FARMLAND PRICING IN AN INFLATIONARY ECONOMY WITH IMPLICATIONS FOR PUBLIC POLICY

K.L. Leathers

J.D. Gough

RESEARCH REPORT NO. 162

October 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.

UNIT RESEARCH STAFF: 1984

Director
P.D. Chudleigh, B.Sc. (Hons), Ph.D.

Research Fellow in Agricultural Policy
J.G. Pryde, O.B.E., M.A., F.N.Z.I.M.

Visiting Research Fellow
E. A. Attwood, B.A., Dip.Ag.Sc., M.A., Ph.D.

Senior Research Economists
A.C. Beck, B.Sc.Agr., M.Ec.
R.D. Lough, B.Agr.Sc.
R.L. Sheppard, B.Agr.Sc.(Hons), B.B.S.

Research Economist
R.G. Moffitt, B.Hort.Sc., N.D.H.

Research Sociologist
J.R. Fairweather, B.Agr.Sc., B.A.,M.A.,Ph.D.

Assistant Research Economists
L.B. Bain, B.Agr., LL.B.
D.E.Fowler, B.B.S., Dip. Ag. Econ.
G. Greer, B.Agr.Sc.(Hons) (D.S.I.R. Secondment)
S.E. Guthrie, B.A. (Hons)
S.A. Hughes, B.Sc.(Hons), D.B.A.
M.T. Laing, B.Com.(Agr), M.Com.(Agr) (Hons)
P.J. McCartin, B.Agr.Com.
P.R. McCrea, B.Com.(Agr), Dip. Tchg.
J.P. Rathbun, B.Sc., M.Com.(Hons)

Post Graduate Fellows
C.K.G. Darkey, B.Sc., M.Sc.

Secretary
C. S. McNicol

CONTENTS

LIST OF TABLES

LIST OF FIGURES

PREFACE

While the importance of the price of land in agricultural production and policy is well recognised, land price formation is a process not well understood.

The study reported here was aimed at an examination of the cause and implications of farmland price inflation in New Zealand over the past 20 or so years. The report attempts to isolate some of the factors other than annual earnings that could explain the sudden increase in the market value of farmland during an inflationary period.

The report was written by Dr K.L. Leathers and Ms J.D. Gough (both now with the Centre for Resource Management at the College).

Financial assistance to the project from the Ministry of Agriculture and Fisheries is gratefully acknowledged.

J.B. Dent
Acting Director

ACKNOWLEDGEMENTS

This study was carried out as part of a larger investigation on farm size and amalgamation funded by the Economics division, Ministry of Agriculture and Fisheries. The authors' also wish to acknowledge the considerable support extended by the Valuation Department (Christchurch) in accessing and interpreting land and sales price statistics, and the assistance of Rob Davison, Meat and Wool Boards' Economic Service, in accessing the time series of sheep and beef farm income data. Ron Sandrey of the Department of Agricultural Economics and Marketing provided some constructive comments on an earlier draft of this report. The authors' are especially grateful to Peter Chudleigh for his assistance in reviewing the final draft.

SUMMARY

The market price for farmland in New Zealand and throughout the world generally rose more rapidly in the late 1970's and early 1980's than any previous decade this century. The causes of land price inflation are not clear, but the consequences are beginning to be recognised as a serious potential threat to the future of the traditional family farm. This study examines the implications of farmland price inflation on two important national policy objectives: efficiency of resource use and equity in ownership transfer. The general problem is characterised as one of low current returns and high farm asset values, focussing on the question... Is farmland overpriced? Adopting the view that an asset is worth what a rational individual ought to be willing to pay for it, an analytical framework was formulated to depict the demand-side of the land market. Valuation Department and Meat and Wool Boards' Economic Service data provide an annual time series of farm income, production asset values and land prices for the empirical analysis covering the period 1960 through 1983. The specific study objectives were: (1) to identify the factors or decision variables which influence land value determination, (2) to evaluate the relative importance of the value determinants under inflationary and non-inflationary economic conditions, and (3) to identify the implications of selected policies for controlling inflation or for remedying associated problems such as low cash returns.

The results of this analysis reject the contention that farmland has been overpriced in recent years. Indeed, it was found that the two components of farmland earnings - current (cash) and deferred (capital appreciation) - provided a return to productive farm resources equivalent to (and in some cases better than) other forms of productive investment. While it is hypothesised that large deferred earnings tend to distort resource allocation decisions in the short run, a careful examination of this effect was beyond the scope of this study. The liquidity problem which arises as a result of low current returns in an inflationary economy however was clearly demonstrated. Without special policies to augment current incomes,entry-level farmers and farmers with high debt loads cannot sustain the ownership cost of their productive assets. Farm transfer via inheritance and purchase by individuals with significant non-farm income are less affected by rapidly rising land values. It was also clear that measures to tackle the cash flow problem such as subsidised inputs and product price supports are themselves inflationary as they are quickly capitalised into land values.

Use of the demand-side approach to the problem revealed some possibly significant insights into the causes of land inflation. The willingness to pay or "bid" model produced an upper bound on the offer price considerably greater than the actual sales price in years of high rates of inflation. This "excess demand" condition did not occur for that part of the time series characterised as non-inflationary. On the basis of this finding it was hypothesised that the so-called excess demand put an upward pressure on farmland prices during the mid 1970's

to early 1980's, resulting in observed market price changes considerably in excess of the inflation rate as measured by the Consumer Price Index. A sensitivity analysis of the model parameters suggested that certain factors had a greater relative (individual) impact on excess demand than others. The variables which had the greatest influence on the bid value are in order of importance: the general inflation rate, a tax on deferred earnings (capital gains), the opportunity cost of capital, and the length of the planning horizon. Some implications of specific policies to alter land price inflation and liquidity are discussed along with suggestions for further study.

CHAPTER 1

INTRODUCTION

During the past decade, farmland prices have risen considerably faster than current net farm incomes would seem to warrant. Since the early 1970's unrealised capital gains have accounted for a greater proportion of total land earnings than realised cash income, a result that has never been consistently observed in previous decades. The amount of this inflation-induced wealth creation is staggering when one considers that it is a world-wide phenomenon. Using New Zealand's 14 million hectare pastoral sector as an example, nominal capital gains have ranged between $0.5 and $1.5 billion per annum in recent years, or up to one third of this country's gross agricultural export earnings.

This report examines the causes and implications of farmland price inflation in New Zealand. The root causes of inflation are generally understood, but the relationship between general price inflation and the market value of farmland is not readily apparent. The capitalisation of land earnings, as conventionally measured by net annual returns (rent) to the land owner, is no longer a reliable predictor of market value. In an inflationary economy it has become clear that factors other than annual earnings play an important role. The purpose of this study was to analyse the land value mechanism in a market economy during an inflationary episode, and to identify the substantive issues and implications for farm policy.

1.1 The Problem

Market evidence in recent years indicates that the price of farmland has increased at a rate greater than the general rate of inflation. Since 1960, the price of land for fattening and grazing uses increased by nearly 800 per cent while the general inflation rate, as measured by the Consumer Price Index, increased by about 500 per cent. The change in land values during the past two to three years has been most notable: the general farmland price index increased by 33 per cent in 1980-81 and by over 40 per cent in 1981-82, but declined slightly in 1982-83. In contrast, net farm income in real terms (i.e., adjusted for price inflation) has essentially remained unchanged since the early 1970's. On the surface these rates of change in market value suggest that farmland may be overpriced as a productive asset.

The implications of land price inflation are cause for considerable concern to policy makers. U.S. researchers, for example, Melichar (1979) and Stevens (1978), have shown that severe liquidity problems can arise from the situation where land provides a low current return and a relatively high deferred return in the form of capital gains - a "growth stock" behaviour. More recently, Tweeten (1981) examined the question of whether the source of the cash flow problem was inflation or a real increase in land earnings, and he concluded that the land market has exhibited a "text book" response to the

condition of the 1970's. Webb (1982) has demonstrated how investors with a high marginal tax rate can effectively (and rationally) "bid away" land from investors in lower tax brackets. Others, particularly accountants and appraisers, have explored the implications of negative "effective" borrowing rates for land purchase as a hedge against inflation (Gibbons, 1980).

The extent of research on the causes and implications of land price inflation in New Zealand is very limited. None-the-less recent changes in policy regarding tax exemptions for the sale or exchange of farmland are likely to have significant implications on how the farmland market operates in the future. The recent legislation (NZ Government, 1982) was a major attempt to lessen the effect of non-farm 'speculative' incentives to land ownership. If farmland is treated as a growth stock-type investment, then the position of the young or entry-level farmer must be looked at very carefully. The possibility that the price of farmland can be bid up by speculators with outside sources of income to supplement farm earnings is an issue of current importance to policy makers. Accordingly, there is a need to identify the various groups which compete in the farmland market. These groups vary between countries according to government policy on land ownership (for example, foreign investment in farms is strongly discouraged in New Zealand), but the same principles of competition apply. In most countries, and particularly in New Zealand, it is considered desirable that young farmers aspire to farm ownership, and considerable emphasis is placed on government policies to assist with this objective (Economist, 1979).

With capital gains being a large component of farmland earnings during an inflationary period, farmer expectations may lead to suboptimal investment decisions from the national economic efficiency point of view. New Zealand policy makers are concerned that "farming for capital gain" might have a distorting influence on investment flows, with scarce capital resources tending to favour longer-term gains at the expense of maintenance and shorter-term development which is necessary to sustain a desired rate of growth in agricultural output.

The implications of inflation on cash flow and liquidity, land tenure and ownership transfer and sustained productivity are not well understood, and so far very little research work has been directed to these issues. One problem which may be important relates to the definition of inflation; it is conceivable that the results of an analysis of inflationary impacts would depend on the definition of inflation used. More importantly, however, are the criteria appropriate to assessing impacts as these relate directly to policy objectives and alternative policy instruments.

1.2 Study Objectives

The primary aim of this study was to provide an explanation of the recent inflationary trend in farmland prices and to identify the implications for agricultural policy. The specific objectives were:

1. to construct a theoretical model of farmland valuation as an aid to identifying the factors which influence value determination, particularly the factors of inflation, interest rates and expected earning flows;

2. to apply the model in an analysis of New Zealand pastoral land prices during the past two decades; and

3. to examine the possible consequences of selected policy measures to influence land values directly or to remedy problems associated with inflation, such as liquidity.

1.3 Data Sources and Method of Analysis

Data for the analysis were obtained primarily from two sources: the Meat and Wool Boards' Economic Service (MWBES) and the Valuation Department. It is recognised that historic prices based on market transactions will differ from the standard measures of value, notably the income capitalisation approach, hence both data series are required in the analysis. The MWBES data provided basic information on annual farm income, production assets, liabilities and net worth for sheep and beef farms covering the period 1960 through 1983. The MWBES 'all classes average' farm was used so the results of this analysis could be broadly representative of conditions in the sheep and beef sector as a whole. The Valuation Department data series was used to construct price trends for land classes consistent with the MWBES definition of the 'all classes average' farm.

Two basic types of quantitative analysis were undertaken. Using a modification of the Lee and Rask (1976) capitalisation formula, a sensitivity analysis of the bid-price model parameters representing New Zealand conditions was used to identify causal relationships between capitalisation (willingness to pay) variables and land price. Cross-section analysis, depicting bid responses for different types of farmland purchasers, and time series analysis of bid responses in comparison with actual market prices observed since 1960 formed the basic approach to this study. Linear regression techniques were also applied to the time series data in an attempt to estimate statistical relationships between land value, returns, inflation and other factors.

1.4 Organisation of the Report

The findings of the study are reported in the three remaining chapters. Chapter 2 presents a brief review and interpretation of the data and approaches used to assess the implications of farmland pricing during periods of general price inflation. In Chapter 3 the results of the empirical analysis are reported, and in Chapter 4 the policy implications to be derived from the analysis are summarised. The time series data on land prices, current returns and production assets and the adjustments used to prepare the data for analysis are summarised in Appendix A.

CHAPTER 2

RECENT RESEARCH AND PERSPECTIVES ON LAND VALUE

2.1 Introduction

Classical economic theory treated land as a productive asset fixed by nature, and equated its value to its ability to generate rent or income. Ricardo was among the first early economists to explain the relationship between the market value of land and its marginal productivity. However, the land problem that preoccupied early social policy makers - namely, the spectre of excessive rent accruing to the landlord as a result of land scarcity - has not so far materialised. The barrier posed by nature has evidently been "pushed back" by technological advances in agricultural production methods and enlightened social policies regarding land tenure. With the exception of the 1970's and early 1980's, historical analyses demonstrate the close correspondence between land value (as reflected by market price) and capitalised annual net earnings (Melichar, 1979).

If land value is to be defined in terms of land rent, or returns to the factor land, then the question "Is land overpriced?" requires a careful, evaluative comparison of changes in asset value and net farm income over time. The crux of the problem in making such a comparison lies in the fact that the meaning of 'value' and, in particular, 'rent', is open to different interpretations. Recent research however has helped to clarify some of the issues pertinent to the present policy debate and the implications of policy actions.

2.2 Review of Recent Research

Melichar (1979) studied the relationship between real capital gains and the current return to farm assets using aggregate U.S. data. He hypothesised that "...a farm economy characterised by rapid growth in the current return to assets will tend to experience large annual capital gains and a low rate of current return." The time series analysis confirmed the hypothesis that the rate of change in current income was capitalised into land value, and that policy actions seeking to increase the growth rate of current return will in fact depress the rate of current return due to the increase in capital appreciation. He concluded that the farming sector, at current interest (discount) rates, would continue to experience low returns on the market value of farm assets. In the mid to long term, farmland provided an attractive investment with eventual high rates of return to the established farmer or non-farm investor with large cash reserves.

While persons of limited means (young or part-time farmers) might find it difficult to undertake such an investment, Melichar's main point is that any aid provided to these people should be designed to

avoid increasing the growth rate of the current return.[1] This implication was reinforced by Reinsel and Reinsel (1979), who argued that the process of land inflation was likely to be accentuated by current U.S. policies designed to assist the beginning farmer. Further implications of continuously rising land values were that land ownership will become concentrated in fewer hands and that entry into farming will occur mainly through inheritance.

Working from the assumption that it is undesirable to have agricultural land concentrated in a few hands and that this is the inevitable end of inflating land value, Plaxico (1979) suggested some alternative policy objectives: reduce the rise in land prices, reduce the appeal of wealth increases relative to current income via taxes, reduce the ability of farmers to hand the wealth on to their children, and design commodity support programs so that returns accrue to factors other than land. While he was referring to the U.S. situation, these could make for useful further discussion in the New Zealand policy context.

