DETERMINATION OF FARMLAND

VALUES IN NEW ZEALAND :

THE SIGNIFICANCE OF FINANCIAL LEVERAGE

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PREFACE

Changes in the value of farmland have a significant impact on the returns which farmers achieve through their ownership of land and the entry and exit of people to and from farming. While the returns to farmers from actual farming activity have been considered to provide a "poor return on investment" compared to other types of business investment, the return via capital gains has at least compensated for "lower" returns via income. The non-taxable nature of capital gain has in turn encouraged a higher proportion of the "farming return" into this area. However, analyses have shown that the increase in farmland capital value has been greater than that which would be expected based upon actual and expected farm incomes.

The study presented in this Research Report provides evidence of the role of financial leverage in the establishment of farmland values. Where loan finance is available, increases in capital values are recorded. The findings presented have significant implications for agricultural policy in that where actions are taken by Government or institutions to make farm purchase finance more readily available, one of the significant outcomes is likely to be an increase in farmland prices.

This Research Report represents a significant contribution to the literature on farmland valuation.

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SUMMARY

An examination of the growth rates in farm asset values and returns in New Zealand between 1962 and 1987 reveals that a significant divergence has developed between the two. The value of nominal total production assets for the N.Z.M.W.B.E.S. 'All Classes Average' increased at an annual compound rate of 12.57 percent during the twenty five year period while net income increased at a rate of only 9.33 percent. Moreover, a comparison of the compound growth rates in real terms accentuates what Scholfield (1961) and Chryst (1965) termed the 'land price paradox', as farmland prices appeared to be increasing more rapidly than increases in farm incomes seemed to warrant. Between 1972 and 1982 the real value of total production assets increased at an annual compound rate of 5.71% despite the decrease in the real value of net farm income of 0.37% per annum.

In his study of farmland price determination, Seed (1986) points out that the historical changes in New Zealand farm values and incomes closely parallel the United States experience during the 1962 -1987 period. As a result, many agricultural economists have addressed this apparent land price paradox, making some attempt to more accurately identify the variables which have an impact on farm asset values. Although all accept the basic proposition that land rent is a key determinant of farmland value, numerous other casual variables have been advanced. These include the impact of expected earnings growth on expectation for capital gains which arises from farmland being treated as a speculative investment, the possible impact of inflation on real farm values and an increase in the consumptive demand for farmland.

However, the effect of financial leverage on land price variation has received relatively little attention. The objective of this study was to examine the impact of financial leverage on farmland price determination in New Zealand between 1962 and 1987.

Before constructing a land price model with which to test the hypothesized impact of debt finance, a number of other important considerations were addressed. The first concerns the need to identify a reasonably homogeneous land market on which to base the analysis. Burt (1986) suggests that many of the apparent difficulties of the existing empirical work are exacerbated by using aggregate data to analyze land prices. This may introduce such problems as extreme heterogeneity in land quality and the impact of non-agricultural values of farmland which are not reflected in current or historical land rents. Robison et al. (1985) also emphasize the need to identify and define a homogeneous market before selecting possible price determinants. By doing so, the land value model may be able to more precisely incorporate the factors considered relevant to that individual market. Attempting to pre-determine which factors are relevant in an aggregate market is obviously more difficult.

The N.Z.M.W.B.E.S. class seven survey farm data was chosen as possibly the most homogeneous sample available within New Zealand. Examination of the New Zealand Valuation Departments' classification of farm buyers indicates that the class seven farmland area is predominantly made up of single family units which are purchased for their productive use. As such, the possible impact of demand from consumptive users is considered small. The limited number of farm purchases by those classified as businessmen may also suggest that the motive of anticipated capital gains has had a negligible influence on farmland price determination in the class seven sample area.

With particular regard to the sub-market to be analyzed, and having reviewed all of the advanced land price determinants, a farmland value model was constructed. Only three of the possible land price determinants are hypothesized to have a significant influence on the value of land in the class seven survey region. These are the expected returns to farmland, the impact of financial leverage and the erosion in the real value of debt caused by inflation. Unfortunately, the statistical significance of each of these variables cannot be directly estimated from the available data, as the relevant circumstances of the marginal land purchaser are not observable. There is no information available concerning the marginal land purchasers' proposed debt/asset ratio, mortgage interest rate or marginal tax rate. As all of these factors are included in the land price model as explanatory variables, direct econometric estimation of their impact on land price is not possible.

However, the explanatory variable of primary interest in this study was the debt/asset ratio used by the marginal land purchaser. Therefore, in order to examine the importance of this factor in land price determination, the specified land price equation was used to calculate four farm asset value series which differed only in respect to the debt/asset ratio used. The four assumed capital structures ranged between 100% equity and 100% debt finance. By statistically comparing each of the calculated series to the proxy series of actual farm asset values, some assessment was made of the apparent impact that debt levels has had on the determination of farmland prices.

The calculated farm asset value series which provides the most accurate comparison to the proxy series of actual values between 1962 and 1987 uses the assumed debt/asset ratios described by case 3. These are based on the maximum level of debt that the New Zealand Rural Banking and Finance Corporation will allow a mortgagee to borrow, measured as a percentage of total farm asset value. During the 1962 to 1987 period that limit has ranged between 31.1% and 49.7%. The results of this analysis therefore provides some evidence to suggest that the use of financial leverage has been an important factor in the determination of farm asset values.

The advantages of using debt finance in a farm purchase have been examined in section 4.4 of this study. It was argued that the effects of both tax deductibility of interest payments and debt erosion reduce the investor's effective required rate of return, and that the capitalized value of farmland for a purchaser who uses debt finance is subsequently greater than that calculated for an all equity investment. That the case 3 model has been shown to produce the most accurate estimates of farm asset values supports the advanced hypothesis that the marginal land purchaser was expected to use a relatively high level of debt finance to take advantage of its potential benefits.

However, it was also hypothesized that the level of debt finance used by a marginal land purchaser may have been influenced by several variables which are exogenous to the specified land price equation. The level of government assistance to agriculture has changed appreciably throughout the 1962 - 1987 period. Although the variations in input subsidies and product price supports are reflected in changing farm asset values through their impacts on farm net incomes, changes in government policy were also expected to affect asset values in another way. The introduction of policy initiatives such as the Supplementary Minimum Price Scheme and the Land Development Encouragement Loan Scheme effectively reduced the variability, and consequently the risk of cash flows from farming. It was suggested that if the firm's business risk was affected by changes in government assistance, the confidence of participants in agricultural production would be similarly affected, and thereby have some impact on the amount of debt finance used by a land purchaser. The observed changes in

(x)

government agricultural policy during the 1962 - 1987 period were therefore used to help to identify four distinct sub-periods in which the relevant level of financial leverage may have changed. These hypothesized changes in debt levels were examined using the same analytical procedure as that applied to the data for the entire 25 year period.

As expected, the results for the first sub-period indicate that the degree of financial leverage used between 1962 and 1968 was the lowest of all four sub-periods. The case 2 model, which used the debt/asset ratios observed in the N.Z.M.W.B.E.S. class seven data, provides the most accurate estimates of actual farm asset values for this period, with a range between 21.6% and 27.9% of total farm assets.

The second sub-period of 1969 to 1977 saw the introduction of a number of significant policy interventions by the New Zealand Government. These included an increase of several input subsidy schemes in 1969 and the introduction of a minimum price guarantee for lamb and wool in the 1974/75 season. The rate of general inflation also increased markedly over this period, reaching a peak of 17.8% in 1976. The debt-eroding advantage of using borrowed funds should therefore have become more apparent between 1969 and 1977 and this factor is expected to have added to the incentive of increasing the degree of financial leverage used in a land purchase. Although the results indicate that the case 2 model again provides the most accurate estimates of total farm asset value for the second sub-period, they also provide some evidence to suggest that the relevant level of debt used by the marginal land purchaser did increase during the 1969 - 1977 period.

However, the analytical results from the final two sub-periods are rather surprising. In both the 1978 to 1983, and the 1984 to 1987 periods the assumed debt levels of the case 3 model appears to provide the most accurate series of calculated farm asset values. During the third sub-period the scale of government support measures for agriculture reached its peak, and this was expected to have caused a substantial increase in the levels of debt finance used by the marginal land purchaser. Although the results indicate that debt levels did increase compared to those used between 1968 and 1977, the amount of increase was not as high as was expected.

Conversely, during the 1984 - 1987 period the majority of existing agricultural support measures were dismantled. As the inherent business risks of farming were returned to their non-distorted levels, the amount of debt used by a farm buyer was expected to decrease appreciably. Although the results from the analysis of this period do support that hypothesis, the debt levels found to be most relevant between 1984 and 1987 are still higher than those expected.

The results of this study and the conclusions subsequently drawn from the analysis are all dependent on a number of limiting and unavoidable assumptions. Several of these limitations need to be emphasized. First, the land price equation has been specified with respect to the marginal farmland purchaser. The relevant explanatory variables are however taken from the N.Z.M.W.B.E.S. sample data which in effect represent average levels. Some potential biases may also arise due to the way in which the data is recorded. Net farm incomes, for example, may be biased downwards because capital expenditure cannot be easily disaggregated from general expenditure. As a result, such expenditure may be included in repairs and maintenance and thereby reduce the observed, or calculated level of farm income.

Second, because several of the included variables are unobservable it is not possible to

directly estimate the relationship between the explanatory variables and the dependent variable. Thus the relative impact of each variable on the calculated value of total farm assets is the direct result of its mathematical specification. Any conclusions made concerning the apparent impact of financial leverage on farm asset values are reliant on the assumption that the specified land price equation is a close representation of the true but unknown value determination process.

The third major limitation of the analytical procedure adopted in this study is a consequence of the second. Because the specified land price equation is non-parametric, it is not possible to estimate the relative importance of the two distinctly different advantages that the use of debt finance provides a land purchaser. Thus, even if financial leverage is found to have had a significant impact on farm asset values, the combined effects of interest deductibility and debt erosion cannot be disaggregated.

CHAPTER 1

INTRODUCTION

Asset valuation theory states that the value of any asset or resource can be determined in one of two ways. The first and most widely used technique is to establish a value based on comparable sales information from market analysis. Or alternatively, one may follow the tenets of resource economics and capitalize the residual which can be imputed to the fixed resource at a market determined discount rate. However, the asset has only one value. Therefore both of these techniques should provide an appraiser with the same calculated value. Despite this, and in accordance with the statutory definition of value, the New Zealand valuation profession relies almost exclusively on the comparable sales analysis approach.

The New Zealand Valuation of Land Act (1951) defines capital value as:

> ".... the sum which the owner's estate or interest therein, if unencumbered by any mortgage or other charge thereon, might be expected to realise at the time of valuation if offered for sale on such reasonable terms and conditions as a bona fide seller might be expected to require".

This value definition does not explicitly reveal the way in which land market participants determine value. An individual investor who adopts the comparable sales approach has neither undertaken a present value of income approach to his investment analysis, nor actually computed any net present value. But he must assume that the market has computed them for him and that current market values, as established from comparable sales are a valid measure of net present value.

From the viewpoint of both the land economist and the agricultural policy maker, the direct observation of changes in current market price levels is simplistic and of limited analytical value. They are more concerned with establishing the exact nature of the value determining process which is implicitly expressed through market sales levels. The literature on the determinants of farm land value had, up until the 1960's generally accepted that land values were directly attributable to land rents.

The use of net income as the proxy for rent was, at that time considered reasonable because income and land prices seemed to be significantly related. However, in the 1960's researchers began to question the then accepted theory, claiming the existence of a "land price paradox". Scholfield (1961) and Chryst (1965) both suggested that land prices were increasing far more rapidly, on a percentage basis, than increases in income seemed to warrant. Moreover, because of this apparent paradox, a significant proportion of the total return to farm real estate necessarily took the form of capital gain.

Melichar (1979) summarised the implications of receiving a total return that is dominated by capital gains as follows:

> "Given a growth rate of four to five percent in the constant dollar current return to assets, the farming sector is doomed, at likely discount rates, to a relatively low rate of current return on the market value of assets. This

inescapable consequence is the common root of many of the farming sector's current problems: cash flow difficulties; large increases in debt; troubles of beginning farmers; and the attraction of farm real estate to persons of large wealth or high income..." (page 1091).

The same author argued further that the preservation of the wealth created by the process described above is dependent upon continued earnings growth. As a consequence, the processes which lead to large capital gains "are just as powerful when they operate in reverse, producing relatively enormous real capital losses when real earnings stop growing or decline" (Page 4, 1983).

By relating Melichar's argument to the experience of farmers in New Zealand over the past two decades, Seed (1986) discovered an interesting parallel to the United States' situation. Seed found that during the mid to late 1970's the New Zealand government embarked on the type of policy intervention which Melichar hypothesised would result in a low percentage rate of current return and high capital gains. The justification for such a policy was to overcome cash flow difficulties and to "shield farmers from a potentially severe income drop" (Muldoon, 1982). Regardless of government intention, Melichar asserts that the longer term effects of such policies are not to increase the profitability of farming but rather to increase the degree to which profit takes the form of capital gain.

Although the policy initiatives that were introduced by the New Zealand Government did not dramatically increase current farm incomes, farm asset values nevertheless continued to rapidly escalate throughout the late 1970's and early 1980's. An explanation for this apparently illogical situation may however relate to the way in which the policy interventions affected the variability, and consequently risk, affecting cash flows from farming. Although the raft of price support, income smoothing and guaranteed minimum price schemes did not appreciably increase current income, they did effectively reduce the inherent risk of the farming enterprise and thereby increase the confidence of participants in agricultural production. Increasing farm asset values could conceivably be attributed to this factor alone. However, the increased reliance on debt finance that paralleled this period of rapidly increasing farm values may also be a significant factor. As Government policy worked to improve farmer confidence, an accompanying increase in the use of financial leverage may have been induced. And due to the impact of taxation, inflation and the concessionary finance schemes that were available, an increase in debt may indeed have been a significant contributor to the escalation in farm value.

All of the foregoing arguments imply government policy is important in the way in which it may impact on asset values. If, as Melichar argues, income support measures are capitalised into land values then the disadvantages of a rapidly increasing land price are indeed imposed on both existing and intending participants in farming. However, the policy implications of any proposed government measure cannot be definitively assessed until the real land price determinants are found. As a result, many authors have addressed the observed land price paradox, making some attempt to more accurately identify the variables which have an impact on farm asset values. Although all accept the basic proposition that land rent is a key determinant of price, numerous other causal variables have been advanced. Among these are allowances for expected growth in land rent, expected capital gain, expected inflation and demands from consumptive users of land.

Of all the empirical work that has been done on land price determination , only two studies that specifically use New Zealand data could be found. The work by Leathers and Gough

(1984) replicated Lee and Rask's (1976) bid price model and applied it to New Zealand data. While Seed (1986) attempted to model, and then empirically test what he determined to be the three major land price determination theories. However, neither study attempted to address the possible influence that financial leverage has had on land price levels during the analysed period. Given that the impact of this variable may have been considerable, that becomes the primary objective of this research.

