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THE UNIVERSITY OF ALBERTA

Farmland as an Asset in the Context of Portfolio Investment

by

Jeanne E. Mercier

A THESIS

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Supervisor

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Date..September 16, 1988

DEDICATION

This thesis is dedicated to my parents, Joseph and Elizabeth, who, through genetics and their own philosophies of life have given me "*adaequatio*"

Abstract

What has been termed the financial crisis in Canadian agriculture has created a great deal of interest in finding viable alternatives to debt financing for agricutlural operations. Possibilities have ranged from commodity based loans or subsidies to venture capital creation through the sale of shares in farming operations.

This thesis was prompted by the possibility that a non-farm investor might consider farmland as a portfolio investment. If land could be viewed as an investment the same as financial assets such as common stocks, this suggestion may present a way to inject outside equity into agriculture. The non-farm investor could hold the land as a capital asset and rent or lease it to a farm operator, thus gaining dividend returns as well as any capital appreciation which may accrue to the asset. immediately apparent.

Before an investor will consider investing in any asset, he must be able to measure its performance against other assets bearing similar risks. With land, no readily available data exist to measure this performance. The first objective of this thesis was to construct a data set consisting of land sales transactions throughout Alberta from which the performance of capital returns to land could be determined. A second objective was to create a rental index based on crop yields and prices from which possible dividend income could be estimated. Once the data set was established, the Capital Asset Pricing Model (CAPM) was applied to determine the amount of systematic or non-diversifiable risk attached to farmland.

The results of this analysis show that the returns to farmland and the risk surrounding those returns have not behaved in a manner similar to those of the stocks which comprise the Toronto Stock Exchange 300 Composite Index. This non covariance with the market, coupled with the fact that the returns to land have exceeded that which is necessary to compensate for non-diversifiable risk, indicate that farmland may be a logical asset to consider for certain portfolios. These findings, while limited by the restrictive assumptions of the CAPM provide useful insight into the analysis of farmland as an investment, and the possibility for channelling outside equity into agriculture.

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A completed thesis, while bearing the name of only one author, is really a cooperative effort by many people. This one is no exception. Firstly, to my advisor and friend Bill Phillips, and the members of my thesis committee, Len Bauer and Glen Mumey, thank you for your wisdom and your advice. It has been a great learning experience.

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I. Introduction

A. Background

The agricultural economic climate of the 1970's was characterized by very low real interest rates, high rates of inflation, strong commodity prices, and escalating real estate values. The strength of the industry prompted considerable expansion in farming operations, much of which was made possible through debt financing.

The economic downturn of the early 1980's resulted in significant decreases in land values in Alberta, severely eroding the security position held by lenders to the agriculture industry. Deterioration of major commodity prices brought on by surpluses on the world market and the aggressive marketing stategies of major exporters worsened the financial situation of the industry. Many producers were left with debt which they could not service and the incidence of farm bankruptcies grew. With the forecast of low commodity prices continuing into the next decade, all participants in the agriculture industry are looking for a solution to this financial dilemma.

Recently, many proposals have offered solutions in the form of equity financing. Some proposals call for the producer to seek an investor to buy into his farm business in return for a share of the profits of the business. Recent works have studied several different business arrangements of this sort and found that none were particularly appealing from an investor's point of view except for use in protfolio diversification.

A recent proposal from the Farm Credit Corporation (Ashmead, 1986) called for a "private enterprise approach" to agricultural financing. Through this approach a public corporation (likely a crown corporation) would be formed whose shares would be traded in a market such as the Toronto Stock Exchange. The major purpose of this organization would be to buy farmland presently held by public and private lending institutions, and from farmers wishing to exit the agricultural industry who could find no other interested buyers. The land would then be leased back to farmers, especially beginning farmers, or those whose financial situation did not allow for continued ownership or further purchases of land. For this

proposal to be viable, the rate of return on land, and therefore on the investment in the corporation, must match that of other investments in the market bearing similar risk as there is no reason to expect that an investor would accept anything less than a market rate of return, adjusted for risk.

If the rate of return on land makes it an attractive investment, it may not be necessary for a corporation to hold the land. Instead, an individual may invest in land and rent it to a farmer on a cash rent or crop share basis. From the farmer's point of view this scenario may be appealing, as he would be able to farm without having concern for considerable financial committments. The investor would receive any benefits from capital gains in the value of the land, and would obtain an annual dividend return in the form of rental. In his address to the American Agricultural Economics Association annual meeting, Melichar (1979) alluded to this idea in suggesting that land is a growth stock, in the terminology of the stock market, in which a good proportion of the return to the investment is made up of capital gains, and should therefore be held by "those who can tolerate its low current return in the first few years after its purchase".

B. Need for the Study

In order to assess the merit of investing in farmland, it is necessary to determine whether farmland is priced to provide an adequate return for an outside investor. Since investors generally hold portfolios of assets rather than single assets, it is necessary to determine the risk surrounding the return to farmland in the context of its contribution to the riskiness of the portfolio rather than in terms of the asset held in isolation.

A financial model called the Capital Asset Pricing Model (CAPM) was developed in the early 1960's as a means of determining the equilibrium relationship between risk and required rates of return on assets when the assets are held as part of a well diversified portfolio. Although the CAPM is ordinarily applied to returns on financial investments such as common stocks, it is the intent of this study to apply to a series of returns on farmland in Alberta.

Such a study was undertaken in the United States using national and regional level data (Barry, 1980). The findings of the study were that land contributed essentially no systematic risk to a diversified portfolio of assets, and exhibited returns in excess of those required to compensate for risk. Based on these results it appears that land may be a reasonable candidate for inclusion in a portfolio as a risk reduction tool.

An analysis of the equilibrium risk and return relationships for Alberta farmland is a necessary component in the evaluation of any proposal aimed at channelling outside equity into agriculture. To perform such an analysis there is a need for a series of land sales data for the province of Alberta providing information from as many transactions as possible. In addition to sales data, a system for estimating possible rental return from land is required. With these data at his disposal, an investor would have the means of comparing an investment in farmland to investments in other assets. This type of comparison is necessary in making an informed decision as to the financial performance of farmland in Alberta, and its suitability as a candidate for inclusion in a diversified portfolio.

C. Objectives of the Study

The inaccessibility of exisiting data sources with respect to land sales and rental revenue in Alberta is a major concern in attempting to analyze the risk and return characteristics of the asset. It was the primary objective of this study to establish such a source in computer readable form, for an extended period of time. These data were to be collected on the most specific level possible, so that land in one part of Alberta can be compared to land in other parts. It was to be possible to compare land influenced by urban developments with those which are more isolated.

Using these data, a second objective of the study was to estimate a total return on farmland in various parts of Alberta and compare them to the total returns which could have been gained on an investment in the stock market over the same time period. These results were to be used to evaluate whether the CAPM explains the prices of farmland, and the possible implications this may have for attracting outside equity into agriculture.

D. Outline of the Study

Chapter two provides the background theory which is used in the study as well as an introduction to the Capital Asset Pricing Model. This discussion begins with a brief mention of utility theory as it applies to investment decisions. It covers the measurement of risk and return for a single asset and for a portfolio of assets. Optimal portfolio choice is analyzed given several different blends of asset types. This outline leads into a discussion of portfolio diversification and individual asset risk. Finally, the properties, assumptions and derivation of the CAPM are presented in detail.

Chapter three describes the data set being developed. The three components of the data set are:

(a) the total returns to farmland, made up of the annual capital gains and the dividend or rental return portion,

(b) the total annual returns in the stock market, and

(c) the annual risk free rate of return.

The CAPM is then applied to the data to determine a risk premium for farmland in Alberta.

Chapter four contains the results of the analysis and an interpretation of each of the return estimates made.

The fifth chapter concludes the study with summary implications and limitations of the results with respect to channelling outside equity into agriculture as a means of alleviating some of the financial stress currently present in the industry. Recommendations for further study are also included in this final chapter.

II. Theoretical and Modelling Framework

A. Utility Theory

An investment decision, which is the object of the theory of investor choice, arises from utility theory in that it is a delayed consumption decision and a determinant consumption patterns over time. As such, it is covered by the axioms of utility theory which ensure rational behaviour by consumers. A complete discussion of utility theory and the governing axioms is widely available (e.g. Henderson and Quandt, 1980; Russell and Wilkinson, 1984; Varian, 1980; and Green, 1976).

Consumers are compelled to delay consumption by virtue of the fact that they are compensated for doing so at rates above individual time preference rates. In financial terms, this compensation is referred to as the time value of money and is reflected in the market by the risk free rate of return. Delaying consumption also involves some risk in that there is uncertainty as to what the of nature at the end of the investment period. The investor must also be compensated for bearing this risk. The amount of compensation required to bear this risk will vary among investors depending, in part, on their degree of risk aversion. This aversion is measured by the individual's risk premium which is defined as the amount of wealth one would be willing to forego in order to remove uncertainty. The risk premium is determined from the utility function. An asset which carries higher risk than other assets must also reap higher returns, or investors will choose the less risky asset.

B. Measuring Risk and Return

The most salient feature of an asset is the extent to which an investment in that asset will affect the investor's wealth. The contribution is measured by the return on the investment which is defined as follows:

$$R = \frac{W-I}{I} \qquad (1)$$

where R is equal to the return on investment, W is equal to the end of period wealth, and I is

equal to the initial investment.

Since end of period wealth is not known with certainty, probabilities must be assigned to various possible outcomes. The expected return on an investment is usually estimated by using the mean value of the historical returns on the asset. Assuming that the returns on the asset are normally distributed, the variance can be used as a measure of the risk surrounding those returns. These statistics are calculated as follows:

$$E(\tilde{r}) = \sum_{i=1}^{N} p_i r_i \qquad (2)$$

where:

$E(\tilde{r})$ = expected return on the asset

p_i = probability of outcome i, and

r_i = return on the asset given outcome i

$$Var(\tilde{r}) = E(r_i - E(\tilde{r}))^2 \quad \text{or} \quad \Sigma(p_i r_i - E(\tilde{r}))^2 \qquad (3)$$

The mean of the expected return for a portfolio of assets is simply a weighted mean of the expected returns of each of the individual assets in the portfolio. The weights used are the percentage of the portfolio invested in each asset.

$$E(R_p) = \sum_{i=1}^{N} w_i E(R_i) \qquad (4)$$

where:

$E(R_p)$ = expected return on portfolio,

w_i = proportion of the portfolio made up of the *ith* asset, and

$E(R_i)$ = expected return on the ith asset.

The variance of a portfolio of assets is calculated as follows:

$$\mathrm{Var}(R_p) = \sum_{i=1}^{N} \sum_{j=1}^{N} w_i w_j \sigma_{ij} \qquad (5)$$

where σ_{ij} is the covariance between assets i and j and $\Sigma w_i w_j = 1$.

If, in a portfolio, an investor holds two securities with negative covariance, the portfolio is less risky than it would be if the assets had positive covariance. It is in the best interest of the investor to determine the combination of securities offering minimum variance given his level of risk aversion.

One can determine the minimum variance portfolio by setting the first derivative of the variance (equation 5) with respect to the weights of the assets equal to zero. For any given rate of return, there exists a minimum variance opportunity set which is the set of all risk and return combinations available from a portfolio of risky assets which offers the minimum variance.

C. Optimal Portfolio Choice

Two Risky Assets, No Risk Free Asset

A world with two risky assets and no risk free asset is analogous to a simple one person-one good economy, except in this case the trade-off is between risk and return instead of present and future consumption. Each individual's risk-return trade-off, or the marginal rate of substitution between risk and return, is represented by the steepness of an indifference curve. The marginal rate of transformation between risk and return is given by the slope of the minimum variance opportunity set. The point at which the indifference curve and the minimum vaiance opportunity set are tangent is the optimal portfolio of the two risky assets for that individual. The investor will trade one asset for the other until he achieves this optimal portfolio.

Different investors having homogeneous expectations will choose different combinations of the two risky assets because they will have differing levels of risk aversion. All however, will choose from the efficient set, which is the set of all combinations of assets which have the highest level of return for a given level of risk. In other words only stochastically dominant combinations are included in the efficient set.

The investment decision now is to choose the combination of assets with the minimum variance subject to an expected return constraint. The decision can be made using quadratic programming as outlined by Markowitz (1959).

Many Risky Assets, One Risk Free Asset

A risk free asset is one whose return is certain. It has a variance of zero and a covariance with the market of zero. Such an asset is hypotheical, but is most closely approximated by an asset such as government treasury bills.

If a portfolio consists of one risky asset and one risk free asset, the variance of the portfolio is equal to the variance of the risky asset, multiplied by the square of its weighting in the portfolio. The opportunity set for this portfolio is linear.

The risk free rate of return is assumed to be equal to the borrowing/lending rate; that is to say that the market is frictionless. No transactions costs, infinitely divisible assets, and investors with homogeneous expectations are also assumed.

The measurements of expected return and risk are the same for a portfolio of many risky assets as they are for only two. The investment opportunity set also has the same shape with many risky assets as for two risky assets. Because more than two assets are being combined, some of these portfolios will fall into the interior of the set. These combinations are stochastically dominated by those on the upper boundary of the set, and are therefore not considered. Those portfolios making up the upper boundary of the investment opportunity set are called efficient portfolios.

With the introduction of a risk free asset, a straight line can be drawn between the risk free rate of return and the rate of return on any portfolio of risky assets. Only one of

these lines will dominate, that being the line which is tangent to the investment opportunity set. This property means that, given the previously stated assumptions of homogeneous expectations and risk aversion, all investors will invest in different combinations of only two portfolios; the risk free asset and the market portfolio. This line between the risk free rate and the market portfolio is called the Capital Market Line (CML) and represents the relationship between portfolio risk and return. The equation for the capital market line is as follows:

$$E(R_p) = R_f + \frac{[E(Rm)-Rf]}{\sigma R_m}\sigma R_p \qquad (7)$$

where:

$E(R_p)$ = the expected return on the portfolio,

$E(R_m)$ = the expected return on the market,

R_f = the risk free rate of return,

σR_m = the variance of the return on the market, and

σR_p = the variance of the return on the portfolio.