Data similar to that used by Melichar (1979) were constructed from the Meat and Wool Boards' Economic Service (MWBES) Sheep and Beef Survey 'All Classes Average'. In Figure 1 real capital gains and nominal capital gains versus current net income, in $1960, are summarised. To be correct conceptually nominal capital gains should measure the increase in the value of physical assets minus total net investment and net transfers into the farming sector (Bhatia, 1971). The MWBES data however do not provide information about net investment and net transfers. An estimate of real capital gains was computed by adjusting the nominal capital gains for the gains or losses resulting from each year's change in the value of the funds tied up in assets and liabilities. It should be noted that this approach only provides an approximation of the 'net' change in equity.[2] A three year moving average was used in the 1960's since at this time land valuations were revised at three year intervals. A concise summary of land price trends and the assumptions made in calculating capital gains for the period is reported in Appendix A.

The New Zealand result is very similar to that presented by Melichar. Net income has remained fairly constant over the 23 year period while real and nominal capital gains fluctuated more noticeably. The pre 1970's non-inflationary period is clearly distinguished in these data (also see Appendix A). Prior to 1972 capital gains were at a level of about one third of net income, and after that the two were more nearly equal. Nominal capital gains have exceeded annual net income since 1971-72. The drop in real capital gains in 1974-75 and the increase in 1978-79 are attributed to product price changes.

---

1. In other words assistance to beginning farmers would best be found as subsidised loans and debt service policies rather than price and income supports, which would enhance the cash flow of all farmers in general.

2. While the conclusions are dependent on a rather crude measure of net investment, the authors' do not believe a more refined estimate would substantially change the overall results.

FIGURE 1

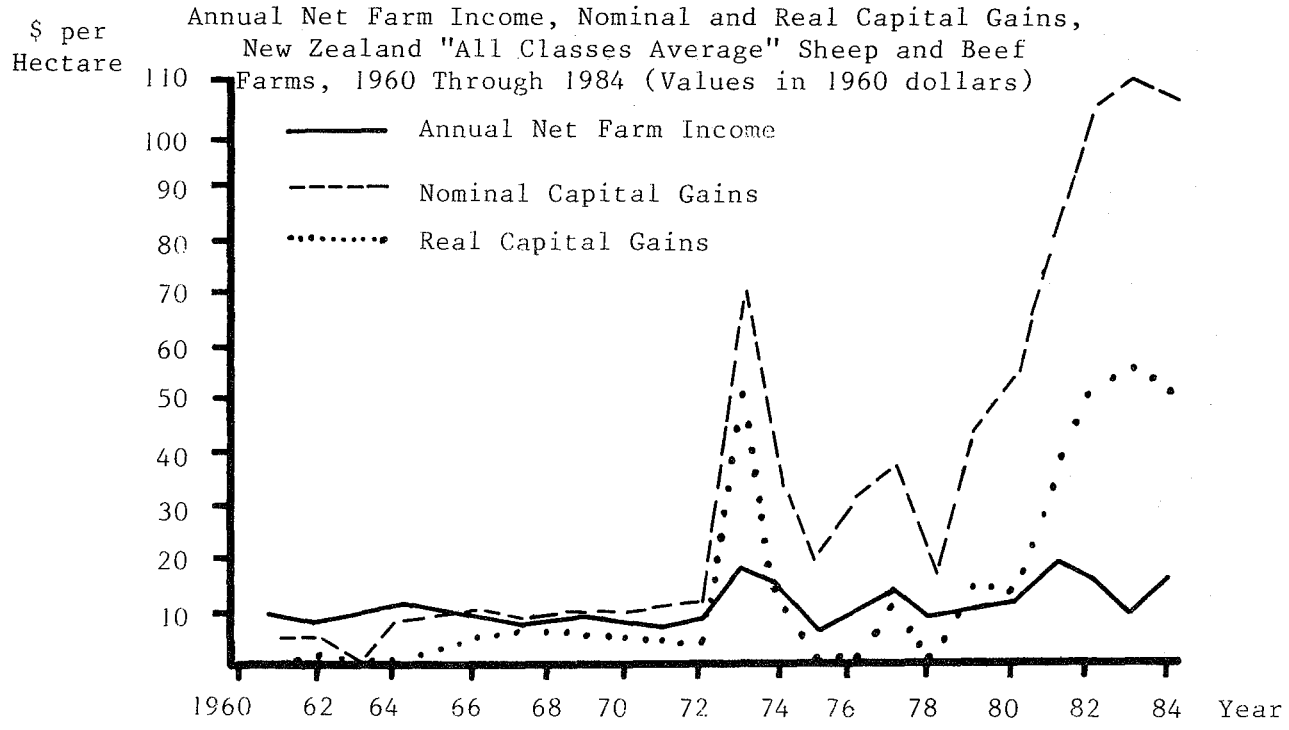
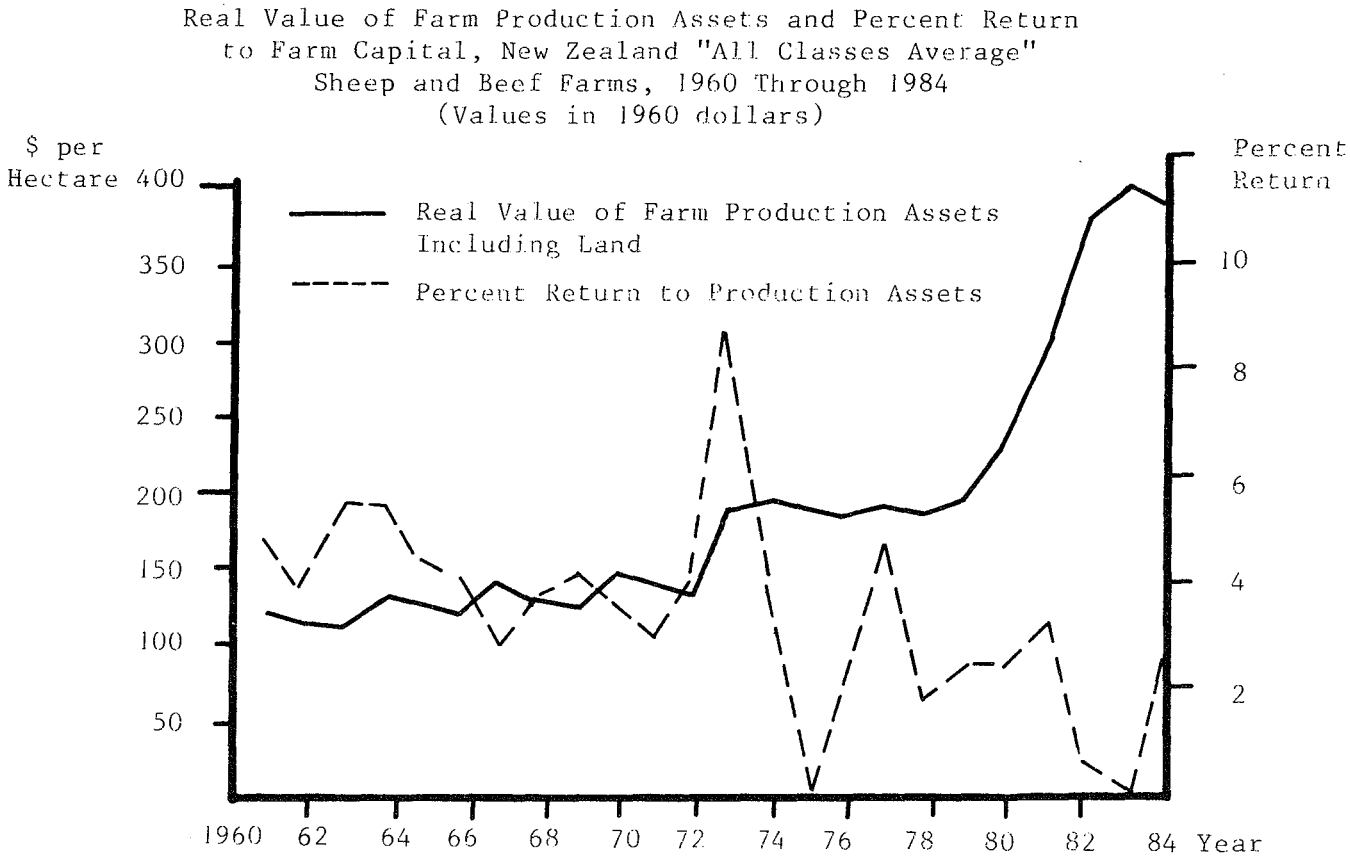


FIGURE 2



Throughout the 1970's capital gains moved in the same direction as net income but in an exaggerated manner. The high farm income in 1972-73 was accompanied by a massive capital gain, eventually evened out by the downturn in 1974-75. Realised or expected income is positively correlated with shifts in capital gains through the 20 year period, but it does not seem that capital gains compensate for years of low income. The divergence between nominal and real capital gains reflects the increasing importance of farm debt servicing in the 1970's and 1980's.[3]

Perhaps a more appropriate measure of the inflationary impact of land price on farm income is the residual return to production assets. The rate of return to farm production assets is compared with the value of production assets in Figure 2. The rate of return was calculated according to the MWBES definition which includes an allowance for family and operators labour.[4] The results clearly show a steady decline in the efficiency of farm capital investment, particularly from about the mid 1970's on.

Excluding the years of extreme fluctuation these data indicate an average annual rate of current return to production assets at between 2 and 6 per cent, with a rate of growth in current return varying from -0.4 to 0.1 per cent. The apparent zero growth rate may be due to limitations of the data or possibly in the assumptions used.[5] However, at such low rates much of the total return to farmland is in the form of unrealised capital gains. In a theoretical examination of the relationship between current return, capital gains and assets at equilibrium, Melichar concludes (with respect to the U.S. experience) that the substantial capital gains received are no greater than would be expected to occur at equilibrium with the current growth rate in net income in the neighbourhood of 2 to 6 per cent.

Economists have generally avoided adding current income and capital gains to obtain a total return to farmland. The two measures are often incompatible because income is a realised gain whereas capital gains are generally unrealised. Bhatia (1971) concluded that farmers tend to have a high propensity to save from capital gains

---

3. Nominal capital gains, that is the appreciation in asset value relevant to liabilities at current prices, is not easily translated into a form of 'net worth' or equity that is of immediate benefit to the farmer. In a period of high price inflation 'real' capital appreciation can be considerably less than the "nominal" gain, yet the terms of borrowing are typically based on nominal value estimates. The resulting effect is that many farmers who are in the process of expanding their operations find it difficult to service new mortgage obligations out of current income and/or real 'realised' capital gains through the sale of previously held farmland.

4. In this case "efficiency" is measured in terms of the net return to the productive farm assets employed, which is the appropriate measure from the national viewpoint (Leathers and Gough, 1984).

5. See for example Bhatia (1971).

probably because they have little choice. It may be, however, that unrealised capital gains may become realised as farmers seek to refinance mortgages on an ongoing basis or expand their operations through amalgamation based on improved leverage.

Assuming that a broad view of the rate of return is relevant, namely that a portion of all of the annual capital gain is treated as annual farmland earnings, then the above conclusions might lend themselves to a different interpretation. Rates of return to equity in farm production assets, including cash income and capital gains, are summarised in Table 1 for MWBES 'all classes average' data covering the last two decades, 1960-61 through 1979-80. The calculations for current returns, real capital gains and production assets are consistent with the measures used in constructing the data series reported in Figures 1 and 2. For comparison purposes, Table 1 also reports the real rate of return on secured savings (as a surrogate for non-farm investment opportunities), the inflation rate as measured by the Consumer Price Index, and the corresponding U.S. decade averages (in brackets) for rates of return as reported by Tweeten (1981) in a recent study of farms in the American midwest.

The conclusions drawn from these time series data are summarised as follows:

1. Annual returns in the form of unrealised capital gains are more volatile than residual returns out of cash income;

2. capital gains have become a progressively more important component of the returns to farmland ownership, especially during the 1970's and particularly in the latter years of the series;

3. the relative proportions between current residual cash returns to equity and capital gains for New Zealand and the U.S. during this time period are almost mirror images of each other; and

4. the percent return to farm equity, measured by cash income and capital gains, has generally exceeded the real expected rate of return on secured (riskless) non-farm investment (savings) opportunities.

Clearly the inflation-hedge aspect alone - an average real gain of 4.6 per cent versus -0.6 per cent on insured deposits during the 1970's and early 1980's - made land an attractive investment during this period. It is also clear that land is not overpriced at these rates of return. In Tweeten's view of the definition of land rent, the net returns, both realised and expected (capital gains), fully explain the prices observed in the market for farmland in recent years.

2.3 Analytical Approaches to Land Value Analysis

Harris and Nehring (1976) constructed a theoretical model of the maximum bid price prospective buyers would be willing to offer to

TABLE 1

Rates of Return to Equity in Farm Production Assets in Relation to the Rate of Inflation and Non-Farm Investment Returns, 1960-61 to 1979-80, 'All Classes Average' Sheep and Beef Farm Data[a]

Year	Percent Return to Farm Equity[b]			Rate of Return on Secured Savings[b]	Inflation Rate[b]
	Farm Residual Income	Real Capital Gains	Total Earnings		
	%	%	%	%	%
1960-61	4.8	-3.5	1.3	3.1	2.0
1961-62	3.7	-7.7	-4.0	2.3	2.9
1962-63	5.5	1.5	7.0	3.3	1.9
1963-64	5.5	16.5	22.0	1.8	3.3
1964-65	4.5	-3.2	1.3	3.1	3.6
1965-66	3.8	-0.3	3.5	4.1	2.6
1966-67	2.7	14.8	17.5	1.1	5.9
1967-68	3.3	-2.8	0.5	2.8	4.4
1968-69	4.5	-2.4	2.1	2.0	5.0
1969-70	3.7	13.1	16.8	0.9	6.6
1960-70	4.2	2.6	6.8	2.5	3.8
US average[c]	(3.7)	(3.1)	(6.8)		
1970-71	3.0	-6.2	-3.2	-2.1	10.6
1971-72	3.9	-3.0	0.9	0.4	6.8
1972-73	8.7	31.5	40.2	-0.9	8.1
1973-74	4.0	9.5	13.5	0.7	11.3
1974-75	-0.1	-3.8	-3.9	-2.5	14.5
1975-76	3.2	-0.5	2.7	-4.0	17.0
1976-77	4.7	5.9	10.6	-0.4	14.4
1977-78	1.9	-3.1	-1.2	2.2	11.8
1978-79	2.4	8.1	10.5	1.7	13.8
1979-80	2.4	7.1	9.5	-0.7	17.2
1970-80	3.4	4.6	8.0	-0.6	12.6
US average[c]	(4.8)	(7.3)	(12.2)		
1960-80	3.8	3.6	7.4	0.9	8.2
US average[c]	(4.3)	(5.2)	(9.5)		

a. Data expressed in terms of per average farm statistics.
b. Refer to Appendix A for definitions and method of calculation.
c. US average data as reported by Tweeten (1981).

obtain a risky asset.[6] The variables included in the model were net income, income variability, wealth, degree of risk aversion, marginal income tax, rate of pure time preference and expected rate of growth in land earnings and relationships between different types of buyers competing in the land market.[7]

The major difficulty faced in this approach concerns the specification of utility functions for the purchasers. One of the major factors affecting the ability of one group to outbid another proved to be the degree of risk aversion, and it is by no means certain that the largest farmers will always offer the highest bid.

