to be significant in explaining changes in sheep and cattle numbers in each age class. The influence of the economic variables was found to be complex but the predominant effect was on sheep/cattle ratios and on herd and flock composition, rather than on total stock numbers. The relative returns of lamb to prime beef were found to be important influences causing changes in the number of breeding ewes and ewe hoggets respectively. Also change in wool prices had a strong positive effect on ewe numbers with higher wool prices altering flock composition in favour of breeding animals. Both the environmental effect (represented by a soil moisture deficit index) and capital investment in land development (lagged one year) were found to be significant factors determining sheep and cattle numbers, particularly those for breeding stock.

Following the estimation of livestock-number equations, Laing and Zwart estimated a series of equations to explain wool, mutton, lamb, prime beef, manufacturing beef and milkfat production. They found that: "Apart from the livestock demographic variables which as expected are major contributors to each individual equation's significance, the most significant variables are those relating to capital intensity. In each case, increases in land capital per stock unit initiated growth in total output. Environmental constraints on pasture growth, as represented by days of soil moisture deficit, consistently reduced total production."

(iii) Elasticities

Further insight into the behaviour of the pastoral sector as a system can be gained from examining the elasticities generated using the complete Laing and Zwart model. Elasticities were estimated relating changes in various exogenous variables to changes in selected physical and financial aspects of the pastoral sector system. In addition to product prices for wool, lamb, mutton and beef, the other exogenous variables included fertiliser price, market rate of interest and days of soil moisture deficit. Both the short-run or "impact" elasticities and long-run elasticities were estimated.

Impact elasticities - Generally, the estimated impact elasticities were very low indicating that there is minimal short-run response to changes in economic conditions. For example, the elasticity of total stock units to changes in any product price did not exceed 0.02. Similarly, most categories of farm operating and investment expenditure were found to be insensitive to short-term changes in product prices. For example, the impact elasticity relating lamb price to expenditure on fertiliser and seed was 0.01, with 0.04 for repairs and maintenance, 0.05 for plant and machinery, and 0.04 for land development. These results suggest that farmers "wait and see" before responding to economic changes.

Further evidence of this behaviour is provided by the impact elasticities estimated for savings. Savings was found to be the variable most sensitive to changes in product prices. Elasticities relating change in savings to changes in wool, lamb, mutton and beef prices were 4.86, 0.69, 1.74 and 1.46 respectively.

Contrary to the findings of Woodford and Woods (1978) and the analysis conducted for this study (described below), the short-run response of livestock numbers to climatic conditions, while significant, was low (-0.02 for total stock units). This relatively low elasticity estimate may be a function of the aggregated nature of the Laing and Zwart study and the fact that the soil moisture deficit index calculated for the whole of New Zealand is likely to display less variability than for regions or individual farms.

Long-run elasticities - In the longer run (10 years), adjustment to sheep/cattle ratios and the impact of investment, allow larger responses to occur. Laing and Zwart illustrated these responses for a 1.0 per cent increase in wool price. Such an increase led to an 11.0 per cent increase in sheep stock units but only a 0.71 per cent increase in total stock units. Fertiliser and seed, and repairs and maintenance were found to be the most income sensitive in the long-run with expenditure increasing 0.84 and 1.81 per cent respectively for a 1.0 per cent increase in wool price. Off-farm investment increased by 0.16 per cent in the short-run but was reduced by 0.72 per cent in the long-run as funds were used for on-farm investment. Of the capital investment categories, land development had by far the largest long-run elasticity, 1.38 per cent.

5.3 An Analysis of Factors Affecting North Island Hill Country Stock Numbers

The recent econometric studies reviewed above have confirmed the significant influence of climatic conditions on stock numbers in the pastoral sector. To measure the strength of this influence in North Island hill country, a soil moisture deficit-day index was derived and tested as an explanatory variable for annual changes in the stock units per hectare carried on Class 4 farms, over the period 1961/62 to 1980/81. The soil moisture index used was adapted from that published by Morgan (1981) which in turn was based on a time-series of soil moisture deficit-day values derived by Evans and Green (1981) for counties in New Zealand over the period 1950 to 1981.

The series constructed by Evans and Green (1981) was monthly and, for each county, recorded the number of days when soil moisture was insufficient to permit pasture growth. From this data series Morgan (1981) derived June year moisture deficit indices for six districts (corresponding to Stats. Dept. Rural Districts) with significant North Island hill country farming activity i.e. North Auckland, South Auckland, Gisborne, Hawkes Bay, West Coast (N.I.) and Wairarapa. To derive these aggregated indices Morgan established a system of weights which was used to combine county data into district totals relevant to the North Island hill country farm distribution. To this end, the ratios of numbers of beef cows to total numbers of beef cattle for each country were used to determine the relative importance of beef breeding in each country. A comparison with MWBES survey results indicated that counties with a breeding/total ratio of at least 0.30 could be regarded as having significant North Island hill country farming activity within their boundaries. This criterion was used to select appropriate counties for the construction of a weighted average moisture deficit-day series for each district. The weights given to the counties in the weighted average were then determined as the total stock units in the county during the 1976/77 year relative to the total stock units in all "North Island hill country" counties in the district. As the final step in the construction of the indices Morgan transformed each series of district moisture deficit-day values into standard deviations around a ten-year moving average. These district indices are shown in Table 5.1; an abnormally dry year is shown as a positive value.

To establish an aggregate North Island hill country moisture deficit index for this study, the district indices calculated by Morgan were weighted by the district distribution of North Island hill country (Class 4) farms (as indicated in the 1980/81 MWBES survey) and combined into an average index. The weights used, together with the weighted North Island hill country average index, are shown in Table 5.1. This average soil moisture deficit-day index (SMDD), was regressed against changes in average stock units per hectare (DSU/HA) values for Class 4 for the period 1961/62 to 1980/81. The result was as follows:

$$DSU/HA = 0.132 - \underset{(0.074)}{0.188}\ SMDD \qquad \bar{R}^2 = 0.25$$

$$D.W. = 1.56$$

TABLE 5.1

Soil Moisture Deficit Indices for North Island Districts and North Island Hill Country (Weighted Average)*