With the introduction of the risk free asset, and hence the capital market line, some investors may be made better off, and no one is made worse off. Investors can improve their position by moving along the minimum variance opportunity set, as they could without the risk free asset. They can further improve their position by borrowing or lending at the risk free rate and thus move along the CML. Those who are risk averse may choose to hold more of the risk free asset in their portfolio. Those who are less risk averse may invest more than 100% of their wealth in the market portfolio by borrowing at the risk free rate.

D. Portfolio Diversification and Individual Asset Risk

As the number of assets held in a portfolio increases the variance of the portfolio decreases, and approaches the weighted average covariance between the assets. This is what makes diversification desirable to investors. It also means that the risk of a single asset cannot be compared to the risk of a portfolio by simply comparing the variances.

Rather than look at the risk of a single asset, it is more informative to determine the amount of risk that would be contributed to a portfolio as a result of the inclusion of that asset in the portfolio. This risk is calculated by taking the partial derivative of the relationship for variance (equation 5) with respect to the percentage invested in the asset concerned.

The weighting of each asset in the portfolio approaches zero as more assets are added to the portfolio. The risk contributed to the portfolio by each asset approaches its covariance with the other assets in the portfolio as the number of assets approaches infinity. If the portfolio represents the market, then the contribution of risk by this single asset is its covariance with the market, or with the economy in general.

E. Capital Asset Pricing Model

Assumptions

The Capital Asset Pricing Model (CAPM) is an economic model that was developed in the mid 1960's by Sharpe (1964), Lintner (1965), and Treynor (1961). It shows that in equilibrium the rate of return on a risky asset is a function of that asset's covariance with the general economy.

There are some fairly restrictive assumptions to the CAPM, most of which are made in utility theory and mean-variance analysis. These are:

- Investors are risk averse utility maximizers.
- Investors are price takers and have homogeneous expectations.
- Returns on assets are distributed normally, quantities are fixed, and all assets are perfectly divisible and marketable.

- There exists a risk free asset, and investors may borrow or lend unlimited amounts at the risk free rate.
- There are no transactions costs or taxes.

The assumption of efficiency of the market guarantees that only stochastically dominant portfolios are considered, and homogeneous expectations guarantees that all investors perceive the same minimum variance set.

The market portfolio is comprised of all marketable assets held in proportion to their percentage of the overall value of the market, therefore:

$$w_i = \frac{\text{value of asset i}}{\text{value of market}}$$

where W_i is equal to the weight of asset *i* in the market portfolio.

Given this definition of the market portfolio, a portfolio consisting of the market plus one risky asset has the following expected or mean return.

$$E(R_p) = aE(\tilde{r}_i) + (1\text{-}a)E(R_m) \tag{8}$$

where *a* is equal to the weight of asset *i* in the portfolio, $E(\tilde{r}_i)$ is equal to the expected return on the *ith* asset, and $E(R_m)$ is equal to the expected return on the market. The standard deviation of the return is expressed as follows.

$$\sigma(R_p) = [a^2\sigma_i^2 + (1\text{-}a)^2\sigma_m^2 + 2a(1\text{-}a)\sigma_{im}]^{1/2} \tag{9}$$

where R_p is the standard deviation of the return on the portfolio, *a* is equal to the weight of asset *i* in the portfolio, σ_i^2 is equal to the variance of the return on asset *i*, σ^2_m is equal to the variance of the return on the market, and σ_{im} is equal to the covariance between asset *i*

and the market.

The market portfolio already contains w_i of asset i, therefore any amount *a* invested in asset i is excess demand. In equilibrium there is no excess demand, meaning that *a* is equal to zero. The equilibrium price relationship for the market portfolio can be found by taking the first derivitive with respect to *a* of the above two relationships.

$$\frac{\delta E(Rp)}{\delta a}\Big|_{a=0} = E(R_i) - E(R_m) \tag{10}$$

$$\frac{\delta \sigma(Rp)}{\delta a}\Big|_{a=0} = 1/2(\sigma^2_m)^{-1/2}(-2\sigma^2_m + 2\sigma_{im}) = \frac{\sigma im - \sigma^2 m}{\sigma_m} \tag{11}$$

The slope of the minimum variance set at equilibrium evaluated at the point which is tangent to the capital market line is:

$$\frac{E(Ri) - E(Rm)}{\sigma_m} \cdot \sigma^2_m \tag{12}$$

and the slope of the capital market line is given by:

$$\frac{E(Rm - Rf)}{\sigma_m} \tag{13}$$

In equilibrium therefore:

$$\frac{E(Rm) - Rf}{\sigma_m} = \frac{E(Ri) - E(Rm)}{\sigma_m} \cdot \sigma^2_m \tag{14}$$

By solving the above equality for $E(R_i)$ the following is obtained.

$$E(R_i) = R_f + (E(R_m - R_f))\, \sigma_{im}/\sigma^2_m \tag{15}$$

where R_i is equal to the return of asset *i*, R_f is equal to the risk free rate of return, and R_m

is equal to the return on the market. This equation is the Capital Asset Pricing Model. It shows that the required rate of return on an asset is equal to the risk free rate of return, plus a risk premium. This risk premium is composed of the price of risk multiplied by the quantity of risk. The difference between the expected rate of return on the market and the risk free rate is equal to the price of risk. The covariance between the risky asset and the market, divided by the variance on the market gives the quantity of risk attached to the risky asset. This quantity of risk is called that asset's Beta.

The beta for the market is equal to one, because it is measured by the covariance of the market with itself, or the market variance, divided by the market variance. The beta for the risk free asset is zero because the covariance of the risk free asset with the market is zero.

Properties of the CAPM

The quantity of risk attached to any risky asset can be divided into two parts. Unsystematic risk is created by those forces which affect only that asset of that type of asset. This part of risk is diversifiable. Systematic risk is a result of the covariance of the asset with the market or with the economy. These economy-wide forces cannot be diversified away and an investor will only pay to avoid systematic risk. The beta on an asset is a meaure of its systematic risk. The alpha value indicates the amount by which the return on an asset is in excess or short of that which is required to compensate for systematic risk.

The appropriate measure of risk for a single risky asset when comparing it to a portfolio of assets is its beta. The variance of a single asset will always be higher than that of a diversified portfolio, and is therefore an unacceptable measure of risk.

The beta for a portfolio of assets is simply the weighted average of the betas for all the assets in the portfolio. The weight used is the proportion of the portfolio invested in each asset. This property allows for the calculation of the efficient set without the use of quadratic programming.

Perhaps the most important feature of the CAPM is that assets can be valued without regard for individual risk preference. This has important implications for corporate decision

makers.

The following chapters contain an application of the CAPM to a series of returns to Alberta farmland investments to determine a risk premium for that asset. The CAPM can be rearranged and expressed in terms of excess returns, or returns in excess of the risk free rate.

$$E(R_i)-R_f = ((E(R_m)-R_f)\beta \quad (16)$$

where $E(R_i)$ is equal to the expected return on the asset, R_f is equal to the risk free rate or return, and $E(R_m)$ is equal to the rate of return on the market.

Rather than using expectations of returns, which may be subjective and are not readily available, a time series of historical data can be used. A regression analysis can be made using the excess returns to farmland as the dependant variable and excess returns to the market as the independant variable.

$$r_{lt} = \alpha_l + r_{mt}\beta_l + e_{lt} \quad (17)$$

The terms r_{lt} and r_{mt} are excess returns to land and the market in time *t*, and e_{lt} is the error term. It is anticipated that the value of alpha will be zero. Non-zero values indicate a return on land (or a loss) in excess of those necessary to compensate for undiversifiable risk.

There are numerous studies which apply the CAPM to the evaluation of financial assets in relation to a portfolio of assets, however few apply the model to physical assets such as land. One such study was conducted in the United States using aggregate and regional data (Barry, 1980). No similar study has been done in Canada to date.

The data requirements for this study are discussed in detail in the following chapter.

III. Data and Model Application

There are three components of the data set being used in this analysis. These are the total return to farmland investment in Alberta, the total return to the market, and the risk free rate of return. The period being studied is 1963 through 1985.

A. Total Returns to Farmland Investment

The total return to farmland is made up of two subsets, the first being the capital gains portion of the return, and the second being the dividend portion. The capital gains from an investment in farmland were determined using the Farm Credit Corporation's land sales registry from its inception in 1963 to 1985. This registry is composed of every land sales transaction in Alberta of which a Farm Credit Corporation credit agent was aware, whether FCC financing was involved or not. This represents an average exceeding 1000 sales per year for the period.

To ensure that only agricultural parcels were being considered in the analysis, only those sales involving 80 acres or more were included. The sales of long term grazing leases were also excluded and only arms-length sales were considered.

The bareland selling price per acre was calculated by subtracting the value of houses and buildings from the total selling price, and dividing by the total number of acres sold. Sales were identified by municipality. In several of the municipalities there were no land sales in one or more years throughout the period. For these years, a ten year average composed of the five preceeding and five following years (where possible) was used.

B. Dividends

To determine the dividend portion of the returns to an investment in farmland a rental index was developed. This index was calculated on a crop share basis with the landlord taking 25% of the crop revenue. The landlord was assumed to be responsible for property taxes. The assumption of a simplified crop share scheme was made to reduce data requirements. Although 25-75 crop share agreement is used, crop share agreements are more

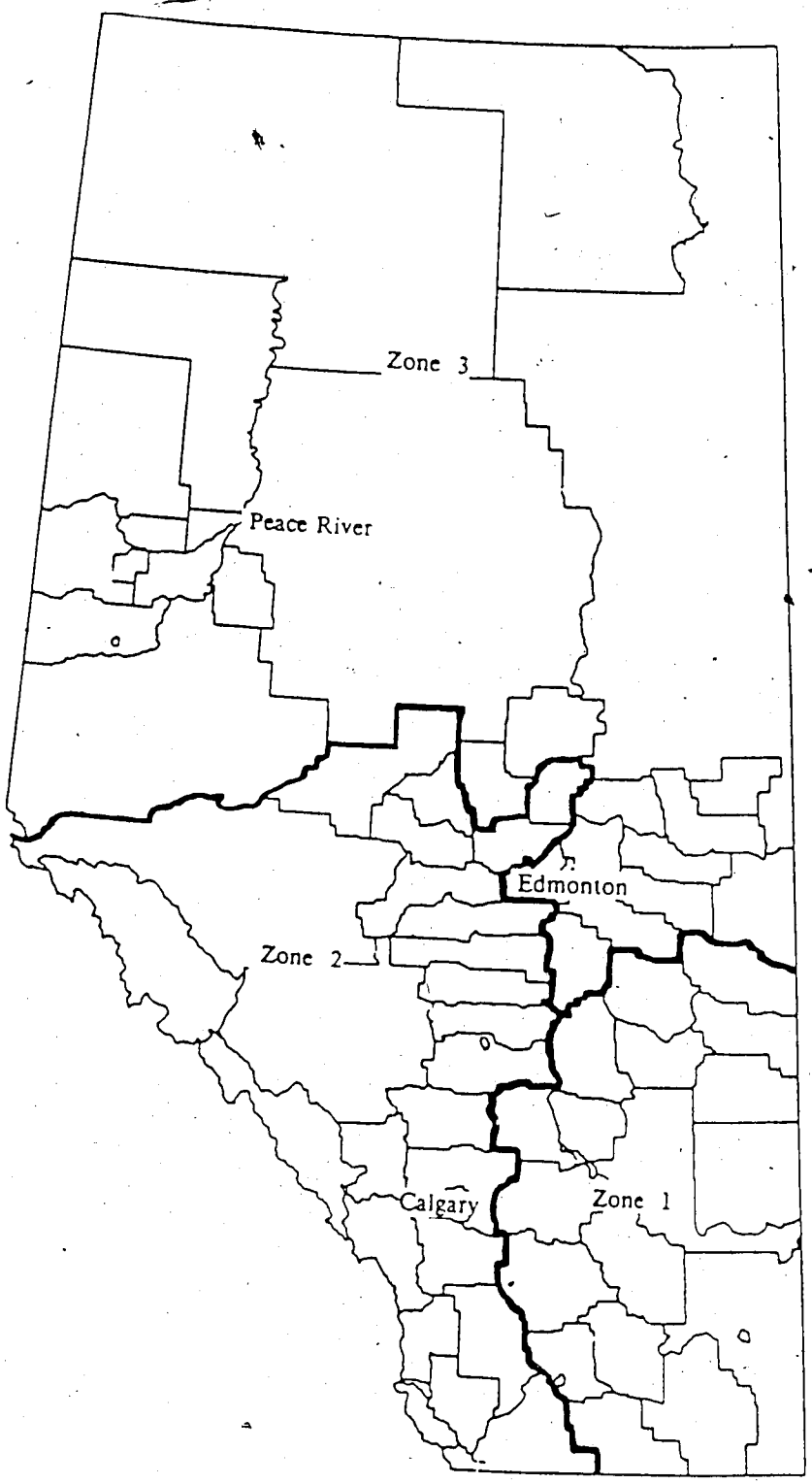
typically negotiated on a two thirds-one third tenant-landlord split, with the landlord paying part of the operating expenses such as fertilizer and herbicide costs (Alberta Agriculture Custom Rates Survey, 1982-1986). Data on herbicide and fertilizer usage were not collected, therefore the less popular 25-75 crop share agreement was used as a basis for rent determination. In this manner revenue was reduced in lieu of the landlord's share of the operating expenses.

The crops used to determine crop revenue were wheat, oats, barley and canola. These four crops make up at least 75% or more of the seeded acreage each year in most of the province (Alberta Hail and Crop Insurance Corporation, 1973-1985). In four municipalities in southern Alberta's irrigation district these crops make up only about 65% of seeded acreage (the rest being specialty crops), but because no other crops were consistently significant these four were the only crops considered. This may cause a slight downward bias on the dividend returns in these municipalities, although the higher operating costs per acre due to irrigation equipment and more expensive inputs such as seed may mitigate against this bias.

The weighting for each of the crops was determined using AHCIC's crop yield data. These data include information from producers as to the number of acres of each crop grown and the municipality in which they were grown. A frequency distribution was constructed for the four crops by municipality. The municipalities were then grouped into zones based on similarities in cropping patterns.

It was possible to break the province into three distinct crop zones, which are depicted in Figure 1. In Zone 1 wheat comprised 40% or more of all crops grown, and oats, barley and canola split the remaining 60% fairly evenly. In Zone 2 barley made up 40% or more of all crops grown, and wheat, oats and canola split the remaining 60%. In Zone 3 no single crop emerged as being dominant, and the seeded acreage was fairly evenly distributed among the four crops. Although oats and canola average approximately equal acreage over the entire time period, oats has become a somewhat less significant crop and canola has gained in importance since 1963.