Plaxico and Kletke (1979) analysed unrealised capital gain in farmland with the use of a capital budgeting approach. Three alternative models were used to compare capital gain decisions. The first model considered the present value of capital gains only when the asset was sold. Essentially this model defines value as equal to the discounted expected return divided by the capitalisation rate. The second decision model viewed the stream of unrealised annual capital gain as equivalent to a tax deferred income stream with tax being paid at capital gains rates when the property was sold or at the end of the planning horizon. With this approach equity increases occur annually and can be viewed as increased reserves. Whilst the second model assumes that the equity increases have value only in the year in which they occur, a third model considered the increase as an annual cumulative equity being continuously re-invested with interest paid each year.

The above study did not attempt to compare the characteristics of different farm operations, but it does illustrate the effects of varying attitudes to increases in land value. The rate of land price inflation and the length of the planning period were varied to show the effects on the annual capital gains. Whereas the third model produced the highest total value of capital gains, the second model produced the highest present value gain. The authors also examined the sensitivity of a number of other variables and concluded that factors besides capital gain could be possibly more important as a basis for policy decisions regarding farmland marketing.

In a paper by Lusht and Zerbst (1980), variations on the standard capitalisation formula are suggested and results compared for periods of high inflation in land value. Particular emphasis was given to mortgage market factors and equity positions.

---

6. For present purposes farmland is considered a risky investment owing to the variability of annual net returns. This is in contrast to a riskless investment such as government stocks and bonds which specify guaranteed premiums for the term of the investment.

7. The rate at which future income is discounted in terms of the present. The concept of a pure rate of time preference as distinguished from an opportunity cost of capital measure is appropriate here (D'arge, 1970).

A somewhat similar approach has been adopted by Tweeten (1981). He examines land pricing under stationary and inflationary conditions and obtains solutions for 'breakeven years' or years in which interest payments are first covered by annual income. The question of realising capital gains by refinancing mortgages was analysed, and it was shown that this method would lessen the problem of cash flow faced by new farmers.

For the purposes of the present analysis, the conceptual framework suggested by Tweeten (1981) was adopted. Essentially the Tweeten framework is an expansion of the classical Ricardian model of asset valuation. The market value of an asset is computed by dividing the expected annual return by the rate of return of the next best alternative for the time period in question.

In the Tweeten formulation expectations of future land earnings, hence current price per hectare P_o, are a function of the initial earnings R_o and the rate of growth in earnings attributed to inflation i, the earnings increment in excess of general inflation and alternative investment options i', the difference in tax rates that favour capital gains ϵ, the potential benefits from leverage L and "cheap" mortgage money when the borrowing rate is less than the rate of inflation. Given a real rate of return α, the discount rate provides an estimate of the present worth of a hectare of farm land:

$$(1) \quad P_o = R_o/(\alpha - i' - \epsilon - i\mu L/\alpha)$$

Under perfect knowledge and competitive equilibrium $P_o = R_o/\alpha$. But in an inflationary economy with less certain expectations on the part of borrowers and lenders, severe distortions can be introduced into the land market. As the denominator in (1) approaches α, land price increases and the current rate of earnings decreases. If the rate of inflation i is 9 per cent and $\alpha = .04$, $\mu = .02$ and $L = .8$ (disregarding i' and ϵ for the moment), the annual rate of increase in nominal earnings is 12.5 per cent. If the purchaser pays cash ($L = o$) or if the mortgage interest rate is in line with the inflation-adjusted land returns ($\mu = o$), the capitalisation formula in equation (1) no longer applies. If $\mu > o$, say 1 per cent, the land value/earnings multiplier $1/(\alpha - i\mu L/\alpha)$ is increased from 25 (when $= o$) to 45 which yields a land price 80 per cent higher than if concessional mortgage financing did not exist. The correct capitalisation formula becomes:

$$(2) \quad P_o = \int_{t=o}^{\infty} \frac{R_o e^{it}}{e^{rt}}\, dt = \frac{R_o}{r-l} = \frac{R_o}{(\alpha+i) - i} = \frac{R_o}{\alpha}$$

where:

e = natural log base
t = o, ∞ time horizon
r = discount rate or nominal expected rate of return

Money market disequilibrium can occur from several sources, the most important being a negative real rate of interest for borrowed

funds. Under perfect expectations, no real wealth transfer would occur between lenders and borrowers. But with unanticipated inflation i[1] and fixed mortgage interest rates, i = o, real wealth w transfers between lenders and borrowers, benefiting the borrower when i > o. This is shown by the expression:

$$(3)\quad \omega = \int_{t=o}^{\infty} \frac{R_o e(i + i')t}{e^{rt}} = \int_{t=o}^{\infty} \frac{R_o e^{it}}{e^{rt}}\, dt = \frac{i' P_o}{\alpha - i'}$$

Several important consequences of concessional credit and leverage in a period of unanticipated inflation follow from Tweeten's conceptual model:

1. net transfers of real wealth to farmers;

2. the more highly leveraged farmers gain the most;

3. larger farmers are in a position to "bid" away land from small farmers, providing the stimulus for amalgamation;

4. non-farm investors in farmland are disadvantaged[8] in benefiting from concessional credit due to the lending policies of the Rural Bank (but their role in the farmland market may increase due to the problem of liquidity); and

5. in the absence of government subsidies which influence the borrowing rate, the money market disequilibrium should dissipate as lender expectations adjust.

Inflation results in a severe cash flow or liquidity problem because the initial rate of return falls by i' as can be seen in equation (2). Finance instruments have terms which are normally fixed over time, hence e^{it} drops out of the formula and r is replaced by $\Theta + i$ where Θ represents the real rate of market interest in competitive equilibrium and i the inflation premium. With a perpetual mortgage on the land, annual interest payments are $P_o(\Theta + i)$ with surplus cash in year t:

$$(4)\quad C_t = R_o e^{it} - P_p (\Theta + i) = P_o (\alpha e^{it} - (\Theta + i))$$

---

8. In New Zealand concessional terms and conditions for farm development loans available through the Rural Bank are limited to individuals whose primary income source is farming. The major exceptions to this rule are programs such as the Livestock Incentive Scheme and the Land Development Encouragement Loan which are based on a 'performance test' rather than a 'tenure test' in granting assistance.

where: $C_t = 0$ if $i = 0$ and $\alpha = \theta$

Since high levels of inflation have their greatest impact on cash flow in early years, large cash deficits affect new landowners more than established farmers.

The liquidity problem is illustrated in Table 2. A "with and without" inflation case was compared using two alternative rates of growth in real farm land earnings (α) and rates of return of 4 and 6 per cent which were consistent with the historical data presented in Table 1. The non-inflationary state assumes a mortgage interest rate of 3 per cent, and at 15 per cent inflation the results illustrate what happens if the "effective" borrowing rate is 3 percentage points below the nominal rate, that is from the earlier discussion $\mu = 0.03$. A full perpetual mortgage was assumed and no allowance is made for principal repayment. The results are a good indiction of the liquidity problem faced by many New Zealand farmers during the 1970's.

Tweeten (1981) concluded from his empirical analysis that the hypothesis of the land earnings/price ratio being invariant to inflation should not be rejected. His results for ten mid-western U.S. States were consistent with those found using New Zealand pastoral sector data (Table 1) and Melichar's (1979) aggregated U.S. data. The long run implication was that the current rate of return to farm production resources will fall until total real earnings are in line with all other investment opportunities, ceteris paribus. So far this has not happened because capital gains are not easily realised. Further, if the present trend continues through the 1980's, non-farm investors will find farm land increasingly attractive, and young aspiring farmers will find it less attractive, leading to a change in the social structure of land ownership. Part-time farmers with non-farm incomes and large corporate farm organisations will be in an improved bargaining position in the land market.

As illustrated in Figures 1 and 2, the rapid decline in inflation in 1983 along with a downturn in farm income resulted in a sharp decline in nominal capital gains as a component of farmland earnings. This is a significant result for it is the first time in nearly a decade that the rate of price inflation has dropped below a double digit figure (see Table 1). If a low level of inflation were to continue through the 1980's it would have the effect of reducing the attractiveness of investing in farmland by non-farmers. If inflation were to return after several years then it is likely that the recent trend in the change of land ownership would continue, namely an increasing proportion of non-farm income earners and corporate farm organisations participating in the farmland market.

TABLE 2

Illustration of Equilibrium Cash Flow to Owner–Operator in the Initial Year with Full Debt Financing of Farmland with Alternative Rates of Inflation, Real Growth in Land Earnings and Real Rates of Return

Measure of Cost and Return Items for Consideration	Inflation and Real Land Earnings Growth Rate							
	No national inflation and annual real growth in land earnings of:–				Fifteen percent national inflation and annual real growth in land earnings of:–			
	0 percent		2 percent		0 percent		2 percent	
	=.04	=.06	=.04	=.06	=.04	=.06	=.04	=.06
	Percent of Land Value							
Returns								
Current earnings	4	6	2	4	4	6	2	4
Deferred earnings	0	0	2	2	15	15	17	17
Real capital gains	(0)	(0)	(2)	(2)	(0)	(0)	(2)	(2)
Nominal capital gains	(0)	(0)	(0)	(0)	(15)	(15)	(15)	(15)
Total Returns[a]	4	6	4	6	19	21	19	21
Cost								
Mortgage interest rate	3	3	3	3	12	12	12	12
Cash–flow surplus[b]	1	3	–1	1	–8	–6	–10	–8

Source: Adapted from Tweeten (1981) p.19.

a. Rate of return to farm production assets

b. Current land earnings rate less mortgage interest rate on a perpetual mortgage. The cash flow surplus would be smaller if principal payments were included.

CHAPTER 3

THE EMPIRICAL ANALYSIS AND RESULTS

3.1 Introduction

The dramatic increase in farmland value since 1970, as discussed in Chapter 2, is only partially explained by the residual returns to land. Indeed the evidence presented suggests that the level of current earnings (residual cash income) plus unrealised capital gains during the 1970's could have supported even higher land values than the market prices actually observed. In this chapter the various determinants of the conventional valuation formula are examined in detail. As an extension of the theoretical framework suggested by Tweeten (1981), a bid-price model was used to examine the importance of selected variables on the purchasers' "willingness to pay" or demand for land ownership. The chapter concludes with a summary of the empirical results and limitations of the analysis.

3.2 The Bid-Price Approach

This approach to land value determination considers the 'bid' or offer price that the prospective buyer is willing to pay under a set of specified conditions. The bid-price is dependent upon a number of factors which vary according to the financial position and resources of the buyer. Lee (1976) and Lee and Rask (1976) developed the approach as a quantitative framework for calculating the maximum bid-price. With this model it is possible to look at changes in land value over time and also to examine the ability of different purchasers under varying financial conditions to service mortgage repayment obligations.

Factors hypothesised to influence land value are, in addition to earnings, current mortgage interest rates, current finance company or bank interest rates (the opportunity cost of alternative investments), the general inflation rate, the level of government subsidies to agriculture, current and expected product prices, the mortgage finance terms, and the length of the investment planning period, among others.

3.2.1 Model specification.

It is assumed initially that the bid-price will be dependent primarily upon the expected income from the land and the debt service obligation (including down payment and current mortgage interest rates). If the purchaser is a farmer seeking a farm unit to live and work on, then the expected income will be critical since servicing the debt and developing the property will come out of earned farm income. In the case of a farmer owning a self-sufficient unit and seeking to purchase additional land, expected income may be less important. However, for at least an initial period the income from the purchased land will be needed to service the debt. The latter case may not

necessarily apply to a businessman, with an outside source of income.

The conventional formula used widely by real estate appraisers to obtain a residual earnings measure of land value is:

$$(5)\quad V = \frac{I}{r}$$

where: r is the capitalisation rate,

I is the expected residual net return (rent) to land, and

V is the resulting land value.

The assumptions inherent in this formula are that the investment is expected to produce the same annual rent over time, that the capitalisation rate used to discount future net rent remains constant, and that the investment time horizon is infinite.

The improved formula developed by Lee (1976) is based on the premise that purchasing a parcel of land is an acceptable investment alternative if:

1. the present value of net cash receipts is equal to or greater than the present value of the cash outlays (that is, if the net present value is equal to or greater than zero), or

2. the yield or internal rate of return exceeds the opportunity cost of capital.

The cash inflows are annual income adjusted for capital gains tax (if any) at the end of the planning period, and the outflows are the initial cash outlay and interest payments adjusted for tax shelter effects.

Lee's improved capitalisation formula is:

$$(6)\quad BID = \left\{\sum_{i=1}^{n} \frac{(1+GNI)^i}{(1+CC)^i}(ANI)\,)(1-MTR) + \frac{(1+INF)^n}{(1+CC)^n}(P)\,(1-T)\right\}$$

$$\div \left\{DP + (1-DP)\left[\frac{(1+CC)^t-1}{CC(1+CC)^t}\right]\left[\frac{IR(1+IR)^t}{(1+IR)^t-1}\right]\right.$$

$$-(1-DP)(MTR)(IR)\left[\frac{IR(1+IR)^t}{(1+IR)^t-1}\right]\sum_{i=1}^{t}\frac{1}{(1+CC)^i}\left[\frac{(1+IR)^{t-i+1}-1}{IR(1+IR)^{t-i+1}}\right]$$

$$\left. - \frac{I}{(1+CC)^n}\right\}$$

Where the variables are defined as:

P = the average price per hectare from recent sales

CC = the after tax opportunity cost of capital

n = the planning horizon of the purchaser

ANI = the expected annual net cash income per hectare before taxes

GNI = the expected annual rate of growth in net cash income per hectare

MTR = the purchaser's marginal income tax rate

DP = the proportion of the purchase price paid down

IR = the nominal rate of interest charged on mortgage loans

INF = the rate of inflation in the general price level

t = the amortisation period of the loan

T = the capital gains tax rate, and

BID = the computed maximum bid or offer price per hectare.

The data used and/or assumptions for the parameters in equation (6) are summarised below:

P: The market price for fattening and grazing properties sold was obtained from annual Valuation Department reports from 1970 onwards. Prior to 1970, sales price indices for fattening and grazing units had to be used to compute a series for the 1960's. Using the actual sales price for 1979 as the common basis, the two series were combined as a weighted average based on the number of sales reported by farm class in each ten year time period.

CC: The opportunity cost of capital was taken to be the secured savings rate available in the commercial banking system. Reserve Bank Bulletins provide a 'finance company rate' for no risk term savings of four or more years. This was reduced by a specified range of marginal tax rates to give the after tax opportunity cost rates or return.