Districts

Years	Nth. Auck.	Sth. Auck.	Gisborne	Hawkes Bay	W. Coast (NI)	Wairarapa	NI Hill Country
57/58	1.00	-0.76	3.15	0.59	-1.87	0.56	-0.07
58/59	-1.48	-1.30	-0.29	-1.44	-0.97	-0.76	-1.12
59/60	1.06	-0.22	-1.34	-0.16	0.91	2.43	0.48
60/61	1.38	0.86	-1.48	-1.71	0.97	-1.47	-0.18
61/62	0.74	-0.05	-0.05	0.80	1.03	0.71	0.55
62/63	0.26	-0.11	-0.52	0.59	0.06	0.51	0.18
63/64	1.80	0.97	0.52	2.08	1.52	1.57	1.46
64/65	-0.42	-0.16	-0.52	-0.05	-1.21	-0.81	-0.51
65/66	-1.96	-0.98	0.19	-0.27	-0.48	-0.10	-0.57
66/67	-0.42	-1.08	-1.15	-1.01	-0.85	-1.16	-0.98
67/68	1.38	0.38	0.81	1.07	0.91	0.10	0.71
68/69	-0.48	-0.76	0.43	0.11	0.12	0.35	-0.10
69/70	0.37	1.46	-1.34	-0.37	1.69	0.30	0.64
70/71	-0.05	-0.27	-0.62	-0.85	0.67	0.86	-0.03
71/72	0.05	0.22	-0.52	-1.12	-0.91	-0.71	-0.53
72/73	1.16	1.84	1.05	2.03	1.27	1.47	1.59
73/74	1.91	1.57	0.29	-0.53	0.67	0.25	0.65
74/75	0.48	-0.27	-0.76	-0.75	0.30	-0.30	-0.24
75/76	0.90	0	0.05	0.27	0.06	-1.56	-0.10
76/77	-0.69	0.49	-0.24	-0.37	-1.03	-0.46	-0.32
77/78	0.58	1.73	1.15	0.80	1.27	1.11	1.20
78/79	-0.74	-0.54	0.91	-0.11	-0.91	-0.46	-0.42
Weights	0.08	0.26	0.07	0.22	0.21	0.16	(1.00)

Source: District Indices; Morgan (1981)
Weights; MWBES Sheep and Beef Farm Survey, 1980/81

* Indices represent standard deviations around the ten year moving average of days of soil moisture deficit.

FIGURE 5.1

**Changes in Class 4 Stock Units per Hectare
Actual and Predicted**

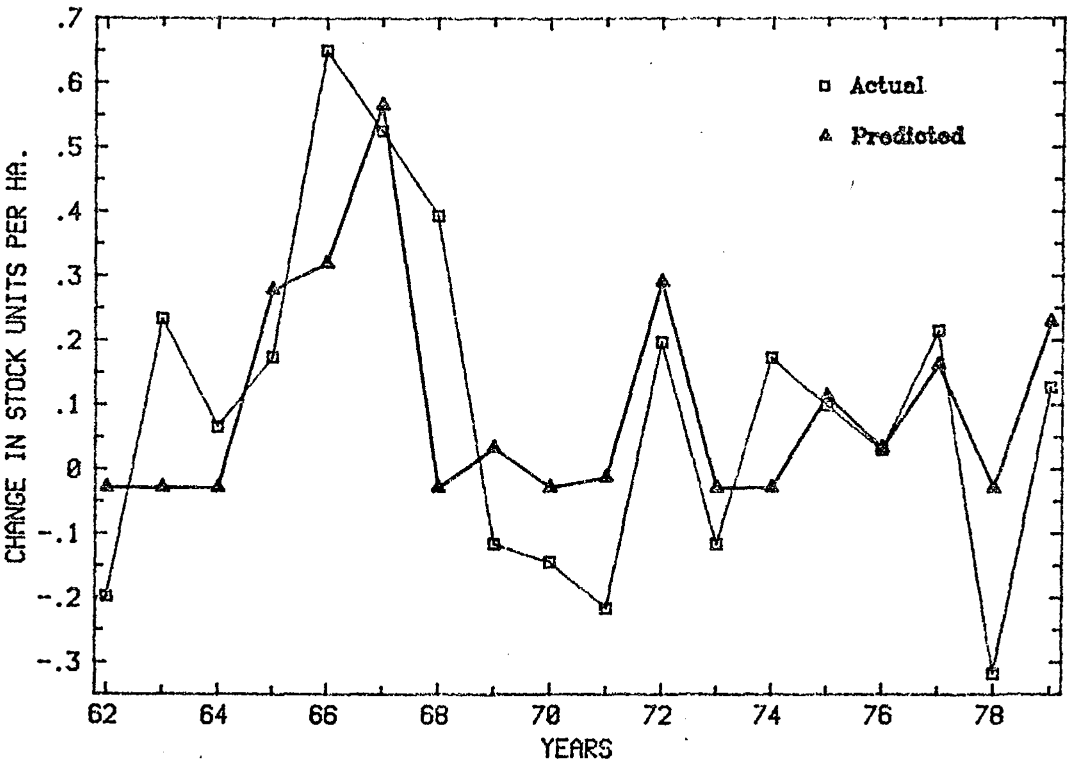
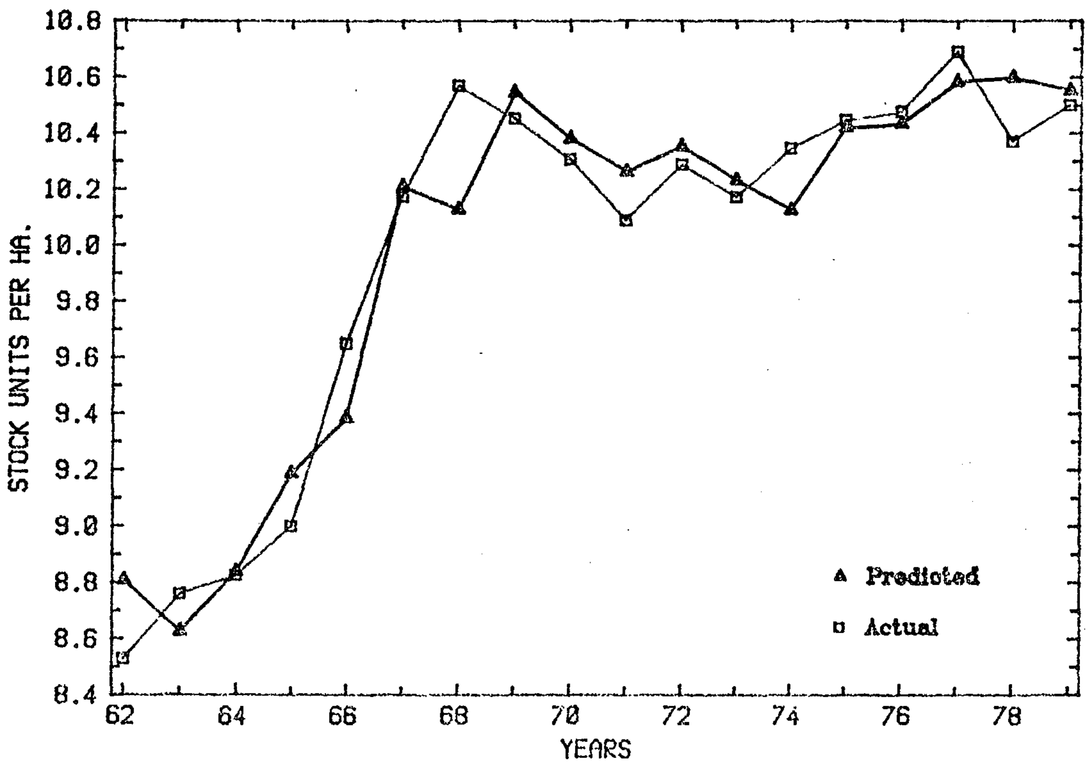