CHAPTER 2

LAND PRICE ISSUES

2.1   A Review of Farm Asset Values and Returns, 1962-1987

Seed (1986) calculated that from 1963 to 1972 the nominal value of total production assets for the New Zealand Meat and Wool Board Economic Service (N.Z.M.W.B.E.S.) "All Classes Average" increased at an average annual compound rate of 5.2 percent. Over the same time period nominal net income for the sector increased at approximately the same rate of 5.4 percent. In fact, the average compound growth rates for total production assets and net income were very similar over the total study period of 1962 - 1987, at 8.5 percent and 8.66 percent respectively. Examination of these figures would tend to suggest that, prima facie the increase in farm asset values was closely related to its income earning capacity. However, this situation does not appear to hold for a number of other selected periods.
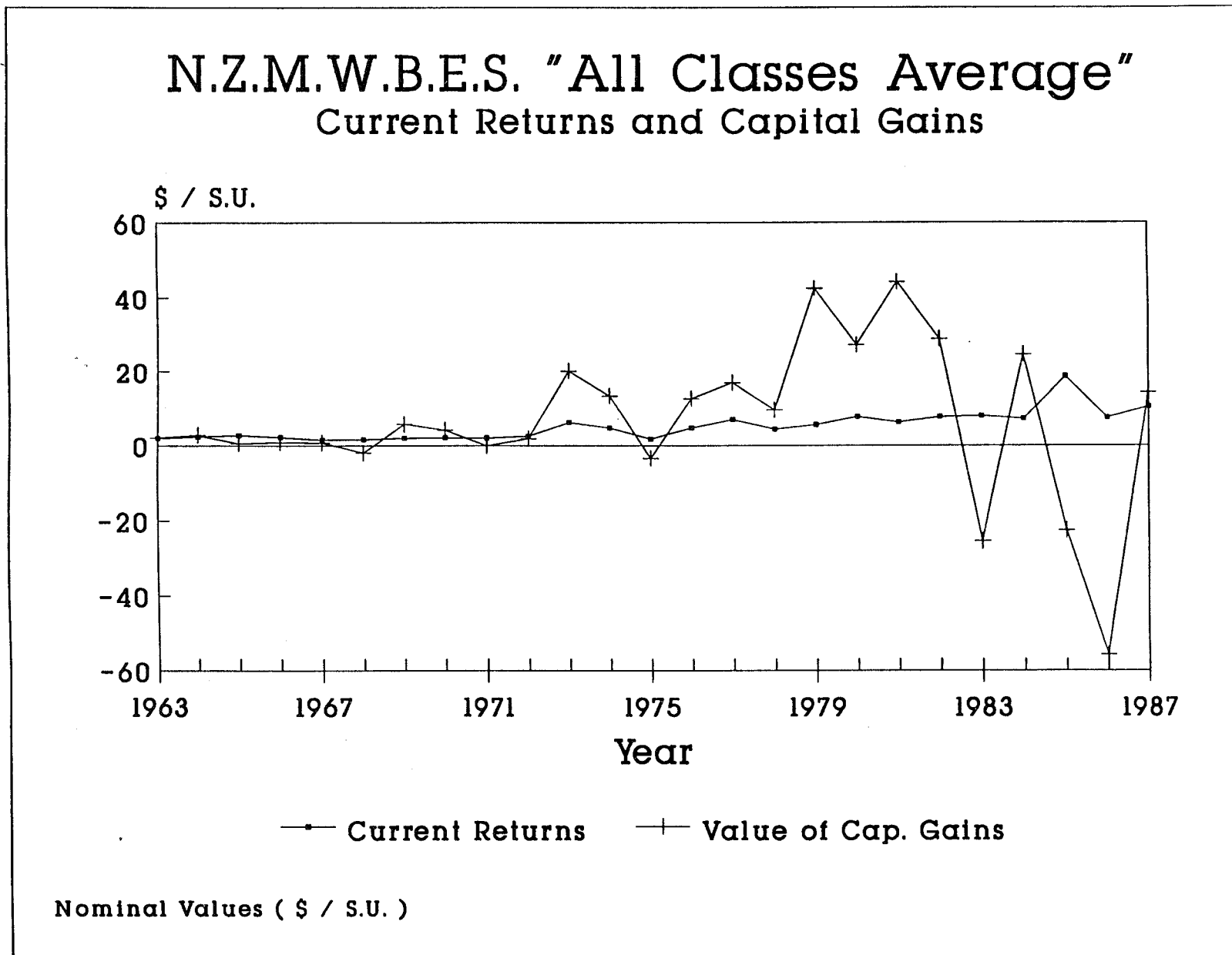
From 1962 to 1982, total production assets increased at an average annual compound rate of 12.57 percent. Over the same twenty year period net income increased at only 9.33 percent in nominal terms. This apparent divergence between farm incomes and value is also evident between 1972 and 1982 when the value of total production assets increased at an average rate of 20.35 percent per annum compared to an increase of just 13.42 percent for net income. An examination of the compound growth rates in real terms further accentuates what Scholfield (1961) and Chryst (1965) termed the "land price paradox", where land prices appeared to be increasing more rapidly than increases in income seemed to warrant. From 1972 to 1982 the real value of total production assets increased at a compound rate of 5.71 percent each year even though the real value of net farm incomes actually decreased by 0.37 percent per annum. This situation is shown graphically in figures 2.1 and 2.2 where current returns are compared to the annual changes in the value of total production assets in both nominal and real terms.

Many alternative theories have been advanced as an explanation for the divergence between farm incomes and values, and these are subsequently examined in Chapter 3. But it may be pertinent to note that although nominal farm values continued to increase for the majority of the 1962 - 1987 period, a significant decrease in values was experienced during the last five years of the period. In fact, between 1982 and 1987 when real net incomes decreased at an annual compound rate of 5.37 percent, the real value of total production assets dropped by some 18.86 percent per annum. It may therefore be reasonable to expect that those same unknown factors which have caused farm values to increase at a disproportionately fast rate compared to farm incomes may also operate in a reciprocal manner.

The values of total production assets from 1962 to 1987 are shown in figure 2.3 in both nominal and real terms. The variation in real values during the twenty five year period ranges between $335,055 ($103/s.u.) in 1987 and the 1981 high of $815,062 ($242/s.u.). The real value of total production assets remained relatively constant from 1962 until 1972, when values began to increase appreciably. However, once the peak was reached in 1981 values began to decrease with similar speed, before plummeting dramatically in 1986. The lowest value of total assets in real terms, for the entire period, was measured in 1987.

N.Z.M.W.B.E.S. "All Classes Average"
Current Returns and Capital Gains

Figure 2.1
Source : N.Z.M.W.B.E.S. Sheep and Beef Farm Surveys

(6)

N.Z.M.W.B.E.S. "All Classes Average"
Current Returns and Capital Gains

$ / S.U.

— Current Returns   + Value of Cap. Gains

Real Values ($1982) ($ / S.U.)

Figure 2.2
Source : N.Z.M.W.B.E.S. Sheep and Beef Farm Surveys

(7)
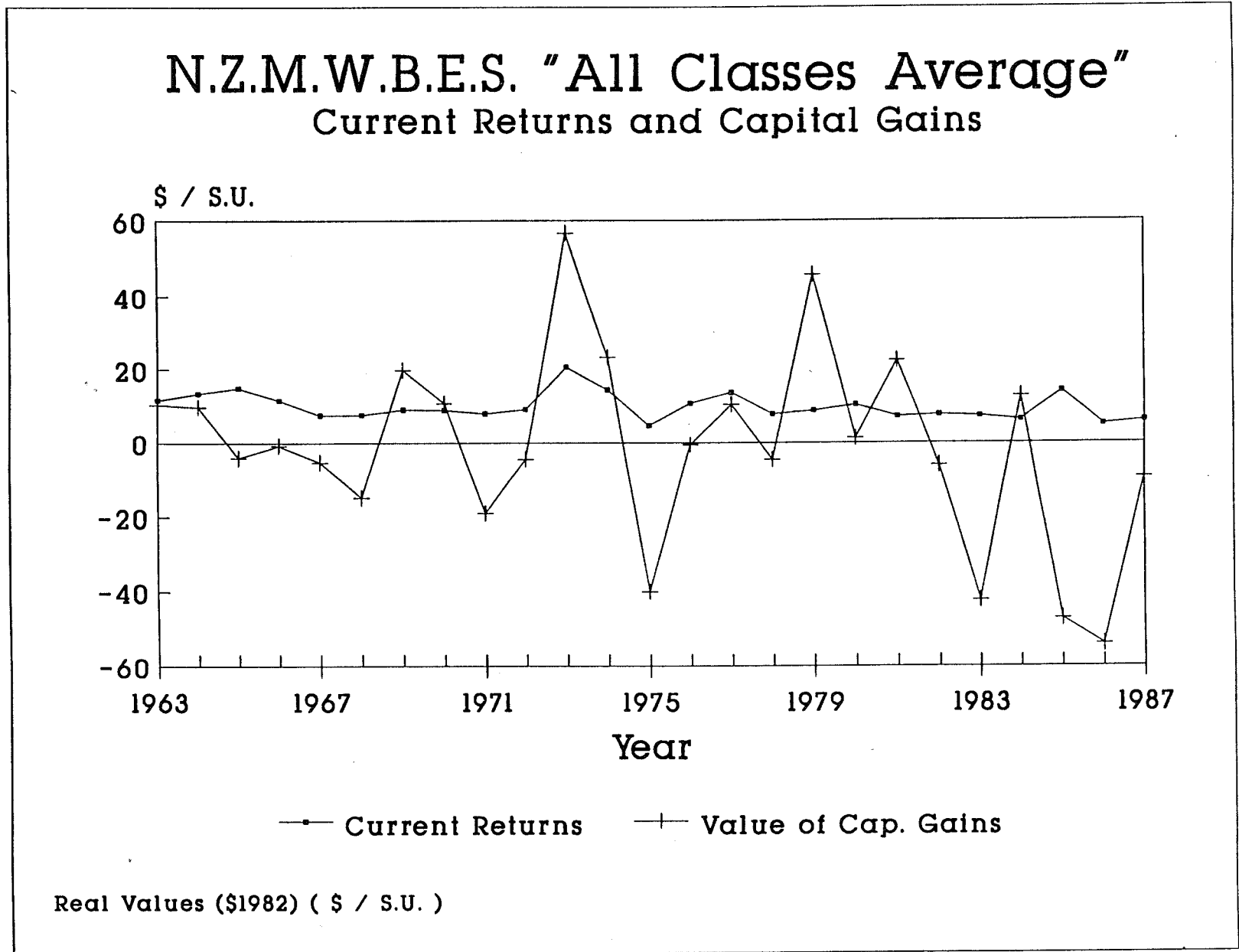
The variation of values in nominal terms presents a rather different picture. Although the nominal value of total production assets still remained relatively constant until 1973, the escalation of farm values during the following ten year period is more accentuated than that observed in real terms. The value of nominal total production assets for the N.Z.M.W.B.E.S. "All Classes Average" increased from $186,220 in 1973 to $789,041 at the end of 1982. This is a significant increase, and as explained earlier, one that does not appear to be closely or exclusively related to the associated increases in net farm incomes. Before examining the possible causes of this apparent disparity between the growth in farm incomes and the increases in farm asset values, it is important to examine the consequences of such large farm value fluctuations with particular reference to economic efficiency and equity. These factors are addressed in the following Section.

2.2 Factors Affecting Farm Asset Value Fluctuations

Melichar (1979) has asserted that any government action which attempts to support or augment farm income does not increase the profitability of farming but instead increases the degree to which profit takes the form of capital gains rather than current return. As Section 4.5 below explains, the New Zealand government has introduced many policy initiatives over the 1962 - 1987 period which were designed precisely for this purpose. For example, Le Heron (1989) observes that such policies as the Livestock Improvement Scheme and Land Development Encouragement Loans were introduced during the late 1970's to stimulate further investment in pastoral agriculture. However, the author suggests that if these policies were to be successful, the government also needed to provide farmers with some assurance that future product prices would not suffer a substantial decrease. A Supplementary Minimum Price Scheme was therefore introduced in an attempt to ensure farm incomes remained at an adequate level.

If Melichar's argument is accepted, the major consequence of the Government's income support scheme during the late 1970's and early 1980's was to amplify the increases in farm asset values which occurred over that period. In a later paper Melichar (1983) suggests that the preservation of the wealth created by the process described above is dependent upon continued earnings growth. When real earnings stop growing or decline, relatively large real capital losses may result as the processes which create the large capital gains are just as powerful when they operate in reverse. The implications of this argument may certainly be construed as being analogous to the experience of New Zealand farmers since 1984. The election of a Labour government in 1984 saw virtually all existing agricultural support measures being either immediately removed or phased out over a period of time and, with the exception of 1985, coincided with a significant decrease in real net farm incomes. That large real capital losses were subsequently experienced during the 1984 - 1987 period could be due, at least in part, to the processes to which Melichar was referring.

The preceding discussion suggests that a number of additional economic adjustments follow any government attempt to subsidize or maintain farm incomes. First, if policy makers wish to sustain farm incomes at an 'adequate' level, for whatever reason, then it should be acknowledged that these policies may have a greater impact on asset prices than on current farm cash flows. Although a wealth increment may be effectively conferred on existing land owners, their cash incomes may not necessarily be enhanced. Seed (1986) points out that the outcome of the policy may in fact be immiserising rather than beneficial to the group the policy is targeted at.

N.Z.M.W.B.E.S. "All Classes Average"
Total Production Assets

Real (1982) and Nominal Values

Figure 2.3
Source : N.Z.M.W.B.E.S. Sheep and Beef Farm Surveys
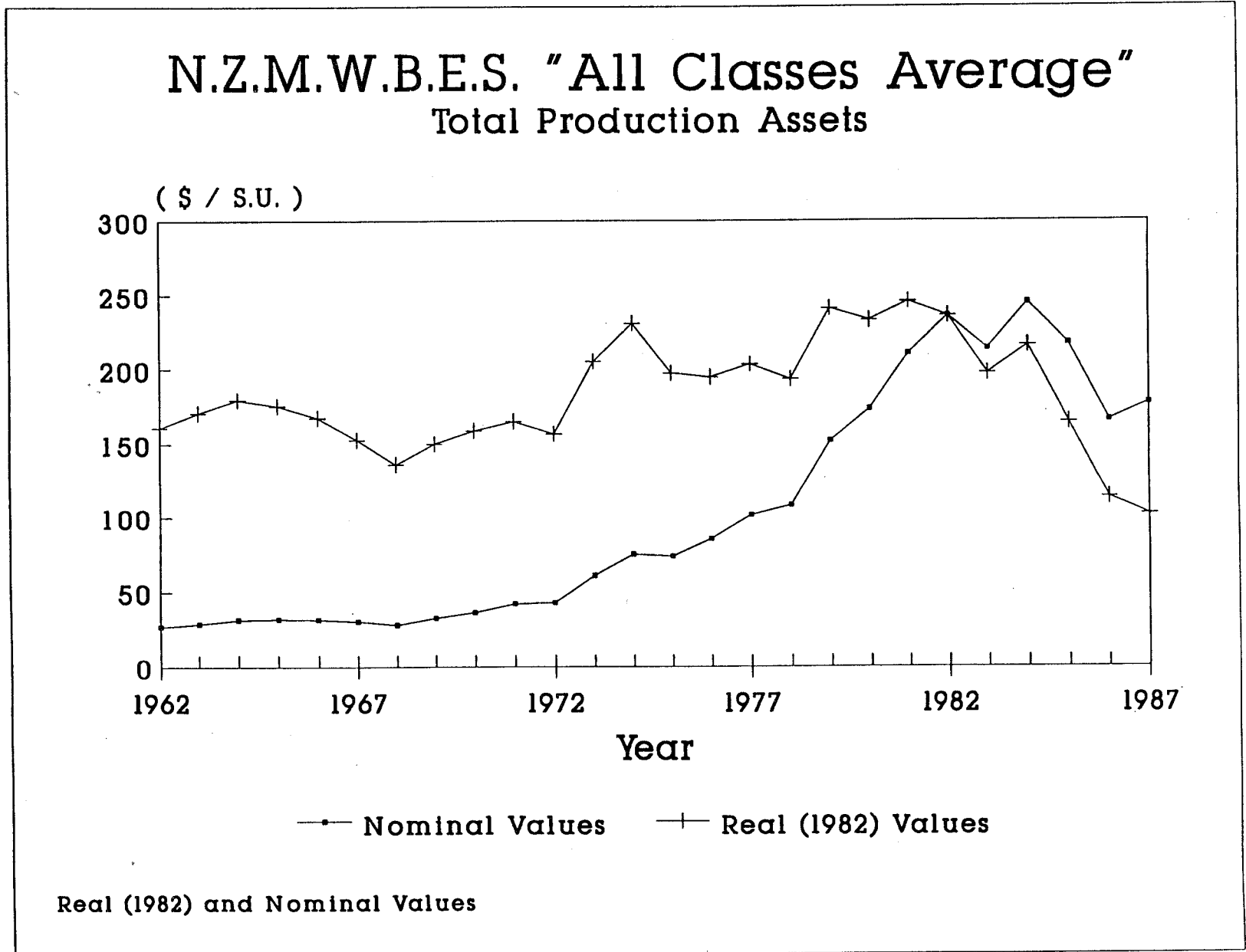
Second, any form of agricultural subsidization introduces the question of both intersectoral and intrasectoral equity. The income support measures should be considered as a transfer payment from central government to a specific group. Le Heron (1989) observes that most of the policy initiatives introduced during the late 1970's and early 1980's were designed to encourage greater pastoral production in an attempt to promote agricultural export led growth in the New Zealand economy. Thus, one could argue that the transfer payments made to farmers ultimately benefited all sectors of the economy and thereby overcomes the intersectoral equity question. The sufficiency of this argument is obviously dependent on whether or not the policies achieved the results for which they were designed. That is, were the government support measures and accompanying payments to farmers fully reflected in an increase in economic growth, or did they simply improve the wealth position of existing land owners?

Seed (1986) also suggests that policy makers should recognize that any attempt to maintain farm incomes through price subsidization creates the equity question of intra-sectoral distribution. He argues that some group or groups of individuals within the agricultural sector may either 'benefit' or 'suffer' as a result of a particular policy stance. If, as Melichar asserts, increases to farm asset values are the main consequence of an income support policy then existing farmers obviously benefit from the subsequent wealth increment. But on a falling land market, the farm purchasers who bought when asset prices were at a peak will suffer a loss of wealth. The equity question arises if this drop in land values is partly precipitated by a reduction or reversal in the government policy which originally created the increased wealth of existing farmers. As Seed explains, if due to one particular policy stance existing farmers benefit from a wealth increment, is it equitable that new purchasers of land should now be disadvantaged by an alternative policy stance? This advances the further question of whether or not the government should intervene to maintain the wealth positions that their agricultural policies may have inadvertently created.