ANI: Two different measures of annual current returns were used. Before tax annual net income was calculated from the MWBES sheep and beef farm survey reports. Farm classes 4 and 6 were used to derive the time series income data. The residual return to land was calculated as gross profit minus total expenditure: plus salaries, interest and rent paid: minus a managerial reward and the interest on the capital value of stock and plant. A weighted average of the two classes was computed using the estimated number of properties sold in each class per year. The weighted average of classes 4 and 6 was thought to be a more reliable estimate of

income than the "all classes average" data. The residual return to land was used in preference to the net income, since it is the residual return that is used in estimating the value of land less mobile improvements.

GNI: There was no discernible growth in net income during the two decades under study. Accordingly, several alternative rates of growth were assumed for the purpose of sensitivity analysis.

MTR: The marginal tax rate was based on the average taxable earnings of a 340 hectare class 4 or class 6 farm. The New Zealand tax rate on this level of income assumes standard exemptions for a wife and two children, school fees, superannuation and life insurance.

IR: The nominal interest rate used was the average rate for new mortgages as reported in the monthly Reserve Bank Bulletins.

INF: The inflation rate used was the general price inflation index (the CPI) as reported by the Department of Statistics.[9]

DP: The down payment on the purchase price was assumed to vary according to characteristics of the purchaser, but in general it ranged between 20 and 50 per cent.

n,t: The planning horizon and amortisation periods were specified at several alternative lengths of time in years.

T: The capital gains tax was varied from zero to 50 per cent depending on the particular situation under analysis.

3.2.2 Sensitivity analysis of model parameters.

The sensitivity of the bid values to changes in model parameters was examined at three levels: (1) to ascertain the relative importance of individual variables and interactions between variables, and to explore the effect of different definitions of land earnings; (2) to demonstrate the influence of price inflation on willingness to pay by comparing the model results between inflationary and non-inflationary time periods; and (3) to evaluate the effect of inflation on willingness to pay from the perspective of different types of land purchasers - or assumptions regarding buyers' 'ability to pay'. Assuming that the buyer responds rationally to market forces and formulates rational expectations about the future, the bid (or valuation) model should yield theoretically sound estimates of willingness to pay (or demand). The logical consistency and scope of the model in handling a broad range of variables and interactions should aid understanding of the influence that particular factors such

---

9. It should be noted that the INF variable (a measure of the value of the dollar) is different from land price inflation. That is, INF is used as an explanatory variable in the model to generate estimates of P or "bids" for comparison with actual sale prices (see P above).

as inflation have on market demand, hence land prices. The first step in the analysis was to formulate a 'base case' of conditions and to test the sensitivity of individual variables on bid values.

The purpose in establishing a non-inflationary 'base case' was to provide a basis for comparing the sensitivity of model parameters and interactions with that of an inflationary situation. It was hypothesised that both the relative importance of individual variables and the interactions between them would differ, since the relativities between the variables might be different in an inflationary versus non-inflationary environment. The base year selected was 1969-70, a representative pre-inflationary period in New Zealand. The values of the variables used in the model were obtained from secondary sources of published data on the base year (refer to the Appendix for a summary of the data series). The base case and results of the sensitivity analysis are summarised in Table 3. The values of each of the variables identified in the left hand column are believed to closely depict the actual market and other conditions which were experienced by farmland buyers in 1969-70. The values for n and t were arbitrary but, as will be demonstrated later, they have apparently little impact on the outcome.

TABLE 3

Sensitivity Analysis: Percentage Change in Individual Variables and Related Percentage Changes in Bid, Non-Inflation Base Period 1969-70

Variable	Non-inflation Base Case [a]	+50%	% change in BID	-50%	% change in BID
P	$228/ha	342	+42	114	-43
CC	0.041	0.062	-11	0.021	+11
ANI	$8.53/ha	12.75	+7	4.26	-7
GNI [b]	0.0	0.10	+10	0.05	+4
MTR	0.45	0.68	-1	0.22	0
DP	0.33	0.50	0	0.18	0
IR	0.0715	0.1073	-7	0.0358	+7
INF	0.036	0.054	+16	0.018	-14
T [b]	0.0	0.50	-14	0.25	-5
n	10 years	15	+3	5	-5
t	20 years	30	+1	10	0
BID	$257/ha				

a. The base case values should be interpreted as follows:

Purchase price, P	= $228 per hectare
Opportunity cost, CC	= 4.1 per cent
Annual residual income, ANI	= 8.53 dollars
Growth in net income, GNI	= 0, 5 and 10 per cent
Marginal tax rate, MTR	= 45 per cent
Down payment, DP	= 33 per cent
Interest rate, IR	= 7.15 per cent
Inflation rate, INF	= 3.6 per cent
Capital gains tax, T	= 0, 25 and 50 per cent
Amortisation period, t	= 20 years
Planning horizon, n	= 10 years

b. The percentage changes in the bid for the variables GNI and T are not directly comparable to the others, however, since their beginning values were zero.

The percentage change in bid values was calculated for a plus and minus 50 per cent change in the value of each of the model variables. Each variable was changed independently of the others. The model was most sensitive to the variables P, the average price paid per hectare in recent market sales, INF, the expected annual inflation in land values, and CC, the opportunity cost of capital. Variables which had little to no effect upon the bid were ANI, the annual residual return to land; GNI, the growth in net income; n, the planning period; and t, the amortisation period of the loan. The variable T, capital gains tax, did significantly affect the bid, with a 14 per cent reduction at

50 per cent tax on gains and a 5 per cent reduction at a tax rate of 25 per cent. The rate of growth in net income (GNI) from 5 to 10 per cent per annum had very little effect on the results.

Table 4 reports results of a second method of sensitivity analysis. In this case the parameters were varied over a given range selected as being plausible for that variable. The range used in some cases resulted in a greater variation than a ± 50 per cent change. The authors regard these as feasible ranges of change and report the results to illustrate the possible relative importance of each variable in the determination of rational bid values. Again, each variable was altered in isolation of the others.

TABLE 4

Sensitivity Analysis: Percentage Change in Bid Values Over a Feasible Range of Change in Model Variables, Base Period 1969-70

Variable	Range in Variable		
	Low	High	Range in BID
			$
P	200	250	230-278
CC	0.03	0.07	273-219
ANI	1.00	10.00	223-263
GNI	-0.02	0.05	252-268
MTR	0.25	0.60	258-256
DP	0.15	0.85	257-255
IR	0.06	0.16	262-217
INF	0.05	0.15	288-659
T	0.00	0.50	257-222
n	5	20	245-272
t	5	20	256-258

The variables CC, P, T and INF had the greatest effect on bid value. In particular, the pronounced effect of high price inflation is most notable. Whilst a large change in DP has little effect on the bid when considered in isolation, in conjunction with ANI (which might be affected by the amount of interest payable) it could have a much larger effect depending on the financial status of the purchaser. Similarly, the model is insensitive to the marginal tax rate alone but sensitive to the opportunity cost of capital which is affected by the MTR. Hence the model is also sensitive to ANI and MTR, but indirectly through their interaction with other variables.

A closer look at the income variable, ANI, is warranted. As defined in the present analysis the residual income measure is used as this is consistent with the concept of land rent, the value to be capitalised to determine asset worth. However, under this definition of ANI the estimates of residual return to land and fixed improvements were very low in most years (see Appendix A). The alternative is to capitalise annual before tax net income as was done by Lee and Rask (1976). Although not conceptually correct, this is perhaps a more accurate measure of annual expected income for the non-farm investor or the farmer with an alternate source of income. A comparison of the two income measures was made and the results are presented in Table 5.

TABLE 5

Analysis of Model Sensitivity Comparing Two Alternative Measures of Annual Net Income, 1969-70 Base Period

	Percent Change in Bid by Income Measure Used:			
	Residual Income[a] ANI = $8.53/ha		Before Tax Net Income ANI = $26/ha	
Variable	+50%	-50%	+50%	-50%
P	+42	-43	+34	-34
CC	-11	+11	-7	+7
ANI	+7	-7	+16	-16
GNI				
MTR	-1	0	+6	-7
DP	0	0	-2	+2
IR	-7	+7	-7	+8
INF	+16	-14	+18	-15
T				
n	+3	-5	+15	-17
t	0	0	+1	-1

a. As reported in Table 3.

As expected the alternative measures of net income had a marked effect on the importance of ANI in the model. It was also made clear that the relative importance of some of the other variables could be affected by the magnitude of ANI as well. The most notable changes were a diminished importance of the opportunity cost of capital and an increased importance of the planning horizon. The effect of increasing ANI resulted in the rate of inflation, annual net income and the length of planning period becoming equally important in the determination of the bid value.

A second step in evaluating the model's sensitivity to change involved comparing results between time periods. In effect, this was a similar test as was performed on the income variable, only in this case more than one variable was changed. Two periods were selected as representative of inflationary and non-inflationary conditions in the New Zealand economy; 1979-80 and 1969-70 respectively.

The results summarised in Table 6 compare the non-inflation case (as described earlier in Table 3) with a period of high price inflation. The 1979-80 case describes the relativities between model parameters observed in that year. While 1979-80 is not necessarily one of the years of the highest annual rates of price inflation, this year was thought representative of the general inflationary period of the late 1970's and early 1980's. However it is unlikely that the selection of different years (representing the two base periods) would markedly change the results of the comparative analysis.

TABLE 6

Sensitivity Analysis of Inflationary and Non-Inflationary Effects on Model Parameters: A Comparison of 1969-70 and 1979-80 Economic Conditions

	Base Conditions		Percent Change in Bid for ± 50% Change in Individual Variables:			
			1969-70		1979-80	
Variable	1969-70	1979-80	+50%	-50%	+50%	-50%
P	$228	792	+42	-43	+42	-42
CC	.04	.09	-11	+11	-21	+22
ANI	$8.53	60	+7	-7	+8	-8
GNI	-----(0,0.04)-----		----(+7)---		----(+4)---	
MTR	.45	.45	-1	0	+5	-4
DP	.33	.50	0	0	0	+5
IR	.072	.12	-7	+7	-12	+13
INF	.036	.12	+16	-14	+57	-35
T	------(0,0.5)-----		----(+1)---		---(-24)---	
n	10	10	+3	-5	+15	-17
t	20	20	+1	0	+2	-4
Bid	$257	1,373				

The influence of inflationary conditions is clearly evident in the predicted bid prices for the two periods. The model suggests that, under the assumed economic conditions for 1969-70, the rational buyer could offer up to $257 per hectare for land currently valued at $228, a bid of approximately 13 per cent above the going market price. This is contrasted with a similarly rational bid of $1,373 for the same hectare

of land in 1979-80 worth $792, or almost 80 per cent more than its comparative value based on current sales. The main factors behind the greater willingness to pay for land in a time of high price inflation were identified as:

1. The reduced attractiveness of investment opportunities outside farming (the CC variable became a much more important influence on the bid, ranging from a ±11 per cent in 1969-70 to about ±21 per cent in 1979-80);

2. The increased importance of the interest rate for mortgage funds (increasing from ±7 per cent to ±12 per cent);

3. The increased importance of the planning horizon (from ± 3 to 5 per cent in 1969-70 to ± 15 to 17 per cent in 1979-80);

4. The increased importance of a 50 per cent tax on capital gains (from essentially no effect in 1969-70 to a 24 per cent reduction in the 1979-80 bid value);

5. The greatest influence of all, the rate of inflation (which increased the bid from about ±16 per cent in 1969-70 to ±35 per cent and more in 1979-80).

The variables which did not show any significant change were: the previous sales price of land, the net return, the rate of growth in net return, the marginal tax rate on annual income, the portion of the purchase price as down payment, and the term or amortisation period of the mortgage.

The final procedure in the sensitivity analysis was to compare willingness to pay on the basis of types of prospective purchasers, or the 'ability to pay'. While it was easy to conceive of different types of buyers who enter the farmland market, it proved difficult to establish a unique set of conditions which would logically discriminate between prospective buyer groups. In general, the preceding analyses are probably more appropriate for evaluating individual buyer situations. The basic premise here is that prospective buyers of farmland with the highest ability to pay tend to set the market trend in price. All willing buyers therefore must compete, at differing levels of financial resources (and investment skills), under the prospect that the average price trend will be set by the highest bidder. Factors which can affect an individual's ability to pay include down payment, mortgage terms, expected net returns, investment opportunities elsewhere, and marginal tax rate among others.

Three different types of buyers with contrasting ability to pay characteristics were used for comparison. The buyers were characterised as:

1. a young farmer looking for his first farm,

2. an established farmer with a low debt to asset ratio looking to expand his present farm, and

3. a businessman looking for a medium-term investment with tax shelter benefits, and who would operate in a partnership with a full-time farm manager.

Each hypothetical buyer was characterised by a different set of market and financing conditions which were assumed applicable in each case. One important feature which was not incorporated in this analysis is the amount of capital available for investment and annual cash flow. The likely effect of this on willingness to pay for different sizes of farmland properties will be discussed later. For present purposes the 'scale effects' of the purchase or bid (or price) determination was assessed to be neutral. The assumptions used and bid values obtained are summarised in Table 7. The bid values are also compared under inflationary (1979-80) and non-inflationary (1969-70) conditions.

The main differences in ability to pay factors between the three hypothetical buyers relate to assumptions about expected annual net returns, the opportunity cost of capital, the marginal tax rate, the cash payment down, and the mortgage interest rate. Although these assumptions have a certain degree of plausibility they are still arbitrary and should not be interpreted as having a sound empirical foundation.

With respect to annual net income (ANI), the differences between the three cases are attributed to the higher debt service (see DP and IR) for the young vs established farmer and to a manager's salary and/or share of income for the businessman/partnership. The young farmer may enjoy a slight advantage over the others in terms of mortgage interest (e.g. subsidised interest available through the Rural Bank for a 'first farm' purchaser), whereas the businessman would likely borrow through the commercial banking system at a higher rate than the established farmer. The marginal tax rates (MTR) were scaled for low, average and high income earners, hence the opportunity cost of capital variable (CC) reflects this difference between the three buyers. Finally, the differences in the values of the other factors between the two time periods (non-inflationary vs inflationary) are based on historical data as reported earlier (Refer to Table 6 and Appendix A).