FIGURE 5.2

**Class 4 Stock Units per Hectare
Actual and Predicted**



The standard error of the SMDD coefficient (shown in brackets above) indicates that SMDD is significant at the 5 percent level.

The SMDD index, as used in the above equation, includes both positive and negative deviations around the moving average. When used to explain stocking rate variations the implication is that the impact on stock numbers of drier than average conditions will be proportional to the impact of wetter than average conditions; however, it might reasonably be expected that the relative impacts will differ. To test this hypothesis, the SMDD index was split into two series; one for all positive derivations from the mean (SMDD(+)) i.e. for all drier than average years, and the other for all negative deviations from the mean (SMDD(-)) i.e. wetter than average years. Using these series separately as variables to explain changes in stock units per hectare, the following result was obtained:

$$DSU/HA = -0.023 - \underset{(0.211)}{0.595}\ SMDD(-) - \underset{(0.110)}{0.010}\ SMDD(+)$$

$$\bar{R}^2 = 0.41$$

$$D.W. = 2.22$$

This result indicates that negative deviations are highly significant in determining stocking rate changes while positive deviations are non-significant. Dropping the non-significant SMDD(+) from the equation gave the following result:

$$DSU/HA = -0.029 - \underset{(0.170)}{0.606}\ SMDD(-)$$

$$\bar{R}^2 = 0.41$$

$$D.W. = 2.24$$

Actual, and predicted changes in stock units per hectare based on this latter equation are shown in Figure 5.1. The fact that SMDD(-) is highly significant but SMDD(+) is non-significant suggests that farmers respond to good seasons by significantly increasing stock rate, but in poor seasons are reluctant to reduce stocking rates. Recent experience with the effects of the 1982/83 drought, which led to significant reductions in stock numbers, would suggest that this reluctance cannot be sustained in the face of extreme and prolonged adverse conditions.

In an attempt to isolate any economic influences which might further explain changes in stocking rates, two economic variables, together with SMDD(-), were tested. These variables were:

(i) a variable reflecting current stock prices. This variable was included to test for short-term response to price; either a "cashing in" response where potential breeding stock are sold off when prices are high, or alternatively, an "expectation" response whereby stock are retained to take advantage of continuing high prices. The variable used in this case was the real price of PL grade lamb (RPL).

(ii) an investment proxy. Several variables were tested as investment proxies. These were lagged real gross income per hectare, lagged real cash expenditure per hectare and lagged real expenditure on fertiliser.

The equation which included lagged real gross income per hectare (LRGY/HA) as the investment proxy gave the following result.

$$DSU/HA = -0.004 - \underset{(0.194)}{0.587}\ SMDD(-) + \underset{(0.0042)}{0.0008}\ RPL + \underset{(0.0011)}{0.0003}\ LRGY/HA$$

$$\bar{R}^2 = 0.30$$

$$D.W. = 2.03$$

The soil moisture deficit index remained significant at the 1 per cent level but neither of the economic variables were significantly different from zero. The results remained similar regardless of the investment proxy used. Also, the testing of lagged lamb prices failed to show any significant effect.

The conclusion that can be drawn from these results and from the previously reviewed studies is that farmers respond most to climatic factors when determining annual changes in stocking rate. This response generally appears to be in the nature of a "rachet" effect and it provides a reasonable explanation for the levels of stocking rates attained on North Island hill country farms over the last 20 years. This explanatory power is illustrated when actual stocking rate (SU/HA) is regressed as a function of lagged stocking rate (LSU/HA) and SMDD(-) for the period 1962/63 to 1979/80:

$$SU/HA = 0.819 + \underset{(0.067)}{0.915}\ LSU/HA - \underset{(0.176)}{0.583}\ SMDD(-)$$

$$\bar{R}^2 = 0.92$$

$$D.W. = 2.31$$

The coefficients of both lagged stocking rate and the negative deviations SMDD index are significant at the 1 per cent level. The overall explanatory power of the equation is high as is demonstrated in Figure 5.2 where both actual and predicted Class 4 stocking rates are shown.

A behavioural explanation for this "rachet" form of response could be that farmers wait for good seasonal conditions before increasing stocking rate to take advantage of previously developed pasture. This strategy would minimise the danger of feed shortages and minimise the need to buy in extra stock. Having achieved a new stocking level, continued investment in land development may allow that stocking rate largely to be maintained, even if poor seasons follow.

This hypothesis implies the existence of an investment response yet, with respect to economic factors tested in this study and others , there is little or no discernible short-term response to price, nor to the investment proxies. While a lack of a short-term price response is not surprising given the long-run costs of liquidating breeding stock and uncertainty about future price levels, the lack of an investment response cannot be accepted. The existence of an investment response on individual farms is obvious and Laing and Zwart (1983) found some evidence of it in their study; however, in aggregate this response has generally proved very difficult to measure. It would appear that the investment response, with its complexity caused by different forms of investment with different lags and different effects on the farm operations, defies measurement with the simple investment proxies used in this and most of the previously reviewed studies. Also, if the explanation presented above for the "rachet" stocking rate response is correct, then climatic conditions may significantly affect the rate at which investment is manifested in increased stock carried.

5.4 Conclusions with Respect to Investment Behaviour

The apparent lack of short-term response to economic variables generally indicated by econometric studies can be rationalised by considering the nature of New Zealand pastoral farming systems. Being based predominantly on breeding flocks and herds which utilise pasture as the feed source, New Zealand pastoral farming systems are severely constrained with respect to the rate and the extent to which they can respond to economic variables, particularly in the short-term.