New entrants in farming may also face another important problem if they purchase land on a market which is buoyed by government income support measures. As explained, the large increases in the nominal values of farm assets during the late 1970's and early 1980's did not appear to be supported by an associated increase in current income. Thus, both Melichar (1979) and Stevens (1978) contend that prospective new entrants were likely to face a major disincentive through liquidity difficulties. Farm asset values were at a level that in many cases required extensive borrowing by new farmers to help finance the land purchase, and the concomitant interest payment requirements could not be supported by the farm's cash flows. In this instance the result of government policy may have been to construct an entry barrier to farming, as the escalation in farm asset values was not matched by similar increases in current cash incomes. As Leathers and Gough (1984) point out, this situation is contrary to the stated objective of the New Zealand government of 1978 which considered it desirable that young farmers aspire to farm ownership. Substantial emphasis was then placed on government policies to help facilitate this objective.

In response to the high level of land value inflation preceding 1982, the government introduced legislation in an attempt to restrict the effect of non-farm 'speculative' incentives to land ownership. Leathers and Gough suggest that if farmland is treated as a form of growth stock investment, the position of the young or entry-level farmer must be carefully examined. 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 much importance to policy makers. However, given the Melichar (1979) argument which suggests that income support measures are effectively capitalized into asset values, the introduction of the

legislation described above presents a paradoxical situation. On one hand, the Supplementary Minimum Price Scheme introduced in 1978 may have not only increased the returns to sheep and beef farmers, but also precipitated the large increases that occurred in farm asset prices between 1978 and 1982. On the other hand, as the government became aware that rising farm values may attract speculative investors into the farmland market and subsequently push farm values beyond the reach of new entrants, new legislation initiatives were designed to limit the potential impact of this group of land market participants on farm asset prices.

Lastly, the implementation of any government agricultural support policy also raises the important consideration of national economic efficiency. Seed (1986) questions the economic efficiency of subsidizing traditional pastoral agriculture given the medium to long term outlook for world demand for its products. He suggests that given increasing real world incomes and the low income elasticities for the products produced by a sector which had been heavily subsidized, the policy stance prior to the 1984 election may not have been prudent.

The efficiency questions raised by Leathers and Gough (1984) take a slightly different point of view. With capital gains being a large component of farmland earnings during an inflationary period, they contend that "farming for capital gains" might have a distorting influence on investment flows. Because of the large capital gains, investment of scarce capital resources may tend to favour longer-term gains at the expense of maintenance and shorter-term development which is necessary to sustain growth in agricultural output.

CHAPTER 3

THE COMPETING THEORIES FOR LAND PRICE DETERMINATION

3.1 Introduction

The principal thrust of farmland price determination research has undergone a significant revolution since the early 1960's. This change in focus was precipitated by Scholfield's (1961) discovery of an apparent 'land price paradox', which suggested a divergence had developed between farm income levels and farmland values. Agricultural economists accordingly put forward several new theories with which they sought to help explain land price movements.

There are five alternative theories for land price determination. First, the hypothesis that advances net income as the sole determinant of farm value : Second, the theories which suggest that expectations of inflation are an important factor in land price determination : Third, that land prices are affected by the impact of expected capital gains : Fourth, that land prices are influenced by the capital structure adopted by farmers : Fifth, researchers have suggested that there are possible price effects from the consumptive demand for land. New Zealand research which examines some of these issues follows the literature reviews.

3.2 Net Farm Income

Of all the literature on land price, the argument advanced by Melichar (1979) has provoked the most discussion. Melichar in fact questioned the supposed existence of the "land price paradox". He argued that land prices had appeared to increase more quickly than net rent because the previous research contains two major oversights. First, the validity of using net income as a proxy for land rent was questioned. That is, should net income be regarded as a return to farmland alone, and thereby implicitly ignore the contribution of other productive assets toward total return? And second, Melichar suggests that land purchasers incorporate some expectation for future earnings growth into their pricing decision.

Although a more carefully defined measure of income was a significant part of Melichar's argument, the introduction of an expectation for earnings growth was more important. He argued that once this factor was considered, the "land price paradox" no longer appeared to exist. Melichar suggested that land purchasers examine not only current income but also the rate at which it is increasing, and that these data are used to calculate land price. This assessment of the growth rate in income, which Melichar asserts to be both constant and perpetual, is incorporated into the classic capitalization formula as follows:

$$V_0 = \frac{R_1}{d - g}$$

Where: $V_0 =$ The current value of the asset
$g =$ Constant growth rate

$d =$ discount rate.
$R_1 =$ Earnings of the asset in period $t + 1$

(13)

The author demonstrates that this formulation can generate an increase in land value in two ways. First, a change in R, g or d will result in a new value of V_o. And second, even if all of the variables are unchanged, land value will be increased as the expected return is magnified by the constant growth rate.

Although the introduction of an income growth variable was largely supported by Reinsel and Reinsel (1979) and Harris (1979), Melichar's assertion that expectations for income growth are constant and perpetual won less support. Reinsel and Reinsel concur that land earnings have not remained constant over time but have increased, invalidating the assumptions of the simplified capitalization model. However, following a review of the trends in the ratio of cash rents to land value data for selected regions of the United States, they propose that earnings expectations among land buyers have changed over time. This finding could also have an intuitive application to the New Zealand experience of the past two decades. Given the large historical fluctuations in farming returns that have been observed since the 1960's, it is unlikely that participants in the farm land market have had a constant anticipation of future earnings growth. Indeed, their experience of large income fluctuations throughout the 1980's would have caused a continual reappraisal of farmers' expectations for future earnings.

In a review of the Melichar hypothesis, Doll and Widdows (1981) questioned whether earnings growth has had the full effect suggested by the author. They agree with the conclusion that the growth in earnings has an effect on asset values, however, it is the extent of the effect that they question. Bergland and Randall (1984) supported Melichar's reasoning even though they found evidence in the United States has shown that there has been a less than perfect correlation between rents and land price. Their research attempted to demonstrate that a one-off increase in land price can be generated by virtually any positive change in expectations. The expectations of the participants in the land market may therefore be important, even if Melichar's assumptions are overly simplistic.

Since these partial rejections of the constant income growth hypothesis, a raft of other possible price determinants have been suggested. However, Burt (1986) has also refuted the supposed pricing influence of all these alternative factors, and again attempted to demonstrate the dominant role of land rents in the determination of farm prices.

Burt firstly argued that many of the recent land price studies have a common weakness in their modelling approach. He concurs that rent expectations of buyers and sellers in the farmland market are not the only influence on price levels, as "one would also expect a dynamic adjustment mechanism in the movement of price between equilibria after some perturbation in the economy" (p. 12). But Burt then argues that one would have to be quite optimistic to anticipate identification of separate structures for price expectations and adjustment rigidities in the price of farmland. Models that have attempted to do so would not be rejected statistically as time series data typically do not contain enough information to reject any reasonable hypothesis.

The dynamic regression equation was estimated using net rent data from high quality grain land in Illinois for the period of 1960 - 1983. The results show that the dynamic structure of farmland prices can indeed by quantified with a good deal of precision by a second-order rational distributed lag on land rents. But the value, or ability of this model to explicitly reveal the actual determinants of land price are not so clear and precise.

It must be assumed that the estimated equation is an approximation to a market adjustment process, which is a weighted sum of both current rent, and rent from the previous period.

And further, it is assumed that these two rent figures comprise all the information utilized by individual decision agents to estimate future rent. By his own admission, Burt recognizes these assumptions to be very tenuous. If rental expectations are formulated using this econometrically derived structure, it implies they possess a very high level of economic sophistication. The interpretation of the results from this analysis also depend on the validity given to the above assumptions.

3.3 Expectations of Inflation

Much of the land price research has used a partial analysis strategy when attempting to determine the causes of land price variation. That is, it has concentrated on the impact of economic factors which are specific to agricultural production alone. Feldstein (1980a, 1980b) however adopted a general equilibrium framework in his attempt to discover the determinants of farmland value. He developed a model of portfolio equilibrium that not only dealt with factors that influenced the price of land but also the impact of these factors on other assets that may be part of a rational investor's portfolio.

Feldstein proposed that the effect of inflation on asset returns in the United States is not neutral because of the tax system, where capital gains tax is lower than that for current income. The portfolio modeled in his study consists of three assets; land, bonds and shares, the last two Feldstein termed reproducible capital. Price equations were developed for each asset, and the initial weighting of each holding related to a previous set of expectations about asset yields and risk. The current level of inflation is assumed to be known but the inflation rate for future time periods is not. The returns for all three assets are assumed to consist of two components. First, a real rate of return and second, an allowance for inflation gains which in the case of farmland is received through an increase in land value. Feldstein also argued that competition between investors will cause the ratio of the net marginal products to asset price for each asset to be equal.

As the investor's expectation of inflation increases, the inflation component of the return for each asset also increases. But Feldstein (1980b) pointed out that capital gains from land due to inflation are taxed at a lower rate than income from other sources. Also, the payment of tax is deferred until the gain is realized. In contrast, the inflationary component of the interest return from bonds, and the dividend return from shares are taxed at the ordinary income tax rate. Because the real rate of return to land is higher than that for the two alternative asset classes, investors bid up the price of land to equate the marginal rates of return between the assets of the portfolio.

Feldstein therefore suggests that the continuous increase in the price of land during the 1970's in the United States may be considered to be a combination of two factors. The equilibrium real price of land has changed as expectations of the inflation rate change. And the nominal price of land has increased continually at the historic rate of general inflation.

A number of researchers attempted to empirically test these assertions by specifying a model that included expected inflation as an explanatory variable. The study by Martin and Heady (1982) suggested that the expected rate of inflation, which was adaptively formulated, has a negative impact on farmland prices. Alston (1985) also found that the inflation effect on land prices was significantly negative, although empirically small. The results of both of these tests would therefore indicate that the Feldstein hypothesis does not explain the movements in land price that it purported to. Further, Seed (1986) proposed that both the

work by Martin and Heady, and Alston tends to reinforce the Melichar hypothesis, that growth in land prices is best explained by growth in net rentals.

That the empirical evidence does contradict the Feldstein theory may be explained by some reservations that Martin and Heady raised concerning the applicability of this theoretical construct to the farmland market. They advanced two factors that could inhibit the hypothesised impact of inflation on real land prices. First, the land and financial asset markets may not be adequately interrelated, thereby restricting the portfolio adjustment process. And second, imperfect information may limit all investors' knowledge of future inflation and tax rates.

The first of these cautionary points is most important. The degree to which the markets are interrelated is thought to depend on the particular land market that is being addressed. Investors in farm real estate may have extremely diverse reasons for purchasing land. They may be motivated to acquire a holding for its productive potential, its consumptive use, as a speculative investment, or to form part of a diversified asset portfolio. And the amount of consideration that each of these land users give to the returns available in other asset markets is also expected to differ appreciably.

The Feldstein portfolio adjustment process assumes that all prospective land buyers base their decision to purchase, at least in part, on the returns available from an investment in both bonds and equity. And this further implies that the analyzed landmarket is dominated by buyers whose primary interest in farmland is as part of a well diversified asset portfolio.

This may be a tenuous assumption to make in many cases. It is possible that the marginal land purchaser has quite different reasons for buying a property. If for example, farmland price is being set by consumptive users within a particular market, it is unlikely that prospective returns from alternative investments are considered in the purchasing decision. As such, the hypothesised impact of inflationary expectations is reliant on a set of strict assumptions concerning the circumstances of land market participants. That the empirical evidence of both Martin and Heady, and Alston rejected Feldstein's hypothesis may suggest that the above assumptions are not met in reality.

However, Just (1988) advances an alternative theory which suggests that inflation may have a real impact on land prices in a way that differs from the Feldstein hypothesis. His proposition is derived from the apparent impact of inflation on debt used to finance land investment. Just argued that the reason why the regression results of Alston and Burt indicate inflation has not been important, is because neither model is structured to reflect the debt-reducing effects of inflation.

A simple accounting equation of motion is used to demonstrate how inflation can affect the real value of debt.

$$D_t = \frac{1}{f_t}[(1-\pi)D_{t-1} + d_t]$$

Where D_t = Real debt at the end of period t

        f_t = 1 plus the current rate of inflation

        π = current rate of principal repayment on debt

and, d_t = net current real borrowing at beginning of period t.

Just suggests that this equation reflects the rapid rate of real debt retirement that a farmer can expect with high inflation even allowing for relatively small payments of principal. Conversely, this debt-reducing advantage of holding land is lost in a period of low inflation. If the real value of debt is being eroded then landowner wealth must be improved, assuming asset values are at least being maintained in real terms.

3.4 Expectations of Capital Gains

Observations of large increases in farmland value during the 1970's has led a number of economists to suggest that an expectation of capital gains is itself an important explanatory variable of the price movements. The aggregate levels of capital gains in the United States have been very large. Bhatia (1972) estimated that between 1947 and 1968 real capital gains on farm real estate in that country amounted to U.S. $87.9 billion. The subsequent figure for the 1970's is also expected to be as significant. Melichar (1979) added that in the United States, annual increases in asset values had exceeded annual income by wide margins. Because of the significance of capital gains, some researchers reasoned that intending land market participants must incorporate some expectation of future capital gains into their pricing decisions. The reasons that they give for doing so are however not necessarily the same, and in some cases a capital gain variable is included with no apparent theoretical justification. Instead, the main focus of the capital gains literature concerns the way in which land owners are hypothesised to value the expected increases in the price of their land.

Bhatia (1972) proposed that capital gains do not have to be realised to supplement current income, as the land owner has two alternatives. He can reduce his level of savings now in anticipation of receiving the expected capital gain when the property is sold. Or he may borrow against the security of the appreciated value of the asset. It is argued that either of these alternatives will allow the farmer to benefit from increased land values before selling his farm.

Bhatia does not however suggest any explanation for the reasons why landmarket participants should include expected capital gains in their determination of land price. It must be assumed that it is included solely because capital gains have been observed in the past. And for no other reason than this, land purchasers should expect the appreciation of values to continue.

Plaxico (1979) does however offer an explanation for the inclusion of the capital gains variable. He argues that land can in some cases be likened to nonproductive assets such as gold, diamonds and artwork. This form of asset does not generate current income or produce a cash-flow, but rather acts as a repository for value storage and preservation. Plaxico suggests that the speculative forces which prevail in the market for these assets also has an influence in the land market. The productive potential of the land may therefore be of secondary importance as investors purchase a property with possible future price appreciation as their major consideration. This assertion relies to a great extent upon any assumptions made about the marginal land purchaser, and the particular land market being analyzed.

The relative importance of speculative forces has been statistically evaluated by entering both net returns and capital gains into a regression equation purported to explain land prices. However, Burt (1986) states that interpretation of the given results is extremely difficult because of the way the model is usually specified. An examination of the Plaxico theory is

even more difficult. Even if the estimated parameter for expected capital gain is significantly different from zero, one is unable to explicitly identify the reasons for its importance.

The study by Plaxico and Khetke (1979) again concentrated on the way that land purchasers value expected capital gain. In an extension of the work done by Bhatia, they also reiterated the argument that capital gains do not have to be realised to be spent. As the value of a property appreciates, the associated increases in the farmer's equity will either be available as a financial reserve, or allow increased borrowing.

Three models were used to help examine the way market participants value expected capital gains. The first suggested that the value of capital gains is the present value of the anticipated post-tax gain, which is received when the property is sold. Although Dunford (1980) supported this approach in his review of the Plaxico and Kletke study, the authors argue that it fails to incorporate any benefit that an increase in equity may provide. Instead they recommend that the highest value of capital gains may be measured using the earnings capacity of newly borrowed capital, which is made available by the increase in equity. The two further models were specified so that expected asset appreciation was valued in this way.

However, Dunford argues that such an approach can only be used on a flow basis if the additional borrowing power is used annually and as soon as it becomes available. Seed (1986) then suggests that the reality of liquidity problems in the short term may reduce the value of expected capital gains. New farmers may be unable to utilise the increasing debt capacity because of their inability to meet the servicing requirements.

Another method of valuing expected capital gains is given by Castle and Hoch (1982). They suggest that the divergence between land rents and prices can be explained if annual increases in land price are included as current income. Castle and Hoch propose that the price of real estate is determined by three components. First, they maintain that the present value of future earnings to land is an important determinant of land value. This is measured by the capitalised value of the net rent from the land. The second component of value is derived from the expected rate of growth in the asset price. Importantly this growth is assumed to remain constant into perpetuity, and be regarded as a source of current income. Castle and Hoch further suggest that this 'return' from capital gains is capitalized into value in the same way as net rents.

The final price determining factor is a consequence of possible inefficiencies in the financial market. This occurs when market interest rates do not fully account for inflation, thereby conferring an advantage to borrowers as the general price level increases. The real price of land should therefore increase as the real rate of interest is lowered during periods of inflation, assuming the investor uses debt to help finance the land purchase.