TABLE 7

Bid Value Comparisons for Three Types of Land Purchasers Under Inflationary and Non-Inflationary Conditions

Variable and Year	Young Farmer, First Farm	Established Farmer, Expanding Farm	Businessman in Partnership
1969-70:	Non-Inflationary		
P	$228	$228	$228
CC	0.064	0.041	0.03
ANI	$17.70	$24.65	$7.70
GNI	0.0	0.0	0.0
MTR	0.15	0.45	0.60
DP	0.15	0.50	0.33
IR	0.05	0.06	0.075
INF	0.036	0.036	0.036
T	0.0	0.0	0.0
n,t	10,10	10,10	10,10
BID	$309	$322	$267
1979-80:	Inflationary		
P	$792	$792	$792
CC	0.116	0.074	0.062
ANI	$-19.30	$43.69	$-45.31
GNI	0.0	0.0	0.0
MTR	0.25	0.52	0.60
DP	0.15	0.50	0.33
IR	0.09	0.12	0.155
INF	0.175	0.175	0.175
T	0.0	0.0	0.0
n,t	10,10	10,10	10,10
BID	$1,430	$2,107	$2,041

The main conclusion to be drawn from this analysis is that inflationary conditions have a major impact on land prices via ability to pay factors. This is illustrated quite clearly in the comparison of the two base periods. In pre-inflationary 1969-70, the established farmer has a slight 'ability to pay' advantage over the beginning young farmer as reflected in a higher (willingness to pay) bid value. Under such conditions the businessman is substantially out bid by both the young and the established farmers. But during a period of high price inflation the edge in bidding significantly shifts in favour of the businessman and away from the entry-level young farmer. The established farmer and the businessman are willing to pay about one third more per hectare than the young farmer. In the non-inflationary situation the special advantages of a low interest rate and low

marginal tax rate for the young farmer are offset in an inflationary period by the tax shelter advantages of a high marginal tax rate and low opportunity cost of investment for the businessman. The established farmer appears to retain only a slight advantage in either case, i.e. this category of farmland purchaser might be regarded as possibly ambivalent to the effects of inflation on land prices. In general the results suggest that willingness to pay can be influenced to some extent by ability to pay (i.e. the special attributes of the purchaser), and that the presence or absence of inflation can have a large and different impact on particular individuals.

Thus the 'scale effects' (or the number of hectares to be purchased at the bid value) have been assumed neutral in the analysis. The fact that large land units offered for sale exclude many potential buyers from the market is also a possible ability to pay consideration. This effect is well demonstrated by comparable sales of like farmland where the unit price per hectare is inversely related to the size of the property purchased (Valuation Department, 1983). While willingness to pay would be theoretically the same for two farm properties with exactly the same attributes except size, smaller units are typically more valuable per hectare due to greater buyer competition which puts improved pressure on market price. This aspect cannot be handled by the bid model in its present form. However it is not likely that such scale effects would alter the results for the three cases compared above, since the example is based on 'economic units' of sheep and beef farmland (see Appendix A).

3.2.3 Time Series Analysis.

The previous section illustrated how the bid model developed by Lee and Rask (1976) could be used to demonstrate the effects of changes in a number of parameters affecting land value. Even though the theoretical model is rather more sophisticated than typical land purchase decision processes in the real world, on the basis of the sensitivity analysis it would seem that there ought to be some correspondence between the "predicted" bid values and actual market prices through time. Further, even though the model is a partial approach to market analysis, there are no obvious reasons why the land market in New Zealand would have been constrained on the supply side during the 1960's and 1970's. Particularly with the onset of inflation in the 1970's conditions were such that a buyer's market probably existed most of the time. Accordingly, an attempt was made to use the model as a simulation device to generate bid values that might be correlated with actual market price movements over the range of available data.

Historical data for the period 1965 through 1983 were used to test the model's predictive ability. Certain variables in the model were held constant over the entire period, partly because of interpretation problems but also because there was no reason to vary their magnitudes judging from the available evidence. These included the variables GNI, DP, n,t, and T. Appendix A reports the actual data series used for the remaining model variables. A number of data manipulations were necessary to develop a consistent set of time series information. Calendar year Valuation Department data were reconciled with fiscal

year MWBES data using weighting and averaging techniques for land classes and different reporting dates (see Appendix A). Several methods of lagging and averaging income data were tested using the model, and it was decided that a five-year simple moving average was an acceptable approximation to inflation and income expectations. As to be expected shorter lags resulted in wider fluctuations in bid values, but the overall results were essentially the same. The five year average comprised the four previous years and the present year. The results of the model simulation are tabulated in Table 8 and graphically illustrated in Figure 3.

The sensitivity of the calculated maximum bid price is quite obvious, remembering that the bid is a maximum amount the buyer would be willing to pay given the prevailing conditions. Because of the smoothing of INF, the shifts prior to 1972 do not follow the price movements exactly. The dip in 1971 is probably due to a low INF value and high opportunity cost (CC). This was also a poor farm income year, and consequently a low marginal tax rate prevailed. From 1972, both price and bid increase. The inflation rate in P of 43 per cent in 1974 caused the bid price to become unrealistically high, and this effect was carried right through to 1982 because of continuing high inflation rates and the effects of the five year moving average used. The rapid drop in inflation in 1983 and the remaining high interest rates for borrowing resulted in a sharp decline in the bid value in that year.

When land value is increasing rapidly the bid price and actual sales price diverge considerably. This would suggest that buyers are willing to pay more than the sellers asking price (the amount reflected by P), in anticipation of further price increases. The prospect of an unchecked upward spiral is therefore quite real, at least over a period of several years when land provides a viable alternative investment for those who can afford to buy.

Correlation and regression techniques were also applied to the time series data as an alternative approach to establishing cause and effect relationships. In contrast to the bid model which is a micro approach to value determination, regression analysis in this case is the macro approach.

The neo-classical "quantity theory of money" school, strongly influenced by Milton Friedman in the 1950's, provides a case for controlling the price level (hence economic growth) by managing the money supply (Heilbroner and Thurow, 1978). Indeed, the authors have seen several unpublished studies recently in New Zealand which clearly demonstrate a strong relationship between the rate of change in the money supply and farmland price change (Sandrey, pers. comm.). The practical policy significance of such a relationship however remains to be seen. A discussion of the regression model and results is reported in Appendix B.

FIGURE 3

Comparison of Annual Bid Values and Five-Year Moving Average Model Bids with Actual Prices of Fattening and Grazing Land Since 1960

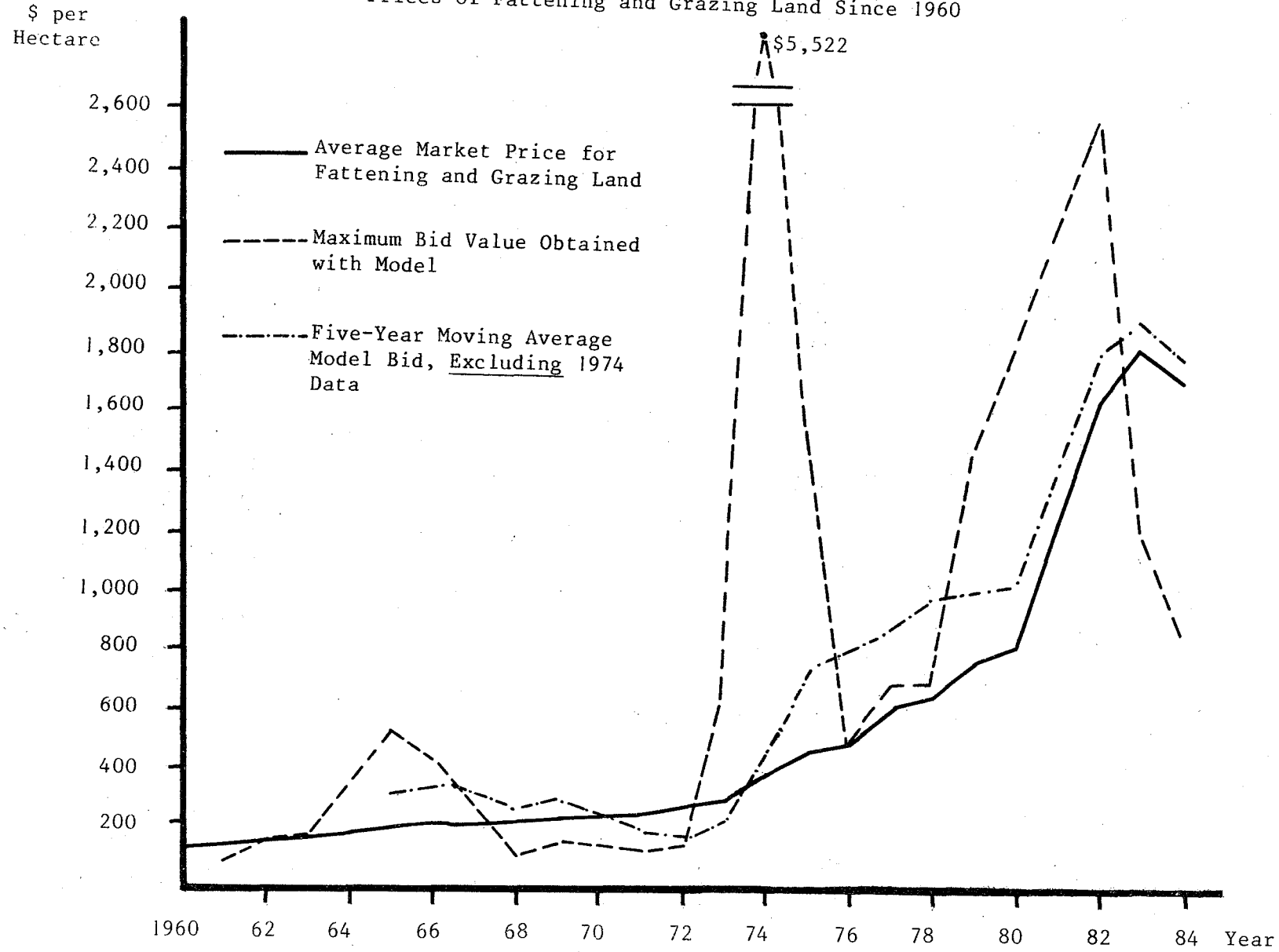


TABLE 8

Model Simulation Results for the Historical Time Series, 1965-1984

Year	Parameter Values[a]						
	P $	CC	ANI[b] $	MTR	IR	INF	BID $
1965	188	0.039	9.05	0.42	0.0641	0.081	324
1966	201	0.036	9.80	0.47	0.0666	0.081	351
1967	195	0.048	9.35	0.32	0.0695	0.075	302
1968	197	0.052	8.44	0.29	0.0736	0.062	262
1969	220	0.039	7.94	0.45	0.0718	0.064	314
1970	228	0.041	7.84	0.45	0.0715	0.040	262
1971	221	0.051	6.54	0.40	0.0732	0.020	199
1972	236	0.041	7.41	0.43	0.0790	0.040	264
1973	303	0.039	14.20	0.46	0.0810	0.095	565
1974	434	0.060	15.27	0.50	0.0823	0.158	1179
1975	490	0.082	12.45	0.32	0.0882	0.176	1268
1976	536	0.055	14.14	0.50	0.0960	0.199	2028
1977	641	0.060	16.76	0.57	0.1062	0.227	2968
1978	680	0.071	7.97	0.49	0.1117	0.181	1906
1979	792	0.074	2.18	0.52	0.1181	0.138	1505
1980	849	0.048	1.05	0.32	0.15	0.155	1076
1981	1249	0.105	2.95	0.45	0.155	0.165	1434
1982	1703	0.118	0.83	0.31	0.17	0.175	1808
1983	1838	0.091	-0.08	0.45	0.165	0.085	1918
1984[c]	1732	0.094	1.05	0.45	0.17	0.06	1799

a. Values held constant were: GNI = 0, DP = 0.33, n and t = 10, and T = 0.

b. Residual Income measure, five year moving average.

c. Authors' estimates

3.3 Summary and Limitations

The bid-price approach has helped identify a number of variables that were shown to influence land value under certain conditions. While the structural model should yield theoretically sound cause-effect responses from a hypothetical buyers point of view, uncertain expectations in the real world and the risks of making wrong choices limit the model's usefulness as a predictive tool in forecasting price trends. However, as an aid in identifying key relationships and explaining the structure of land value determination, the bid model has considerable potential.

The sensitivity of the model to changes in value parameters revealed that certain variables were clearly more important than others. Annual net income, the opportunity cost of alternative investments, the mortgage interest rate, the inflation rate, and the length of the investment horizon were consistently important in determining the maximum bid value under the conditional assumptions used. The amortisation period, the amount of down payment, the rate of growth in income and the marginal tax rate on income were generally of lesser importance as independent influences. The role of inflation, and consequently the importance of capital gains tax on the bid level was perhaps the major result of the analysis.

The bid comparisons made between different types of hypothetical buyers (or bidders) illustrated the model's sensitivity to interactions between the variables. Although the model generates a maximum willingness to pay, this type of analysis is nevertheless potentially useful in the applied policy area where carefully developed assumptions about conditional states can be rationally and accurately compared.

CHAPTER 4

SUMMARY AND CONCLUSIONS

For the tax year ending June 1981 the average [10] pastoral farmer in New Zealand had a net worth (the cash value of farm assets less outstanding debt) of nearly $0.7 million. The average before tax net income was not significantly different from that of the average self-employed New Zealander, about $21,000. This level of income represents a three percent rate of return on net investment, considerably less than, for example, the rate of return required by government on public sector projects. However, the fact of the matter is that the average pastoral farmer actually earned more than $80,000, most of which was a tax free gain in net worth. Indeed, throughout most of the 1970's and early 1980's capital gains have been the most significant contributor to annual farmland earnings in New Zealand and much of the western world. While contributing to wealth and prosperity in the long run, capital gains are difficult to "realise" in the cash sense in the near term and consequently add little to current economic activity. As a result of such a low rate of return to farm assets out of current income, many farmers, and in particular younger farmers who tend to have higher debt to asset ratios, are unable to sustain required levels of investment. There is also the concern from the national viewpoint that resources may not be allocated efficiently in the near term when the main benefits to farmland ownership accrue as deferred earnings. Especially during periods of high price inflation, the appropriate government policy response to depressed incomes and the desire for sustained growth in agricultural output is a matter of much debate.

The basic aim of this study was to improve understanding of the land pricing mechanism during a period of high price inflation. In doing so the nature of (and causal factors behind) capital asset appreciation was brought into clearer focus. A theoretical model of the demand for farmland was used to evaluate the significance of individual variables in estimating a 'willingness to pay' value as an upper bound on what a well informed buyer would willingly offer to obtain ownership. Some of the variables included in the expanded capitalisation formula are more amenable to direct control by government than others, hence the results of the modelling exercise indicate which policy approaches are likely to have the most impact on land values. The results of the theoretical and empirical analyses are reviewed in the following section. In Section 4.2 the authors discuss the implications of the study results with regard to some specific government policy options. Basically, three types of policy issues were considered: (1) income supports, for example supplementary minimum

---

10 Based on "All Classes Average" survey results, Meat and Wool Boards' Economic Service (N.Z. Meat and Wool Boards' Economic Service, 1982).

prices (SMP's); (2) disincentives for deferred income via a capital gains tax; and (3) preferential money-market policies, such as reduced interest charges on first mortgages and liberal refinancing terms on existing debts. The last section of this Chapter outlines some longer term issues and identifies several avenues of future research which would be needed to further test the usefulness of these results for reliable agricultural policy prescription.