While in the short-term a rapid decrease in stock numbers is possible through liquidating breeding stock, knowledge of the time and cost of restocking or increasing stock numbers is likely to dampen this form of short-run response. Also, feed availability is likely to limit the extent to which increases in stock numbers are possible without further capital expenditure on land development. Changing stocking rate, given a particular state of farm development, does not appear to be a commonly applied management strategy in pastoral farming. Rather, farmers may perceive a particular level of per head performance and risk as being acceptable and set stock levels to avoid violating this standard. Under such a management system, "long-run" stocking levels are not likely to increase significantly until the capacity of the farm to produce feed and handle stock is similarly increased.

It can be argued that such a conservative stocking policy is rational given the significant potential management and financial penalties associated with overstocking; animal growth rates and reproductive performance can be adversely affected, while mortality and disease levels may increase. These effects are indicative of other general management difficulties likely to arise. Associated with these stocking rate effects is the increased risk of significant physical and financial difficulty in poor seasons. Also, overstocking can lead to deterioration in pasture quality and condition.

If farmers are unwilling to increase "long-run" stock numbers until feed production is similarly increased, then the availability of funds to undertake development may further dampen and delay response. From this review of studies of the New Zealand pastoral sector, and consideration of the nature of the farming systems in that sector, a behavioural hypothesis can be deduced to explain the nature of changes in stock unit numbers on farms. It is hypothesised that:

(i) Farmers perceive a long-term target state of development and associated carrying capacity for their farms.

(ii) Farmers also perceive a current state of development and associated inherent carrying capacity of the farm. This carrying capacity is directly related to the capacity of the farm to grow and utilise feed and can be regarded as the permanent component of stocking rate.

(iii) Increases in the permanent or potential carrying capacity of the farm toward the long-term target depend on investment, particularly investment in land improvement. Such investment takes place largely out of residual funds which remain from high income years after other operating, debt servicing and consumption expenditure has been undertaken. Investment funds may initially be retained as savings or liquid reserves.

(iv) The rate at which stock numbers are increased to utilise newly developed pasture is dependent on climatic conditions. Also, there is a transitory component to annual stocking rate which is also as a function of climatic conditions.

CHAPTER 6

FURTHER RESEARCH

In the analyses conducted for this study two major areas of data deficiency became apparent. The need for further research in these areas is discussed in the following sections.

6.1 Farm Expenditure and Investment

With the MWBES Survey data used in this study, as with most other New Zealand farm survey data, investment expenditure cannot be separated from general operating expenditure. For this reason accurate farm-level investment and operating expenditure functions cannot be estimated. This problem continues to constrain effective pastoral sector modelling in New Zealand, and as long as farm financial surveys rely primarily on accounts prepared for taxation purposes, the problem is likely to remain. While the alternative (presumably, more detailed questioning of surveyed farmers) may be impractical and excessively expensive if adopted for large samples, it could well be worthwhile for a representative sub-sample of, say, the MWBES Survey farms. The results of such a sub-survey could provide a valuable insight into the relationships between income, operpating expenditure and investment, which could then be adapted to the wider population.

Another aspect of this problem is the lack of farm-level empirical data that could be used to relate different forms of farm investment to changes in farm production and productivity. In this respect a number of issues would appear worthy of further research. In the first instance, more information is needed on what proportion of investment is for replacement of depreciated existing assets, and what is genuinely new investment. Then it would be useful to know how the investment mix (land development, machinery, buildings, etc.) varies from year to year and what factors affect this mix. Also of interest would be the relationship (correlations, lags, etc.) between different forms of on-farm investment; in particular the hypothesised casual relationship between land development and other forms of invetment expenditure should be examined. Finally, where a degree of independence is found between different forms of investment, more information is needed on the relative contribution of each type of investment to production, costs, capital values, etc. Such information would significantly enhance the capacity to understand and model on-farm investment behaviour in the pastoral sector.

Also important, particularly in times of depressed market conditions, is the question of the causes and effects of disinvestment. It is clear that deferred maintenance of buildings, equipment and land improvements provides an important buffer against the effects of income fluctuations, but the circumstances under which deferred maintenance becomes true disinvestment, and the associated production and productivity effects, are not clear. As with investment, the relative effects of different forms of disinvestment are not well known, apart from some projections of the effects of suspended maintenance fertiliser.

To facilitate a better understanding of the investment behaviour and/or to enhance the general standard of pastoral sector analysis, more research to describe and explain the process of pastoral sector investment would appear to be warranted.

6.2 The Role of Reserves in the Pastoral Farming System

A conclusion that can be drawn from Chapter 4 of this study is that the role of savings and liquid reserves, in the financial operation of pastoral sector farms, is important but not well understood. If the impact of government policies, particularly stabilisation policies, on the operation of pastoral farming systems is to be better understood then further research examining the nature and role farm financial reserves may be worthwhile. Several aspects of the issue could be examined; as with the investment research suggested above, a detailed survey of farmers would probably be required. Firstly, a comprehensive classification and description of non-farm financial assets would be useful to determine the degree of liquidity involved and the intended or perceived purpose of maintaining the asset. For example, are some funds only held pending imminent expenditure or investment on the farm? Are some reserves held in semi-liquid form as a hedge against risk? Are other assets held in a genuine effort to augment farm income or diversify the total investment portfolio?

Secondly, although it is likely to be difficult to determine, the nature and causes of short, medium and long-term changes in the reserve asset portfolio would be of particular value in examining the role of reserves as an internal stabilisation fund. Questions in this regard could include the following; To what extent will non-farm assets be liquidated during short and long periods of low farm income. Do farmers perceive some maximum or desired level for reserves. What priority is given to replenishing low reserves. Do reserve levels vary in response to variation in the level of risk inherent in the enterprise.

This last question could form the basis for an interesting econometric study of risk response if an appropriate time-series of data could be established. Conceptually, such a time-series could cover some years before and after the introduction of Supplementary Minimum Prices, which could be regarded as reducing the riskiness of pastoral production. An alternative time-series could be for the period 1965 to 1980, the first half of which saw relatively stable pastoral sector incomes compared with the wide fluctuations of the second half. If the farmer's perception of the risk involved in farming changed systematically then some risk response could be anticipated (Fisher and Hanslow, 1984), perhaps in the form of changed reserve levels and/or as changed management and stocking rate policies. If the existence of such responses could be established and quantified then further development of the model incorporating those responses may be justified.