In a review of this theory, Bergland and Randall (1984) doubted that the expected capital gains variable actually captures the impact on farmland price which it is intended to. They argue that what Castle and Hoch termed the "capitalization of capital gains" can just as readily be explained as the capitalization of the growth in rents. As such Bergland and Randall effectively reassert that the Melichar (1979) constant income growth hypothesis is the true model of land price determination. The Melichar theory has already been discussed, and the assumption that land prices and rents increase or decrease in concert has been largely discounted. As Seed (1986) points out, "in the United States at least, land rents levelled off in approximately 1974 while land prices continued to increase until the early 1980's" (p. 51).

Thus the role of capitalized asset appreciation in a model of land price determination remains ambiguous. It may also be argued that the theoretical justification for including capital gain as an explanatory variable for land value, in any form, seems obscure. If the definition of capital gain is taken to be the first difference in annual asset values, then the factors which contribute to this capital gain are likely to be included in the explanation for land price changes which this research attempts to identify. That is, the identity of other economic or financial variables which lead land market participants to form their expectations for land price appreciation.

It is suggested that the authors who include expected capital gain as a variable are implicitly aggregating some of the determinants which need to be identified. Indeed, in the study by Castle and Hoch (1982) the factors which were attributed to causing capital gain were blandly described as "factors specific to the agricultural sector". By including such a nondescript explanatory variable, the relative importance of each of these "specific factors" is concealed.

Nevertheless, despite the concerns over the limiting restrictions that are included in their theory, Castle and Hoch did describe a potentially important variable. The impact of inflation on the real cost of borrowing, and the associated effect this variable may have on land price is of considerable interest. It is however only one factor which brings attention to the possible importance of capital structure in the determination of farm asset values.

3.5 The Impact of Financial Leverage

Most farmland price literature concentrates on factors that may affect the economic returns from the land. Impacts of such variables as current returns, the expected growth rate of income, inflation and the benefits of asset appreciation have been discussed above with respect to the farmers' expected future income pattern. Although each of these econometric studies must implicitly incorporate a discount rate with which to capitalize expected returns, little of the reviewed research has concentrated on the manner in which this discount rate is established.

Any capitalization rate used to derive asset value is in effect a summary figure that may subsume several significant variables other than just the investor's rate of time preference. These include the land owner's risk aversion, taxation position and possibly more importantly, the level of debt used in his capital structure.

Harris (1979) was one of the first researchers to directly consider the factors that may influence the discount rate. He extends the comparison of land valuation techniques and the methodology used in the valuation of shares and financial assets by further discussing the capitalization rate. In this study, the capitalization rate, d, is expressed as a function of the required rates of return on both debt and equity, where

$$d = W_dD_d + W_eD_e$$

with D_d and D_e representing the nominal required rates of return on debt and equity, and W_d and W_e the proportions of the portfolio financed by debt and equity. Although this presentation explicitly extends the theories which account for factors which may affect the discount rate, Harris stops short of examining how the required returns are estimated.

More particularly, the impact of financial leverage on the required return from debt financed

assets was not discussed. The deductibility of interest payments from taxable income is a valuable advantage of using borrowed capital to fund asset purchases. And because of this tax generated advantage, the effective post-tax cost of debt is reduced. The associated costs of equity financed assets are not however deducted from income before the tax liability is assessed. As such, the overall cost of capital can be seen to be dependent on the ratio of debt to equity in the capital structure. The marginal tax rate in New Zealand has been as high as 67.5% during the 1962 - 1987 period, and this could have had a significant impact on the required rate of return on debt used to purchase assets.

The proportions of debt and equity effected in the capital structure of the marginal land purchaser, and the effective tax rate of the borrower will substantially influence the eventual capitalization rate used in the determination of both the required return on invested equity and of the land price. As with any investment, if the required rate of return is reduced then the price an intending asset owner can afford to pay must increase. This is no less true for investment in farmland.

The taxation advantages of using debt finance in the farm purchase can also be added to, or amplified by a number of other factors. As described above, the marginal income tax rates in New Zealand have been relatively high, and have therefore magnified the effect tax-deductibility can have on an investor's required rate of return.

Even if the impacts of taxation and debt erosion are disregarded, the required returns from debt and equity financed assets in New Zealand were unlikely to be the same during the past twenty five years. Numerous support measures were introduced by the New Zealand government during the 1970's, one of which provided concessionary loans for investment in agriculture. Debt funding was therefore available for farm purchase at a cost that was considerably below the market interest rate. This gave intending farmers a distinct incentive to use debt finance, and effectively reduced their required rate of return and capitalization rate.

3.6 Accounting for Consumptive Values

Several economists state that land is not only an input into agricultural production but also an important argument in many individuals utility functions. Land may not be purchased solely for its productive value but rather for consumptive use and enjoyment.

Both Pope and Goodwin (1984) and Pope (1985) therefore suggest that land price may be influenced by not only productive and speculative value, but also its consumptive value. This consumptive value is thought to depend on size, proximity to metropolitan areas and aesthetic or romantic appeal. Indeed, Pope states that consumptive users of rural land choose a farm in the same manner in which they would choose a hat; style may be of more importance than functional form.

Whether or not consumptive demand should be included as a possible land price determinant depends largely upon the particular land market of interest. If it is to be incorporated into a model, one must assume that land value is being influenced by these consumptive users. Pope and Goodwin suggest that the relative importance of productive and consumptive values alter with farm size. The smaller the parcel of land the higher the consumptive use component. Or alternatively, as the size of the farm increases, the influence of consumptive values on land price decreases as the productive use becomes more

important. The authors also point out that these smaller units are concentrated closer to metropolitan areas where they are more likely to have high recreational, aesthetic or romantic appeal.

Pope (1985) attempted to empirically test the theory of consumptive demand using a sample of rural land in Texas. His model of the land market assumes that land value is determined by both productive and consumptive values, while the demand for land by consumptive users is a function of income, taste, population density and the availability of substitutes. The results indicated that net returns to land explained less than one quarter of the market value of land in Texas. Pope then concluded the consumptive demand for land would continue to apply strong upward pressures on rural land values.

The main inference suggested by these conclusions is that the majority of farmland purchasers in Texas derive income from other, non-farm sources which can be used to subsidise their particular choice of farming operation. The participants in this market are assumed to be purchasing a lifestyle and any income that the property earns is incidental. As Seed (1986) points out, these assumptions should be extrapolated to other land markets with extreme care, and are probably not directly applicable to the majority of rural land markets in New Zealand.

3.7 New Zealand Research

Lee (1976) and Lee and Rask (1976) developed and refined a "bid-price" model to evaluate farmland prices, or more specifically to provide the land buyer with a method of determining farm value. Leathers and Gough (1984) replicated this modelling framework using New Zealand data. Using both New Zealand Meat and Wool Board Economic Service and New Zealand Valuation Department data Leathers and Gough attempted to identify the factors or variables that influenced the land value of sheep and beef farms. They also attempted to examine the impact of "inflationary and non inflationary economic conditions" on land values as well as identifying policy implications. But, as Seed (1986) points out, the usefulness of the "bid-price" approach for establishing land price determinants is limited:

> "Unfortunately, the Lee and Rask model was not the most appropriate (to fulfil their objectives), as it is a non-parametric deterministic model. That is, there is no relationship estimated between the explanatory variables and the dependent variable (bid price), as well, uncertainty is not included. Most importantly however, how do we know that the Lee and Rask specification best describes the "true" model? Given that the variables have been selected from theory, but are untested, what weight can be placed upon sensitivity analysis when the significance of one variable over another is the result of it's mathematical specification? The model does produce estimates of the bid price which closely approximate the land values at that time, although, given it's structure this is hardly surprising" (p.28).

Considering these reservations, a further review of the research by Leathers and Gough is likely to be of limited value.

For the purposes of this study the models specified by Seed hold more interest as they are each stochastic and parametric. And as such, they have the potential to more accurately determine the influence any variable may have on land value. The author stated his study

objective was to:

> "examine the determinants of the price of fattening and grazing farm land in New Zealand over the period of 1962 to 1983. More particularly, (he examined) the relationship between real land price and expectations of real income, real capital gains and the rate of inflation for sheep and beef farms" (p.158).

Having examined the relevant theory and literature on the topic, Seed observed that three broad themes emerged. He then specified a separate model to represent each of these theories, and empirically tested them to identify the one which best explains land price movements.

The first model attempted to represent and test the theory advanced by Melichar (1979) and (1983). The central tenet of this theory is that land behaves as a growth stock. That is, it is assumed that the growth rates of both the value of the asset and its earnings are constant and equal in perpetuity. A second testable model was then specified to incorporate the arguments of Bhatia (1972), Plaxico and Kletke (1979) and Castle and Hoch (1982). And finally, the third model expressed farmland prices as a function of expected net rental income and the expected rate of inflation. This was based on the Feldstein (1980a) and (1980b) hypothesis where expectations of a change in inflation combined with the structure of the United States tax laws leads to changes in the real price of land. That is, the basic neutrality of taxes and inflation broke down when their simultaneous effects were considered.

All three models were estimated using a number of alternative techniques, with model two proving to be superior to the others. That model produced the highest adjusted R-squared (0.7221) compared to the relevant versions of the other two. But given that this study's objective was to "examine the determinants of the price of fattening and grazing farm land" one may argue that the approach taken by Seed was not the most appropriate. All of these models have been based on a mainly theoretical treatise, which by definition abstract away from what may be expected to happen in reality. The theories of Melichar (1979), Castle and Hoch (1982) and Feldstein (1980a) (1980b) do not purport to completely explain all land price movements, but are merely advanced as a contributory factor. Therefore, the ability of each of Seed's models to identify land price determinants should be expected, a priori, to be inadequate. Nevertheless, Seed maintains that the adjusted R-squared (0.7221) represents a "reasonably good fit" and that "this model provides some evidence that increasing land values may be likened to the appreciation which occurs in the value of other assets such as gold or artwork". But, as has already been argued, estimating a significantly positive expected capital gain coefficient does not reveal the reasons for such expectations. The justification for claiming that some speculative motive has caused the observed capital gain is unclear. The expectations could as easily be based on several other variables which may be incorporated into the land purchasers decision. These may include expected inflation and the value increments from debt erosion, and expectation for changing taxation and interest rates, or an expectation for future earnings growth. By merely including an expected capital gain variable in the model, a more precise examination for the causes of the expectations cannot be made. And therefore, even if the explanatory power of model two is considered reasonable, it's ability to explicitly identify land price determinants is unsatisfactory.

Another major weakness of this study is considered to be the use of the New Zealand Meat and Wool Board Economic Service Survey (N.Z.M.W.B.E.S.) "All Classes Average" as the analyzed sector. The time series data taken for asset value, net income and capital gain are

a weighted average of all seven farm classes surveyed by the N.Z.M.W.B.E.S. This approach implicitly assumes that an aggregate New Zealand market exists for all sheep and beef grazing land, and more importantly, that all grazing land has similar qualities. Assuming homogeneity in this aggregate market is still important even if using per hectare data negates the effect of productivity differences between the seven farm classes.

Although the productive capacity of a farm has an obvious influence on its value, there are several other factors which may also significantly affect land price. These include the region in which the property is located, the attractiveness of that regions' climate, the property's vicinity to towns and cities, and it's potential for more intensive development. And because these land qualities vary greatly between most farming regions, the aggregate market assumption breaks down. The motives for purchasing farmland are expected to depend on the region the farm is situated in, and the productive and consumptive qualities that region possesses. Based on the theory of alternative motives for farmland demand, it is apparent that the land market used in any analysis should be as homogeneous as possible. A price model may then be able to more precisely incorporate the determinants of land price which are considered relevant to that individual market.

CHAPTER 4

FINANCIAL LEVERAGE AS AN
ALTERNATIVE DETERMINANT OF LAND PRICE

4.1 Introduction

The literature review given above in Chapter 3 outlined numerous alternative theories which all purported to have some influence on the determination of land price. Before one, or any combination of these variables can be incorporated into a land price model a number of important considerations should be addressed.

Both Pope et al. (1979) and Doll and Widdows (1982c) found that none of the theoretical research has suggested a model specification which is most appropriate to the farmland market. Seed (1986) reasoned that as a result, there has been a proliferation of ad hoc models where variables are added in an effort to improve the overall fit of the model to the data. Johnston (1984) argues further that such data mining produces valueless results from which little information can be taken.

The first requirement of this study was to define an appropriate market on which to base the analysis. Pope (1985) argues that the land market should not be considered to be homogeneous in the aggregate. He suggests that it may be subdivided into several subcategories based on certain characteristics that are unique to buyers or sellers. The importance of defining the market to be examined before hypothesising which of the alternative theories are thought to be relevant is therefore emphasized. This is discussed in Section 4.2. The geographic region from which the data has been taken for the analysis is then described, before the hypothesized determinants of land price are presented.

The most appropriate analytical procedure for this study is described in Section 4.3 before considering the treatment of expectations, and the definition of the variables involved.

4.2 Definition of the Market for Farmland

A market, as defined by Kotler (1986) consists of all those people with an actual or potential interest in a commodity, as well as the right resources for exchanging it. This is the broadest market definition possible as it relates to a complete generic commodity class, within which there exists many subcategories. The market for farmland can be similarly divided into several submarkets.

Doll and Widdows (1982b) suggest that the market for land in the United States may be subdivided into three categories, distinguished by the different motives that participants in each market hold for purchasing land. First, the market for commercial farming land. In this submarket the productive demand for land is most important, although consumptive demand and the demand for land as a store of wealth still have some influence.

The second market category is that for part-time farming and rural residences where the consumptive demand for land is the major factor in the formulation of land values. This land may have little or no value resulting from its productive capacity, and it is suggested that the determinants of land price are not dissimilar to those in the market for private urban

dwellings. The final land submarket identified by Doll and Widdows results from non-agricultural, spatial demand. In this category, land use is changing from agricultural or rural residence to industrial, commercial or urban uses. The main determinant of the size of this market is considered to be dependent on population growth in metropolitan areas. When a land use change is imminent, speculative demand increases with little regard given to the land's agricultural potential.

Although this segmentation is helpful, each of the three given land submarkets should not be assumed to be totally homogeneous. Specifically, the commercial landmarket in New Zealand can be seen to embody many areas of farmland which possess distinctly different characteristics. As has been pointed out in the review of Seed's (1986) work, the motives for purchasing commercial farmland cannot be expected to remain totally consistent in an aggregate market. They are expected to depend on the region the farm is situated in, and the productive and consumptive qualities that region possesses.

In his review of the research, Burt (1986) argues that many of the apparent difficulties of the existing empirical work are exacerbated by using aggregate data to analyze land prices. This will introduce the problems of extreme heterogeneity in land quality, non-agricultural values of farmland which are not reflected in current or historical rents, institutional variations over time and space, and inaccurate estimates of both rents and land values caused by accounting problems in the former and sampling problems in the latter.

Robison, Lins and VenKataraman (1985) also highlighted the importance of constructing a land price model with reference to the particular market under analysis. Their study attempted to show that cash rents and the growth in rents, as well as demand from non-agricultural land users are the critical determinants of land value. However, the model was applied to data from twenty four states in the United States, and gave seemingly inconsistent results. The authors therefore concluded that there may be considerable variation among states in the factors which most strongly influence the land market.

The findings of both Robison et al, and Burt emphasize the need to identify and define a homogeneous market before selecting possible price determinants. The land value model may then be able to more precisely incorporate the factors considered relevant to that individual market. Further, any justification for using a proposed farm value determinant must be related to the market participants and their motives. Attempting to pre-determine which factors are relevant in an aggregate market is obviously more difficult.

4.3 The Chosen Market

Consistent time series data for farm incomes and prices in New Zealand are not readily available. The only consistent data series which contains adequate income and price information is that compiled by the New Zealand Meat and Wool Board Economic Service (N.Z.M.W.B.E.S.). Their sheep and beef farm surveys have been produced since the 1957/58 season, providing reasonably detailed physical and financial information for eight farmland classes.

The class seven farm category has been selected as possibly the most homogeneous sample, and will be used in this analysis for a number of reasons. Despite the fact that the categorization of all sample farms is based on both the type and intensity of farming undertaken, the farms within each sample class are in some cases located in several different

provincial areas. Thus, although levels of production within each class should be directly comparable, a number of other factors that influence land value may not be consistent across the sample. Certainly the most obvious of these is the region in which the property is located. The attractiveness of that region's climate, the property's vicinity to towns and cities, and its potential for more intensive development should all be expected to have some impact on land values. It is therefore suggested that using a sample in which the farms do not share a reasonable proximity to each other may introduce some inaccuracies to the analysis.

The majority of the properties in the class seven sample are located in Southland. And the location factors which influence the overall desirability of each sample farm are expected to be relatively consistent. Difficulties that may result from variations in these consumptive values are therefore minimised by the choice of this sample class.