Figure 1. Crop Districts



Modified from Alberta Bureau of Statistics, "Alberta Statistical Review, Fourth Quarter, 1985".

The prices and grades for all crops were also taken from the Agriculture Statistics Yearbooks. The prices reported in Table 1 are weighted averages of the pri per grade multiplied by the corresponding percentages of total production for each grade.

The annual percentages of acreage for each crop in each zone for the period 1973-1985 were regressed on time to determine whether there was a growth trend in the number of acres seeded. The percentages were then extrapolated back to 1963 to produce a crop distribution for the entire period under study. These distributions are presented in Table 2.

The yields for all crops were obtained from the Agriculture Statistics Yearbooks (Alberta Agriculture 1963-85) for the entire period. These yield data are reported by Agriculture Reporting Area from 1963-1970 and by Census District from 1971-1985. The divisions roughly correspond to the three cropping zones previously mentioned. All yields are reported in tonnes per acre and are presented in Table 3.

Table 1. Average Annual Prices for all Crops in $/tonne, 1963-1985.

YEAR	WHEAT	OATS	BARLEY	CANOLA
	dollars/tonne			
1963	$61.59	$33.77	$42.30	$97.81
1964	$55.59	$38.49	$45.77	$105.83
1965	$59.49	$43.30	$46.40	$92.41
1966	$60.45	$42.91	$46.92	$96.02
1967	$51.71	$42.29	$38.77	$73.63
1968	$78.84	$29.74	$34.96	$69.79
1969	$44.15	$33.59	$29.98	$89.17
1970	$43.36	$28.53	$29.40	$101.41
1971	$36.31	$33.05	$28.41	$92.07
1972	$51.63	$63.42	$60.59	$154.86
1973	$107.59	$169.43	$122.87	$271.56
1974	$87.73	$161.46	$101.31	$306.79
1975	$71.19	$104.93	$69.24	$222.00
1976	$58.82	$74.72	$115.38	$278.16
1977	$65.58	$63.81	$92.78	$279.14
1978	$92.72	$61.88	$83.10	$301.05
1979	$103.49	$56.73	$153.07	$304.53
1980	$107.07	$113.41	$133.26	$319.38
1981	$103.59	$97.09	$117.33	$321.34
1982	$79.84	$85.44	$84.47	$270.37
1983	$99.43	$92.55	$122.93	$438.89
1984	$87.01	$95.60	$113.69	$371.13
1985	$91.22	$83.38	$92.10	$290.64

Table 2. Annual Percentage of Total Acreage for all Crops, by Zone, 1963-1985.

	ZONE 1				ZONE 2				ZONE 3			
YEAR	WHEAT	OATS	BARLEY	CANOLA	WHEAT	OATS	BARLEY	CANOLA	WHEAT	OATS	BARLEY	CANOLA
1963	42.4%	8.0%	37.7%	11.9%	18.2%	17.4%	58.5%	5.9%	26.2%	21.5%	42.8%	9.5%
1964	43.1%	8.0%	37.4%	11.6%	18.1%	17.2%	58.6%	6.0%	26.7%	21.3%	42.4%	9.6%
1965	43.8%	7.9%	37.0%	11.4%	18.5%	17.2%	58.3%	6.0%	27.1%	21.1%	42.0%	9.8%
1966	44.4%	7.9%	36.6%	11.1%	18.7%	17.0%	58.2%	6.1%	27.6%	20.9%	41.6%	10.0%
1967	45.1%	7.8%	36.2%	10.9%	19.0%	16.9%	58.0%	6.2%	28.0%	20.7%	41.2%	10.1%
1968	45.8%	7.8%	35.9%	10.6%	19.3%	16.8%	57.7%	6.2%	28.4%	20.5%	40.9%	10.3%
1969	46.4%	7.7%	35.5%	10.4%	19.6%	16.6%	57.5%	6.3%	28.9%	20.2%	40.5%	10.4%
1970	47.1%	7.6%	35.1%	10.1%	20.0%	16.5%	57.2%	6.3%	29.3%	20.0%	40.1%	10.6%
1971	47.8%	7.6%	34.7%	9.9%	20.2%	16.4%	57.1%	6.4%	29.8%	19.8%	39.7%	10.8%
1972	48.4%	7.6%	34.4%	9.7%	20.4%	16.2%	56.9%	6.4%	30.2%	19.6%	39.3%	10.9%
1973	49.1%	7.5%	34.0%	9.4%	19.4%	16.1%	58.0%	6.5%	30.6%	19.4%	38.9%	11.1%
1974	52.5%	12.5%	28.7%	6.3%	14.8%	19.8%	54.3%	11.0%	21.6%	21.6%	42.2%	14.7%
1975	57.0%	14.0%	34.4%	4.7%	17.2%	16.1%	52.9%	13.8%	28.7%	15.7%	39.8%	15.7%
1976	64.8%	10.5%	22.9%	1.9%	15.5%	21.4%	59.5%	3.6%	35.7%	22.4%	36.7%	5.1%
1977	59.1%	11.0%	25.2%	4.7%	16.0%	15.0%	60.0%	9.0%	28.3%	19.5%	35.4%	16.8%
1978	61.0%	7.4%	23.7%	11.9%	14.4%	12.7%	54.3%	18.6%	26.8%	17.1%	29.3%	26.8%
1979	55.0%	6.1%	18.4%	11.4%	15.2%	12.4%	46.7%	25.7%	21.8%	12.9%	28.7%	36.6%
1980	64.2%	5.5%	21.1%	9.2%	19.6%	9.8%	56.9%	13.7%	30.4%	8.7%	36.5%	24.3%
1981	67.2%	5.2%	22.4%	5.2%	20.2%	13.2%	60.5%	6.1%	34.6%	11.5%	36.5%	17.3%
1982	69.8%	3.9%	24.0%	2.3%	17.5%	12.5%	59.2%	10.8%	27.8%	15.7%	29.8%	16.7%
1983	74.4%	2.5%	17.4%	5.8%	19.3%	10.9%	48.7%	21.0%	40.4%	8.1%	23.5%	27.9%
1984	64.8%	4.9%	16.4%	13.9%	18.9%	7.2%	51.4%	22.5%	35.4%	10.8%	27.7%	26.2%
1985	62.1%	6.8%	16.5%	14.6%	15.5%	10.7%	55.9%	17.9%	31.0%	8.0%	28.3%	32.7%

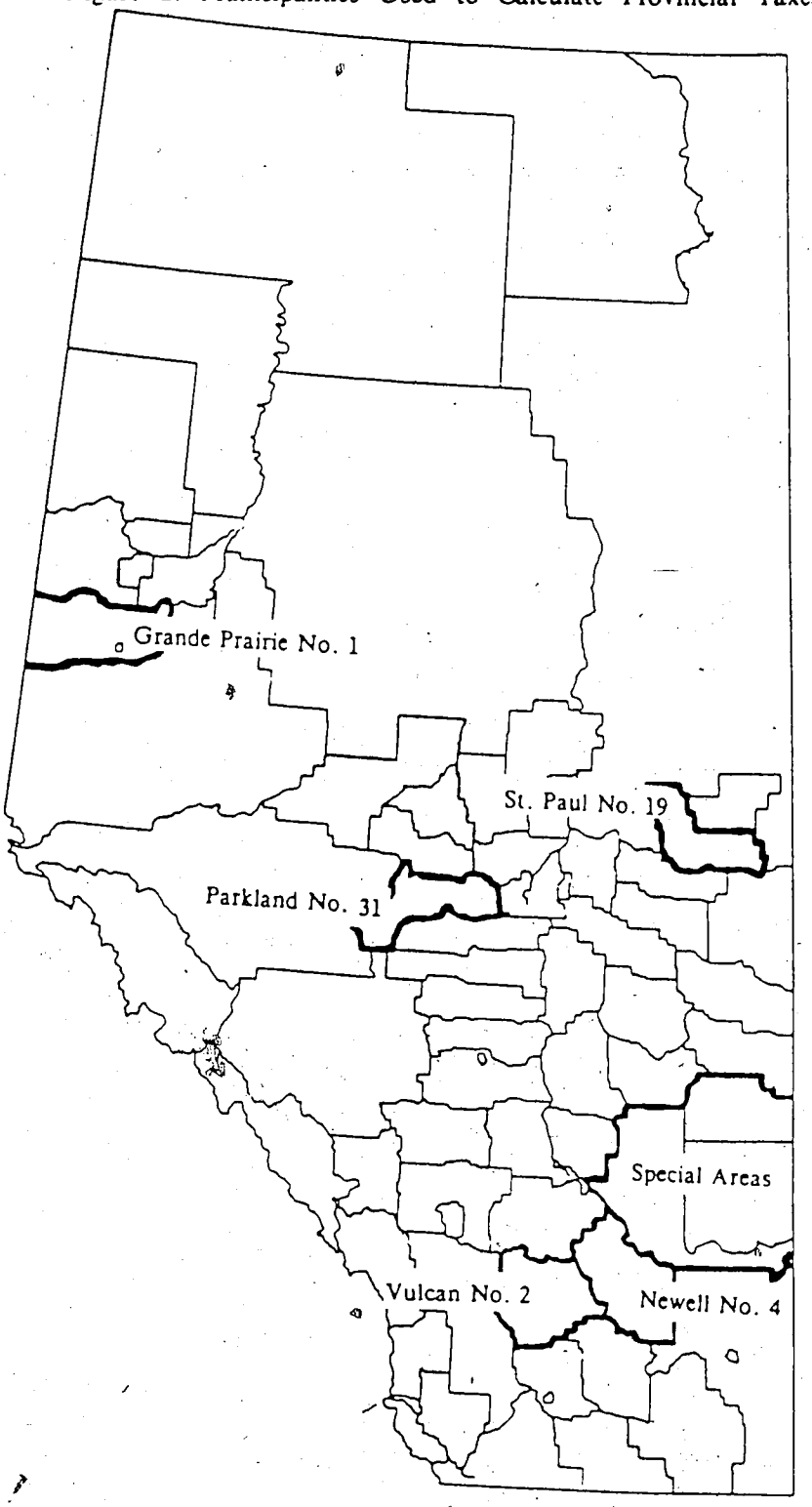
Source: Alberta Agriculture, "Agriculture Statistics Yearbook." 1963 - 1985.

Table 3. - Average Annual Yields in Tonnes/Acre for All Crops, by Zone, 1963-1985.

YEAR	ZONE 1				ZONE 2				ZONE 3			
	WHEAT	OATS	BARLEY	CANOLA	WHEAT	OATS	BARLEY	CANOLA	WHEAT	OATS	BARLEY	CANOLA
	tonnes/acre				tonnes/acre				tonnes/acre			
1963	0.673	0.781	0.798	0.494	0.727	0.833	0.834	0.538	0.727	0.833	0.835	0.505
1964	0.556	0.555	0.647	0.422	0.686	0.685	0.736	0.422	0.687	0.685	0.737	0.436
1965	0.667	0.734	0.862	0.422	0.708	0.767	0.729	0.422	0.708	0.767	0.729	0.401
1966	0.789	0.763	0.925	0.480	0.841	0.834	0.919	0.481	0.842	0.834	0.918	0.433
1967	0.591	0.578	0.679	0.392	0.683	0.666	0.509	0.392	0.684	0.667	0.709	0.406
1968	0.685	0.718	0.859	0.460	0.591	0.842	0.864	0.417	0.703	0.811	0.823	0.386
1969	0.720	0.766	0.930	0.369	0.806	0.848	0.919	0.338	0.807	0.849	0.918	0.381
1970	0.740	0.829	0.963	0.398	0.827	0.935	0.930	0.397	0.827	0.934	0.930	0.417
1971	0.673	0.759	0.889	0.367	0.773	0.836	0.834	0.365	0.773	0.837	0.833	0.382
1972	0.704	0.826	0.928	0.426	0.901	0.952	1.010	0.420	0.901	0.952	1.011	0.446
1973	0.674	0.799	0.869	0.380	0.800	0.878	0.832	0.374	0.801	0.878	0.831	0.408
1974	0.626	0.693	0.836	0.379	0.759	0.811	0.845	0.370	0.759	0.812	0.845	0.400
1975	0.803	0.832	0.965	0.414	0.868	0.907	0.934	0.406	0.868	0.907	0.935	0.436
1976	0.852	0.847	1.020	0.433	0.947	0.936	1.028	0.447	0.948	0.936	1.027	0.489
1977	0.598	0.636	0.826	0.493	0.872	0.930	1.048	0.520	0.872	0.930	1.048	0.545
1978	0.775	0.811	1.055	0.460	0.964	0.960	1.086	0.528	0.964	0.960	1.086	0.542
1979	0.726	0.793	0.962	0.460	0.873	0.909	0.983	0.393	0.873	0.909	0.983	0.430
1980	0.863	0.899	1.113	0.528	1.004	1.026	1.119	0.478	1.004	1.026	1.119	0.488
1981	0.919	0.944	1.117	0.595	1.109	1.149	1.192	0.600	1.109	1.149	1.192	0.607
1982	0.894	0.936	1.152	0.593	0.969	1.013	1.113	0.528	0.969	1.013	1.113	0.533
1983	0.862	0.873	1.062	0.495	0.956	0.934	0.982	0.430	0.956	0.934	0.982	0.450
1984	0.582	0.597	0.711	0.403	0.807	0.775	0.845	0.385	0.807	0.775	0.845	0.452
1985	0.586	0.633	0.798	0.443	0.767	0.770	0.872	0.403	0.785	0.772	0.901	0.450

Source: Alberta Agriculture, "Agriculture Statistics Yearbook." 1963 - 1985.

Figure 2. Municipalities Used to Calculate Provincial Taxes.



Modified from Alberta Bureau of Statistics, "Alberta Statistical Review, Fourth Quarter, 1985".

Total revenue per seeded acre was calculated as follows:

$$((P_w W D_w) + (P_o O D_o) + (P_b B D_b) + (P_c C D_c)) = \text{Gross Revenue}$$

where P_w is the price of wheat, P_o is the price of oats, P_b is the price of barley and P_c is the price of canola; W, O, B and C represent the yields of wheat, oats, barley and canola; and D_w, D_o, D_b and D_c represent the percentages of seeded acreage made up of each of wheat, oats, barley and canola.