REFERENCES

Ando, A. and F. Modigliani (1963), "The Life Cycle Hypothesis of Saving: Aggregate Implications and Test", American Economic Review, 53: 55-84.

Baker, C.B. (1968), "Credit in the Production Organisation of the Farm", American Journal of Agricultural Economics, 50(3): 507-520.

Barry, P.J. and C.B. Baker (1971), "Reservation Prices on Credit Use: A Measure of Response to Uncertainty", American Journal of Agricultural Economics, 53(2): 222-228.

Brougham, R.W. (1973), "Pasture Management and Production", Proc. Ruakura Farmers' Conference, (25): 169-183.

Brown, T.M. (1952), "Habit Persistence and Lags in Consumer Behaviour", Econometrica, 20: 355-371.

Bureau of Agricultural Economics (1977), A Review of Credit in the Australian Rural Sector, Canberra: Australian Government Publishing Service.

Campbell, K.O. (1958), "Some Reflections on Agricultural Investment", Australian Journal of Agricultural Economics, 2(2): 93-103.

Court, R.H. (1967), "Supply Response of New Zealand Sheep Farmers", Economic Record, 43: 289-302.

Dean, R.S. and D.E.A. Giles (1972), "Consumption Equations for New Zealand: Tests of Some Alternative Hypotheses", Reserve Bank of New Zealand Research Paper No. 6, Wellington.

Dean, R.S. and P.W.E. Nicholl (1979), Monetary Policy and the New Zealand Financial System, Wellington: Reserve Bank of New Zealand.

Department of Scientific and Industrial Research (1980), "Land Alone Endures". D.S.I.R. Discussion Paper No. 3, Wellington.

Duesenberry, J.S. 91952), Income, Savings and the Theory of Consumer Behaviour, Cambridge: Harvard University Press.

Durbin, J. (1970), "Testing for Serial Correlation in Least-Squares Regression When Some of the Regressors are Lagged Dependent Variables", Econometrica, 38(3): 410-421.

Evans, L.T. and K.C. Green (1981), "Soil Moisture Deficit Data", Project for Economic Planning, Internal Paper No. 105, Victoria University, Wellington.

Ferber, R. (1970), "Research on Household Behaviour", in Keiser, N.F. (ed), Readings in Macroeconomics, Englewood Cliffs, N.J.: Pentrice Hall Inc.

Fisher, B.S. and K.J. Hanslow (1984), "The Impact of Risk on Agricultural Supply Response: Implications of Rational Expectations", Paper presented at the Conference of the Australian Agricultural Economics Society, Sydney, February 1984.

Fitzharris, M.J. and Wright, D.F. (1980), "Major Farm Management Factors on Gisborne Hill Country Farms". Proc. N.Z. Grassland Association Conference, 213-216.

Freebairn, J.W. (1973), "Some Estimates of Supply and Inventory Response Functions for the Cattle and Sheep Sector of New South Wales". Review of Marketing and Agricultral Economics, 41(2-3): 53-90.

Friedman, M. (1957), "A Theory of the Consumption Function", National Bureau of Economic Research, General Series No. 63, Princeton Univ. Press.

Fuller, W.A. and G.E. Battese (1974), "Estimation of Linear Models with Crossed-Error Structure", Journal of Econometrics, 2(1): 67-78.

Gillingham, A.G. (1980), "Increased Hill Country Production: How Easy Will It Come". Paper presented to 13th Fertiliser Seminar of East Coast Fertiliser Company Ltd.

Girao, J.A., W.G. Tomek and T.D. Mount (1974), "The Effect of Income Instability on Farmers' Consumption and Investment", Review of Economics and Statistics, 56(2): 141-149.

Greer, J.P. (1982), "Motivation and Other Factors Influencing the Adoption of Practices by Sheep Farmers in Oxford County, New Zealand", unpublished M.Sc. Thesis, Lincoln College, University of Canterbury.

Hight, G.K. (1976), "Problems and Potential of Farming on North Island Hill Country", N.Z. Agricultural Science, 10(4): 141-147.

Hight, G.K. (1979), "Hill Country: A Major Agricultural Resource and its Capacity for Increased Production". Proc. N.Z. Animal Production Society Conference, (39): 1-12.

Hight, G.K. and D.B. Wright (1972), "The Effective Utilisation of Pasture on Hill Country". Proc. Ruakura Farmers' Conference, (24): 47-61.

Holden, J.S. (1965), "The Economics of Hill Country Development". Proc. N.Z. Grassland Association Conference, 64-74.

Hu, T. (1973), Econometrics, An Introductory Analysis, Baltimore: University Park Press.

Inglis, J.A.H. (1965), "Stock and Pasture Management on Hill Country". Proc. N.Z. Grassland Association Conference, 46-55.

Jarvis, L.S. (1974), "Cattle as Capital Goods and Ranchers as Portfolio Managers: An Application to the Argentina Cattle Sector", Journal of Political Economy, 82(3): 489-520.

Johnson, R.W.M. (1955), "The Aggregate Supply of New Zealand Farm Products", Economic Record, 31: 50-60.

Johnson, R.W.M. (1981), "The Financing of Agricultural Investment in New Zealand", M.A.F. Economics Division Research Paper, 1/81, Wellington.

Keen, W.L. (1960), "Saving and Spending in the Sheep Farming Industry", Canterbury Chamber of Commerce Bulletin, No. 431, Christchurch.

Keiser, N.F. (1970), "The Consumption-Income Hypothesis and Some of the Evidence", in Keiser, N.F. (ed), Readings in Macroeconomics. Englewood Cliffs, N.J.: Prentice Hall Inc.

Keynes, J.M. (1936), The General Theory of Employment, Interest and Money, London: Macmillan.

Kissock, W.J. (1966), "Mob Stocking Proves Superior". N.Z. Journal of Agriculture, 113(2): 28-33.

Klein, L. and A.S. Goldberger (1955), An Econometric Model of the United States, 1929-52, Amsterdam: North Holland Publishing Company.

Laing, M.T. and Zwart, A.C. (1983), "Investment and Supply Response in the New Zealand Pastoral Sector: An Econometric Model", A.E.R.U. Research Report No. 137, Lincoln College.

Macmillan, J.A. and R.M.A. Loyns (1969), "A Cross-Section Analysis of Farm Household Expenditures", Canadian Journal of Agricultural Economics, 17(2): 92-105.

Maddala, G.S. (1971), "The Likelihood Approach to Pooling Cross-Section and Time-Series Data", Econometrica, 39(6): 939-953.