Unfortunately there is an apparent dearth of recorded information which may help to establish the circumstances or possible motives for land purchase of the participants in the Southland farmland market. However, the New Zealand Valuation Department has recorded some information concerning the land purchaser that may provide some insight into the possible price determinants in this market. A broad classification of farm buyers was started in 1970 which separated all purchasers into five categories. For each transfer of farmland within the Southland provincial area, the purchaser was described either as an existing farmer, a new entrant to farming, a businessman, a government agency or some other party.

Based on these general classifications, some assumptions concerning the predominant motive for purchasing farmland can be made. The number of Southland farms that have been purchased by businessmen since 1970 is considered to be fairly insignificant. Of all the properties that are classified as economically viable, the percentage that have been bought by businessmen ranged between zero percent in 1979 to 12.5 percent in 1985. Importantly, that proportion can be seen to be far more significant in many other provincial areas.

Assuming that the influence of non-farm demand on land values is small, it is argued that a number of advanced price determinants can be reasonably disregarded for this study. The Valuation Department information helps to reinforce the assertion that the class seven farmland area is predominantly made up of single family units which are purchased for their productive use. As such, the possible impact of demand from consumptive users is considered small. The limited number of farm purchases by businessmen may also suggest that the motive of anticipated capital gains has had a negligible influence on price determination. If businessmen had purchased a significant number of the farms that were sold in Southland, any specified land price model would have to incorporate both consumptive and speculative demand.

As a result, basing the analysis on the Southland market facilitates a more explicit examination of the impact of financial leverage as a number of theoretical factors presumed to affect land price can be justifiably omitted. Although the omission of such factors is essentially a subjective choice and lacks conclusive data-based support, it has an advantage over strictly ad-hoc specifications which have little regard to the analyzed market or the purchasing motives of its participants.

4.4 The Land Price Equation

As explained, land price researchers have offered many different theories in an effort to

explain the perceived divergence between the time path of rents and land prices over recent years. In the preceding literature review, it has been emphasised that the relevance of each theory to price determination is dependent on the definition of the analyzed market. The previous section consequently argued that by using N.Z.M.W.B.E.S. class seven survey data for this study, the possible influence of consumptive and speculative demand may be reasonably discounted.

The apparent lack of theoretical justification for including expected capital gains as an explanatory variable was also discussed in Chapter 3. It was suggested that this variable may merely act as a proxy for other relevant determinants that have been excluded from the model. And by including expected capital gains, the identity of specific economic or financial variables which lead land market participants to form their expectations for land price appreciation may be concealed.

As a result, only three possible land price determinants are hypothesized to have a significant influence on the value of land in the Southland provincial area. These are the expected returns to farmland, the impact of financial leverage, and the erosion in the real value of debt caused by inflation.

4.4.1 Expected Net Rent

The value of land that is purchased ostensibly for its productive use must be related to the future income that is expected from it. All of the reviewed research accepts that land rents must be the basis of value, irrespective of the numerous alternative theories that may be appended to it.

With perfect competition among buyers and potential buyers, and in a world of certainty and market efficiency, the price of farmland should obey the classical capitalization formula, which is

$$P_0 = \sum_{t=1}^{\infty} R_t / [1 + r_t]$$

where P_0 is land price at the end of year zero, r_t is the real discount rate for year t, and R_t is the net rent as if it occurred at the end of year t. That net rents do not precisely explain the observed movements in land prices can be attributed to the violation of the assumptions on which this formula is based. Future rents are not known with certainty, and are influenced by many factors which are difficult to forecast; examples are prices of inputs and farm commodities, and technological change. There are also many market inefficiencies which have been hypothesized to influence land value. Taxation and transaction costs are obvious examples of these. But net rents, however formulated and expressed, should remain the basic determinant of land value.

Doll and Widdows (1982c) defined rent for agricultural land as "the excess return above that required for the maintenance, depreciation and interest on buildings and other fixed improvements". American economists have been able to use a proxy for net rents that closely approximates this definition because of the large areas of leasehold land in that

country. The value of lease payments data also has an advantage of essentially representing the value of expected net rents, as payments are usually made at the beginning of the lease period. Landowners can therefore know with some certainty the returns they will achieve for the coming year, at the start of that year.

Land price researchers in New Zealand are unfortunately not afforded the same opportunity. The net farm income data provided by the N.Z.M.W.B.E.S. is not directly synonymous with net rents and several adjustments need to be made. The adjusted data series does however provide a reasonable proxy for rents. The procedure used is described in Section 4.7.2.

The incorporation of expectations into a land price model is more difficult. With expectations, land value is not assumed to depend on the actual value of net rent but rather on the expected, or permanent future level of returns to land. Unfortunately, the way in which land market participants form these expectations is not known. That they are subjective, and as such the personal judgements of an individual further compounds the problem. Several econometric schemes can be used to represent the expectations formulation process, all of which are restricted to the use of historical rent data to help predict future levels. Although the ability of each scheme to closely represent the actual, but unknown method of producing expectations can be empirically measured, this 'artificial' estimation should be expected to introduce some form of bias into the analysis. This important problem is further discussed in Section 4.6 before an expectations hypothesis is chosen for this study.

Despite the problems of definition and the formulation of a suitable expectations scheme, net rent is not surprisingly advanced as the major determinant of land price in the Southland area. However, this model will differ from the classical capitalization formula because of the way in which the discount rate is estimated, where the effects of both financial leverage and debt erosion can be seen to magnify the apparent value of future rents.

4.4.2   The Impact of Financial Leverage

The theoretical justification for expecting financial leverage to have a significant impact on land value is rational and can be explained as follows. From the simple capitalization formula, recall that value can be computed by capitalizing a residual to land, at an appropriate discount rate, or;

$$P_O = A/i$$

where P_0 is the imputed asset value, A represents the expected constant annuity from land and i is the capitalization rate.

The impact of the choice of discount rate, or required rate of return on the computed asset price is quite clear. Any change in the capitalization rate will have an effect on the imputed value. The capitalized effect of any proportional change in the discount rate increases as the discount rate falls. Therefore, the accuracy with which this simple model can identify true market values is reliant on an accurate assessment of the marginal land purchasers' discount rate.

The discount rate used should describe the rate of return that a marginal land purchaser requires from the invested funds. If the entire purchase price is funded from equity, then the appropriate discount rate is the investors' opportunity cost of capital. That rate should

equal the return available from his next best alternative investment which has both a similar risk and temporal structure. However, when debt finance is introduced into the land purchaser's capital structure it is argued that the appropriate discount rate then becomes an average of the two required rates of return weighted by the proportions of debt and equity capital. Even if the impact of taxation is disregarded, the required returns from debt and equity financed assets is unlikely to be the same, and the weighted average cost of capital will differ from that for an all equity financed property.

Thus, if some proportion of the asset price is funded by debt finance the appropriate capitalization rate, (K_t) is:

$$K_t = (E/A * Ke) + (D/A * Kd)$$

Where: K_t = The weighted average cost of capital.

     E/A = The proportion of assets financed by equity funds.

     D/A = The proportion of assets financed by debt funds.

     Ke = The post-tax required return on, (or cost of) equity funds.

     Kd = The post-tax required return on, (or cost of) debt funds.

A commonly used proxy for the required return on equity capital has already been described as the available return from some other risk equivalent investment.

However, the impact of a number of variables including risk must be contemplated before the effective cost of debt can be estimated. The deductibility of interest payments from taxable income is the most obvious advantage of using borrowed capital. This taxation advantage reduces the effective cost of servicing the debt according to the marginal tax rate affecting the relevant net profits. With a marginal income tax rate as high as 67.5% during the past twenty five years, each dollar spent on debt servicing had the potential to reduce the taxation payments by 67.5 cents.

Nevertheless, the degree to which these imputed advantages of financial leverage actually impact on market land values depends ultimately upon the assumptions made about the marginal land purchaser. Or more precisely, what level of marginal tax does the marginal farm buyer expect to pay? The degree to which the effective cost of debt is reduced depends upon the size of the taxation saving which interest deductibility affords. The marginal tax rate paid by the marginal land purchaser is unfortunately not observable, and the procedure used in this study is restricted by that problem. However, for the purposes of this discussion we can presume that both the taxation and capital structure position of the marginal land purchaser are known, and then examine the consequences of relaxing this assumption in Section 4.5.

The capitalization rate has now been explicitly expressed as some function of the required returns from both debt and equity funds. Introducing taxation produces a capitalization rate, Kt, which is calculated as;

$$K_t = (E/A * K_e) + [D/A * (K_d (1 - T))]$$

where T represents the investor's marginal tax rate and all other variables as previously defined. Assuming a marginal tax rate greater than zero, the introduction of taxation can be seen to reduce the overall required rate of return, and consequently increase the capitalized value of any given annuity.

This aggregated capitalization rate, or weighted average cost of capital cannot however be used to directly compute asset value. The respective returns to assets financed by either debt or equity funds are not subjected to the same taxation treatment. Farm drawings are the main source of return to equity funds, but importantly this return must be subjected to income taxation before becoming available. On the other hand, interest payments which represent a return to debt financed assets are not taxed. If total net rents are capitalized by the weighted average cost of capital, this differential tax treatment is not allowed for.

As a result, the aggregate expected annuity should be partitioned to represent a separate return for both debt and equity funds. The separate returns should be apportioned with respect to the debt/asset ratio used by the land purchaser, and subsequently capitalized by the relevant discount rate. Allowing for the differential tax treatment of returns to debt and equity, the appropriate capitalization formula then becomes;

$$VA_t = \frac{[(1 - T)(E/A * YAE)]}{d} + \frac{D/A \times YAE}{Mi(1 - T)}$$

where:
VA_t = The asset value, as at the beginning of the income year, t
d = The appropriate post-tax opportunity cost of equity funds
M_i = Mortgage interest rate
YAE = The expected net profit to the asset.

with all other variables as previously defined.

Although this presentation does not introduce any more variables into the capitalization formula, it does explicitly reveal the possible impact of financial leverage on asset price.

4.4.3 The Impact of Debt Erosion

The theoretical impact of debt erosion on farmland price has already been examined in Section 3.3. In summary, Just (1988) has pointed out that a farmer can expect a rapid rate of real debt retirement during periods of high inflation. Because the nominal value of the debt is constant, the real value must decline, even if the expected rate of inflation is low. With New Zealand having experienced prolonged periods of high inflation over the past two decades, the anticipated rate of debt erosion may have been very significant. Moreover any reduction in the real value of debt must add to the land owner's wealth and should therefore be considered a valuable advantage of using borrowed funds in a farm purchase. The wealth increment from debt erosion can only be received if an investor uses debt.

There are a number of alternative methods which may be used to incorporate this factor into a land price model. The most obvious of these is to calculate the present value of anticipated decreases in the real value of debt. This value, which essentially represents an increment to

the land owner's equity, may then be added to the capitalized value of income to give a total asset value. However, this method requires some information on the nature of the debt. This information is not available. The model would have to pre-determine both the rate of principal repayment and the anticipated term of the loan, as well as making some assumptions about possible refinancing in future periods.

Alternatively, the impact of debt erosion can be seen to reduce the effective cost of debt in a way similar to the effects of interest deductibility. As the real value of debt repayments is reduced by inflation, the associated cost of using debt finance is also reduced in real terms. Consequently, this apparent advantage of debt erosion can be expressed as part of the discount rate calculation, by further reducing the effective post-tax mortgage interest rate. The return to assets which is financed by debt can therefore be capitalized using the following expression:

$$\text{D.C.R.} = \frac{M_i \, (1 - T)}{1 + IE}$$

where D.C.R. is the capitalization rate applied to returns from debt financed assets (Debt Capitalization Rate), IE the expected rate of inflation and all other variables as previously defined.

Although this formulation does not overcome all of the problems associated with the present value alternative, it does provide a more convenient way of incorporating debt erosion. It also directly relates the benefits of both interest-deductibility and debt erosion to the use of debt finance. Obviously, neither advantage can be enjoyed unless a farmer uses borrowed funds, and this formulation explicitly demonstrates that imputed asset value is directly dependent on the amount of debt incurred. Assuming the required return on equity remains constant at all debt levels, then the higher the proportion of borrowed funds, the higher the imputed asset value.

4.4.4 Summary

With reference to both the land market under consideration and the numerous competing theories that have been advanced, it is hypothesized that farm asset values are determined by the three variables which are incorporated in the following equation.

$$VA_t = \frac{[(1 - T)(E/A * YAE_t)]}{d} + \frac{D/A * YAE_t}{\left[\dfrac{M_t \, (1 - T)}{1 + IE_t} \right]}$$

Where: VA_t = The asset value, as at the beginning of the income year, t.

T = The marginal tax rate, as at the start of the income year, t.

E/A = The proportion of the purchase price to be funded from equity (%).

D/A = The proportion of the purchase price to be funded from debt (%).

d = The post-tax opportunity cost of equity funds.

M_t = Mortgage interest rate, as at the beginning of the income year.

IE = Expected rate of general inflation.

and YAE_t = Expected net profit for the period t, as formulated at the beginning of the period.

But before this model can be applied to time series data to test for the impact of financial leverage, a number of further considerations need to be addressed. Because some of the variables included in the equation cannot be observed directly, common econometric testing methods cannot be used. The problems of estimation, and an alternative analytical technique are examined in the succeeding section of this study.

4.5 Analytical Procedure

4.5.1 The Problem of Estimation

The land price equation presented in the previous section is in effect a net present value model, from which the productive value of farmland may be calculated. However, Newman (1986) points out that the majority of land market participants do not explicitly evaluate the net present value of farmland investment when establishing the purchase price. A comparable sales analysis is the most widely used technique, where the value of any given property is estimated using the sales price information from the sale of other similar farms. Although both the productive valuation and the comparable sales techniques should provide an appraiser with the same calculated value, the statutory definition of value requires the valuation profession to rely almost exclusively on the comparable sales analysis approach.

Thus, an individual investor who adopts the comparable sales approach has neither undertaken a present value of income approach to his investment analysis, nor actually computed any net present value. But he must assume that the market has computed them for him and that current market values, as established from comparable sales are a valid measure of net present value. This implies that some group of land market participants calculate the productive value of farmland, and that that value is consequently related to the remaining participants via land market transactions. Intuitively, one would expect that this market value should be set by the purchaser whose individual circumstances create a value to him which is the highest of all potential purchasers. This individual is described as the marginal land purchaser.

As a result, it is argued that any model which purports to examine the determinants of land price must be specified with the purchasing motives of the marginal land buyer in mind. For the Southland land market it is hypothesized that land value is set by productive users based on their expectations of future income and the required rates of return from both debt and equity funds. Importantly, the possible impact of consumptive and speculative users can be disregarded (as explained in Section 4.3).

However, because the specified land price equation must relate to the marginal land

purchaser, a number of particular analytical difficulties arise. The relevant circumstances of the marginal land purchaser are not directly observable, nor do they have reasonable proxies. There is no information available concerning the marginal land purchasers' proposed debt/asset ratio, mortgage interest rate or marginal tax rate. As all of these factors are included in the land price equation above as explanatory variables, direct econometric estimation of their impact on land price is not possible.

4.5.2 An Alternative Method

The major objective of this study is to examine the impact that financial leverage has had on farmland values. Thus, although three of the included explanatory variables are unobservable, the variable of primary interest is the debt/asset ratio used by the marginal land purchaser. In order to examine the importance of this factor in land price determination, the land price equation will be used to calculate four land value series, which differ only in respect to the assumed debt/asset ratios used in the calculations. All other variables will be held constant. These calculated land value series can then be statistically compared to the proxy series of actual land values and some assessment made of the impact that leverage has had on asset values.

The four alternative capital structure scenarios to be used in the analysis are as follows:

Case 1 - 100% Equity Finance

In this case, the entire net rent is subjected to income taxation before being capitalized at the opportunity cost of equity funds. As no debt finance is used, the expected advantages of tax-deductibility and debt erosion cannot be received.

Case 2 - Average Debt/Asset Ratio

This series is taken from the class seven sample data (Southland sheep and beef farms), and is calculated from the balance sheet figures for long-term liabilities and total farm capital.

Case 3 - Maximum Debt/Asset Ratio

This series is based on the maximum level of debt, measured as a percentage of asset value, that the Rural Banking and Finance Corporation will allow a mortgagee to borrow.

Case 4 - 100% Debt Finance

Although all lending institutions set a debt limit, 100% debt financing is possible if the lender has additional assets against which to secure the loan. As such, expanding farmers may use their existing property to effectively finance an additional land purchase entirely from debt.

Clearly the relative debt levels for each of the alternative debt/asset ratio series can differ quite substantially. Further, given the hypothesized importance of debt levels on the capitalization rate in the land price equation (shown in Section 4.4.4), these differences should ensure that the series of calculated asset values also differ considerably. Such a variation in the four series of calculated asset values is important. It allows a better comparison to the actual asset value series which in turn should highlight any apparent significance of financial leverage in the value determination process. Each of the calculated series differs only with respect to the debt/asset ratio used, and should any one series better represent the actual

value levels, then the impact of debt levels is more explicitly revealed.