To arrive at the landlord's share of gross rental revenue per seeded acre, this figure was multiplied by 25%. To calculate the net rental revenue per seeded acre property taxes were subtracted from the landlord's share of the gross revenue.

Property taxes were calculated on the basis of information obtained from tax assessors in six counties in the province. These counties were selected to represent a cross section of Alberta. They were: The County of Grande Prairie No. 1, The county of Vulcan No. 2, the county of Newell No. 4 (Brooks), the county of St. Paul No. 19, the county of Parkland No. 31 (Stony Plain), and the Special Areas whose administrative office is located in Hanna (See Figure II). The number of counties in Alberta, and limited time and financial resources, made the cost of collecting information from every county prohibitive. It is assumed that this added cost could not be justified by potential improvements in the accuracy of the final estimates.

Assessments for the county of Grande Prairie were used to represent taxes in the northern part of the province. The effect on property taxes from urban influence is reflected in the information from the county of Parkland which is located just west of the city of Edmonton. The county of Vulcan, which is in the south-central part of the province, is representative of quality farmland without irrigation. The special areas represent poorer quality dryland farmland, and are located in east central Alberta. The county of Newell borders on the county of Vulcan, and represents similar quality farmland with the benefit of irrigation. The county of St. Paul, which is relatively unaffected by urban influences, represents the parkland.

In general, the assessment base for taxation is comprised of non-farmland, farmland, buildings and improvements, machinery and equipment, and electic power and pipelines. These assessments are not necessarily based on construction costs and land values for the same year throughout the province, and are therefore not comparable. The municipality's need for revenue to fund education; hospital boards, senior citizens home foundations, etc. will be used to determine a mill rate which will be applied to this assessment base to calculate the taxes to be paid by each property owner. No distinctions with respect to taxes could be detected when comparing lands in northern Alberta to those in southern or central Alberta, or those influenced by urban development. Similarily, CLI soil classifications had no apparent bearing on property assessments. Consequently, an an average provincial tax rate was developed using the information from the six counties.

To arrive at a figure for net rental revenue per acre (including both seeded and summerfallow acres), it was necessary to multiply the net rental revenue per seeded acre by the percentage of total acres seeded each year. To determine seeded acreage, the number of fallow acres was divided by the total improved acres and subtracted from one. These data were obtained from Statistics Canada Census data, and the Alberta Agriculture Statistics Yearbooks. Both sources report acreage by census district.

The total improved acres per census division was taken from the census data and were assumed to remain constant for the inter-census years. The total number of fallow acres was reported on an annual basis from 1963 to 1978 in the agriculture statistics yearbooks. The data for the period from 1979 to 1985 were obtained from the Statistics Branch at Alberta Agriculture.

The equation for net rental revenue per acre is as follows:

$$NRR = (GRR - T) \times SA$$

where, GRR is gross rental revenue per seeded acre, T is property taxes per acre, and SA is the percentage of total acres that are seeded. Net revenue was estimated for each census

district and rural municipality, with the provincial estimate being a weighted mean of these. This figure is analagous to the dividends received for holding stocks. The sum of the rate of return from rental and the rate of return form capital gains per acre gives the total rate of return to an investment in farmland. This investment can be compared to investments in financial instruments such as the stock market and the bond market.

C. Total Returns to the Market and the Risk Free Rate

The theory of the market portfolio postulates the existance of a portfolio representative of the value of all assets available in the market. To calculate the value and returns of such a portfolio would be virtually impossible but certain indicies can be used to approximate it. The Toronto Stock Exchange (TSE) 300 Composite Index is a collection of 300 stocks traded on the TSE which represent fourteen group indicies and 41 sub-group indicies. The group indicies are:

1. metals and minerals
2. gold and silver
3. oil and gas
4. paper and forest products
5. consumer products
6. industrial
7. real estate and construction
8. transportation
9. pipelines
10. utilities
11. communications and media
12. merchandising
13. financial services
14. management companies

The TSE 300 Stock Price Index (SPI) gives a measure of investment performance through time for the TSE based on price appreciation. The Total Returns Index (TRI) takes into consideration both price appreciation and appreciation resulting from the reinvestment of dividends. A comparison of the average annual compounded rate of return between the TRI and the SPI provides a means of examining the impact of dividends. These indicies were used to approximate the market portfolio for the purposes of this analysis. The average annual compounded rate of return was calculated for both farmland and the market index as

$$\left(\frac{\text{end of year value}}{\text{beginning of year value}}\right) - 1.$$

To obtain an annual value for the total returns to the market, the month end values were averaged for each year. In this manner any sudden and short-lived up or down turns in the market at year end are not considered to be the value for the entire year.

The rate of return on six month treasury bills was used as an approximation of the risk free rate of return. Like the total returns to the market, an annual risk free rate was estimated by averaging the month end rates for each year. The month end rate is taken as the Thursday tender following the last Wednesday of each month. These figures are reported in the Bank of Canada Review and the Bank of Canada Statistical Summary.

D. Application of the Model

Initially, average annual total rates of return and the standard deviation of those returns were estimated for farmland in Alberta as a whole, in each of the counties, and for the Toronto Stock Exchange 300 Composite Index.

The risk premiums for both the stock market and farmland were then determined by subtracting the risk free rate of return from the total rate of return. The risk premiums for farmland were then regressed on the risk premiums for the market to estimate a Beta coefficient for farmland. The results of the analysis and an interpretation of those results are

presented in chapter four.

IV. Results, Interpretations and Limitations

A. Results

The results are initially presented in terms of means and standard deviations for the period 1963-1985. Table 4 presents the mean total return to farmland in Alberta for the province as a whole, by census division, and the mean total return to the Toronto Stock Exchange. Table 5 presents the total return to farmland in Alberta by county. The performance of Alberta farmland and the stock market are compared grapically for the period in Figures 3 and 4. Figure 3 shows the trends for each asset, while Figure 4, the barchart comparison, allows for year to year comparison of returns.

Table 4. Average Annual Total Rates of Return and Standard Deviation for Alberta Farmland by Census Division.

Census Division	Total Returns Mean	STD DEV
TSE 300 Composite Index	12.2%	17.3%
Province	20.1%	18.8%
CENSUS DIVISION 1	23.3%	34.9%
CENSUS DIVISION 2	17.8%	22.1%
CENSUS DIVISION 3	19.9%	24.4%
CENSUS DIVISION 4	20.4%	29.1%
CENSUS DIVISION 5	16.6%	21.1%
CENSUS DIVISION 6	18.0%	24.4%
CENSUS DIVISION 7	22.2%	22.6%
CENSUS DIVISION 8	20.1%	22.1%
CENSUS DIVISION 10	21.4%	23.7%
CENSUS DIVISION 11	21.7%	26.3%
CENSUS DIVISION 12	27.6%	28.4%
CENSUS DIVISION 13	24.9%	20.7%
CENSUS DIVISION 14	32.3%	38.1%
CENSUS DIVISION 15	24.3%	23.0%

The risk premium is calculated as the mean total return to an asset, less the mean risk free rate of return. This premuim for Alberta farmland ranged from a high of 36.9% in Improvement District No. 18 at Lac La Biche to a low of 8.8% in the Municipal District of Kneehill No. 48, which is an area in central Alberta northeast of Calgary. For the province as

Table 5. Average Annual Total Rates of Return and Standard Deviation for Alberta Farmland by County, and the Stock Market.

Municipality	Total Returns Mean	STD DEV
TSE 300 Composite Index	12.2%	17.3%
Province	20.1%	18.8%
Grande Prairie No. 1	22.6%	27.8%
Vulcan No. 2	17.4%	22.9%
Ponoka No. 3	21.6%	24.2%
Newell No. 4	20.0%	27.2%
Warner No. 5	20.5%	26.4%
Stettler No. 6	23.0%	25.4%
Thorhild No. 7	30.1%	34.9%
Forty Mile No. 8	21.5%	30.4%
Beaver No. 9	23.1%	23.1%
Wetaskiwin No. 10	23.6%	30.4%
Barrhead No. 11	26.7%	25.0%
Athabasca No. 12	34.1%	38.5%
Smoky Lake No. 13	28.3%	33.8%
Lacombe No. 14	20.9%	24.6%
Wheatland No. 16	18.9%	30.9%
Mountain View No. 17	18.0%	22.2%
Paintearth No. 18	28.5%	29.7%
St. Paul No. 19	26.2%	28.8%
Strathcona No. 20	20.9%	27.9%
Two Hills No. 21	25.6%	28.6%
Camrose No. 22	18.7%	24.5%
Red Deer No. 23	20.0%	26.9%
Vermilion River No. 24	25.4%	28.2%
Leduc No. 25	27.4%	40.4%
Lethbridge No. 26	17.3%	32.6%
Minburn No. 27	23.6%	23.5%
Lac Ste. Anne No. 28	26.8%	23.7%
Flagstaff No. 29	21.7%	21.4%
Lamont No. 30	24.5%	34.3%
Parkland No. 31	32.1%	54.1%
MD Cardston No. 6	22.2%	38.8%
MD Pincher Creek No.9	24.7%	38.2%
MD Taber No. 14	19.3%	28.1%
MD Willow Creek No. 26	20.5%	26.4%
MD Foothills No. 31	18.3%	25.7%
MD Rockyview No. 44	20.2%	39.4%
MD Starland No. 47	22.4%	31.4%
MD Kneehill No. 48	16.9%	23.1%
MD Provost No. 52	32.0%	45.3%
MD Wainwright No. 61	25.6%	28.4%
MD Bonnyville No. 87	29.2%	27.7%
MD Sturgeon No. 90	19.4%	2[illegible]
MD Westlock No. 92	22.9%	2[illegible]
MD Smoky River No. 130	26.4%	2[illegible]
MD Spirit River No. 133	29.8%	48.3%
MD Peace No. 135	26.6%	35.2%
MD Fairview No. 136	26.6%	28.3%
ID No. 1 Medicine Hat	26.6%	44.3%
ID No. 10 Rocky Mtn House	26.0%	25.8%
ID No. 14 Edson	32.3%	30.4%
ID No. 17 High Prairie	27.3%	25.5%
ID No. 18 Lac La Biche	45.0%	44.0%
ID No. 19 Spirit River	27.5%	32.5%
ID No. 20 Spirit River	26.7%	27.0%
ID No. 21 Spirit River	29.9%	25.8%
ID No. 22 Spirit River	35.9%	44.9%
Special Areas No's 2-4 Hanna	20.3%	28.1%

a whole, the mean risk premium on farmland for the period was 12.1% with a standard deviation of 19.1%. The risk premium on the Toronto Stock Exchange averaged 4.1% for the period with a standard deviation of 17.5%. These returns are summarized in Table 6 on a census division basis and in Table 7 on a county basis.

With the exception of Improvement District No. 1, the returns for all the improvement districts are upwardly biased and should be interpreted with caution. The cause of this bias is twofold. In the northern districts, the capital gains portion is skewed by the clearing of bushland, converting it to productive farmland. The land sales data does not reflect the cost of clearing and breaking the land, resulting in capital gains close to 200% in some years.

The second cause of the upward bias is the method by which rental revenues were calculated. Yields were estimated for the crop districts discussed in Chapter 3 and depicted in Figure 1. This means that land in the more remote parts of northern Alberta are assumed to produce the same rental revenue as those in the region just north and east of Edmonton. It also makes the assumption that land in the Rocky Mountain House-Edson area, which is predominantly pasture and hayland, will produce rental revenue similar to the area in central Alberta around Red Deer and Lacombe. The limitations of climate and soil quality in the more remote regions make these assumptions unrealistic.

With respect to the risk premium relative to the mean, farmland exhibited a lower variation than did the returns to the TSE. These results are consistent with those of Kost (1968) and Barry (1980) for earlier time periods in the United States.

Capital gains, dividends, and risk premiums for each of the counties and census divisions are presented in Tables 6 and 7. The location of the counties and census divisions are depicted in Figure 4 and 5.

Table 6. Average Annual Rates of Return from Appreciation and Rental Revenue, and Risk Premiums for Alberta, the Census Divisions, and the Toronto Stock Exchange.

Census Division	Capital Gains Mean	Capital Gains STD DEV	Dividends Mean	Dividends STD DEV	Risk Premium Mean	Risk Premium STD DEV
TSE 300 Composite Index	7.7%	16.1%	4.4%	2.5%	4.1%	17.5%
Province	12.7%	17.3%	7.4%	4.2%	12.1%	19.1%
CENSUS DIVISION 1	17.2%	35.4%	6.1%	4.0%	15.2%	35.2%
CENSUS DIVISION 2	13.7%	22.7%	4.1%	2.3%	9.6%	23.2%
CENSUS DIVISION 3	13.4%	24.3%	6.5%	3.3%	11.8%	25.0%
CENSUS DIVISION 4	11.6%	28.3%	8.8%	4.6%	12.2%	28.4%
CENSUS DIVISION 5	12.5%	21.4%	4.1%	2.4%	8.5%	32.3%
CENSUS DIVISION 6	13.4%	25.2%	4.6%	2.4%	9.9%	30.3%
CENSUS DIVISION 7	13.5%	19.9%	8.7%	5.6%	14.1%	19.6%
CENSUS DIVISION 8	13.0%	21.2%	7.1%	3.8%	12.0%	22.4%
CENSUS DIVISION 10	13.2%	21.5%	8.2%	5.3%	13.3%	24.3%
CENSUS DIVISION 11	14.8%	25.5%	6.9%	4.2%	13.5%	24.2%
CENSUS DIVISION 12	13.9%	24.3%	13.7%	7.8%	19.5%	27.5%
CENSUS DIVISION 13	13.5%	17.5%	11.4%	5.9%	16.9%	18.6%
CENSUS DIVISION 14	14.2%	32.6%	18.1%	10.4%	24.2%	30.5%
CENSUS DIVISION 15	11.9%	19.0%	12.4%	7.0%	16.2%	16.8%

Regression time series results of excess returns to farmland on excess market returns are presented in Table 8 for the census divisions and in Table 9 for the counties. The inital regressions produced Durbin-Watson statisics indicating positive serial correlation in 24 of the 58 cases. As first order auto-correlation is frequently present in time series data, the Cochrane-Orcutt iterative procedure was used to correct for serial correlation.