Malinvaud, E. (1970), Statistical Methods of Econometrics, Amsterdam: North Holland Publishing Company.

Markowitz, H.M. (1959), Portfolio Selection: Efficient Diversification of Investment, New Haven: Yale University Press.

Mauger, J.H. (1977), "Selective Topdressing", N.Z. Journal of Agriculture, 134(3): 40-42.

Mauger, J.H. (1981), "Development and Maintenance Fertiliser Requirements on Hill Country". Proc. Lincoln College Farmers' Conference, 41-51, Lincoln.

Maunder, W.J. (1974), "The Prediction of Monthly Dairy Production in New Zealand through the Use of Weighted Indices of Water Deficit". Technical Note 227, Wellington: New Zealand Meteorological Service.

Meat and Wool Boards' Economic Service (1980), Sheep and Beef Farm Survey, 1979/80, Wellington.

Meat and Wool Boards' Economic Service (1982a), Annual Review of the Sheep and Beef Industry 1981/82, Wellington: M.W.B.E.S.

Meat and Wool Boards' Economic Service (1982), Sheep and Beef Farm Survey 1980/81, Wellington.

Meat and Wool Boards' Economic Service (1984), An Analysis of 1980 Sheep and Beef Farm Term Liabilities, M.W.B.E.S. Paper No. 1886, Wellington.

Meat and Wool Boards' Economic Service (various), Sheep and Beef Farm Survey, Wellington.

Meat and Wool Boards' Economic Service (various), Annual Review of the Sheep and Beef Industry, Wellington.

Miller, J.G. (1965), A Survey of Farm Credit in New Zealand, Wellington: M.A.F.

Ministry of Agriculture and Fisheries (1975), Rural Credit Survey 1975, Wellington: Economics Division, M.A.F.

Ministry of Agriculture and Fisheries (1980), Rural Industry Incentives, Wellington. M.A.F. Media Services.

Ministry of Agriculture and Fisheries (1984), Agricultural Statistics, Wellington: M.A.F. Media Services.

Morgan, G. 91981), "Modelling Sheep and Beef Farming. Volume 1", Project for Economic Planning, Occasional Paper No. 51, Victoria University, Wellington.

Mullen, J.D., R.A. Powell and B.F. Reece (1980), "The Income and Expenditure Experiences of a Sample of Farm Families", Australian Journal of Agricultural Economics, 24(3): 268-282.

National Research Advisory Council (1978), Hill Country Research, Wellington: NRAC.

New Zealand Dept. of Statistics (1982), Monthly Abstract of Statistics, Wellington.

New Zealand Dept. of Statistics (various), Agricultural Statistics, Wellington.

New Zealand Meat Producers' Board (various), Annual Report, Wellington.

Parker, B.W. (1981), "Developing Hill Country Without Grants and Incentives". Proc. Ruakura Farmers' Conference, (33): 23-38.

Parker, B.W., G.K. Hight and N.A. Cullen (1977), "Techniques for Increasing the Production of Meat and Wool", Proc. Ruakura Farmers' Conference, (29): 64-69.

Paul, A.C. (1963), "Perspective on New Developments in Farm Credit", Agricultural Finance Review, 24: 1-7.

Pearce, R.A. (1955), "An Empirical Micro-Study of Some Factors Influencing New Farm Investment", Economic Record, 30: 261-273.

Pryde, J.G. (1978), "Survey of New Zealand Farmer Intentions, Expectations and Opinions, June-August 1978", A.E.R.U. Research Report No. 96, Lincoln College.

Pryde, J.G. and S.K. Martin (1980), "A Review of the Rural Credit System in New Zealand, 1964 to 1979" A.E.R.U. Research Report No. 114, Lincoln College.

Pryde, J.G. and P.J. McCartin (1983), "Survey of New Zealand Farmer Intentions and Opinions, October-December, 1982", A.E.R.U. Research Report No. 136, Lincoln College.

Quin, B.F. 91982), "Does Fertilizer Pay, The Agricultural Economist, 3(4): 9-12.

Rao, P. and R.L. Miller (1971), Applied Econometrics, Belmont, California: Wodsworth Publishing Company.

Rattray, P. (1982), "Introduction", in Shimmins, M. (ed), The Whatawhata Way: an Integrated Approach to Hill Country Farming in New Zealand, Wellington: Agricultural Promotion Associates Ltd.

Rattray, P.V. (1982b), "Extracting the Potential of North Island Hill Country: Animal Production Aspects". Proc. N.Z. Society of Farm Management National Conference, 9-28.

Rayner, A.C. (1968), "A Model of the New Zealand Sheep Industry", Australian Journal of Agricultural Economics, 12(1): 1-5.

Reynolds, R.G. and Gardiner, B. (1980), "Supply Response in the Australian Sheep Industry: A Case for Disaggregation and Dynamics", Australian Journal of Agricultural Economics, 24(3): 196-209.

Rich, M.M. and Taylor, N.W. (1977), "Econoclimatic Models for Forecasting the National Tailing Percentage and Wool Clip", New Zealand Agricultural Science, 11(2): 65-72.

Rowe, J.W. (1956), "Economic Influences on Livestock Numbers in New Zealand 1920-1950", Journal of Farm Economics, 38: 860-863.

Scott, M.E. (1981), "An Assessment of the Potential of Pastoral Farming on North Island Hill Country". M.A.F. Economics Division Research Paper 14/81, Wellington: M.A.F.

Shepherd, A.A. and M.A. Worsop (1980), "Factors Affecting Agricultural Production from a Group of Hill Country Farms Comprising Akitio County", Paper presented at the Conference of the N.Z. Branch of the Australian Agricultural Economics society, Picton.

Shimmons, M. (ed) (1982), The Whatawhata Way: An Integrated Approach to Hill Country Farming in New Zealand. Wellington: Agricultural Promotion Associates Ltd.

Smith, M.E., Dawson, A.D. and Short, W.D. (1976), "Increasing Hill Country Production Without Increasing Costs". Proc. Ruakura Farmers' Conference, (28): 22-25.

Stanbridge, R.J. (1973), "Sources and Uses of Funds in the New Zealand Farm Sector", Australian Journal of Agricultural Economics, 17(1): 17-32.

Suckling, F.E.T. (1975), "Pasture Management Trials on Unploughable Hill Country at Te Awa". N.Z. Journal of Experimental Agriculture, 3: 351-436.

Thompson, R.T. and Taylor, N.W. (1975), "The Application of Meteorological Data to Supply Forecasting in the Meat and Wool Industry", Technical Paper No. 11, New Zealand Meat and Wool Boards' Economic Service, Wellington.