However, before statistically comparing the calculated values to the proxy series of actual asset values, an explanation of the expected significance of financial leverage is given. The way in which its importance is thought to have changed during the 1962 - 1987 period is also examined.

4.5.3   The Expected Impact of Financial Leverage

The theoretical impact of financial leverage on farm asset values has been closely examined in Section 3.5. It was argued that through the impact of both interest deductibility and debt erosion the inclusion of debt finance in a farm buyer's capital structure will reduce the total required rate of return compared to that required from an all equity investment. If the capitalization rate is decreased, the imputed value of an investment in farmland should increase. This implied impact of financial leverage on the effective discount rate, and subsequent farm value has therefore been explicitly incorporated into the land price equation presented in Section 4.4.4.

The previous section also argued that farmland price is set by the purchaser whose individual circumstances create a value to them which is the highest of all potential purchasers. Such factors as managerial ability, the amount of available equity and the possible available sources of finance are considered to be important in determining who the marginal land purchaser is. If one assumes that the specified land price equation is an accurate representation of the true value determination process, the importance of an individual's debt capacity is readily apparent. As more debt is included in the purchaser's anticipated capital structure, the overall capitalization rate will be successively reduced by the lower cost of mortgage finance. Thus, assuming further that all potential land purchasers have identical expectations for future income, the individual with the highest debt/asset ratio will subsequently impute the highest land value for any given property.

It is therefore hypothesized that of the four series of calculated farm asset values, the one that will most accurately represent the actual series of values will incorporate a high level of debt. Because of the suggested impact that the financing structure may have on farm asset value determination, the marginal land purchaser is expected to use a relatively high level of debt finance. And as each of the farm asset value series calculated using the land price equation differs only with respect to the assumed levels of debt finance, their comparison to the actual series of values should help to highlight the possible influence of debt on value determination.

However, it is also hypothesized that the impact of financial leverage has not remained constant over the analyzed twenty five year period. Although no research evidence could be found to confirm the significance of factors which may govern the level of debt used in an asset purchase, a number of political, institutional and economic considerations are expected to be important. Possibly of most consequence is government agricultural policy which has changed quite dramatically throughout the 1962 - 1987 period.

During the late 1970's and early 1980's a raft of input subsidies and product price supports were introduced, farm development was actively encouraged through the provision of concessionary finance and suspensory loans and a number of producer board income smoothing schemes were set up which were both supported and guaranteed by government. The effects of these measures on farm asset values is expected to have been twofold. First,

and most obvious is the impact on farm incomes which were increased by both input and product subsidies. For example, Seed (1986) estimates that payments to sheep-meat producers were boosted by government assistance of some $624 M during the 1983/84 year. Such increases in farm incomes are likely to be reflected in an increased asset value as farmers' rent expectations for the future may also increase. But it is suggested that the policy interventions may have had an even more important impact on farm values by the way in which they affected the variability, and consequently risk of cash-flows from farming.

Government assistance had in effect guaranteed that farm incomes would not fall below a particular level, and as a consequence the inherent cash-flow, or business risk of the farming enterprise had also been significantly diminished. It is suggested that as the firm's business risk was reduced by the support measures, the confidence of participants in agricultural production increased. Simultaneously farm purchasers became more willing to accept higher financial risk through increased borrowing. This factor may provide an explanation for the large increases in farm asset values during the late 1970's and early 1980's, which Seed (1986) argued could not be solely attributed to increases in current farm incomes. With lower cash-flow variability, the marginal land purchaser may have increased the level of debt used in their capital structure and, following the given land price equation increased the imputed value of farmland.

Conversely, this process may be seen to have been reversed since the election of the Labour Government in 1984. Most of the existing agricultural support measures were either immediately removed or phased out over a period of time and as a result farm incomes become directly exposed to such variables as international commodity prices and a floating exchange rate. Farmers then faced a much higher level of income variability and subsequently could have far less confidence in future income expectations. The large decreases in farm asset values that occurred during the 1984 - 1987 period are suggested to be due in part at least to the increased business risk of farming and the associated reduction in the level of debt used by marginal land purchasers.

The large changes in the rate of inflation during the 1962 - 1987 period is another factor which is shown to have had an impact on the level of debt used by the marginal land purchaser. The debt-reducing effects of inflation were examined in Section 3.3 where it was shown that the effective cost of borrowed funds can be significantly decreased during a period of high inflation. However, the rate of inflation in New Zealand remained relatively low throughout the 1960's, until reaching double figures in 1974. The debt-reducing advantage of using borrowed funds during that period was therefore not great. But from 1974 until 1982, when the inflation rate ranged between 10% and 17.8%, that situation was changed appreciably. Because debt erosion then became a more significant factor, it is suggested that land purchasers would have been encouraged to use more debt finance during this eight year period to take advantage of the resultant capital gain.

The observed changes in both inflation and government policy during the 1962 - 1987 period will therefore be used to help to identify a number of distinct periods in which the hypothesized impact of financial leverage may have changed. These are the main factors which are thought to have influenced the expectations of land market participants, and ultimately their attitudes to the use of financial leverage in a farm purchase.

Although the choice of periods is essentially a subjective one, the research by Le Heron (1989) does give some information which may be used to make the decision. Le Heron took a political economy perspective on the expansion of New Zealand livestock farming from 1960

to 1984, and as a part of the study the author carefully documented the changes that occurred in government policy over the period. That information was used to split the entire period into the following four distinct sub-periods.

Period 1: 1962 - 1968

The level of government support for agriculture remained relatively low over this period. An income equalisation and retention scheme was initiated in 1965 in response to a rapid increase in wool prices during 1963 and 1964. By 1967 however, wool prices had declined to the point where it was not necessary for the Wool Commission to intervene in the market by purchasing wool offered for sale. Relatively volatile farm incomes and a constantly low rate of inflation would suggest that likely debt levels were low during this period.

Period 2: 1969 - 1977

During this period real net income and real capital gains were extremely volatile. Primarily this was due to a commodity boom in 1972 and 1973 and the first oil shocks of October 1973 and January 1974, when the price of crude oil quadrupled within three months. These large fluctuations in real farm incomes are expected to have acted as a major disincentive for the use of high debt levels in a farm purchase.

However, between 1969 and 1977 there were also a number of significant policy interventions by central government. These ranged from the introduction of a number of input subsidies in 1969 to the introduction of a minimum price guarantee for lamb and wool in the 1974/75 season. Seed (1986) points out that agriculture as an export sector was perceived to be disadvantaged by protection provided to the import competing sectors. To compensate for any distortions in commodity markets which may have disadvantaged agriculture, the government introduced a range of tariff policies to ensure that farm incomes remained at an "adequate" level.

Mainly as a consequence of the oil shocks, the rate of inflation also increased markedly over this period, reaching a peak of 17.8% in 1976. The debt-eroding advantage of using borrowed funds should have become more apparent between 1969 and 1977 as the rate of inflation consistently reached double figures. This factor, coupled with the beginning of large scale government intervention in the pastoral agricultural sector are expected to have induced an increase in the level of debt employed by marginal land purchasers.

Period 3: 1978 - 1983

During this six year period the scale of government support measures for agriculture reached its peak, and is one of the main reasons why farmers are expected to have utilized the highest levels of debt in the entire 1962 - 1987 period.

Seed (1986) explains that this period saw the introduction of three large assistance schemes designated to ensure that farm incomes were "adequate", to encourage production in the pastoral agricultural sector and to restore its "competitiveness" as an exporter. The three schemes were, the Livestock Incentive Scheme, the Land Development Encouragement Loan Scheme and The Supplementary Minimum Price Scheme. A crawling peg exchange rate adjustment system was also introduced in 1979. This system attempted to maintain the real exchange rate at a constant level by adjusting the nominal exchange rate in response to domestic and foreign inflation rates. The Governments' objective was to maintain the

competitiveness of New Zealand's export sector.

However, as explained above, one of the main consequences of these policy initiatives may have been to effectively reduce the business risk of the farming enterprise. As the volatility of farm incomes decreases, farmers should become more confident about future income expectations and therefore be more willing to accept an increased financial risk through larger borrowing. It is hypothesized that the government policy initiatives introduced during this period helped to induce a greater use of debt finance by the marginal land purchaser, and that this factor contributed to the large increases in farm asset values between 1978 and 1983.

Period 4: 1984 - 1987

This final period saw the election of a Labour Government which quickly dismantled the existing agricultural support measures. Farmers again faced a future of highly uncertain cash-flows as both input and output prices became directly dependant on world price levels. As the inherent business risks of farming were returned to their non-distorted levels the farm buyer's attitude towards debt finance is also expected to have changed quickly. It is therefore suggested that the amount of debt used by the marginal land purchaser between 1984 and 1987 returned to a moderate level.

4.6 Expectations

4.6.1 Introduction

In the previous section it was pointed out that some of the explanatory variables included in the land price equation are unobservable. The particular financial circumstances of the marginal land purchaser are unknown, and there are no reasonable proxies for the purchaser's proposed debt/asset ratio, mortgage interest rate or marginal tax rate. To overcome this problem a number of alternative values for each of these variables have been selected and used to calculate a farm asset value series for each of the four debt/asset ratio scenarios. There are however two further explanatory variables included in the land price equation which are unobservable.

The model has a dependent variable that does not depend on the actual value of both farm income and inflation, but rather on the expected or permanent level of these variables. When a land market participant forms an estimation of asset value, he is obviously more concerned with the likely future levels of income and inflation than the present or historical level of both variables. Thus any land price determination model must attempt to reflect the manner in which economic agents formulate expectations and incorporate them into the decision process. The problems of doing so are not inconsiderable. First expectations are, at least in part, subjective and therefore the personal judgements of an individual. And second, economic agents are required to make a point estimate that may not refer to a single future period, but rather describes the expectations for a multi-period planning horizon.

Carter and Maddock (1984) have presented four general schemes which may be used to represent the formulation of expectations. These are: (i) static expectations, (ii) extrapolative expectations, (iii) adaptive expectations and (iv) rational expectations, all of which will be briefly discussed in the next Section.

4.6.2 The Treatment of Expectations

(i)   The static expectations behavioral equation is the most simplistic of the four general schemes. It states that economic agents base their expectations for the value of an explanatory variable on the actual level of that variable in the previous period. Thus, the behavioral equation is:

$$V_t^* = V_{t-1}$$

where: V_t^* = the expected level of the variable in period t.

This obviously assumes that the decision maker does not consider the past direction of change in the level of the variable, nor the possibility that any given observation may be significantly different from an otherwise stable trend.

(ii)   The extrapolative expectations scheme improves on the static case by including the direction of change in the economic variable. The behavioral equation then becomes;

$$V_t^* = V_{t-1} + Q(V_{t-1} - V_{t-2})$$

where Q is the coefficient of expectation.

Expectations for the future period are then equal to the current period's level plus a fraction, Q, of the change between the previous two periods. If Q is positive, the existing trend is expected to continue, while that trend is expected to be reversed if Q is negative. The extrapolative expectations scheme becomes identical to static expectations if Q is equal to 0, implying that no trend information is included.

(iii)   The adaptive expectations includes an error correction term as agents are assumed to revise their expectations for the future period according to the degree of error in their previous estimates. The expected level of the variable, V, in period t is defined as;

$$V_t^* = V_{t-1}^* + (1 - \lambda)(V_{t-1} - V_{t-1}^*)$$

where λ is the coefficient of adaptation and $(V_{t-1} - V_{t-1}^*)$ measures the previous periods' error. The size of λ determines the speed with which economic agents' expectations adjust to past errors. It may also be considered a gauge of whether or not agents expect the factors which contributed to the expectation error to exist in the future.

Carter and Maddock (1984) suggest that all three of these expectations hypotheses have a common weakness in that they are not based on any underlying theory of economic behaviour. Each of the schemes essentially states that the expected value of a variable is formulated using some manipulation of past levels of that variable only. Muth (1961), on the other hand advanced the hypothesis that economic agents would use all of the information available to them in forming their expectations.

(iv)   The rational expectation hypothesis therefore attempts to incorporate an assumed knowledge of the economic system into the formulation process. That is, the expected

value of a variable should be considered endogenous to the model, where the expected value is equal to the equilibrium value of the explanatory variable plus the expected value of the error term. Seed (1986) points out that although rational expectations has the advantage of providing a basis for calculating weights in a distributed lag, truly rational expectations require a large amount of information to be operational.

Irrespective of the advantages that the rational expectations hypothesis may provide, a number of reservations concerning the relevance of all four schemes to the land market remain. Of most consequence is the fact that the schemes are essentially retrospective, and in some cases use information which may not always be available to, or considered by, the economic agents that the model purports to represent. Any expectations hypothesis should be formulated with careful regard to the economic sophistication of the relevant market participants. The extrapolative, adaptive and rational expectations models may inadequately represent the way in which farm buyers form expectations, partly because they incorrectly assume that these agents have a thorough understanding of the economic system. Thus, as Hebden (1983) points out, sometimes the most naive model can (rather humiliatingly) perform just as well as any others.

Moreover, the relevance of these hypothetical constructs is questionable when it is known that the decision makers have some appreciation of what is going to happen in the near future, and almost certainly use this information when forming their expectations. For example, at the beginning of any given year farmers usually have some knowledge of likely product prices and input costs for the coming period. This information will obviously be used to help form expectations of future income, and may suggest a level of income not discernable from historical information alone. That the four expectations schemes described by Carter and Maddock (1984) use past information only is a major problem.

Unfortunately, none of the research reviewed for this study has attempted to incorporate any allowance for future predictions of the level of a variable into the formulation of expectations. It is obviously difficult to retrospectively determine what future information is known by the economic agents when they form expectations. Indeed, most of the reviewed studies have empirically tested the relevance of the four general schemes, and then simply used the hypothesis which provides the best fit of the sample data. As a result, the particular expectations scheme is often chosen with more regard to empirical accuracy rather than the theoretical justification that each suggests.

The expectations hypotheses that are considered most relevant to this study are discussed in the next two Sections.

4.6.3 Expectations of Returns to Total Production Assets

Selection of an expectations hypothesis that accurately reflects the way in which income expectations are actually formed by land buyers is obviously an important task. From the specified land price equation, expected income is one of the most important determinants of farm asset values and the calculated values are subsequently very sensitive to the particular expectations scheme used. The previous section argued that the chosen hypothesis should best reflect the assumed economic behaviour of the agents in the model. In this instance, the most appropriate scheme will depend on the level of economic sophistication and amount of information that farmland buyers are assumed to have. The choice should not be made

strictly on the criterion of which expectations scheme allows the best fit of the data.

The previous Section also suggested that all four retrospective hypotheses do not realistically represent the way in which farmers form expectations, since they do not permit the incorporation of all relevant future information that may be available to the agents. This is an important failing as most farmers, and certainly all marginal land purchasers are thought to base future income expectations on predicted future product prices and input costs. In many instances, these future predictions cannot possibly be implied by the returns from previous periods alone. The most obvious example of this is when a government price support, or input subsidy is announced. An expectations hypothesis based on historical farm returns cannot incorporate this important information even though it is available to farmers, and almost certainly used when forming their expectations of future returns.

As a result this study will use an expectations scheme which allows for the incorporation of future information. Actual returns to farm assets for each period, as calculated from the N.Z.M.W.B.E.S. surveys will be used as a proxy for the future periods' expected income. However, although this gives a reasonable approximation of what land market participants may budget on receiving in the coming year, the farmers' prediction should not be expected to exactly equal actual returns. A constrained random error term will therefore be added to the expected value of farm returns to allow for this anticipated prediction inaccuracy. There is unfortunately no research evidence available that may indicate how large the budgeting errors have historically been, although expert opinion and experience[1] suggests that an error of 10% may be a reasonable estimate.

Previous experience also suggests that farmers incorporate a small amount of past information into the formulation of expectations. That is, their estimations of the future, or permanent level of income are based on some weighted average of last period's income and the budgeted return for the coming period. Again there is no research evidence available to suggest what the respective weightings may be, and the proportions used in this study must be arbitrarily set. Nevertheless, despite the obvious shortcomings of this scheme, it is still thought to more realistically represent the manner in which expectations are actually formulated by land buyers compared to the four schemes previously discussed.

Initially, the expected level of farm income will be determined using the following behavioral equation.

$$YA^*_t = 0.3YA_{t-1} + (0.7YA_t + RE_t)$$

where YA^*_t = expected returns to farm assets in the current period, t, as formed at the beginning of that period.

YA_{t-1} = Actual returns to farm assets in the previous period.

YA_t = Actual returns to farm assets in the current period t.
This value will be used as a proxy for the budgeted, or predicted return for the current period.

RE = A random error term which will be constrained to a range of ± 10% of YA_t, with a mean of 0.

and the period weightings will initially be set at the levels shown.