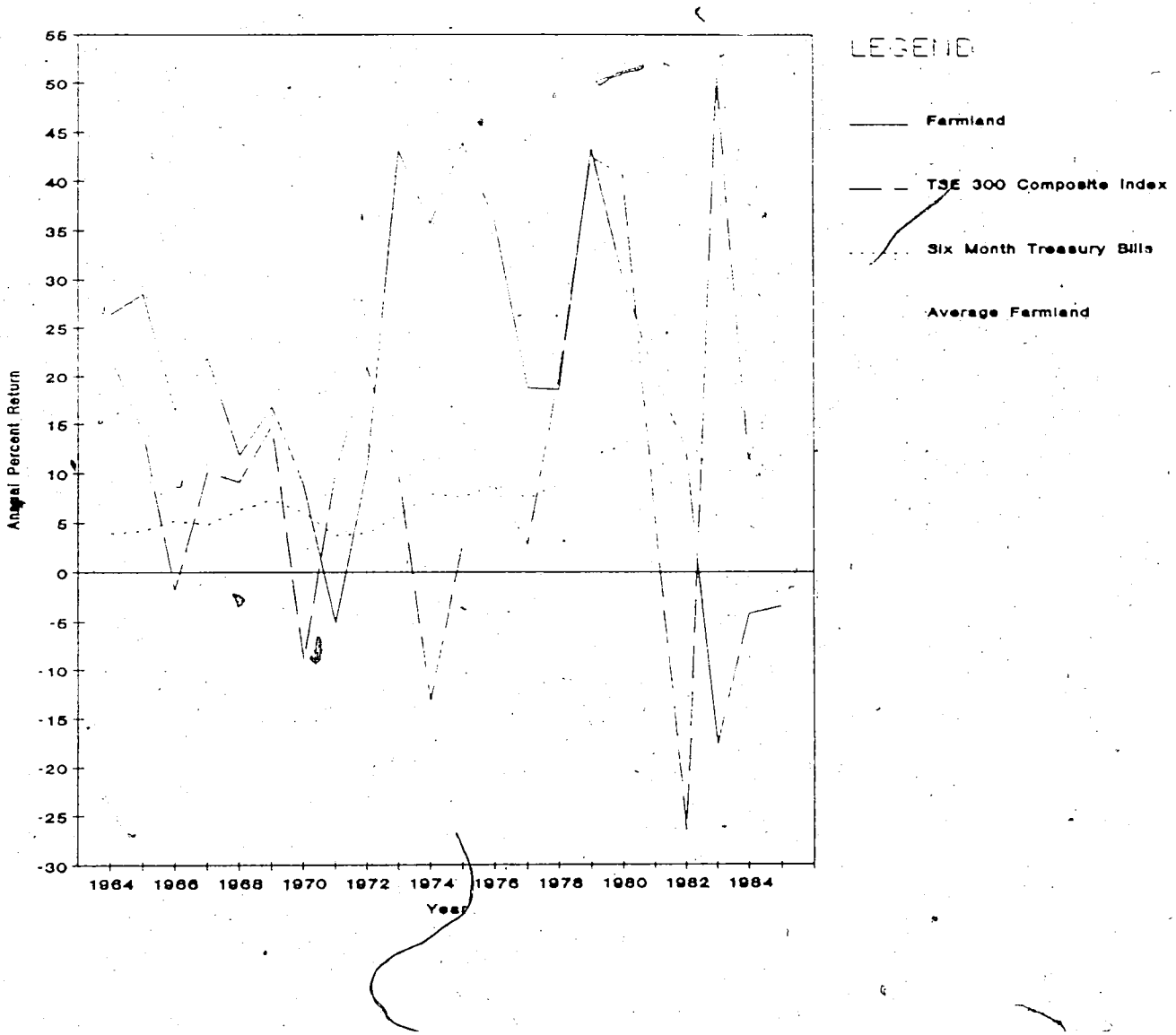
The beta for Alberta farmland overall is -0.1613, and is not significantly different from zero at a 95% confidence interval. Betas were calculated for each municipality and for each census division. Four of the fifty-seven municipalities had beta coefficients which were significantly different from zero. Two of the fourteen census districts had significant beta coefficients, one of which was negative and one which was positive. The remaining betas were not significantly different from zero. These results are presented in Table 9.

The alpha coefficients were positive for all municipalities and for the province. Of the fifty-eight regressions, thirty produced significant alpha coefficients, indicating that the return on land exceeded that which was necessary to compensate for non diversifiable risk. In the regression results by census division, six out of fourteen alpha coefficients were positive

Table 7. Average Annual Rate of Return from Appreciation and Rental Revenue, and Risk Premiums for Alberta, the Counties, and the Toronto Stock Exchange.

Municipality	Capital Gains Mean	Capital Gains STD DEV	Dividends Mean	Dividends STD DEV	Risk Premium Mean	Risk Premium STD DEV
TSE 300 Composite Index	7.7%	16.1%	4.4%	2.5%	4.1%	17.5%
Province	12.7%	17.3%	7.4%	4.2%	12.1%	19.1%
Grande Prairie No. 1	12.7%	27.3%	10.5%	6.0%	14.5%	28.9%
Vulcan No. 2	13.0%	22.7%	4.3%	2.6%	9.3%	23.3%
Ponoka No. 3	13.2%	23.0%	8.2%	4.7%	13.5%	24.8%
Newell No. 4	14.8%	27.1%	5.1%	3.3%	11.9%	27.1%
Warner No. 5	14.8%	26.6%	5.6%	2.7%	12.4%	26.0%
Stettler No. 6	14.0%	24.1%	8.9%	5.4%	14.9%	25.8%
Thorhild No. 7	17.3%	34.3%	12.6%	8.8%	22.0%	35.2%
Forty Mile No. 8	15.7%	30.3%	5.7%	3.8%	13.4%	29.7%
Beaver No. 9	13.7%	20.9%	9.2%	5.3%	15.0%	23.4%
Wetaskiwin No. 10	14.9%	30.7%	8.5%	5.0%	15.5%	30.6%
Barrhead No. 11	16.0%	24.1%	10.5%	5.9%	18.6%	25.7%
Athabasca No. 12	17.7%	38.9%	16.0%	9.9%	26.0%	39.1%
Smoky Lake No. 13	14.8%	32.3%	13.3%	8.8%	20.2%	34.2%
Lacombe No. 14	13.9%	23.4%	6.8%	4.1%	12.8%	25.3%
Wheatland No. 16	15.0%	30.6%	3.9%	2.4%	10.8%	31.4%
Mountain View No. 17	12.9%	21.4%	4.9%	2.7%	9.9%	22.6%
Paintearth No. 18	16.2%	28.9%	12.1%	8.1%	20.4%	30.1%
St. Paul No. 19	13.5%	27.5%	12.5%	6.7%	18.1%	29.4%
Strathcona No. 20	16.6%	27.9%	4.2%	2.8%	12.8%	28.4%
Two Hills No. 21	14.2%	27.3%	11.2%	7.2%	17.5%	28.7%
Camrose No. 22	12.5%	23.6%	6.1%	4.0%	10.6%	24.7%
Red Deer No. 23	13.9%	26.4%	6.0%	3.4%	11.9%	27.0%
Vermilion River No. 24	16.4%	28.0%	8.9%	6.1%	17.3%	28.2%
Leduc No. 25	21.1%	40.6%	6.1%	3.9%	19.3%	40.2%
Lethbridge No. 26	14.3%	32.4%	2.9%	1.8%	9.2%	32.3%
Minburn No. 27	14.2%	22.3%	9.3%	6.2%	15.5%	23.8%
Lac Ste. Anne No. 28	14.1%	21.4%	12.4%	7.3%	18.7%	24.4%
Flagstaff No. 29	14.2%	20.7%	7.3%	5.0%	13.6%	22.1%
Lamont No. 30	16.3%	34.7%	8.0%	5.2%	16.5%	35.0%
Parkland No. 31	23.6%	55.4%	8.3%	5.0%	24.0%	54.1%
MD Cardston No. 6	16.4%	38.7%	6.1%	2.6%	14.1%	38.0%
MD Pincher Creek No.9	18.1%	38.3%	7.0%	3.5%	16.6%	37.6%
MD Taber No. 14	15.2%	28.4%	4.4%	2.8%	11.2%	27.6%
MD Willow Creek No. 26	13.9%	25.9%	6.9%	3.5%	12.4%	26.2%
MD Foothills No. 31	13.8%	25.4%	4.8%	2.1%	10.2%	26.7%
MD Rockyview No. 44	16.2%	39.4%	4.3%	2.1%	12.1%	39.6%
MD Starland No. 47	16.5%	31.7%	6.4%	3.6%	14.3%	32.3%
MD Kneehill No. 48	13.2%	22.9%	3.9%	2.3%	8.8%	23.1%
MD Provost No. 52	21.7%	45.1%	11.4%	7.1%	23.9%	45.0%
MD Wainwright No. 61	16.3%	26.6%	10.2%	6.2%	17.5%	28.6%
MD Bonnyville No. 87	15.3%	26.9%	14.9%	9.2%	21.1%	28.5%
MD Sturgeon No. 90	13.9%	27.9%	5.8%	2.8%	11.3%	28.6%
MD Westlock No. 92	13.1%	25.3%	10.2%	5.1%	14.8%	26.3%
MD Smoky River No. 130	14.0%	25.7%	13.3%	7.1%	18.4%	27.9%
MD Spirit River No. 133	18.4%	49.2%	12.2%	6.1%	21.7%	48.5%
MD Peace No. 135	16.2%	34.8%	11.0%	7.0%	18.5%	35.8%
MD Fairview No. 136	15.9%	28.9%	11.3%	6.1%	18.5%	29.0%
ID No. 1 Medicine Hat	20.4%	45.0%	6.8%	4.2%	18.5%	43.7%
ID No. 10 Rocky Mtn House	16.8%	25.2%	10.0%	5.0%	17.9%	26.7%
ID No. 14 Edson	14.2%	32.6%	19.1%	10.4%	24.2%	31.6%
ID No. 17 High Prairie	13.4%	25.9%	14.6%	8.0%	19.2%	26.3%
ID No. 18 Lac La Biche	19.1%	41.7%	23.9%	19.3%	33.7%	40.8%
ID No. 19 Spirit River	14.0%	33.2%	14.1%	6.7%	19.4%	32.2%
ID No. 20 Spirit River	11.6%	24.3%	15.6%	7.9%	18.6%	26.9%
ID No. 21 Spirit River	13.1%	23.4%	17.6%	8.2%	21.8%	26.4%
ID No. 22 Spirit	18.5%	47.5%	18.0%	10.9%	27.8%	44.7%
Special Areas - Hanna	11.6%	28.3%	9.2%	4.6%	12.2%	28.4%

Figure 3. Performance of Alberta Farmland and the Stock Market, 1963-1985.



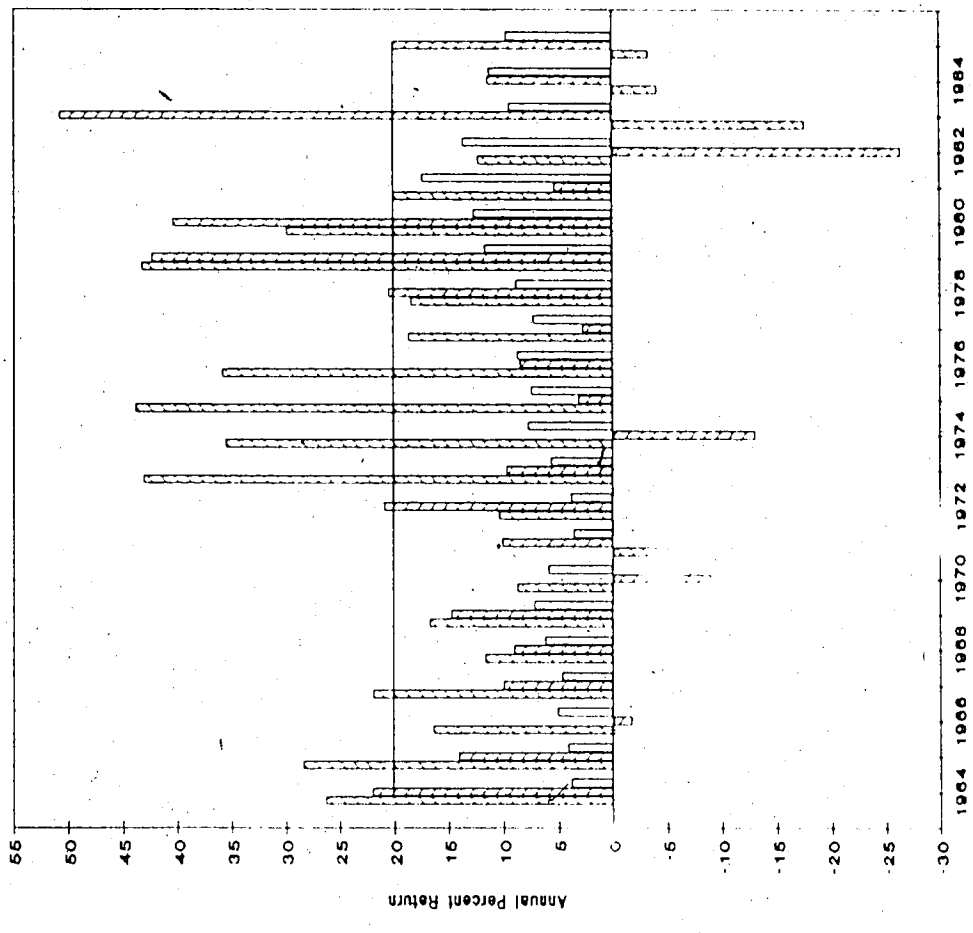


Figure 4. Performance of Alberta Farmland and the Stock Market, 1963-1985, Barchart Comparison.

Table 8. CAPM Results by Census Division.