4.1 Overview of Results

The concern that farmland might be overvalued is not a new one, but it has taken on special meaning in the 1970's and 1980's. The problem for the analyst is that land value appears to be determined primarily by the amount that a prospective purchaser is willing and able to pay for it. The cash income accruing to farmland is not necessarily the most important consideration. In an inflationary economy land gives a medium to long-term capital return, and this complicates the valuation issue by introducing new elements of which little is currently understood. [11] Land is worth different amounts to different people for different reasons, and a relatively free functioning market apparently responds accordingly.

U.S. researchers in the late 1970's (Melichar, 1979; Reinsel and Reinsel, 1979; Plaxico, 1979) demonstrated a strong empirical relationship between the growth rate of current income and asset (farmland) value. Regardless of how the growth rate in current return eventuated, whether by the shortage of feed and food grains of the early 1970's or as a result of the oil shock or other external influence, it became clear in the 1970's that the change in the rate of growth in current income was capitalised into land values. This finding took many policy analysts by surprise, since the conventional formula for asset valuation (or appraisal) did not explicitly treat changes in income growth rates as a determinant of asset value. History records a marked decline in the rate of return to productive assets since the 1960's, for example from 6 to 8 percent during the decade of the 1960's to 3 to 4 percent in the 1970's. Yet unrealised capital gains during this period rose substantially, resulting in an overall rate of return to farmland ownership comparable with the stock market, gold, and other assets held for long-term investment income. Certain analysts (e.g., Tweeten, 1981) argued that the behaviour of the market for farmland during the past two decades exhibits an almost textbook case of the free market mechanism at work.

In retrospect other implications now appear more important. While the market in the U.S. (and New Zealand) appears to have rationally allocated land between buyers and sellers, the concern now is focussing on the implications of those 'free market conditions' on individuals and the efficiency of agricultural land use. By way of contrast with U.S. agriculture, which is becoming dominated by corporate ownership

---

11 That is, at least the policy implications of deferred returns to farmland ownership are not well understood at present.

and the influence of outside sources of investment funds [12], New Zealand pastoral agriculture is largely family-owned and operated. Steps to avoid unintended increases in capital gains and undue land value appreciation, are therefore very important with respect to the needs of entry-level farmers. Where current income is insufficient to service debt and investment requirements, it becomes clear that special assistance programs are necessary to effect the desired intergenerational transfer of land ownership in New Zealand. Under conditions of high land price inflation, which is driven by factors other than current returns (as has been generally true in the late 1970's and early 1980's), inheritance is about the only way to acquire a farm, and this has the tendency of excluding many qualified entry-level farmers from ownership.

As a means of avoiding the concentration of farmland ownership in the U.S., Plaxico (1979) suggested several policy options: (1) control the price of farmland, (2) reduce the appeal of wealth vs. current income via changes in taxes, (3) reduce the ability of farmers to transfer their wealth to their children via inheritance taxes, and (4) design commodity and income support programs to generate benefits that accrue to factors other than land. Clearly, while some of these are obviously heavy-handed approaches, there is merit in exploring the effect such options have on stated policy aims. The first task is to clarify what these policy aims are, and secondly to confirm where possible what likely effects policy changes would have on these aims and other social policy objectives. While it is clear that land has held its own in recent years as an effective hedge against inflation [13], the liquidity problem posed by high asset values and low current returns and the issue of efficient resource allocation in the near term confront policy makers with some difficult choices. Measures to correct the liquidity problem faced by many farmers will possibly exacerbate the problem for others wishing to enter farming. A careful assessment of the trade-offs between policies and policy objectives is clearly warranted.

There are (or have been) several different approaches to the evaluation of agricultural policies toward land pricing under inflationary conditions. The conceptual approach suggested by Tweeten (1981) was adopted in this study. This approach can be characterised as 'demand-side' analysis and focuses on empirical models to estimate willingness to pay values from the buyers' viewpoint. Harris and Nehring (1976) and Plaxico and Kletke (1979) developed willingness to pay models based on capital budgeting which allowed the structure of the land purchase decision to be examined in more detail. More refined models such as that used by Lusht and Zerbst (1980) have been used to explore a wide range of motivational factors and policy variables on

---

12 In a recent census of U.S. Agriculture more than 40 percent of farm family income was reported as derived from non-farm sources (Melichar, 1979).

13 In fact comparative analyses show that farmland has out-performed almost any other asset in capital value growth in the past decade (Sorenson, 1983).

farmland purchase decisions. The present study, drawing on this earlier work, applied the bid analysis framework to New Zealand time series data which to the authors' knowledge has not been attempted elsewhere. Used in this way the willingness to pay model provides a measure of "excess demand" much in the same way as the familiar demand-pull mechanism for price inflation.

The results of the empirical analysis revealed some important differences in comparing inflationary and non-inflationary conditions. First, for much of the 1970's and early 1980's the combination of the variables used to compute the maximum willingness to pay for a fully rational buyer resulted in very high excess demand, i.e. the difference between the bid value and the previous actual price was very large during this inflationary period. After the price level began to fall in 1982, the excess demand condition disappeared as represented by rapidly falling bid values in 1983 and (estimated) 1984. Prior to the rapid rise in land prices beginning in the mid 1970's the model did not yield any significant bid values that would indicate an excess demand condition. The authors conclude from this analysis that in an inflationary economy the existence of an excess demand apparently has a strong "pulling effect" on land prices.

Second, the structure of the bid model suggests some possibilities for isolating individual variables which may influence this excess demand condition to a greater or lesser extent. By holding the model parameters constant and varying a single variable at a time, the relative importance of each parameter in the model was identified. In as much as these parameter values can be influenced by specific government policies, this approach provides some insight into the possible effect certain policy options might have in controlling farmland price inflation. Because the model has a behavioural-theoretic base -- which is conceptually superior to other available analytical techniques such as regression analysis of macro data -- specific policies can be 'targeted' to evaluate potential individual responses. The analysis of the 'young farmer', 'businessman' and 'established farmer' scenarios are an example of this possibility. The authors' concluded from this part of the analysis that certain variables were clearly more important than others in their partial effects on land prices. The variables which appear to have the greatest impact are direct controls on the price level (e.g. a price freeze), a tax on capital gains, and possibly the interaction of changes in the marginal income tax rate with the mortgage interest rate. Interest rates and terms on loans, changes in annual net income (via subsidies to farmers), and the length of the planning horizon have relatively little effect on 'excess demand' in an inflationary period. In the next section some of the policy implications of these results are explored.

4.2 Implications for Present Policy

Because of New Zealand's dependence on pastoral product exports for foreign exchange earnings, and because pastoral farming income is to a large degree determined by prices received in foreign markets, the intervention of government in the marketing of pastoral products and production inputs is of considerable importance to all New Zealanders.

Depressed world markets in the last several years have resulted in significant income subsidies to the pastoral farming sector under the government's supplementary minimum price programs. Also for many years significant subsidies have been used to reduce the cost of superphosphate fertiliser to farmers and hence to encourage the development and maintenance of lands where phosphorus is the limiting factor in pastoral output. Such policies augment farmer incomes for the purpose of stimulating new development or maintaining existing levels of output. Farm subsidies and income support programs are capitalised into farmland values, hence during times of depressed current returns such policies are believed to fuel inflation and deepen the liquidity problem for young farmers or those with high existing debts.

In comparison with the U.S. experience where recently it has been shown (by Melichar, 1979 and Tweeten, 1981) that annual net income and the growth rate of annual income played a significant role in land inflation, the New Zealand case is apparently similar. However, using the bid modelling approach the results suggest that annual income and the growth rate in annual income are relatively insignificant as individual influences on bid values. A fifty percent reduction in annual income reduces excess demand by about eight percent, and vice versa. The effect of the change in growth rate is substantially less. Accordingly, it could be argued that SMP's, even at the levels paid to pastoral farmers in 1982-83 (in some cases as much as 50 percent of net disposable income) probably had only a modest inflationary effect on land prices. This result was obtained for both the inflationary and other factors which are more important in explaining the excess demand condition. These preliminary findings suggest that other policies may in fact be more important with respect to controlling or influencing land values.

An important policy option that deals directly with the issue of deferred income is the capital gains tax. A tax on capital gains, it is argued [14], would discourage the land owner from "farming for capital gains" as it would shift the emphasis from future to current returns. If there was no deferred gain, for example by means of a 100 percent tax on capital appreciation, then the capitalised value of the land resource would reduce to a relatively simple calculation based on current expected income and the opportunity cost of investment funds. In a perfectly functioning economy this condition would be indistinguishable from a perpetual lease, where the landholder (or lessee) benefits (and pays rent) according to the current return from the land holding. At general equilibrium the marginal returns from farming would be equal to the marginal returns from capital resources employed elsewhere, hence the relatively low rate of current returns on farm production assets observed in the last two decades would have to improve (i.e., adjust upward until a parity was reached with other competitive investment opportunities). Ironically, the basic argument against a capital gains tax is that the land owner deserves some recompense for the fact that the current returns to net investment are

---

14 For a cogent, well argued case see Henry George's "Single Tax" (Heilbronner, 1970).

(and have been historically) abhorrently low [15].

There are many ways to approach the taxation of deferred income (capital gains) accruing to land ownership. Three broad types of tax methods include: (1) a capital gains tax as presently applied in the U.S., (2) a general 'wealth' tax as currently used in France, and (3) a factor or 'productivity' tax as has been discussed from time to time in New Zealand [16]. The implications of an asset tax are considered in light of the model results in the following discussion. The effects of an asset or capital gains tax are examined with respect to efficiency of resource allocation, production and employment, and ease or difficulty of administration.

In the United States all exchanges of real property are subject to a tax on the net gain obtained through sale, trade or transfer. The taxable gain is computed on the basis of sales or value at transfer of ownership less acquisition cost (or book value). Typically, a certain proportion of the net gain in value is excluded from taxation. In recent years this has been about 50 percent. The balance of the appreciation in asset value (50 percent) is taxed as ordinary annual income at the individual's marginal income tax rate. However, a special provision of the tax law excludes taxation of capital gains where the sales proceeds are used to purchase a property of 'like types'. In other words, a farmer can avoid paying capital gains tax if the proceeds of the farm sale are used to purchase another farm.

Under a similar tax policy as applied to capital gains in the U.S. (for illustrative purposes the authors used a tax rate of 50 percent, which is considerably more severe than the U.S. tax provisions at present), the results of the demand model suggest a major reduction in the bid value during an inflationary period. In comparison with the non-inflationary situation where the capital gains tax has virtually no effect, during rapid inflation the 50 percent tax on capital gains reduces the bid value by 24 percent. Next to direct controls on price inflation itself, the capital gains tax was the most effective policy instrument in reducing the bid value. Tax revenues obtained from the capital gains tax were not included in this analysis. Their financial impact on Treasury revenues however would not be large, and it would be logical to expect that revenue from a capital gains tax would be linked with land improvement expenditure programs.

The so-called 'wealth tax' and 'productivity' options are difficult to assess with the demand model developed in this study. Presumably, a standard percentage tax would be applied across the board on the capital value of farm assets. In some cases the wealth tax could be limited to net worth (assets minus debts), in others to the valuation of total farming assets. In France the wealth tax rate,

---

15 In some years a wage earner (with very little capital) may earn the same annual income before tax as a typical pastoral farmer who may command some several hundred thousand dollars in net productive assets.

16 See for example Evans (1980).

which is an annual tax on production assets, ranges between 2 and 5 percent depending on exemptions for particular farm types and farming situations. While the wealth tax would (or could) be applied differentially based on a farmer's relative efficiency in using his productive farm assets, the more efficient the farmer in managing his resources the lower the effective tax on assets. In as much as these types of asset taxes affect current income rather than deferred income, the bid values obtained from the model for both inflationary and non-inflationary cases suggest that they are less effective in reducing 'excess demand' for farmland. A fifty percent change in annual net income results in a 7 to 8 percent change in the bid value, approximately half that obtained with the U.S.-type capital gains tax in an inflationary economy. In a non-inflationary period the capital gains tax does not affect the bid price at all.

Besides the possible effects on land price inflation, the use of asset and capital gains taxes may also affect other important national policy objectives. If deferred income is large relative to current income so introducing a distortion in resource allocation, then a capital gains tax could be expected to lead to an improvement in resource use efficiency. Both the wealth and productivity tax approaches specifically aim at improving the allocation of resources in terms of current income and production objectives. However, from an administrative point of view only the capital gains tax can be applied with relative ease. In fact the current Inland Revenue Department legislation governing the recapture of development and interest deductions for farms sold before ten years is perhaps more difficult to administer than a capital gains tax. Implementation of a national productivity tax would require immense quantities of annual farm production data for monitoring the performance of the program and its distributional effects on individuals and rural communities.

The last set of policies examined are those that attempt to ameliorate the cash flow problem. Liquidity is the most important concern of farmers in an inflationary economy because current income is typically too low to service a mortgage on farm assets. Individuals in the best position to buy or own farmland have either low debt loads or significant non-farm income. Individuals entering farming for the first time typically do so through inheritance. Subsidised loans to first farm buyers and preferential terms on mortgages and development loans are ways to reduce the cash flow problem and 'open up' farming to a broader population of potential future farmers. Interest rates on Rural Bank loans for farm purchase are sometimes 50 percent or less of commercial rates, hence debt servicng can be significantly reduced for entry level farmers.

Achieving this objective however may also be a stimulus to further inflation. The results of the bid model show that a 50 percent reduction in the mortgage interest rate causes a 13 percent increase in the bid value. Other loan terms such as the percent down payment and length of time for repayment were not significant influences on the bid value. It is also worthwhile to point out that the effect of a change in the interest rate in a period of low inflation has much less effect on the bid price. It would be reasonable to conclude, then, that while subsidised interest rates appear to aid farmers with liquidity problems they also have the opposite effect by stimulating the excess demand

condition.

4.3 Suggestions for Further Research

The basic hypothesis which emerges from this study, namely the "excess demand" thesis, warrants further examination. Apparently, during an inflationary period factors which are important to land purchase decisions combine in such a way that a rational buyer's willingness to pay often exceeds the offer price of the seller. This excess willingness to pay can have a "pulling effect" on farmland prices through competitive bidding. If the rate of change in land prices is perceived as too rapid or inconsistent with national policy objectives, then it should be possible to influence land prices by restructuring certain policies directed at reducing the excess demand condition. Hence the model provides an opportunity (at least potentially) to manage excess demand in the land market.

One of the high priorities for subsequent work should be to devise a more rigorous empirical test of the excess demand hypothesis. This work would concentrate on removing some of the weaknesses in the present conceptual structure of the model. The major shortcomings are: (1) the failure to incorporate expectations adequately, particularly the risks associated with key decision variables; (2) the assumption of rationality - it was limited to a single objective, the present value of net worth; and (3) the absence of strategic behaviour rules - no constraints were considered for the supply-side of the land market. A general equilibrium framework for the land market could prove a better approach in some cases. In particular, where farmland is physically constrained by urban or competing land uses an equilibrium model of supply and demand would provide a sound theoretical formulation for examining 'excess demand' as well as strategic bidding behaviour.