Tweedie, A.J. and Spencer, G.H. (1981), "Supply Behaviour in New Zealand's Export Industries", Reserve Bank of New Zealand Discussion Paper G/81/1, Wellington.

Wallace, T.D. and Hussain, A. (1969), "The Use of Error Components Models in Combining Cross Section with Time Series Data", Econometrica, 37(1): 55-72.

Woodford, K.B. and Woods, L.D. (1978), "Production and Supply Relationships in the New Zealand Sheep and Beef Industries". A.E.R.U. Research Report No. 88, Lincoln College.

Yeoman, P.G. (1973), "Potential of Hill Country Farming in the King Country", Proc. N.Z. Grasslands Conference, 1973.

Zellner, A. (1957), "The Short-Run Consumption Function", Econometrica, 25: 552-67.

APPENDIX 1

CREDIT RELATED QUESTIONS IN THE 1981/82

FARMER OPINION SURVEY

CAPITAL STRUCTURE AND INVESTMENT

(A) According to your latest Balance Sheet and/or your own estimates please enter the values of your assets as at 30 June 1982.

1. Farmland	
2. Other Farm Assets	
3. Off-Farm Assets	

(B) At the end of the 1981-82 season how were your liabilities distributed among the following sources? Please indicate the term for which each loan was granted.

Long Term (longer than 10 years)	(1)
Medium Term (3-10 years)	(2)
Short Term (up to 3 years)	(3)

Lender:	Amount	Term
1. Rural Banking and Finance Corp.		
2. Govt. Agency other than RBFC		
3. Trustee Savings Bank		
4. Your Trading Bank		
5. Building Society		
6. Insurance Company		
7. Stock and Station Agent		
8. Trust Company		
9. Solicitors' Trustee Funds		
10. Family Loan		
11. Private Source		
12. Local Body		
13. Finance Company		
14. Dairy Company		
15. Private Savings Bank		
16. Other (specify)		

(C) In the following table could you indicate approximately your new borrowings in respect to medium and long term loans during the 1981-82 production season and the rate of interest you are being charged; also please indicate whether the loan was medium or long term.

Long Term (longer than 10 years) (1)
Medium Term (3-10 years) (2)

	Lender:	Amount	Int.	Term
1.	Rural Banking and Finance Corp.			
2.	Govt. Agency other than RBFC			
3.	Trustee Savings Bank			
4.	Your Trading Bank			
5.	Building Society			
6.	Insurance Company			
7.	Stock and Station Agent			
8.	Trust Company			
9.	Solicitors' Trustee Funds			
10.	Family Loan			
11.	Private Source			
12.	Local Body			
13.	Finance Company			
14.	Dairy Company			
15.	Private Savings Bank			
16.	Other (specify)			

(D) MAIN REASONS FOR THE NEW BORROWINGS

If you were asked to state the main reasons for your additional medium and long term borrowing in 1980-81 how would you apportion them among the following?

Reason:	Percentage of New Borrowing
1. To purchase new or additional land	
2. To finance farm development	
3. To purchase plant and machinery	
4. To refinance existing loans	
5. For personal reasons	
6. I did not borrow additional funds	

(E) If you formally applied to borrow funds during the 1981-82 season, were you able to borrow all the money you needed for your farming requirements (including development and land purchase).

Yes (1) No (2) Don't Know (3) [ ]

(F) Could you please indicate the amount you were unable to borrow in the box beside the purpose for which the loan(s) were required.

Reason:	Amount
1. I was not refused finance	
2. To purchase new or additional land	
3. To finance farm development	
4. To purchase plant and machinery	
5. To refinance existing loans	
6. For personal reasons	
7. I did not borrow additional funds	

(G) What reason was given for declining your application for funds?

Insufficient Security	(1)	
Income not sufficient to meet repayments	(2)	
No funds available	(3)	☐
No reason given	(4)	
Other	(5)	
Did not seek Finance	(6)	
Was not refused Finance	(7)	

(H) During the 1981-82 season did you either:

Not borrow but believe you could have obtained finance if required

<u>or</u>

Borrowed finance but believed that if required could have borrowed more.

Yes (1) No (2) Don't Know (3) ☐

(I) Why did you not borrow (more) finance during 1981-82 ?

Refused by lending institutions	(1)	☐
Didn't want to increase indebtedness	(2)	
Repayments too difficult	(3)	
No profitable use for additional finance	(4)	
Other		