Municipality		Alpha Value	Alpha T-stat	Alpha Standard Error	Alpha 95% Confidence Range Minimum	Alpha 95% Confidence Range Maximum		Beta Value	Beta T-stat	Beta Standard Error	Beta 95% Confidence Range Minimum	Beta 95% Confidence Range Maximum	Durbin Watson
Census Division 1	*	0.1780	3.0366	0.0586	0.0557	0.3002		-0.5953	-1.4674	0.4057	-1.4416	0.2510	1.9274
Census Division 2		0.0822	1.1420	0.0720	-0.0679	0.2323		0.0968	0.3681	0.2629	-0.4516	0.6451	1.9465
Census Division 3		0.1201	1.7124	0.0701	-0.0262	0.2664		-0.1977	-0.6774	0.2919	-0.8065	0.4111	1.7977
Census Division 4	*	0.1573	2.9764	0.0528	0.0470	0.2675	*	-0.8578	-2.7779	0.3088	-1.5019	-0.2137	1.9594
Census Division 5		0.0890	1.1191	0.0795	-0.0769	0.2549		-0.2545	-1.2018	0.2118	-0.6963	0.1873	1.9624
Census Division 6		0.0974	1.2460	0.0782	-0.0657	0.2604		-0.0661	-0.2173	0.3041	-0.7005	0.5683	2.0625
Census Division 7		0.1414	1.7459	0.0810	-0.0275	0.3102		0.0155	0.0730	0.2121	-0.4270	0.4580	2.1006
Census Division 8		0.1154	1.3959	0.0826	-0.0570	0.2878		-0.1041	-0.4414	0.2357	-0.5958	0.3877	2.2198
Census Division 10		0.1347	1.5278	0.0881	-0.0492	0.3185		-0.1633	-0.7396	0.2208	-0.6239	0.2973	2.0286
Census Division 11	*	0.1508	2.5577	0.0590	0.0278	0.2738		-0.3930	-1.2581	0.3124	-1.0447	0.2586	1.9622
Census Division 12	*	0.1646	2.4237	0.0679	0.0229	0.3063	*	0.6628	2.2100	0.2999	0.0372	1.2884	2.0888
Census Division 13	*	0.1644	2.3157	0.0710	0.0163	0.3124		0.0928	0.4367	0.2126	-0.3506	0.5362	1.9494
Census Division 14	*	0.2356	2.6146	0.0901	0.0476	0.4236		0.0705	0.1857	0.3796	-0.7213	0.8622	1.8469
Census Division 15		0.1657	1.8436	0.0899	-0.0218	0.3531		-0.1847	-0.9778	0.1889	-0.5787	0.2093	1.8692

* Asterisk denotes significance at the .05 level

Table 9. CAPM Results for the Province and Municipalities.

Municipality	Alpha					Beta					Durbin Watson
	Value	T-stat	Standard Error	95% Confidence Range Minimum	Maximum	Value	T-stat	Standard Error	95% Confidence Range Minimum	Maximum	
Province	0.1157	1.1759	0.0982	-0.0892	0.3207	-0.1613	-1.2145	0.1328	-0.4384	0.1158	1.4062
Grande Prairie No. 1	0.1447	1.6333	0.0886	-0.0401	0.3296	-0.0651	-0.1974	0.3301	-0.7537	0.6234	2.0643
Vulcan No. 2	0.0966	1.6188	0.0597	-0.0279	0.2211	-0.1257	-0.4328	0.2904	-0.7315	0.4801	1.8791
Ponoka No. 3	0.1329	1.5757	0.0844	-0.0431	0.3089	-0.1320	-0.4980	0.2650	-0.6847	0.4208	2.0846
Newell No. 4	0.1180	1.8960	0.0622	-0.0118	0.2478	0.0171	0.0490	0.3473	-0.7073	0.7415	1.6994
Warner No. 5	* 0.1309	2.2060	0.0593	0.0071	0.2546	-0.1729	-0.5220	0.3311	-0.8635	0.5177	1.7760
Stettler No. 6	0.2012	1.4888	0.1351	-0.0807	0.4831	0.2986	0.6354	0.4700	-0.6818	1.2790	2.0844
Thorhild No. 7	* 0.2316	2.8980	0.0799	0.0649	0.3983	-0.3033	-0.6800	0.4460	-1.2336	0.6271	2.0972
Forty Mile No. 8	* 0.1544	2.3040	0.0670	0.0146	0.2942	-0.4932	-1.3180	0.3741	-1.2735	0.2871	2.3499
Beaver No. 9	* 0.1555	2.0971	0.0742	0.0008	0.3102	-0.2152	-0.8331	0.2583	-0.7541	0.3237	1.8944
Wetaskiwin No. 10	* 0.1479	2.1150	0.0699	0.0020	0.2937	0.1881	0.4820	0.3902	-0.6259	1.0021	2.0012
Barrhead No. 11	* 0.1979	3.4240	0.0578	0.0773	0.3184	-0.2947	-0.9140	0.3225	-0.9674	0.3779	1.9320
Athabasca No. 12	* 0.2851	3.3120	0.0861	0.1055	0.4647	-0.6178	-1.2860	0.4804	-1.6198	0.3843	2.1106
Smoky Lake No. 13	0.1840	1.8328	0.1004	-0.0254	0.3934	0.3149	0.7949	0.3961	-0.5114	1.1411	1.9898
Lacombe No. 14	0.1243	1.4258	0.0872	-0.0575	0.3061	0.0989	0.3780	0.2616	-0.4469	0.6446	2.0188
Wheatland No. 16	0.1311	1.9210	0.0683	-0.0113	0.2735	-0.5690	-1.4940	0.3809	-1.3635	0.2255	1.5727
Mountain View No. 17	0.0919	0.9505	0.0967	-0.1098	0.2936	-0.1896	-0.9794	0.1936	-0.5934	0.2142	2.0689
Paintearth No. 18	* 0.2130	3.1320	0.0680	0.0711	0.3549	-0.3431	-0.9040	0.3796	-1.1349	0.4487	1.8946
St. Paul No. 19	* 0.1620	2.4730	0.0655	0.0254	0.2987	0.1339	0.3660	0.3658	-0.6292	0.8969	2.0973
Strathcona No. 20	* 0.1417	5.5661	0.0255	0.0886	0.1948	-0.3660	-1.0420	0.3512	-1.0986	0.3667	1.7628
Two Hills No. 21	* 0.1735	2.2785	0.0762	0.0147	0.3324	-0.0462	-0.1303	0.3544	-0.7855	0.6932	2.0330
Camrose No. 22	0.1086	1.2591	0.0863	-0.0713	0.2886	-0.1192	-0.4737	0.2517	-0.6443	0.4058	2.0345
Red Deer No. 23	0.1416	2.0306	0.0697	-0.0039	0.2871	*-0.7447	-2.6078	0.2856	-1.3404	-0.1490	1.9811
Vermilion River No. 24	* 0.1883	2.9900	0.0630	0.0569	0.3197	-0.3661	-1.0420	0.3514	-1.0992	0.3670	1.5174
Leduc No. 25	* 0.2086	2.2280	0.0936	0.0133	0.4039	-0.4096	-0.7840	0.5224	-1.4994	0.6802	1.9825
Lethbridge No. 26	0.0970	1.3100	0.0740	-0.0574	0.2514	-0.1171	-0.2840	0.4124	-0.9773	0.7431	1.5997
Minburn No. 27	0.1533	1.9623	0.0781	-0.0097	0.3162	-0.0841	-0.3208	0.2623	-0.6313	0.4630	1.8631
Lac Ste. Anne No. 28	* 0.1959	2.3508	0.0833	0.0221	0.3697	-0.1812	-0.7273	0.2492	-0.7010	0.3386	1.8115
Flagstaff No. 29	0.1252	1.7161	0.0729	-0.0270	0.2773	0.2590	1.0927	0.2370	-0.2354	0.7533	2.0750
Lamont No. 30	* 0.1749	2.1940	0.0797	0.0086	0.3411	-0.2556	-0.5750	0.4445	-1.1829	0.6717	1.8720
Parkland No. 31	0.2562	2.0810	0.123	-0.0006	0.5131	-0.4072	-0.5930	0.6870	-1.8403	1.0259	2.4967

Table 9. Continued.

Municipality	Alpha Value	Alpha T-stat	Alpha Standard Error	Alpha 95% Confidence Range Minimum	Alpha 95% Confidence Range Maximum	Beta Value	Beta T-stat	Beta Standard Error	Beta 95% Confidence Range Minimum	Beta 95% Confidence Range Maximum	Durbin Watson
MD Cardston No. 6	0.1622	1.9140	0.0848	-0.0146	0.3390	-0.5186	-1.0960	0.4732	-1.5056	0.4684	2.5079
MD Pincher Creek No.9	0.1631	1.8900	0.0863	-0.0169	0.3430	0.0682	0.1420	0.4815	-0.9362	1.0725	2.1886
MD Taber No. 14	0.1275	2.0690	0.0616	-0.0010	0.2560	-0.3753	-1.0920	0.3437	-1.0923	0.3416	1.8291
MD Willow Creek No. 26	0.1215	1.5721	0.0773	-0.0397	0.2826	-0.1402	-0.4545	0.3084	-0.7836	0.5032	1.6985
MD Foothills No. 31	0.0994	1.6240	0.0612	-0.0283	0.2271	0.0728	0.2130	0.3417	-0.6401	0.7857	1.7688
MD Rockyview No. 44	0.1154	1.2720	0.0907	-0.0739	0.3047	0.1477	0.2920	0.5065	-0.9089	1.2042	1.8828
MD Starland No. 47	0.1271	1.7510	0.0726	-0.0243	0.2785	0.3910	0.9650	0.4051	-0.4542	1.2361	2.2798
MD Kneehill No. 48	0.0970	1.2935	0.0750	-0.0594	0.2533	-0.3740	-1.6318	0.2292	-0.8521	0.1041	1.8715
MD Provost No. 52	* 0.2415	2.3430	0.1031	0.0265	0.4565	-0.0242	-0.0420	0.5767	-1.2271	1.1787	2.0273
MD Wainwright No. 61	0.1777	1.9380	0.0917	-0.0136	0.3689	-0.1083	-0.3457	0.3133	-0.7620	0.5453	1.9943
MD Bonnyville No. 87	* 0.1929	2.3045	0.0837	0.0183	0.3675	0.3492	1.0644	0.3281	-0.3352	1.0336	2.0370
MD Sturgeon No. 90	0.1140	1.7380	0.0656	-0.0228	0.2508	-0.0312	-0.0850	0.3660	-0.7948	0.7324	2.1001
MD Westlock No. 92	* 0.1363	2.3040	0.0592	0.0129	0.2598	0.2847	0.8620	0.3303	-0.4043	0.9737	1.8944
MD Smoky River No. 130	* 0.1871	2.9350	0.0638	0.0541	0.3201	-0.1010	-0.2840	0.3556	-0.8427	0.6407	1.7531
MD Spirit River No. 133	0.2293	2.0720	0.1107	-0.0015	0.4601	-0.2920	-0.4730	0.6173	-1.5797	0.9957	2.4493
MD Peace No. 135	* 0.1738	2.1370	0.0813	0.0041	0.3435	0.2845	0.6270	0.4538	-0.6621	1.2312	1.5537
MD Fairview No. 136	* 0.1694	2.6180	0.0647	0.0344	0.3043	0.3809	1.0560	0.3607	-0.3715	1.1334	2.0329
ID No. 1 Medicine Hat	* 0.2164	3.1389	0.0689	0.0726	0.3602	-0.7460	-1.5070	0.4950	-1.7785	0.2866	1.9965
ID No. 10 Rocky Mtn House	0.1433	1.8861	0.0760	-0.0152	0.3017	* 0.7741	2.8170	0.2748	0.2009	1.3474	2.0417
ID No. 14 Edson	* 0.2356	2.6170	0.0900	0.0478	0.4235	0.0708	0.1864	0.3795	-0.7209	0.8624	1.8470
ID No. 17 High Prairie	* 0.2163	3.1884	0.0678	0.0748	0.3578	-0.5001	-1.6683	1.9020	-4.4677	3.4674	1.6493
ID No. 18 Lac La Biche	* 0.3308	3.5390	0.0935	0.1358	0.5258	0.1481	0.2840	0.5213	-0.9395	1.2356	1.4833
ID No. 19 Spirit River	* 0.2147	3.0290	0.0709	0.0668	0.3625	-0.5209	-1.3170	0.3955	-1.3459	0.3041	2.2604
ID No. 20 Spirit River	* 0.1937	3.1880	0.0607	0.0669	0.3204	-0.2202	-0.6500	0.3388	-0.9269	0.4865	1.5334
ID No. 21 Spirit River	* 0.2143	3.5420	0.0605	0.0881	0.3406	0.0792	0.2350	0.3371	-0.6241	0.7825	1.6000
ID No. 22 Spirit River	* 0.3232	4.7589	0.0679	0.1815	0.4649	*-1.0278	-2.1158	0.4858	-2.0411	-0.0145	2.0437
Special Areas No's 2-4	* 0.1777	3.1620	0.0546	0.0588	0.2866	*-0.8370	-2.7470	0.3047	-1.4726	-0.2014	2.1390

* Asterisk denotes significance at the .05 level

and significant.