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[1]. Dr G.A.G. Frengley, Lincoln University.

Because both the relative period weightings and the size of the random error have been arbitrarily set, a sensitivity analysis will be carried out to establish whether the results of the analysis are dependent on these imposed values.

4.6.4 Expectations of Inflation

The importance of choosing an expectations hypothesis which has particular regard to the assumed economic sophistication of the economic agents involved is emphasized in Section 4.6.1 of this study. It is advanced that the chosen hypothesis should only use information which is thought to be both available to, and considered by land market participants when formulating their expectations. Unfortunately there is no research evidence available to suggest which variables are actually incorporated into a land purchaser's formulation of expected inflation.

In a survey of expectations hypotheses used in United Kingdom models, Holden et al (1985) find that most of the expected price level models are similar to that used by the British Treasury. Expected inflation is calculated as a weighted average of the previous year's inflation and the rate of growth of the money supply during the previous years. The weights are determined by regression analysis. Thus to the extent that past money growth indicates future inflation, this price expectation series may be regarded as a compromise between forward and backward looking expectations.

However, this hypothesis is not considered to be directly applicable to the economic agents that this study is attempting to model. The rate of growth in the money supply is not expected to be used by farmland purchasers as an explanatory variable of the future inflation rate. Inclusion of this variable would necessarily require an assumption that land market participants have an advanced appreciation of the macroeconomic system and its underlying economic theory. It is argued that such an assumption cannot be made in this instance.

As a result, the expectations scheme to be used in this study is a second order distributed lag. This model is considered to be a more realistic representation of the way in which land owners estimate expectations of the future level of inflation. Farmers are assumed to use the observed levels of inflation in previous time periods to form their expectation of the inflation rate in the current period. The respective weights were calculated using regression analysis.

4.7 Definition of the Variables

The previously specified land price equation states that land price is some function of the returns from the land, or more correctly, net rent. But, as has already been pointed out, time series data in New Zealand are not readily available. Seed (1986) suggests the alternative is to calculate proxies for land price and net rental income which will capture the effects of the unobtainable variables and maintain the relationship between the price of land and its explanatory variables. Although this procedure will unavoidably introduce some amount of computational error into the analysis, its use is necessitated by the lack of net rental data.

The approach taken in this study is to adjust land price and net income to obtain two theoretically comparable series. The data used for the computation of most variables is taken from the N.Z.M.W.B.E.S. sheep and beef farm surveys, and the period of the study was 1962 - 1987. Class seven farms (representing Southland) have been chosen as the sector to be studied. All variables are measured in nominal terms.

4.7.1 Proxy for Net Rent: Current Returns to Total Production Assets

This variable represents the return to total farm capital and is not specific to the form of ownership or the method of financing. It is calculated by adding rent, interest and managerial salaries to the farm cash surplus. Because this figure still contains a return to labour and management, an assessed management reward has been deducted to obtain an estimate of residual return attributable to production assets alone. The N.Z.M.W.B.E.S. calculates management reward by adding one percent of total farm capital to the current average wage for a married couple.

4.7.2 Proxy for Land Value: The Value of Total Production Assets

Because the chosen proxy for net rent is an aggregate return to total farm capital, it cannot be justifiably compared to land value alone. Thus, the value of total production assets is calculated by adding the value of livestock, plant and machinery, and working capital to the property's capital value, less the value of the dwelling. The use of this proxy series avoids the need to calculate a separate return to all of the other assets so as to extract a return that is solely attributable to land. An accurate return to assets such as livestock, plant and machinery would require significantly more data in order to be accurately quantified.

4.7.3 Proxy for the Inflation Rate: Consumer Price Index

In this study the percentage change in the Consumer Price Index has been chosen as a measure of the overall inflation rate in the general economy. This index provides the best indication of how the real value of outstanding debt is reduced by inflation.

4.7.4 Proxy for the Rate of Income Tax: The Highest Marginal Tax Rate

The effective income tax rate faced by the marginal land purchaser is unobservable. However, it is anticipated that the highest marginal tax rate is most applicable as it reflects the high income earning position that the marginal land purchaser is assumed to hold.

4.7.5 Proxy for the Opportunity Cost of Equity: Long Term Government Security Yields

The chosen proxy for this variable is thought to have a similar risk and temporal profile as equity investment in farmland. The chosen series has also been used as it is one of only a few truly consistent long term series.

4.7.6 Proxy for the Cost of Debt: Rural Bank Mortgage Interest Rate

This proxy series reflects the concessional interest rates available to farmland investors through most of the period covered by the analysis.

4.7.7. Potential Problems with the Data

In his study of land price determination, Seed (1986) also used N.Z.M.W.B.E.S. data and pointed out that some potential biases may arise due to the way in which it is recorded. He suggests that farm incomes may be biased downwards because capital expenditure cannot be easily disaggregated from general expenditure. As a result, such expenditures may be included in repairs and maintenance and thereby reduce the observed, or calculated level of

farm income.

Seed further suggested that in periods of high product prices, and subsequently high gross incomes farmers may increase expenditure on several capital items in an effort to reduce taxable income. Or conversely, in years of low gross incomes farmers may limit maintenance expenditures such as fertiliser applications in an attempt to preserve an adequate income level. In both of these cases expectations of income may differ significantly from the actual recorded income levels.

Although both of these factors are likely to introduce some inaccuracies into the analysis, there is a more important concern regarding the use of the N.Z.M.W.B.E.S. surveys as the data source. The land price equation has been specified with respect to the marginal farmland purchaser. The relevant explanatory variables are however taken from a survey sample and, in effect represent average levels of those variables. As such, the proxy series for net rent is expected to consistently under-estimate the level of income obtained by marginal land purchasers, who are expected to perform better than average. The N.Z.M.W.B.E.S data is however the only consistent data series available.

CHAPTER 5

RESULTS OF THE ANALYSIS

5.1 Introduction

The hypothesized determinants of farm asset values for the N.Z.M.W.B.E.S. class seven sample farms are incorporated into a land price equation in section 4.4, and includes the level of debt used by the marginal land purchaser as an explanatory variable. Unfortunately, the importance of financial leverage in the farm value determination process cannot be directly estimated. As explained in section 4.5.1, the relevant circumstances of the marginal land purchaser are not directly observable and nor do they have identifiable proxies. Most importantly there is no information available concerning the marginal land purchaser's proposed debt/asset ratio. This factor precludes econometric estimation of their impact on land price.

As a result, an alternative analytical method is proposed in section 4.5.2 which involves the calculation of four land value series that differ only in respect to the assumed debt/asset ratios used in the calculations. With all other variables held constant these calculated land value series can be statistically compared to the proxy series of actual land values. Consequently some assessment can be made of the impact that financial leverage has had on farm asset values during the 1962 - 1987 period.

Because direct estimation is not possible, some alternative descriptive statistics are needed to measure the relative ability of each of the calculated value series to accurately reproduce the proxy series of actual values. Two main accuracy measures are used in this study. They are the correlation coefficient and Theil's inequality coefficient, both of which are described in section 5.2. These are then applied to the class seven data in section 5.3 to determine which of the four debt/asset ratio alternatives provides the best fit to the actual asset value data. In section 5.4 the same descriptive statistics are used to estimate how the hypothesized impact of financial leverage may have changed during the 1962 - 1987 period, by individually analyzing the four sub-periods identified in section 4.5.3.

5.2 Statistical Measures of Accuracy

5.2.1 Correlation Coefficient

The correlation coefficient is normally used as a measure of the linear relationship between two variables. The coefficient of correlation, r, is a relative measure of the linear association between these two variables. It may vary from 0, which indicates no correlation to ± 1, which indicates perfect correlation. When the correlation coefficient is greater than 0, they are said to be positively correlated. However, it is important to note that an apparent relationship between the two variables does not necessarily infer that changes in the value of one of the variables depends upon, or is caused by changes in the value of the other variable.

Makridakis et al. (1982) suggest that the correlation coefficient can be correctly interpreted in two ways. First, the sign of r shows the direction of the relationship between the variables. And second, the strength of the association is measured by the absolute value of

(45)

r. As the absolute value of the correlation coefficient moves away from zero, the two variables become more strongly associated. Moreover, the intuitive interpretation of the correlation coefficient is also dependent on the type of analysis to which it is applied.

In this study, it is being used to measure the accuracy with which the specified land price equation replicates the actual farm asset value time series. Thus, although a high correlation coefficient may indicate that any given change in the actual value of farm assets is closely matched by a similar change in the corresponding calculated value, it does not necessarily follow that the land price equation is an accurate representation of the true land value determination process. There may be large divergences in the values of the two time series in absolute terms, even if the correlation between the two variables is high. For example, the calculated value of farm assets may be consistently higher or lower than the proxy series of actual values throughout the entire period, even though the changes in each series are similar in both direction and size.

As a result, the correlation coefficient should not be used as a sole measure of model accuracy.

5.2.2 Theil's Inequality Coefficient

The fundamental measures of how well an explanatory model is able to reproduce known data all use some variation of the estimate errors. For any given time period, the estimate error is calculated as the difference between the actual observation of a variable and the estimate of that variable's value. The 'goodness - of -fit' provided by an explanatory model can be established with reference to such statistics as the mean error, the mean absolute error, or the mean squared error, which has the advantage of penalising large errors by squaring them. But as Makridakis et al. (1982) explain, all of these measures have several limitations and can be misleading.

Another method of examining the adequacy of an explanatory model is by comparing its performance to that provided by a simple naive model. The most naive model uses the actual value of the dependent variable in the previous period as the best estimate of its value in the current period. Theil's inequality coefficient, or U-statistic considers both of these factors. It allows a relative comparison of an explanatory model with the naive approach, but also incorporates an advantage provided by the mean squared error, where the disproportionate cost of large errors are given more weight than small errors.

Mathematically, Theil's U-statistic is defined as:

$$U = \sqrt{\frac{\sum_{i=1}^{n=1}\left(\dfrac{P_{i+1} - X_{i+1}}{X_i}\right)^2}{\sum_{i=1}^{n=1}\left(\dfrac{X_{i+1} - X_i}{X_i}\right)^2}}$$

Where P_i = The predicted value of the variable in time period i.
and X_i = The observed value of the variable in time period i.

The numerator can be defined as the relative prediction error while the denominator describes the relative changes in the observed variable.

For a perfect predictor the calculated and observed values of the variable are equal in each time period, thereby forcing the value of the numerator term equal to zero. In this case the value of Theil's U-statistic will also equal O. Alternatively the U-statistic will have a value of 1 only if the errors in the calculated values are the same as those that would be obtained by using the observed value in the previous period as the estimate of that variable's value for the current period.

The ranges of the U-statistic are summarised by Makridakis et al. as follows. If, U = 1, then the estimation model being evaluated is no better than a naive model.

U < 1, then the estimation model being used is better than a naive method. The smaller the U-statistic the better the estimation model is relative to the naive method.

U > 1, there is no point in using the specified estimation model, as the naive method will product better results.

Another method of evaluating the adequacy of an estimation model also provides an explanation of the reasons why the calculated U-statistic differs from zero. This involves a regression of the actual changes in the observed variable on the changes in the estimated values. If the specified model produces estimates which exactly replicate the observed values of a variable, then the regression intercept will equal O and the slope coefficient will equal 1. The calculated U - statistic will also equal zero. However when the model produces results which are less than perfect, Theil (1966) suggests the calculated mean square error can be broken down into three parts.

The first, called the bias proportion corresponds to that part of the mean square error resulting from a tendency to produce estimates which are either too high or too low, and is reflected by the extent to which the regression intercept differs from zero. The second proportion of the mean square error is measured as that due to systematic influences. It is measured by the extent to which the slope coefficient in the regression equation differs from 1. The third, called the disturbance proportion reflects that part of the mean squared error resulting from an unpredictable error, which in turn is measured by the variance of the residuals from the regression equation. The specified explanatory model is considered to be more accurate if the difference between the U - statistic and zero is the result of error explained by this third category. The proportion of error due to the other two parts will therefore then be approaching zero.

Theil (1966) also gives an alternative composition of the mean squared error, where it is broken down into bias, variance and covariance proportions. However, because this alternative has been shown by Granger and Newbold (1973) to have questionable meaning, the first decomposition explained above will be used in this study.

5.3 The Impact of Financial Leverage on Farm Asset Values, 1962 - 1987

Using the land price equation presented in Section 4.4 of this study, the four alternative series

of farm asset values were calculated and subsequently compared to the proxy series of actual values. The primary objective of the analysis is to establish which of the four assumed debt/asset ratios provides a series of calculated values that most accurately represents the observed time series data. The Time Series Processor (T.S.P.) econometric package was used to perform the analysis.

Before the statistical results are reported and discussed, it is important to reconsider some problems and limitations the chosen analytical method presents. The specified land price equation is a non-parametric deterministic model. As no allowance is made for uncertainty, the model used in this study is open to similar criticisms as those Seed (1986) levelled at the model used by Leathers and Gough (1984). There is no relationship estimated between the explanatory variables and the dependent variable, and as a result the relative impact of each variable on the calculated value of total farm assets is the direct result of its mathematical specification.

However as previously discussed, direct econometric estimation of the relationship between the explanatory and dependent variables is not possible because several of the included explanatory variables are unobservable. The analytical approach taken in this study is a direct consequence of this problem. Thus, any conclusions made concerning the apparent impact of financial leverage on farm asset values are reliant on an assumption that the specified land price equation is a close representation of the true but unknown value determination process. This is obviously a crucial assumption and one that must depreciate the potency of any conclusions drawn from the analysis.

With regard to this factor, a summary of the statistical results is reported in table 5-1. The calculated farm asset value series which provides the most accurate comparison to the proxy series of actual values over the entire period uses the assumed debt/asset ratio described by case 3. Of the four alternative calculated scenarios, case 4 provides the highest correlation coefficient of 0.8925, which suggests that this series is the most strongly associated with the actual value series. However, the calculated U-statistic for case 4 is the highest of all the alternatives at 0.8684, indicating that this estimation model is least able to replicate the observed series of farm asset values. Decomposition of the calculated error shows that although the relative changes in the actual values of farm assets are closely matched by the changes in the case 4 calculated values, the calculated values are consistently and appreciably larger than the proxy series. The tendency of this model to overestimate farm asset values is reflected by the high calculated proportion of the error caused by bias. It is therefore suggested that the amount of debt used by land purchasers during the 1962 - 1987 period was significantly lower than the 100 percent level assumed in the case 4 calculated series.

Table 5.1

Summary Results: Comparison of Actual and Estimated Series, 1962-1987

	Case 1	Case 2	Case 3	Case 4
Assumed Debt Levels	Nil	Average	Max.	100%
Correlation Coefficient	0.1800	0.6956	0.7983	0.8925
Correlation Coefficient Squared	0.0324	0.4839	0.6372	0.7965
Mean Absolute Error	80.31	74.59	40.15	110.58
Theil's U Statistic	0.8269	0.5429	0.3778	0.8684
Fraction of Error Due to: Bias	0.4899	0.1868	0.0033	0.8684
Due To: Difference From Unity	0.0021	0.1845	0.0841	0.0337
Due To: Residual Variance	0.5080	0.6287	0.9127	0.0980

The results from the comparison of both case 1 and case 2 calculated values with the proxy series of actual farm asset values also indicates that neither of the debt levels assumed in these scenarios closely represents those used by the marginal land purchaser. Case 1 assumes that no debt was used in the farm purchase and all of the statistics suggest that this explanatory model is a poor representation of the true asset value determination process. With a correlation coefficient of just 0.1800 and a calculated U-statistic of 0.8269 the case 1 model produces estimates of farm asset value which are consistently lower than the proxy series of actual values. The case 2 model, which incorporates the debt levels observed in the N.Z.M.W.B.E.S. class seven farm data produces marginally better results. However the U-statistic of 0.5429 is still relatively high, with a large proportion of the error due to both bias and the difference between the regression coefficient and unity.

Thus of all the four alternative scenarios, the case 3 model with a correlation coefficient of 0.7983 and a calculated U-statistic of 0.3778 produces estimates of farm asset value which most accurately replicates the proxy asset value series. Decomposition of the errors between the estimated and observed series also indicates that this debt level is most relevant of the four alternatives. The proportion due to bias is calculated at less than one percent, while that due to the difference between the regression coefficient and unity is also relatively small at 8.41 percent. The size of these two proportions indicates that the level of structural error within model three is low, and that most of the difference between the observed and

calculated values is a result of residual variance or unpredictable error.

As explained in Section 4.5.2, the debt/asset ratios described by case 3 are based on the maximum level of debt that the New Zealand Rural Banking and Finance Corporation will allow a mortgagee to borrow, measured as a percentage of total farm asset value. During the 1962 and 1987 period that limit has ranged between 31.3 percent and 49.7 percent. The results of this analysis therefore provides evidence to suggest that the use of financial leverage has been an important factor in the determination of farm asset values. The advantages of using debt finance in a farm purchase have been examined in Section 4.4 of this study. It was argued that the effects of both tax deductibility of interest payments and debt erosion reduce the investor's effective required rate of return, and that the capitalized value of farmland for a farmer who uses debt is subsequently higher than that calculated for an all equity investment. That the case 3 model has been shown to produce the most accurate estimates of farm asset values supports the hypothesis advanced in Section 4.5.3, which argues that the marginal land purchaser was expected to use a relatively high level of debt finance to take advantage of its potential benefits.