RECENT PUBLICATIONS

RESEARCH REPORTS

125. *The Ecomomics of Soil Conservation and Water Management Policies in the Otago High Country,* G.T. Harris, 1982.
126. *Survey of New Zealand Farmer Intentions and Opinions, September–November, 1981,* J.G. Pryde, 1982.
127. *The New Zealand Pastoral Livestock Sector: An Econometric Model (Version Two),* M.T. Laing, 1982.
128. *A Farm-level Model to Evaluate the Impacts of Current Energy Policy Options,* A.M.M. Thompson, 1982.
129. *An Economic Survey of New Zealand Town Milk Producers 1980-81,* R.G. Moffitt, 1982
130. *The New Zealand Potato Marketing System,* R.L. Sheppard, 1982.
131. *An Economic Survey of New Zealand Wheatgrowers: Enterprise Analysis, Survey No. 6, 1981-82,* R.D. Lough, P.J. McCartin, M.M. Rich, 1982.
132. *An Economic Survey of New Zealand Wheatgrowers: Financial Analysis, 1980-81,* R.D. Lough, P.J. McCartin, 1982.
133. *Alternative Management Strategies and Drafting Policies for Irrigated Canterbury Sheep Farms,* N.M. Shadbolt, 1982.
134. *Economics of the Sheep Breeding Operations of the Department of Lands and Survey,* A.T.G. McArthur, 1983.
135. *Water and Choice in Canterbury,* K.L. Leathers, B.M.H. Sharp, W.A.N. Brown, 1983
136. *Survey of New Zealand Farmer Intentions and Opinions, October-December, 1982,* J.G. Pryde, P.J. McCartin, 1983.
137. *Investment and Supply Response in the New Zealand Pastoral Sector: An Econometric Model,* M.T. Laing, A.C. Zwart, 1983
138. *The World Sheepmeat Market: an econometric model,* N. Blyth, 1983.
139. *An Economic Survey of New Zealand Town Milk Producers, 1981-82,* R.G. Moffitt, 1983.
140. *Economic Relationships within the Japanese Feed and Livestock Sector,* M. Kagatsume, A.C. Zwart, 1983.
141. *The New Zealand Arable Sector: Foreign Exchange Implications,* R.D. Lough, W.A.N. Brown, 1983.
142. *An Economic Survey of New Zealand Wheatgrowers: Enterprise Analysis, Survey No. 7, 1982-83,* R.D.Lough, P.J. McCartin, 1983.
143. *An Economic Survey of New Zealand Wheatgrowers: Financial Analysis, 1981-82,* R.D. Lough, P.J. McCartin, 1983.
144. *Development of the South Canterbury-Otago Southern Bluefin Tuna Fishery,* D.K. O'Donnell, R.A. Sandrey, 1983.
145. *Potatoes: A Consumer Survey of Auckland, Wellington and Christchurch Households,* R.L. Sheppard, S.A. Hughes, 1983.
146. *Potatoes: Distribution and Processing,* S.A. Hughes, R.L. Sheppard, 1983.
147. *The Demand for Milk: An Econometric Analysis of the New Zealand Market,* R.J. Brodie, R.G. Moffitt, J.D. Gough, 1984.
148. *The Christchurch and New Zealand Eating Out Markets,* A. van Ameyde, R.J. Brodie, 1984.
149. ***The Economics of Controlling Gorse in Hill Country: Goats versus Chemicals,* M.A. Krause, A.C. Beck, J.B. Dent, 1984.**
150. *The World Market for Fruit Juice Products: Current Situation and Prospects,* M.T. Laing, R.L. Sheppard, 1984.
151. *The Economics of Controlled Atmosphere Storage and Transport for Nectarines, Apples and Kiwifruit,* M.T. Laing, R.L. Sheppard, 1984.
152. *Survey of New Zealand Farmer Intentions and Opinions. October-December, 1983,* J. G. Pryde, P. J. McCartin, 1984.
153. *Dynamics of Herd Buildup in Commercial Deer Production,* R. A. Sandrey, A. C. Zwart, 1984.
154. *The Economics of Farm Accidents and Safety in New Zealand Agriculture,* K. L. Leathers, J. D. Williams, 1984
155. *An Information System for the Control of Brown Rust in Barley,* P. K. Thornton, J. B. Dent, A. C. Beck, 1984
156. *An Assessment of the Effects of Road Dust on Agricultural Production Systems,* P.R. McCrea, 1984
157. *An Economic Survey of New Zealand Town Milk Producers, 1982-83,* R. G. Moffitt, 1984
158. *The Optimal Location of Egg Production in New Zealand,* A.C. Beck, J.P. Rathbun, C.D. Abbott, 1984.
159. *The Economics of Irrigation Development of the Amuri Plains Irrigation Scheme,* Glen Greer, 1984.
160. *An Economic Survey of New Zealand Wheatgrowers: Enterprise Analysis, Survey No. 8, 1983-84,* R.D. Lough, P.J. McCartin, 1984.
161. *An Economic Survey of New Zealand Wheatgrowers: Financial Analysis, 1982-83,* R.D. Lough, P.J. McCartin, 1984.
162. *Farmland Pricing in an Inflationary Economy with Implications for Public Policy,* K.L. Leathers, J.D. Gough, 1984.
163. *An Analysis of Production, Consumption and Borrowing Behaviour in the North Island Hill Country Pastoral Sector,* A.C. Beck, J. B. Dent, 1984.

DISCUSSION PAPERS

66. *Design Considerations for Computer Based Marketing and Information Systems*, P.L. Nuthall, 1982.
67. *Reaganomics and the New Zealand Agricultural Sector*, R.W. Bohall, 1983.
68. *Energy Use in New Zealand Agricultural Production,* P.D. Chudleigh, Glen Greer, 1983.
69. *Farm Finance Data: Availability and Requirements,* Glen Greer, 1983
70. *The Pastoral Livestock Sector and the Supplementary Minimum Price Policy,* M.T. Laing, A.C. Zwart, 1983.
71. *Marketing Institutions for New Zealand Sheepmeats,* A.C. Zwart, 1983.
72. *Supporting the Agricultural Sector: Rationale and Policy,* P.D. Chudleigh, Glen Greer, R.L. Sheppard, 1983.
73. *Issues Related to the Funding of Primary Processing Research Through Research Associations,* N. Blyth, A.C. Beck, 1983.
74. *Tractor Replacement Policies and Cost Minimisation,* P.L. Nuthall, K.B. Woodford, A.C. Beck, 1983.
75. *Tomatoes and the Closer Economic Relationship with Australia,* R.L. Sheppard, 1983.
76. *A Survey of Farmers' Attitudes to Information,* R.T. Lively, P.L. Nuthall, 1983.
77. *Monetary Policy and Agricultural Lending by Private Sector Financial Institutions,* R.L. St. Hill, 1983.
78. *Recreational Substitutability and Carrying Capacity for the Rakaia and Waimakariri Rivers,* B. Shelby, 1983.
79. *"Consider Japan": Papers from a Seminar Conducted by the Japan Centi of Christchurch,* Edited by R.G. Moffitt, 1984.
80. *Deregulation: Impact on the Christchurch Meat Industry,* R.L. Sheppard, D.E. Fowler, 1984.
81. *Farmers Record Keeping and Planning Practices: a postal survey,* J. Ryde, P.L. Nuthall, 1984.
82. *The State of Agricultural Credit in New Zealand,* J. G. Pryde, L. B. Bain, 1984.
83. *The Future of the Common Agricultural Policy and its Implications for New Zealand,* E. A. Attwood, 1984.
84. *The Economic Potential of Growth-Promoting Agents in Beef,* D. E. Fowler, 1984
85. *Some Aspects of the Farm Income Situation in New Zealand,* E.A. Attwood, 1984
86. *Financing New Zealand Horticulture,* J.G. Pryde, L.B. Bain, 1984
87. *The New Zealand Farm Business and the Current Changes in its Structure,* E.A. Attwood, 1984.
88. *The Agricultural Sector in New Zealand – a Joint Farm - Industrial Perspective,* S.E. Guthrie, R.G. Lattimore, 1984.

Additional copies of Research Reports, apart from complimentary copies, are available at $8.00 each. Discussion Papers are usually $5.50 but copies of Conference Proceedings (which are usually published as Discussion Papers) are $8.00. Discussion Paper No. 60 is available at $5.50 per volume ($27.50 for the set). Remittance should accompany orders addressed to: Bookshop, Lincoln College, Canterbury, New Zealand. Please add $0.90 per copy to cover postage.