B. Interpretations

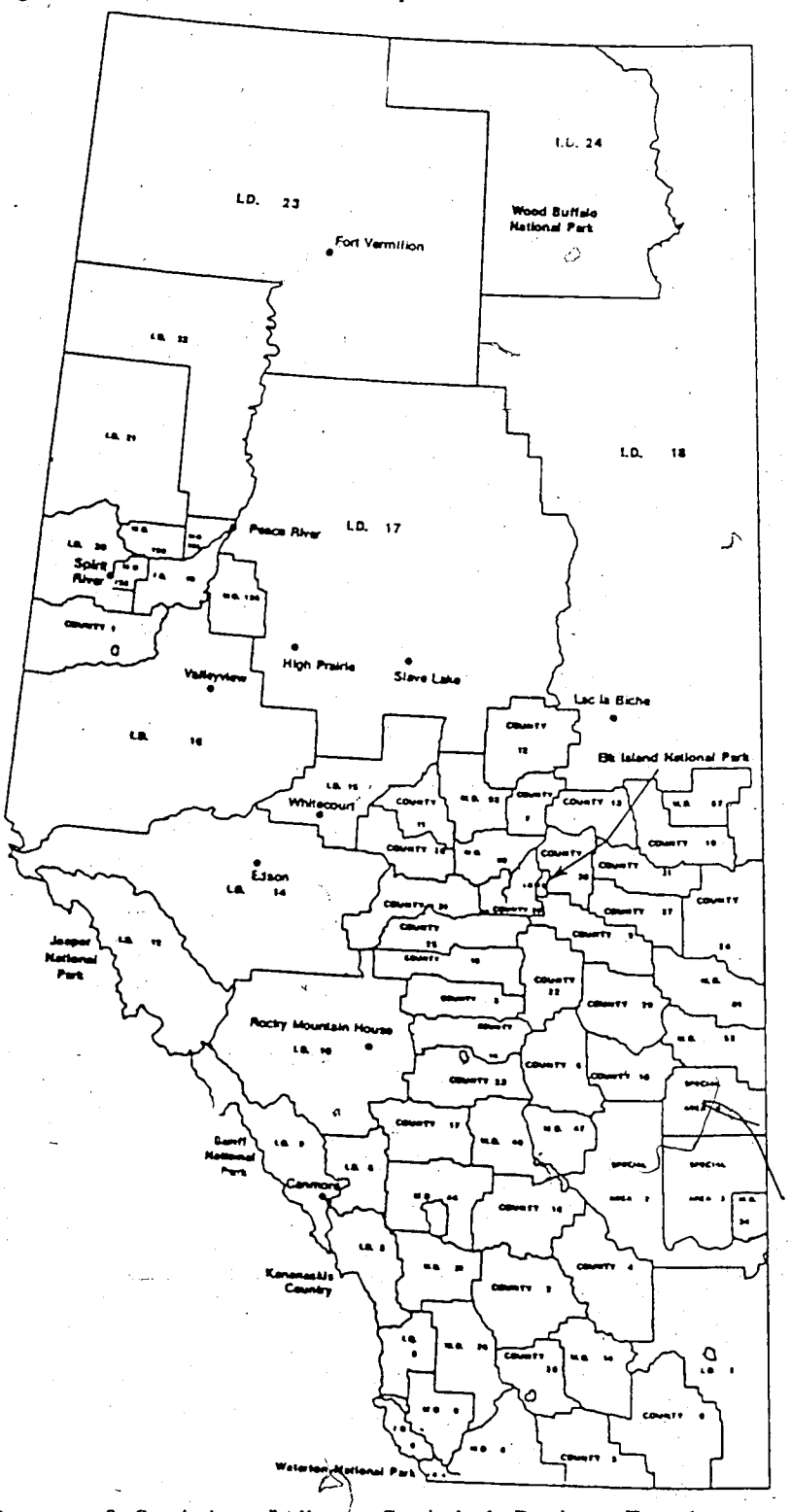
The beta coefficients for farmland in the municipalities and census divisions in Alberta show a substantial amount of variation in absolute terms but are by and large not significantly different from zero. Statistically, therefore, this variation is not significant. Of the four regressions that did produce significant betas, one was positive and the other three were negative.

A beta of zero can be a result of two things. If the returns on an asset are independant of the returns to the market, the covariance, and hence the beta, of that asset will be zero. If the returns on the asset are certain, as in the risk free asset, the covariance and beta will also be zero. The returns on an investment in farmland are not certain, therefore betas not significantly different from zero are a result of returns that are essentially independant of the returns in the market. Alternatively stated, the insignificant beta values indicate that the CAPM is not an accurate explanator of farmland prices in Alberta.

With respect to the four beta values that were significantly different from zero, it is most likely that the linear association is attributable to chance. The three negative significant betas were for the County of Red Deer No. 23, Improvement District No. 22, and the Special Areas. These three municipalities comprise substantially different kinds of farmland therefore it would not be expected that their beta values would be similar. It would be more likely that the risk-return characteristics of an investment in farmland in the County of Red Deer would be similar to an investment in farmland in the County of Lacombe, the County of Stettler, or perhaps the County of Lethbridge where there is an urban municipality of similar size. The beta value for both the County of Lacombe and the County of Stettler was positive, for the County of Lethbridge it was negative, and none was significantly different from zero.

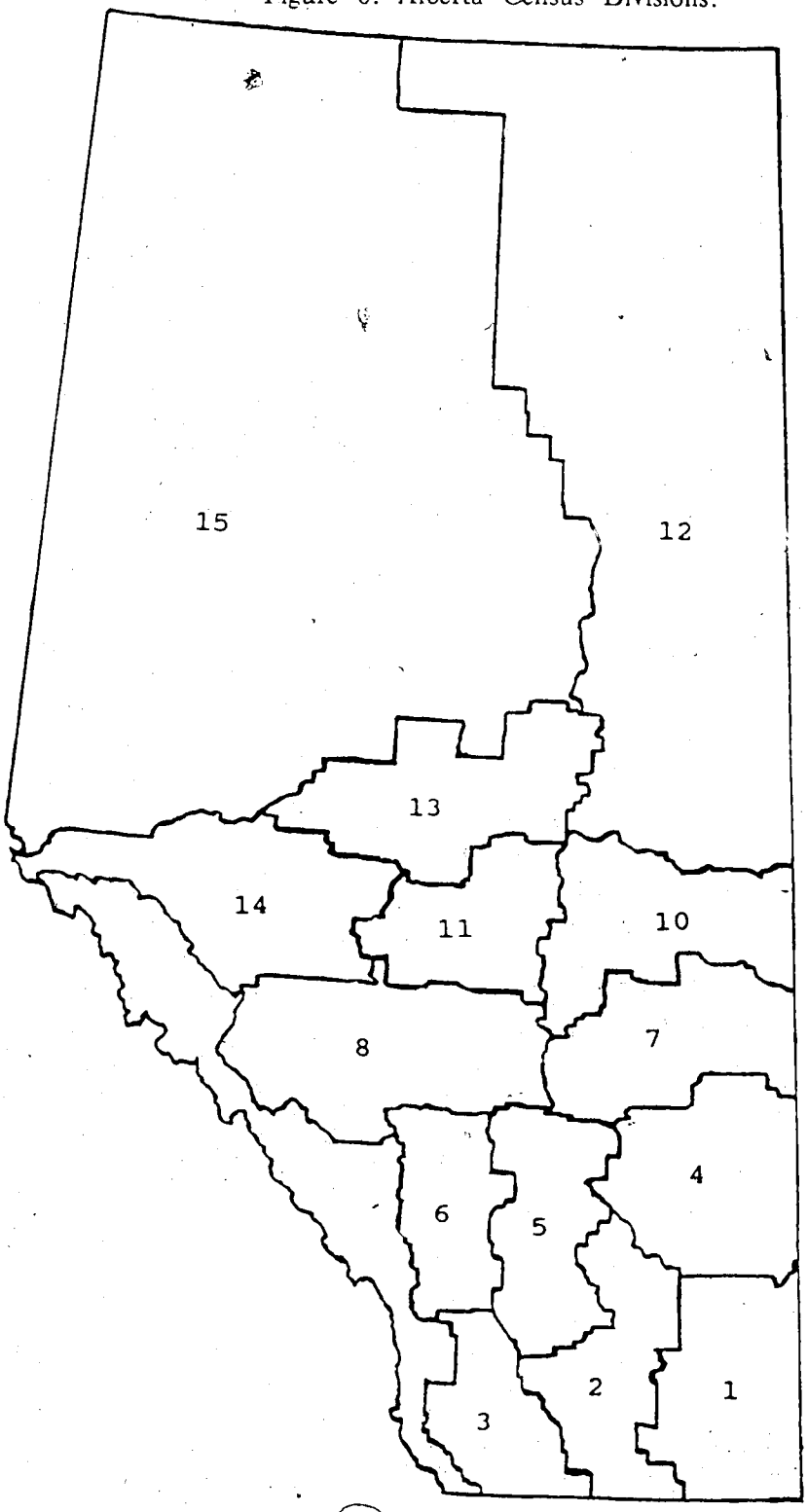
Slightly more than half of the alpha values calculated in the regressions were significantly different from zero. This implies that historical returns on farmland in Alberta have been in excess of that which is required to compensate for non diversifiable risk, by as

Figure 5. Alberta Rural Municipalities.



Modified from Alberta Bureau of Statistics, "Alberta Statistical Review, Fourth Quarter, 1985."

Figure 6. Alberta Census Divisions.



Modified from Alberta Bureau of Statistics, "Alberta Statistical Review, Fourth Quarter, 1985."

much as 32%. The combination of low betas and significant alpha values indicates that an investment in farmland is worthy of consideration as a tool of portfolio diversification, and would contribute less systematic risk to a portfolio than an average stock, which is defined as having a beta of 1.

While the risk premiums on land appear to be substantially higher than the risk premiums on the Toronto Stock Exchange, it should be noted that the period under study was one of atypically low risk premiums on the TSE. The risk premiums on land over this time may be normal when compared to longer period risk premiums on the TSE.

In general, the returns on farmland are not as volatile as the returns on the TSE when considered in the context of portfolio investment, as is represented by a beta value of -0.16. As the data is disaggregated, the range of the betas widens, but most are still not significantly different from zero. An investor considering an investment in farmland as a means of diversifying a portfolio would be best advised to base his decision on the provincial beta, rather than on the county betas, as the provincial estimate is based on a larger and more diverse data set. In some of the counties there were few if any sales transactions in some years. If the sales transactions which did take place in those years were not representative of a typical land sale in that county, the estimate for beta may be biased.

C. Limitations

The assumptions of the Capital Asset Pricing Model are very restrictive and create some question as to the model's applicability to farmland. The assumption that assets are perfectly divisible and marketable causes the greatest concern. The market for farmland in Alberta, and in general, is characteristically thin, with less than 5% of deeded acreage being sold each year. Atypical sales in several years may bias the results of the analysis, especially over so short a time period as being anaylzed in this study.

For the purposes of this study the minimum parcel considered was eighty acres. Other studies consider any sale of sixty acres or more to be agricultural in nature. At any rate, the asset is by no means perfectly divisible. Although the same could be said to be true of the

stock market in that nothing less than one common share can be sold, stocks are infinitely more marketable and divisible than land. These shortcomings of land characteristics in satisfying the assumptions of the CAPM may bias the estimates of beta for farmland.

The effects of government involvement in establishing the value of farmland has not been considered in this analysis, but cannot be ignored. The value of an acre of farmland is greatly influenced by the value of the commodities which can be produced on that land. Subsidies, stabilization programs and other forms of government involvement in agriculture do play a large role in establishing the value of agricultural commodities and therefore in the value of land. These effects however, have been present throughout the entire period being studied and do not influence the results in some years and not in others. Furthermore, it is not the intent of this analysis to study the determinants of farmland value, but to study the market in which farmland is valued.

Finally, in an anlysis which is based on historic data there is always some question as to the quality of these data. Changes in record keeping systems, the people keeping the records, and units of measurements can all influence the accuracy of these data. As mentioned earlier, there were several years in which no sales transactions occurred in certain counties. The land sales data were collected by the Farm Credit Corporation, and although they included transactions which did not involve FCC financing there is a possibility that a higher than normal porportion of FCC land sales transactions is reflected in these data.

The rental index used in this study was created from the most micro level of data available, but yield data are only disaggregated to the level of census division. This represents a significant weakness in the rental index in that it does not allow for differences in productivity among the different land types. For example, because Improvement District No. 10 at Rocky Mountain House is in the same Census Division as the Counties of Lacombe, Red Deer and Ponoka, it is assumed to have the same income generating capacity as those counties. Much of the land in the Rocky Mountain House Region is pasture and does not have the same income generating capabilities as the cropland to the east of it. As a result, the rental revenue is overstated for the less productive areas, and understated for the more

productive lands. This shortcoming could be solved to an extent by the establishment of a database of crop yields on a county by county basis. Ideally, such a database would give an average yield for several different kinds of crops on each of the different Canadian Land Inventory land classifications within the county.

In addition to more accurate crop yield information, data on the use of fertilizers and pesticides in each of the counties would allow for the creation of a more reliable rental index. If this sort of data were available, the landlord-tenant split could be more accurately estimated using the cost of these inputs.

Despite these limitations, this analysis is valid and informative. It is shown that rates of return on farmland do not covary with the market in general, but do exceed that which is necessary to compensate for non-diversifiable risk.

V. Summary, Conclusions, and Recommendations

A. Summary

Two objectives were outlined in the initial chapter of this thesis. The first objective was to establish a data base which could be used to analyze the risk and return characteristics of an investment in farmland in Alberta. This was achieved through the compilation of data from a variety of sources including the Farm Credit Corporation, Alberta Agriculture's Statistics Branch, and the Alberta Hail and Crop Insurance Corporation. These statistics were combined to establish both a capital gains return on an investment in farmland and a dividend return, expressed as rental income.

The second objective of the study was to estimate total returns to farmland in various parts of Alberta and compare them to total returns to investments in the stock market over the same period of time. This was accomplished by applying the Capital Asset Pricing Model to the above mentioned data base to estimate beta values for farmland.

B. Conclusions

While there are limitations to the applicability of the CAPM to farmland, this analysis does provide some general conclusion about investments in farmland. To begin, the fact that returns to farmland appear to move in a different fashion from the returns in the stock market in general indicates that farmland may be a useful tool for portfolio diversification. Secondly, farmland has performed well as an investment in the period being studied. This is evinced by beta values of less than one, significant alpha values, and an average risk premium of 12.1%.

Given these statistics for an investment in farmland, one is led to wonder about the fact that most agricultural land buyers are producers. Why are more outside investors not involved in the agricultural land market? There are some distinct similarities between an investment in farmland and an investment in common shares. Both represent equity ownership, and both are earning assets subject to similar forms of risk. There are however,

several factors which may partially explain the lack of non-farm participation in this market.

One of the cardinal rules of making successful investments is to understand the market in which you invest. In order to have this comprehension, information is necessary, and information on the farmland market is scarce and difficult to collect. Existing information sources are highly aggregated and are often not an accurate reflection of the fair market value of one particular parcel of land. For example, the available data may not exclude arms-length transactions, or the sale of long term grazing leases may be treated as legitimate land sales. An investor is more likely to place his money in an asset which he understands and about which he can obtain accurate information. Given the abundance of accurate information on the stock and bond markets, as well as numerous forecasting newsletters, the investor may decide it is simpler to place his money there.