LIST OF REFERENCES

BHATIA, K.B. (1971). "On Estimating Capital Gains in U.S. Agriculture" American Journal of Agricultural Economics 53 pp. 502-6.

D'ARGE, R. (1970). "Sorting Out the Issues in the Discount Rate Controversy", Western Journal of Agricultural Economics, 15 pp. 71-83.

THE ECONOMIST. (1979). "The Landed View of Land", July 14-20 pp. 70-71.

GIBBONS, J.E. (1980). "Influence of Inflation on Real Estate Valuation and Investment Analysis", Appraisal Journal, October.

HARRIS, D.G. and NEHRING, R.F. (1976). "Impact of Farm Size on the Bidding Potential for Agricultural Land". American Journal of Agricultural Economics 58 pp. 161-169.

HEILBRONER, R.L. (1972). The Worldly Philosophers, 4th Edition, Simon and Schuster, New York.

HEILBRONER, R.L. and THUROW, L.C. (1978). The Economic Problem, Fifth Edition, Prentice-Hall, Englewood Cliffs, New Jersey.

LEATHERS, K.L. and GOUGH, J.D. (1984). "Economics of Size in New Zealand Pastoral Agriculture", (manuscript in preparation), AERU, Lincoln College.

LEE, W.F. (1976). "A Capital Budgeting Decision Model for Evaluating Farm Real Estate Purchases". Canadian Farm Econ. 11, pp. 1-10.

LEE, W.F. and RASK, N. (1976). "Inflation and Crop Profitability: How Much Can Farmers Pay for Land " American Journal of Agricultural Economics 58 pp. 984-990.

LUSHT, K.M. and ZERBST, R.H. (1980). "Valuing Income Property in an Inflationary Environment". The Real Estate Appraiser and Analyst, July-August, pp. 11-17.

MELICHAR, E. (1979). "Capital Gains Versus Current Income in the Farming Sector". American Journal of Agricultural Economics 61, pp. 1085-92.

New Zealand Government (1982). Research Report Series, selected years, Valuation Department, Wellington.

PLAXICO, J.S. (1979). "Implications of Divergence in Sources of Returns to Agriculture". American Journal of Agricultural Economics 61, pp. 1098-1102.

PLAXICO, J.S. and KLETKE, D.D. (1979). "The Value of Unrealised Farm Land Capital Gains". American Journal of Agricultural Economics 61, pp. 327-330.

REINSEL, R.D. and REINSEL, E.I. (1979). The Economics of Asset Value and Current Income in Farming" American Journal of Agricultural Economics 61, pp. 1093-1097.

STEVENS, N.Z. (1978). "Rising Farmland Prices and Falling Farm Earnings: Is Agriculture in Trouble". Economic Review. Federal Research Bulletin of St Louis, Vol. 60 No. 5.

TWEETEN, L. (1981). "Farmland Pricing and Cash Flow in an Inflationary Economy". Oklahoma Agricultural Experiment Station Research Report.

WEBB, J.R. (1982). "The Effects of Financing on Capitalisation Methodology", Property Tax Journal, Vol. 1, No. 2, June, pp. 121-132.

APPENDICES

APPENDIX A

DETAILED DESCRIPTION OF DATA SOURCES AND ASSUMPTIONS USED TO ESTIMATE THE BID MODEL COEFFICIENTS

This Appendix describes in some detail the sources of data and procedures used to estimate the parameters of the bid model. Since nearly all data were obtained from secondary sources, and because the quality of available data is highly variable and not always conceptually consistent with the theoretical requirements of the model, it was necessary to adjust and manipulate some of the data sets to achieve comparability and relevance. The discussion is presented in several parts. The first section reports land price data, the forms in which these data are available, and the data series selected for use in the present analysis. Sections 2 and 3 report the calculations used to construct measures of capital gain and net returns to farm production assets, respectively. The parameters required for estimating the model and the information sources and assumptions used to obtain these estimates are reported in Section 4.

1. Land Prices

The data used to describe movements in land prices have been derived from two sources: the New Zealand Valuation Department Research Papers describing semi-annual changes in rural land sales, and the New Zealand Meat and Wool Boards' Economic Service annual Sheep and Beef Farm Survey which reports changes in farm asset values. These are compatible in the sense that the capital values of land, buildings and improvements used by the MWBES are based on values supplied by the Valuation Department. However, the basis of calculating "averages" is different and therefore the reported statistics on land value change are not directly comparable.

The Valuation Department Research Papers present records of actual sales data for nine categories of farmland. Since this study is concerned primarily with pastoral properties, the two relevant categories are "Fattening", described as land suitable for fat lambs, beef and stock breeding, and "Grazing", land used for store sheep and cattle grazing with limited fattening operations. Average price per hectare data for freehold farmland sales are only available from 1970 onwards. Since it was desired to consider as long a time period as possible, and since the Valuation Department publishes a series of farmland price indices for individual categories from 1960 onwards, these indices were used to construct a series of prices from 1960 to 1984. Price series for both fattening and grazing land categories were calculated. These two series were then combined in a weighted average, using the number of sales in each group, to obtain a general price index for New Zealand pastoral land. These data are summarised in

Table 9.

It should be noted that the above procedure excludes the less productive pastoral lands classified by the MWBES as "high country", and the most productive lands classified as "intensive grazing" (e.g. dairy and cropping. Further, the authors used the Valuation Department's definition of farmland "units" sold rather than total land sales data. In effect this excludes small blocks of pastoral land which typically sell at higher average prices per hectare. It was hypothesised that such sales might represent a shift in land use, for example from pasture to horticultural land use, and by including these sales the overall pastoral land price series would be biased upward. The farmland price indices and the methodology used in constructing them is described in the Valuation Department's research reports (New Zealand Government, 1982, pp. 13-15).

An estimate of land value change can also be estimated from the annual MWBES Sheep and Beef Farm Survey data series. These MWBES data are reported with respect to 8 different classes of farms. These data are also combined into an "All Classes Average" using weights based on the estimated number of farms in each class. It was these latter "All Classes Average" data that were used in this analysis. A consistent set of MWBES data has been published since 1960 and is summarised in Table 10. The "capital value" shown is defined as land, buildings and improvements, but excludes a homestead which is typically included in the actual sales values reported by the Valuation Department. Since the MWBES capital value is based on a periodic government valuation (i.e. market trend) rather than an actual appraisal of the individual farm property, it is dependent upon the regularity of the valuation. Government Valuations were updated every three years before the early 1970's and the effect of this can be seen in the data series (Table 10). Overall the two land value series have behaved much in the same way. Whereas before the period of high price inflation (beginning in 1972-73) the ratio of the "All Classes Average" to the authors' "pastoral land weighted average" estimate averaged between 0.6 and 0.8, during the inflationary mid 1970's and early 1980's the ratio consistently varied from 0.8 to 1.2.

2. Capital Gains and Net Farm Income

The definition of nominal capital gain is the increase in the value of physical assets minus total net investment and net transfers into the farming sector. Real capital gains are computed by adjusting nominal gains for the gains or losses resulting from each year's change in the purchasing power of the dollar. The measure used to calculate nominal capital gains was total assets as defined in the MWBES survey, Table 3B line 13 (Annual Reports) for the "All Classes Average". This value is reported in the left-hand column of Table 10. For years prior to 1970-71 the "All Classes Average" was calculated as a weighted average of the eight classes. Since net investment and net capital transfer data are not reported in the MWBES survey results, these data do not permit an accurate measure of capital gain but rather an "indicative" estimate only. Nominal capital gains were therefore represented by the change in total assets between years. Real capital gains were estimated by subtracting from the nominal capital gain (or

TABLE 9

Weighted Average Pastoral Land Sales Prices per Hectare, 1960 to 1984

	Fattening Land[a]			Grazing Land[a]			
Year	Index Base 1979=1.0	Index times 1979 price $	No. of sales (units)	Index 1979 1979=1.0	Index times 1979 price $	No. of sales	Weighted Average[b] $
1960	0.181	167	401	0.140	55	230	126
1961	0.207	190	362	0.147	58	246	137
1962	0.202	186	245	0.142	56	147	137
1963	0.205	189	368	0.141	56	171	147
1964	0.233	214	581	0.156	61	226	171
1965	0.274	252	553	0.183	72	303	188
1966	0.299	275	416	0.207	82	261	201
1967	0.296	272	221	0.239	94	168	195
1968	0.285	262	215	0.227	89	128	197
1969	0.295	271	423	0.245	97	175	220
1970	0.297	273	508	0.242	95	171	228
1971	0.301	277	294	0.247	97	133	221
1972	0.312	287	373	0.248	98	137	236
1973	0.386	355	774	0.318	125	224	303
1974	0.558	513	518	0.506	199	174	434
1975	0.627	577	254	0.570	225	84	490
1976	0.692	637	335	0.614	242	115	536
1977	0.815	750	445	0.706	278	133	641
1978	0.878	808	358	0.795	313	125	680
1979	1.000	920	490	1.000	394	158	792
1980	1.109	1020	526	1.145	451	165	849
1981	1.663	1530	581	1.510	595	162	1249
1982	2.154	1982	377	2.610	1054	104	1703
1983	2.314	2129	229	2.444	965	55	1838
1984[c]	2.174	2000	210	2.104	929	48	1732

Source: New Zealand Research Papers, published by the Valuation Department (selected years).

a. Refer to land use definitions used by the Valuation Department (New Zealand Government, 1982, p. 13-15).

b. Average of the calculated sales price (Index times 1979 price)

c. Author's estimate based on preliminary Valuation Department survey results.

TABLE 10

Capital Value per Hectare of Land, Buildings and Improvements, "All Classes Average" as Given by the Meat and Wool Boards' Economic Service vs. Valuation Department Sales Indices

Year	Capital Value "All Classes Average"[a]	Pastoral Land Weighted Average[b]	Percent Difference Between the Estimates[c]
	$ per hectare		%
1961-62	90	137	.66
1962-63	93	137	.68
1963-64	117	147	.80
1964-65	117	171	.68
1965-66	118	188	.63
1966-67	121	201	.60
1967-68	121	195	.62
1968-69	123	197	.62
1969-70	154	220	.70
1970-71	154	228	.68
1971-72	154	221	.70
1972-73	221	236	.94
1973-74	305	303	1.01
1974-75	352	434	.81
1975-76	387	490	.79
1976-77	448	536	.84
1977-78	496	641	.77
1978-79	576	680	.85
1979-80	790	792	1.00
1980-81	1075	849	1.15
1981-82	1495	1249	1.19
1982-83	N.A.[d]	1703	N.A.
1983-84	N.A.[d]	1838	N.A.

Source: Meat and Wool Boards' Economic Service Sheep and Beef Farm Surveys (selected years)

a. Minor differences between these and the published figures are due to rounding errors in calculation of the "All Classes Average", and in the exclusion of the operator's home from the capital value estimates.
b. Reproduced from Appendix A, Table 9. Due to the difference in reporting periods used by the two agencies, we chose to equate the Valuation Department's calendar year with the first part of the production year used by the MWBES (e.g. 1961 = 1961-62).
c. "All Classes Average" as a percent of the calculated weighted average price change.
d. Yet to be published.

percent change in total asset value) the percent change in the Consumer Price Index.

Along with nominal and real capital gains, net farm income per hectare was also calculated from the MWBES survey data. "Net Farm Income", or total gross farm income minus expenditure and depreciation but unadjusted for the Wool Income Retention or Income Equalisation payments (Table 5B, line 7, "All Classes Average"), was the general definition of income used throughout the empirical analysis. Adjustments to this definition, as necessary when calculating residual returns to production assets, are outlined below.

3. Returns to Production Assets

The return to total production assets per hectare is made up of the three components of the returns to capital, labour and management. The return to labour is measured by wages and managerial salaries which are taken from MWBES survey data, Table 4B lines 1-14 "All Classes Average". Similarly, the return to management is taken to be the managerial reward derived from Table 6, line 2 "All Classes Average". The return to capital was then calculated as the residual after subtracting the returns to labour and management from the income components of income, interest and rent. The measure of annual income used is the unadjusted net income per hectare previously described, while interest and rent are drawn from the standing charges section of the MWBES survey report, Table 4B lines 15 and 16. Consistent with the above definitions, the return to capital is calculated as a percentage of the farm capital figure reported in Table 3B line 7 of the MWBES annual survey reports. This value includes the capital value of land, buildings and improvements, truck and tractor, other plant and machinery and stock, but excludes the homestead and 'other' assets including the family car.

4. Bid Model Parameters and Empirical Estimation

The variables used to derive the willingness to pay estimate of land value are defined as follows:

P: the average price per hectare from recent sales;
CC: the after tax opportunity cost of capital;
n: the planning period, in years;
ANI: the expected annual net income per hectare before taxes;
GNI: the expected annual rate of growth in net cash income per hectare;
MTR: the potential buyers' marginal income tax rate;
DP: the proportion of the purchase price paid down;
IR: the nominal rate of interest charged on mortgage loans;
t: the amortisation period of the loan, in years;
INF: the expected annual rate of inflation in land values; and
T: the capital gains tax rate.

4.1 Alternative measures of net income and their derivation.

Income data for the bid model were derived from the Meat and Wool Boards' Sheep and Beef Farm Survey classes 4 and 6. For the "base case" a residual return to land measure of net income was used. This was calculated for each of classes 4 and 6 as gross profit minus total expenditure, plus managerial salaries paid, interest and rent, minus managerial reward, minus capital value of stock and plant times the before tax opportunity cost of capital. A weighted average of the two classes was computed using the estimated total number of properties in each class for each year. Tables 11 and 12 report a summary of these data. As the bid model was expected to be sensitive to the income parameter ANI, an alternative definition of income - before tax net income - was calculated using a weighted average of classes 4 and 6 as shown in Table 12.

The year selected as a "base case" for the bid model was 1969-70. For that year the following estimates (and sources consulted) of model parameters were:

P = $228/hectare. This was derived from selected annual Valuation Department reports as described in the previous section (see Table 9).

CC = 4.1 percent. The opportunity cost of capital was derived from Reserve Bank Bulletin data for long-term finance company interest rates and adjusted by a marginal tax rate based on the average net taxable income for sheep and beef farmers for that year (see MTR below).

ANI= $8.53 per hectare. For the base year the residual return definition of net income (as reported in Table 12) was used in preference to the net income definition, since the residual return to land is the value used in traditional capitalisation formulations.

GNI= 0. As illustrated in Tables 11 and 12 there was no noticeable growth in net income during the 1960's;

MTR= 45 per cent. The marginal tax rate was selected from Inland Revenue tax tables for the average net taxable income for that year, using a 340 hectare weighted average Class 4 and 6 farm (see Table 12).

DP = 33 percent. The down payment was assumed as one third of the purchase price in all cases.

IR = 7.15 percent. This value, the average interest rate for new mortgages issued (excluding government), was taken from the Reserve Bank Bulletin.