However, it was also hypothesized in Section 4.5.2 that the impact of financial leverage has not remained constant over the analyzed twenty five year period. Comparison of the four alternative calculated value series with the observed series shows that none of the assumed debt levels appears to consistently represent that used by the marginal land purchaser for the entire twenty five years period. In fact, the case 3 model consistently overestimates the value of farm assets for the first nineteen years of the 1962 - 1987 period, indicating that the level of debt used by the marginal land purchaser up until 1981 was less than that represented by case 3. A number of possible factors which have governed the level of debt used in an asset purchase have been suggested. The one of most consequence is thought to have been government agricultural policy which has changed significantly throughout the analyzed period. But before this question is addressed, the sensitivity of the reported results to the way in which income expectations are expressed in this study are examined.

The assumed expectations formulation process attempts to incorporate information about future returns which is known by the land purchaser at the beginning of each period, but which is not expressed in historical net returns data. Thus actual returns to farm assets for each period have been used as a proxy for the budgeted returns in that period, and a proportion of this figure is added to a proportion of net income from the previous period to give an estimate of the income level to be capitalized. This expectations scheme is expressed in Section 4.6.3 as,

$$YA^*_t = 0.3 \, YA_{t-1} + (0.7 \, YA_t + RE)$$

where YA^*_t = The expected level of net income for time period t.

YA_t = the actual level of net income in the time period t, which acts as a proxy for the budgeted level of income in period t.

and, RE = a random error term which has a range of ± 10% of YA, and a mean of zero.

Both the range and mean of the error term have been set with reference to expert opinion only. It is suggested that the difference between farmers' budgeted estimates of net income for the coming period and the actual realized levels of income has a range of ± 10 percent, and that for any given sample of farmers the budget errors would have a zero mean. The

calculated series of income expectations used in the analysis presented earlier has therefore also used an error term with a value of zero.

The sensitivity analysis examines whether or not the statistical results, and subsequent conclusions drawn from the previous analysis are dependent on this assumption. The four alternative farm asset value series were recalculated allowing for a budget error of plus and minus ten percent of YA_t, and then compared to the observed series using the same technique as previously described. Both sets of results are reported in Appendix 4, and these show that the changes to the expected level of income do not alter the conclusions reached earlier. In both cases the third alternative debt level produces estimates of farm asset value which most accurately reflect the proxy series of actual values. In fact the relative accuracy of each of the four alternative cases is not affected by the changes to the error term.

5.4 The Hypothesized Changes in Debt Levels Between 1962 and 1987

The analyzed period of 1962 - 1987 has been split into four distinct sub-periods to examine the hypothesis advanced in Section 4.5.3. This suggests that there are many possible factors which may affect the fraction of debt used by the marginal land purchaser, other than the advantages of tax deductibility and debt erosion. The level of government support measures is expected to be the most influential of these factors. As explained in Section 4.5.3, government policy initiatives which are designed to either boost or maintain net incomes may have an effect other than merely increasing the current profitability of farming. These policies have also had an impact on the level of debt used in a farm purchase because of the way in which they affected the variability, and consequently the risk of cash-flows from farming. It is suggested that as more income support schemes are implemented the level of business risk faced by a farmer is reduced, and a higher level of debt finance is subsequently employed in land purchases.

Thus, the changes in government agricultural policy during the 1962 - 1987 period, as observed by Le Heron (1987) were used to identify a number of sub-periods in which the level of debt used by the marginal land purchaser may have changed. The four chosen periods are described in Section 4.5. together with the corresponding level of debt thought to be most relevant in each particular period. The same analytical procedure as that applied to the data for the entire twenty five year period was used to examine this hypothesis, and the summary results are presented and discussed below.

5.4.1 Period 1: 1962 - 1968

During this period, farmers experienced relatively volatile farm incomes, a consistently low rate of inflation, and received relatively little government income assistance. As a result, it is suggested in Section 4.5.3 that the level of financial leverage employed by farm purchasers was also low. Examination of the summary analytical results presented in table 5.2 tends to support this argument.

The calculated U-statistics for both the case 3 and case 4 models are relatively high, at 0.7111 and 2.5833 respectively. That the majority of the error between the estimated and observed values is caused by bias indicates that the levels of debt that these two cases represent are significantly higher than that used by the marginal land purchaser during the 1962 - 1968 period.

Table 5.2

Summary Results: Comparison of Actual and
Estimated Series, 1962-1968

	Case 1	Case 2	Case 3	Case 4
Assumed Debt Levels	Nil	Average	Max.	100%
Correlation Coefficient	- 0.1061	-0.1547	0.1019	-0.0462
Correlation Coefficient Squared	0.0113	0.0239	0.0104	0.0021
Mean Absolute Error	17.26	13.67	26.38	102.73
Theil's U Statistic	0.4575	0.4039	0.7111	2.5833
Fraction of Error Due to: Bias	0.8373	0.5423	0.8092	0.9299
Due To: Difference From Unity	0.0850	0.3592	0.1586	0.0673
Due To: Residual Variance	0.0777	0.0985	0.0322	0.0025

However, although the statistical results from the first two models are quite similar, model two provides the more accurate representation of the proxy series of actual farm asset values. Case 1 produces a U-statistic of 0.4575 while that for the case 2 model is marginally lower at 0.4039. The highest proportion of the errors between the calculated and observed series is due to bias in both cases. Examination of the two calculated series of farm asset values shows that the case 1 model consistently underestimates the proxy series of actual values while the case 2 values consistently overestimates these values. The degree of financial leverage actually used by the marginal land purchaser between 1962 and 1968 is therefore expected to have fallen between the levels of debt assumed by cases 1 and 2.

5.4.2   Period 2: 1969 - 1977

The changes in both net farm incomes and government agricultural policy during the period are described in Section 4.5.3 It was argued that the combined effect of these two factors, together with a significantly higher level of inflation which persisted after the 1973 oil-shock acted to encourage a greater use of financial leverage in this period than that used between 1962 and 1968.

The summary results from the period 2 analysis are reported in table 5.3, and indicate that the case 2 model again provides the most accurate calculations of total farm asset value. The assumed debt level represented by this scenario is the average debt/asset ratio observed in the N.Z.M.W.B.E.S. class seven data. However, even though the case 2 model has been found to most accurately replicate the proxy series of actual asset values in both the 1962 to 1968, and 1969 to 1977 periods, the results still indicate that some increase in the level of debt used by land purchasers has occurred during the latter period.

Table 5.3

Summary Results: Comparison of Actual and Estimated Series, 1969-1977

	Case 1	Case 2	Case 3	Case 4
Assumed Debt Levels	Nil	Average	Max.	100%
Correlation Coefficient	0.2478	0.4879	0.6723	0.6361
Correlation Coefficient Squared	0.0614	0.2380	0.4519	0.4046
Mean Absolute Error	29.93	18.00	33.17	105.83
Theil's U Statistic	0.5364	0.3542	0.6007	1.7599
Fraction of Error Due to: Bias	0.6329	0.2280	0.6288	0.8579
Due To: Difference From Unity	0.0544	0.1899	0.2257	0.1237
Due To: Residual Variance	0.3127	0.5820	0.1456	0.018

Case 1 has a calculated U-statistic of 0.5364 while that for the case 2 model is measured at 0.3542. The difference between these two statistics is higher than that observed between the U-statistics for cases 1 and 2 in the previous period. The relative accuracy of the case 2 model is also improved when it is applied to the 1969 - 1977 period. These factors provide some evidence to suggest that the relevant level of debt used by the marginal land purchaser has increased during this second sub-period. First, the tendency of the case 1 model to underestimate farm asset value is greater in this time period than that observed between 1962 and 1968. This suggests that the level of debt represented by case 1 is even more inappropriate for the 1969 - 1977 period than it was previously. Conversely, the case 2 model produces more accurate results than those obtained in the analysis of period 1 when it is

applied to the second sub-period. Thus although it continues to overestimate the observed values of farm assets, the degree of overestimation is reduced when using data from between 1969 and 1977.

5.4.3 Period 3: 1978 - 1983

As described earlier in Section 4.5.3 of this study, the scale of government support measures for agriculture reached its peak during the 1978 - 1983 period. As well as the introduction of the Supplementary Minimum Price Scheme, this period also saw the initiation of two other major policies which were designed to actively encourage farm development and intensification. The government was effectively guaranteeing future net farm income at an 'adequate' level, and thereby encouraging farmers to increase investment in both their existing properties and in additional land acquisition.

It is argued that these measures may have also encouraged a greater utilization of debt funds by the marginal land purchaser. This factor is hypothesized to have subsequently contributed to the large increases in total farm asset values over the 1978 - 1983 period. The summary statistical results of the period 3 analysis, which are presented in table 5.4, are therefore expected to reveal that the level of debt most relevant in this period is greater than that observed in the previous two periods.

Of the four alternative capital structure scenarios, the case 3 model provides the most accurate comparison of calculated and observed farm asset values for the 1978 - 1983 period. However, the calculated U-statistic for this model is relatively high at 0.4259, and the calculated values are neither consistently higher or lower than the associated series of actual values. This may indicate that the levels of borrowed funds used by the marginal land purchaser did not remain stable between 1978 and 1983. Rather, it is suggested they may have increased rapidly, from below the debt levels represented by case 3 in 1978 to above that level by the end of the six year period.

Thus, although both the government income support measures and development encouragement schemes were announced at the beginning of this sub-period in 1978, these results may indicate that the policies did not immediately influence the level of debt used in farmland purchases.

5.4.4 Period 4: 1984 - 1987

The summary analytical results for the last sub-period are reported in table 5.5, and are expected to reveal that the levels of debt used by a marginal land purchaser decreased significantly in this period compared to the previous 1978 - 1983 period. Section 4.5.3 describes that after the election of a Labour Government in 1984, the majority of existing agricultural support measures were quickly dismantled. Both product price and farm income guarantees were discontinued, forcing farmers to again face a future of highly uncertain cash-flows. As the inherent business risks of farming were returned to their non-distorted levels, the farm buyer's attitude toward debt finance is expected to have changed quickly.

However, the analytical results suggest that the decrease in debt levels during this period is not as great as that hypothesized. The case 3 model again provides the most accurate estimates of total farm asset value with a calculated U-statistic of 0.2034.

Table 5.4

Summary Results: Comparison of Actual and Estimated Series, 1978-1983

	Case 1	Case 2	Case 3	Case 4
Assumed Debt Levels	Nil	Average	Max.	100%
Correlation Coefficient	0.5740	0.0909	-0.3938	0.5869
Correlation Coefficient Squared	0.3295	0.0083	0.1551	0.3444
Mean Absolute Error	151.24	96.36	65.55	119.25
Theil's U Statistic	0.8339	0.5881	0.4259	0.6633
Fraction of Error Due to: Bias	0.0395	0.7025	0.1910	0.8459
Due To: Difference From Unity	0.0997	0.0011	0.3274	0.0000
Due To: Residual Variance	0.3127	0.2965	0.4816	0.1541

Table 5.5

Summary Results: Comparison of Actual and
Estimated Series, 1984-1987

	Case 1	Case 2	Case 3	Case 4
Assumed Debt Levels	Nil	Average	Max.	100%
Correlation Coefficient	-0.4579	-0.5638	0.8588	0.8536
Correlation Coefficient Squared	0.3002	0.3179	0.7376	0.7287
Mean Absolute Error	197.61	111.19	41.87	122.01
Theil's U Statistic	0.8769	0.5263	0.2034	0.5679
Fraction of Error Due to: Bias	0.9589	0.8427	0.8002	0.8716
Due To: Difference From Unity	0.0165	0.0906	0.0281	0.1057
Due To: Residual Variance	0.0246	0.0667	0.1717	0.0228

The debt/asset ratios represented by case 3 are relatively high, measured as the maximum amount of debt finance that the R.B.F.C. will allow a mortgagee to borrow. Moreover, the results indicate that the case 3 model consistently underestimates the observed values of farm assets for all four years. As such, the level of debt actually used by the marginal land purchaser may have been greater than that assumed in the case 3 model. The evidence therefore suggests that the use of financial leverage has not changed significantly between the 1978 - 1983 and 1984 - 1987 periods.

CHAPTER 6

IMPLICATIONS FOR AGRICULTURAL POLICY

In his study of land price determination in New Zealand, Seed (1986) found that real farmland prices were positively related to expected net rental income. That is, an increase in farmers' expectations for future income, irrespective of how that increase is generated, will lead to an increase in the real price of farmland. These findings led Seed to suggest that an increase in expectations of real farm incomes caused by some form of central government agricultural assistance would therefore contribute to an increase in the real price of land. Thus, the introduction of product price supports, income smoothing schemes or input subsidies which may be designed to assist a particular group such as entry level farmers, may only serve to improve the wealth position of existing land owners. As a result, the ability of entry level farmers to actually enter the industry may be reduced during periods of rapidly rising farmland prices as they may not have the required finance or the necessary cash flow to support a farm purchase.

The policy implications of this study are similar to those advanced by Seed. The analytical results have provided some evidence to suggest that the level of debt funds used by the marginal land purchaser is an important determinant of farm asset value. By incorporating borrowed finance into the capital structure, the required rate of return of the marginal land purchaser is reduced due both to the tax deductibility of interest payments and the inflation induced effect of debt erosion. As with any investment, if the required rate of return is reduced then the price an intending asset owner can afford to pay must increase. These findings have important implications for policies which are designed to ameliorate the possible cash flow problems of prospective new farm buyers.

Leathers and Gough (1984) suggest that liquidity is the most important concern of farmers during periods of high inflation because current income is typically too low to service a mortgage on farm assets. Existing farmers who have either low debt loads or a significant source of non-farm income are therefore in the best position to purchase additional farmland. Individuals who entered farming for the first time during these periods usually did so through inheritance. In an attempt to improve the ability of potential new farmers to purchase land, the New Zealand Government offered concessionary finance to farm buyers throughout the 1962 - 1987 period. Interest rates on Rural Bank loans for farm purchase were up to fifty percent lower than commercial rates, thereby reducing the debt servicing requirements for entry level farmers. Importantly however, the concessionary finance was not restricted to first farm buyers, as existing farmers could also obtain finance with similar terms to purchase additional land.

It is therefore suggested that the government's lending policy which was promulgated to reduce the liquidity problems of prospective new farmers and subsequently improve their ability to purchase a farm actually made it more difficult to enter the industry. Individuals with low current debt loads or significant off-farm incomes had access to a source of debt finance which effectively amplified the taxation advantages of using financial leverage in a farm purchase. With the cheap Rural Bank loans, existing farmers may have been encouraged to use higher levels of debt to acquire additional land and, as the required rate of return on the new investment was reduced, the amount an existing farmer could afford to pay was increased. Thus, the concessionary finance may have helped to create a level of farm values which were beyond the reach of new entry farmers.

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The second policy implication of this study is closely related to the first. The level of government assistance to agriculture, as described by Le Heron (1979) reached a peak during the late 1970's and early 1980's. That period saw the introduction of such policies as the Supplementary Minimum Price Scheme, the Livestock Incentive Scheme and the Land Development Encouragement Loan Scheme which were designed to maintain current farm incomes and to encourage increased investment in agricultural production. Seed (1986) concluded that the effect of these policies was to increase the expected level of future net income and subsequently contribute to an increase in farm asset values. However, that author also concluded that the observed increases in land prices between 1977 and 1982 did not appear to be totally attributable to the raised income expectations of farmers.

The results of this study indicate that the level of debt used by the marginal land purchaser increased during this period, and it is suggested that this factor may explain a significant amount of the observed increases in farmland prices. It may be argued that the Government's policy initiatives at the time contributed to the increased use of debt finance due to the way in which they affected the perceived risk of farming. As the product price supports effectively reduced the variability of farm incomes, the amount of business risk faced by a farmer also decreased. The income guarantees may have therefore encouraged the marginal land purchaser to incorporate a higher level of debt finance into his capital structure, and following the theoretical impact of financial leverage, added to an increase in farm asset values.

Thus, government policies which are intended to support or improve current farm incomes may only act to compound the problem. First, farmland values may be increased as farmers' expectations of future income are raised, and second, the policies may encourage greater use of financial leverage which has also been shown to produce an increase in farm asset values. This only serves to exacerbate the original problem of low current farm returns and a relatively high return in the form of capital gains.

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AAES	Australian Agricultural Economics Society.
AJAE	American Journal of Agricultural Economics.
AER	American Economic Review.
JFE	Journal of Farm Economics.
WJAE	Western Journal of Agricultural Economics.

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