INF= 3.6 per cent. Annual inflation rates were calculated as the percentage change in the Consumer Price Index.

n,t= 10 years.

T = 0. A capital gains tax was not considered at this stage. Later in the analysis a 50 percent tax on capital appreciation was assumed.

TABLE 11

Estimates of Residual Returns to Land Calculated as a Weighted Average of Classes 4 and 6 Farms, 1960 – 1980[a]

Class 4 Farms	Net Farm Income $/Farm	Salary, Interest and Rent $/Farm	Managerial Reward $/Farm	Capital Value Stock & Plant $/Farm	Nominal Interest Rate %	Average Effective Area ha	Residual Return $/ha
1960/61	6,874	1,474	2,560	28,494	0.0509	383	11.33
1961/62	5,158	1,582	2,488	26,664	0.0525	372	7.67
1962/63	5,122	1,334	2,444	22,706	0.0515	320	8.88
1963/64	6,432	1,344	2,706	23,498	0.0506	326	11.90
1964/65	5,560	1,422	2,670	23,560	0.0675	311	8.75
1965/66	6.570	1.572	2.796	25,170	0.0675	322	11.34
1966/67	4,315	1,725	2,656	26,582	0.07	323	4.72
1967/68	4,882	1,759	2,624	27,193	0.0725	319	6.41
1968/69	6,338	1,868	2,962	28,102	0.07	334	9.81
1969/70	7,652	1,850	3,433	34,650	0.075	334	10.39
1970/71	6,470	2,241	3,689	40,193	0.085	335	4.79
1971/72	8,465	2,243	3,936	44,263	0.0725	340	10.48
1972/73	22,123	2,445	4,836	69,619	0.0725	350	41.96
1973/74	15,977	2,660	5,446	56,378	0.12	347	18.52
1974/75	5,883	3,174	5,631	38,369	0.12	332	–3.55
1975/76	15,309	3,517	6,516	63,143	0.13	332	12.35
1976/77	24,793	3,683	7,460	81,066	0.14	334	28.94
1977/78	14,554	4,434	8,669	82,089	0.14	333	–3.52
1978/79	23,020	5,853	11,024	143,967	0.155	346	–12.91

[a] See Table 14 for an extension of selected data through 1984.

Table 11 contd (P.54)

TABLE 11
(contd) [a]

Class 6 Farms	Net farm Income $/Farm	Salary Interest & Rent $/Farm	Managerial Reward $/Farm	Capital Value Stock & Plant $/Farm	Nominal Interest Rate %	Average Effective Area Hectares	Residual Return $/ha
1960/61	5,178	754	2,416	17,198	0.0509	309	8.55
1961/62	4,184	824	2,440	17,340	0.0525	322	5.15
1962/63	6,566	908	2,576	18,658	0.0515	326	12.08
1963/64	7,566	1,088	3,114	21,320	0.0506	333	13.40
1964/65	6,638	1,272	3,170	22,482	0.0675	337	9.56
1965/66	6,772	1,804	3,348	25,468	0.0675	354	9.91
1966/67	4,598	2,036	3,261	26,721	0.07	340	4.42
1967/68	4,165	1,787	3,083	26,322	0.0725	336	2.86
1968/69	6,117	2,225	3,140	26,352	0.07	336	9.99
1969/70	5,020	2,443	3,536	27,187	0.075	360	5.24
1970/71	5,028	2,645	3,790	30,529	0.085	361	3.57
1971/72	5,499	3,032	3,988	31,194	0.0725	361	6.32
1972/73	18,319	2,940	4,815	53,201	0.0725	366	34.39
1973/74	11,369	3,707	5,668	49,679	0.12	376	9.17
1974/75	4,526	3,693	5,884	42,239	0.12	338	−8.09
1975/76	12,962	4,460	6,688	47,977	0.13	336	13.38
1976/77	18,289	4,929	9,033	67,784	0.14	344	13.65
1977/78	10,745	6,184	9,595	67,521	0.14	341	−6.21
1978/79	13,927	6,296	11,149	92,173	0.155	351	−14.85

[a] See Table 14 for an extension of selected data through 1984.

TABLE 12

Residual Return to Land for Classes 4 and 6
Combined as a Weighted Average Using the Estimated Numbers of Properties in Each Class[a]

Year	Number of Properties		Residual Return to Land			
	Class 4	Class 6	Class 4 $/ha	Class 6 $/ha	Weighted Average $/ha	5-year moving average
1960/61	4,500	3,000	11.33	8.55	7.14	-
1961/62	5,500	2,500	7.67	5.15	6.88	-
1962/63	5,500	2,500	8.88	12.08	9.88	-
1963/64	5,500	2,500	11.90	13.40	12.37	-
1964/65	5,500	2,500	8.75	9.56	9.00	9.05
1965/66	5,500	2,500	11.34	9.91	10.89	9.80
1966/67	5,500	2,500	4.72	4.42	4.63	9.35
1967/68	5,500	2,500	6.41	2.86	5.30	8.44
1968/69	5,150	2,900	9.81	9.99	9.87	7.94
1969/70	5,150	2,900	10.39	5.24	8.53	7.84
1970/71	5,000	2,750	4.79	3.57	4.36	6.54
1971/72	5,000	2,750	10.48	6.32	9.00	7.41
1972/73	4,950	2,750	41.96	34.39	39.26	14.20
1973/74	4,950	2,750	18.52	9.17	15.18	15.27
1974/75	5,100	4,100	-3.55	-8.09	-5.57	12.45
1875/76	5,100	4,100	12.35	13.38	12.81	14.14
1976/77	5,100	4,100	28.94	13.65	22.13	16.76
1977/78	5,100	4,100	-3.52	-6.21	-4.72	7.97
1978/79	5,100	4,100	-12.91	-14.85	-13.77	2.18
1979/80						1.05

[a] See Table 14 for an extension of selected data through 1984.

4.2 Parameter values and definitions used for comparisons between types of buyers.

The three types of buyers specified used for comparative analysis were: (1) a young farmer looking for his first farm, (2) an established farmer with substantial net worth looking to expand the size of his farming operation, and (3) a medium-term investment with possible advantages of an inflation hedge and/or a tax shelter that might represent an attraction to a non-farm investor or 'businessman'. The parameter values used are reported in Table 13.

It should be noted that two of the variables thought to be most important, P and INF, are held constant for all three purchasers. Net income before tax was used to introduce some variation in the expected income by different purchasers, since this income will be affected by the terms of the loan. The interest component was added back to the net income figure, and new interest amounts were calculated according to the interest rate relevant to the purchaser and the amount of equity held. An adjustment to 'businessman' net income was made in 1969-70 by deducting a management charge of $10 per hectare under the assumption that a hired manager would be employed. This was not done in 1979-80, since according to common practice by this time it is likely that the manager would also be a shareholder of any partnership or corporation.

TABLE 13

Parameter Values Used for Bid Value Comparisons for Three Types of Farm Land Purchasers

Year	Variable	Young Farmer	Established Farmer	Businessman
1969-70	CC	0.064	0.041	0.030
	ANI	$17.70	$24.65	$7.70
	MTR	0.15	0.45	0.60
	DP	0.15	0.95	0.40
	IR	0.05	0.06	0.075
1979-80	CC	0.116	0.074	0.062
	ANI	$-19.30	$43.69	$-45.31
	MTR	0.25	0.52	0.60
	DP	0.33	0.85	0.50
	IR	0.09	0.12	0.155

4.3 Parameter values and definitions used for the time series analysis

The time series analysis covered the period from 1960 to present. Most data were available from 1960 onwards. However, because a lagged income variable was used - a simple average of the values for the four previous years plus the current year - the time series began in 1965. Experiments were made with other time lags and weighted averages, but they showed no superiority and did not have any improved theoretical justification. The variables to which this procedure was applied were inflation and net income. Some inconsistency arises in the disposition of the net income data since these are calculated from data presented on a June year basis. The 1969-70 income data are allocated to year 1970. Some variables were held constant throughout the historical analysis. These were the expected growth in net income (nil), the down payment (33%), the planning and amortisation period (both 10 years), and the capital gains tax (nil).

Data since 1980 were collected after the initial time series analysis was conducted. These data, used to extend the time series to include the period of the price and wage freeze which began in June 1982, are reported in Table 14.

TABLE 14

Selected Parameter Values for Post-1980 Bid Model Land Value Estimates

	Bid Model Parameter[a]						
Year	P	CC	ANI[b]	MTR	IR	INF	BID
	$		$				$
1979-80 [c]	849	.048	1.05	.32	.15	.155	1,875
1980-81	1249	.105	2.95	.45	.155	.165	2,341
1981-82	1703	.118	.83	.31	.17	.175	2,591
1982-83	1838	.091	-.08	.45	.165	.085	1,276
1983-84 [d]	1732	.094	1.05	.45	.17	.06	912

Source: Refer to section 4.1 (this Appendix)

a. Parameters held constant include: GNI = 0, T = 0, DP = .33, and n,t = 10 years.

b. Residual income definition.

c. From Table 12.

d. Authors' estimate.

APPENDIX B

REGRESSION ANALYSIS OF TIME SERIES DATA

This Appendix briefly reviews a statistical correlation/regression analysis which was carried out in an early phase of the present study. The objective was to identify a statistical relationship between observed changes in farmland values and selected independent variables over time. The variables which were hypothesised as possible 'causal' factors in land price determination are defined in section 1. In section 2 the functional forms and results of the analysis are summarised. The implications and usefulness of such results are discussed briefly in section 3.

1. Explanatory Variables and Data Sources

In this study land earnings were defined as annual returns plus capital gains. Annual income however may be further separated into sources such as crops, meat, wool and government payments. Similarly, on the cost side are input subsidies, preferential interest rates and terms on loans, and a whole range of government policies such as management of the money supply which affect farm and non-farm sectors alike.

Most of the variables used in the regression analysis are alternative measures of farm income. As well as the net income per hectare used to compute the model bid estimate, a number of other income "indicators" may be appropriate. Examples include the export price index, the total value of exports, the value of gross agricultural output, the value of government payments to agriculture, the NZ Institute of Economic Research net income per hectare forecasts, a simple calculation of the capitalised value of land, and the consumer price index.

Twelve variables for the period 1960-1979 were hypothesised as potentially correlated with land price inflation. After this preliminary analysis was carried out, it was not judged worthwhile to extend the time series to include more recent (i.e. up to 1984) data. These variables, many of which are, in one form or another, measures of farm income, were defined as follows:

CV: capital value of land, buildings, fences and yards per hectare, obtained from the Meat and Wool Boards' Economic Service Sheep and Beef farm survey. A simple average for farm classes 4 and 6 was used.

EXP: total value of exports, from the Monthly Abstract of Statistics published by the Department of Statistics. (Tables: Value of Exports $(000) fob, Total of Meat and Meat Products, Value of Principal Exports $(000) fob, Wool)

GAP: gross agricultural production, from Agriculture Statistics published by the Department of Statistics (e.g. Ag. Stats. 1977-78, Table 69, Sheep and Lambs, Wool and Cattle).

NI: net income per hectare from the MWBES survey, a weighted average of classes 4 and 6.

NNI: net income per hectare from the New Zealand Institute of Economic Research, Quarterly Predictions for all farmers.

CAPV: capitalized value of land, equal to net income divided by the interest rate for first mortgages (Reserve Bank Bulletin).

GP: government payments to agriculture (pers. comm., R. Shelton, Farm Management Department, Lincoln College).

BID: calculated Bid value per hectare from time series analysis.

GPHA: Government payments (GP) per hectare.

NIGP: net income (NI) plus government payments per hectare (GPHA).

CPI: consumer price index, from the Official Yearbook published by the Department of Statistics.

EPI: export price index, from Agriculture Statistics published by the Department of Statistics (Index for meat, wool and by-products).

The data used for the time series regression analysis are reported in Table 15.

2. The Analysis and Results

A linear OLS functional form was used to test the significance of single and multiple variables in the regression equation. The dependent variable was historical land value per hectare based on actual sales data for class 4 and 6 pastoral farms. The partial correlation coefficients, using nominal and real (inflation adjusted) data, are reported in Table 16. High nominal-value correlations were found with the Consumer Price Index and the Export Price Index. The CPI and EPI are themselves highly inter-correlated with a coefficient of .962, therefore they cannot be used together to explain changes in land value. The NNI (NZIER quarterly predictions) value for net income is slightly less correlated with land value (as is the MWBES survey data). The close association between the CPI and land value is also demonstrated when 'real' data are used: the only variables which appear to have some significance in explaining changes in land value are government subsidies to agriculture (GP and GPHA).

TABLE 15

Variables Used in the Correlation and Regression Analysis

Calendar Year	P $/ha	CV $/ha	EXPORT $000	GAP $/m	NI $/ha	NNI $/ha	CAPV $/ha	GP $000	BID $/ha [a]	CPI Index	EPI Index
1960	126	131.71	346,288	337	18.46	16.73				1.00	
1961	137	128.99	347,299	322	17.00	15.73	339			1.02	
1962	137	128.42	387,354	306	13.55	13.68	257			1.05	
1963	147	129.67	454,652	357	16.87	15.73	306			1.07	1.000
1964	171	174.83	421,174	435	20.85	18.67	333			1.10	1.174
1965	188	175.80	428,591	427	18.52	18.86	289		324	1.14	1.109
1966	201	174.41	379,058	458	19.98	18.71	300		351	1.17	1.120
1967	195	180.23	418,919	407	14.70	17.41	212		302	1.24	1.043
1968	197	176.00	521,824	409	14.36	16.85	195		262	1.30	0.975
1969	220	178.53	573,125	466	18.69	18.39	260		314	1.36	1.127
1970	228	222.79	578,686	504	19.61	16.46	274	13,514	262	1.45	1.159
1971	221	187.61	627,643	490	17.40	18.83	238	30,911	199	1.60	1.170
1972	236	223.42	959,559	550	21.47	23.28	272	59,233	264	1.71	1.216
1973	303	310.07	891,045	1,009	58.51	24.92	718	70,880	565	1.85	1.863
1974	434	421.48	703,961	918	40.40	26.25	491	37,408	1,179	2.06	2.131
1975	490	463.93	1,050,231	611	15.79	12.80	177	56,333	1,268	2.36	1.618
1976	536	522.70	1,413,753	1,011	42.75	22.69	444	150,090	2,028	2.76	2.032
1977	641	601.25	1,345,133	1,375	64.84	39.86	611	111,804	2,968	3.16	2.751
1978	680	680.82	1,777,340	1,290	38.27	28.56	343	104,949	1,906	3.53	2.825
1979	792	782.08	2,123,178	1,749	54.36	39.29	462	196,137	1,505	4.02	3.387

[a] Five-year weighted average.

RECENT PUBLICATIONS

RESEARCH REPORTS

124. *The New Zealand Wheat and Flour Industry: Market Structure and Policy Implications,* B.W. Borrell, A.C. Zwart, 1982.

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.

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 Centre 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.