While both types of investment represent ownership of equity, they represent differing degrees of ownership. The purchase of a piece of land by an individual makes him the sole proprietor of that land. The fate of his investment is in his hands. As an investor it is assumed that he will not farm the land himself, but that he will rent the land to a farmer. The farmer as such is the manager of the asset, and one cannot assume that this manager will always act in the best intersts of the owner. Based on the asumption of a 75:25 tenant-landlord crop share, with the tenant bearing the costs of inputs, there is no reason to believe that the tenant will use profit maximizing levels of fertilizers or pesticides in producing crops. He may not believe that the gains to be made by using profit maximizing levels of inputs justify the effort required to determine what those levels are. In a worst case situation, the tenant may choose not to use any pesticides or fertilizers, and let the land deteriorate, thus eroding the value of the asset. While this sort of behavior seems irrational and unlikely, tenancy carries with it an uncertaity of its own, and the renter will act accordingly. It may also be difficult to keep one tenant for the long term, especially with less productive lands. The investor may believe that the costs of monitoring the management decisons of his tenant or finding new tenants are too high to [illegible]y making the investment in the first place.

The betas calculated in this project are called ex post betas because thay are based on historical data. Although hindsight is perfect, an individual making an investment decision in 1963 had no way of knowing that farmland would outperform the TSE 300 Composite Index over the next 23 years. If the individual had made his decision based on the information available on each market, he would have invested in the stock or bond markets, which is exactly what occurred.

Assumptions can be made about the future performance of an asset based on its past performance, but the accuracy of this prediction is uncertain. The more stable the relationship between the asset and the economy in general, the more reliable will be the forecast.

Finally, there thrives in the minds of many, an intangible value to owning farmland, which is not economic in nature and which may influence an investor's attitude about land. Such a feeling does not seem to exist where the stock market is concerned. Based on his own beliefs about this intangible value connected to farmland, an investor may believe that the value of land is exaggerated and choose not to buy it. The lack of information available would only support this reasoning.

C. Recommendations

The findings of this study indicate that farmland outperformed the maket in general during the time period between 1963 and 1985. The insignificance of the beta values suggests that farmland cannot be valued in the same manner as financial assets such as stocks and bonds, or that the CAPM is not an accurate explanator of the price of farmland. Based on the estimates of beta however, it appears that farmland may be a suitable candidate for use in portfolio diversification.

The most important contribution of this study has been to initiate a very necessary source of information in the form of a computer stored land sales transactions record. If farmland is to be considered in terms of portfolio investment, it is imperative that this data base be refined and maintained into the future. The data could also be augmented with data from sources other than FCC. Likewise, the rental index which has been established should be

extended to accomodate pastureland and irrigated land. Where possible, the yield data used in such an index should be based on the average yield for a particular soil type or CLI classification by county rather than by each Census Division. The availability and accessibility of such an information source will benefit all investors in farmland, whether they be portfolio investors seeking to diversify risk, or farmers seeking to expand their farming operations.

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Appendix A: Average Annual Value per Acre, and Rental Income per Acre, by County, 1963 - 1985

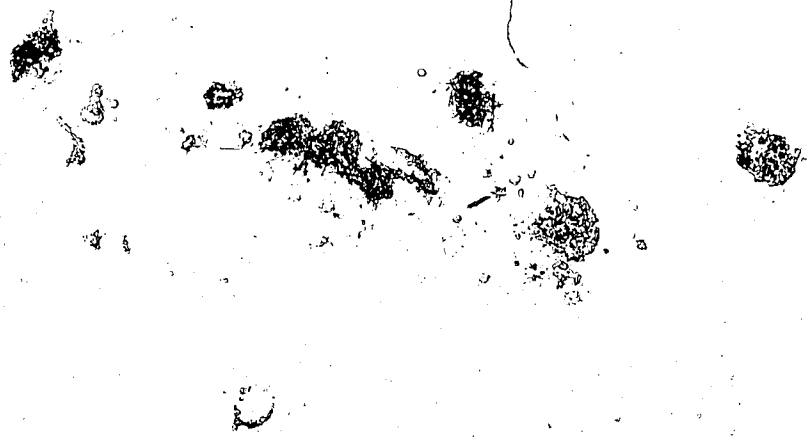

Table 10a. Average Annual Value per Acre by County, 1963 - 1985.

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Province	44.39	51.17	60.50	62.79	72.51	75.20	83.50	86.27	77.11	75.27	92.03	141.64
Grande Prairie No. 1	34.30	42.73	45.29	41.59	77.26	75.06	66.64	58.92	61.50	57.58	70.52	89.51
Vulcan No. 2	56.75	71.11	63.12	77.98	76.64	98.69	96.96	82.83	94.76	105.94	109.50	177.07
Ponoka No. 3	46.82	56.45	70.70	70.45	64.07	72.85	70.96	80.23	72.98	83.77	92.73	158.73
Newell No. 4	58.84	53.59	67.55	66.15	64.84	72.80	88.49	83.02	84.02	89.73	114.69	171.74
Warner No. 5	58.70	54.96	74.31	89.20	87.32	93.75	83.60	51.24	77.15	103.78	117.52	146.77
Stettler No. 6	35.72	37.40	49.96	43.92	58.41	63.42	62.93	59.47	64.00	53.15	78.45	116.72
Thorhild No. 7	31.45	31.90	45.57	48.12	44.72	61.64	65.68	38.02	58.69	40.89	49.04	99.39
Forty Mile No. 8	44.18	43.51	44.39	54.58	60.15	69.29	74.24	71.83	77.12	62.19	84.92	108.15
Beaver No. 9	35.68	46.68	54.26	57.24	60.41	67.85	52.04	58.08	49.51	54.22	76.47	97.51
Wetaskiwin No. 10	51.74	50.47	75.34	49.44	70.67	85.60	80.36	57.48	77.77	77.11	102.98	116.96
Barrhead No. 11	32.44	46.42	49.68	63.31	66.51	66.66	54.14	58.10	83.73	53.03	75.99	90.86
Athabasca No. 12	25.05	36.79	30.27	38.86	38.27	44.42	22.76	48.79	50.46	41.05	60.59	79.31
Smoky Lake No. 13	34.87	44.00	34.11	32.61	45.31	68.22	52.00	36.41	36.94	35.33	48.26	82.57
Lacombe No. 14	60.25	79.22	67.48	83.01	99.97	106.34	98.67	86.83	70.91	90.37	111.17	179.56
Wheatland No. 16	55.97	72.97	64.72	91.89	93.79	81.35	87.33	91.56	107.34	85.07	133.49	276.69
Mountain View No. 17	74.74	80.77	96.39	105.29	114.58	110.25	103.87	98.30	104.51	124.64	157.01	250.55
Paintearth No. 18	25.48	32.94	33.78	42.60	46.38	52.24	41.14	51.42	41.61	46.52	44.40	85.05
St. Paul No. 19	34.14	29.69	29.22	38.59	33.90	49.01	41.46	54.43	45.25	49.19	66.55	85.45
Strathcona No. 20	76.88	119.31	121.73	103.90	122.50	205.70	162.84	231.58	201.28	144.21	167.62	252.10
Two Hills No. 21	35.47	33.31	39.58	46.82	50.59	47.00	58.79	48.08	34.76	54.57	55.09	70.40
Camrose No. 22	55.84	71.75	78.83	85.43	87.12	98.66	87.87	86.51	94.64	87.76	93.54	158.70
Red Deer No. 23	72.58	66.91	90.85	114.43	110.36	97.53	85.77	91.35	94.72	111.54	129.75	226.35
Vermilion River No. 24	33.84	42.39	57.27	53.60	71.39	61.60	63.49	52.47	61.57	68.14	63.81	101.45
Leduc No. 25	44.41	46.60	60.93	72.76	72.77	93.40	175.67	163.68	100.11	110.96	186.07	176.49
Lethbridge No. 26	105.19	76.77	113.49	130.90	117.96	131.11	144.45	131.33	110.07	171.46	220.14	258.87
Minburn No. 27	37.25	45.86	58.53	62.11	70.81	57.97	51.87	60.65	54.77	62.10	62.22	86.82
Lac Ste. Anne No. 28	24.31	34.97	44.60	42.04	39.47	56.38	59.18	60.70	57.70	49.34	58.37	85.79
Flagstaff No. 29	47.05	60.72	63.91	79.77	79.90	80.18	72.33	63.22	70.48	72.58	71.85	110.95
Lamont No. 30	43.74	47.40	61.76	66.35	83.83	90.03	65.30	31.06	63.17	80.41	75.76	104.78
Parkland No. 31	48.85	50.33	55.01	63.33	79.58	93.93	97.07	96.05	103.98	91.63	101.35	145.82

Table 10a. Continued.

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Province	194.26	251.50	285.89	322.46	446.96	560.63	652.03	713.78	556.45	513.27	478.44
Grande Prairie No. 1	155.15	174.23	245.06	303.54	414.04	449.90	439.58	493.73	392.60	326.21	264.72
Vulcan No. 2	244.14	352.62	404.23	399.77	441.50	708.46	713.25	725.36	590.85	688.40	539.81
Ponoka No. 3	184.02	238.12	315.85	394.53	485.36	796.58	804.31	848.23	699.81	614.04	468.48
Newell No. 4	246.44	365.42	359.36	390.06	783.54	835.73	955.04	954.67	671.06	821.49	714.72
Warner No. 5	189.98	229.93	268.51	187.50	297.48	419.19	593.93	884.80	653.65	608.19	741.86
Stettler No. 6	157.33	247.38	231.54	245.03	321.05	384.23	556.49	477.50	551.39	481.50	389.20
Thorhild No. 7	129.07	173.35	273.28	208.49	349.23	340.28	475.89	452.28	371.82	374.17	401.41
Forty Mile No. 8	187.82	302.73	287.86	284.65	473.60	369.69	679.37	717.71	501.33	561.12	536.31
Beaver No. 9	132.94	165.65	247.65	227.24	279.39	417.47	503.08	588.02	499.50	523.74	410.60
Wetaskiwin No. 10	201.89	311.32	364.82	314.95	479.26	505.30	817.21	593.18	568.48	585.69	488.64
Barrhead No. 11	122.53	159.11	228.95	257.81	399.64	389.70	510.58	576.64	479.83	388.22	498.56
Athabasca No. 12	101.73	113.59	138.54	158.31	288.74	305.92	296.45	368.49	290.98	205.30	281.64
Smoky Lake No. 13	126.86	120.50	172.53	145.57	272.65	348.22	412.76	704.99	423.75	362.56	308.75
Lacombe No. 14	227.88	317.88	360.24	446.23	745.32	915.63	811.97	851.54	802.58	678.70	673.32
Wheatland No. 16	328.50	323.02	461.91	661.92	606.32	702.27	1011.76	942.88	812.17	717.03	600.57
Mountain View No. 17	354.14	545.76	517.65	641.48	796.16	1037.27	1222.85	1176.98	768.16	817.86	718.82
Paintearth No. 18	110.90	128.82	182.78	183.57	184.69	336.45	366.87	434.54	362.78	267.32	364.32
St. Paul No. 19	110.63	119.78	199.74	190.25	352.97	384.77	413.13	922.62	424.45	326.61	304.00
Strathcona No. 20	432.03	538.46	596.41	305.73	423.57	1212.50	654.67	1445.83	550.87	1264.09	494.96
Two Hills No. 21	112.35	146.86	215.05	187.58	318.34	365.25	510.83	541.73	411.25	388.35	351.44
Camrose No. 22	206.45	330.32	330.53	358.47	486.75	705.44	772.60	894.56	755.33	548.48	468.81
Red Deer No. 23	299.08	371.84	455.00	589.59	576.32	909.95	955.73	1314.66	744.81	925.01	668.60
Vermilion River No. 24	122.54	161.78	189.06	265.56	463.87	493.57	616.28	1006.15	686.36	463.46	488.62
Leduc No. 25	189.91	425.08	486.35	669.38	586.54	1062.65	1622.42	2277.62	729.13	506.69	681.32
Lethbridge No. 26	491.11	719.23	684.65	677.92	988.40	1158.20	1968.70	1785.29	1330.12	1298.67	842.53
Minburn No. 27	120.12	181.88	218.54	253.22	339.81	526.36	551.09	510.62	392.95	541.15	447.70
Lac Ste. Anne No. 28	118.26	163.08	221.93	236.39	326.50	317.92	410.75	406.25	349.01	367.73	299.71
Flagstaff No. 29	175.01	216.72	277.19	338.75	374.21	582.88	578.60	824.51	687.87	583.10	620.36
Lamont No. 30	191.83	182.08	338.41	304.32	425.33	426.51	593.75	696.34	531.91	483.14	442.70
Parkland No. 31	134.11	132.39	387.39	631.25	331.28	841.09	643.54	800.26	415.03	697.20	831.04

Table 10a. Continued.

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
MD Cardston No. 6	57.23	84.09	93.35	77.93	109.23	97.86	119.54	102.66	104.40	89.11	145.79	235.98
MD Pincher Creek No.9	47.72	59.27	73.60	78.24	73.89	71.09	84.00	60.51	75.15	83.19	105.38	182.90
MD Taber No. 14	78.05	81.29	82.49	90.90	115.74	68.61	109.75	152.26	145.41	108.91	129.11	193.16
MD Willow Creek No. 26	59.72	55.68	63.28	69.02	72.32	90.91	84.50	88.73	82.60	83.12	106.69	181.88
MD Foothills No. 31	73.59	78.35	89.41	109.55	145.75	135.44	119.07	133.61	160.99	142.12	221.22	324.49
MD Rockyview No. 44	73.69	100.63	100.54	100.43	117.26	138.16	184.87	146.13	187.01	150.07	214.41	489.77
MD Starland No. 47	38.66	47.93	60.30	52.73	78.58	56.08	66.28	47.43	81.55	65.52	85.38	121.51
MD Kneehill No. 48	83.29	81.48	89.18	113.51	131.59	116.15	79.16	91.43	93.77	108.79	117.27	203.21
MD Provost No. 52	23.96	24.46	39.64	64.68	54.96	79.10	60.44	55.05	43.41	59.91	57.89	77.82
MD Wainwright No. 61	27.07	33.85	48.49	58.96	60.41	73.58	67.38	56.32	48.62	53.27	59.97	112.23
MD Bonnyville No. 87	24.96	28.02	31.75	32.69	36.22	33.02	50.71	52.66	44.81	49.05	45.11	68.14
MD Sturgeon No. 90	67.35	87.44	92.36	102.48	119.90	127.11	129.60	122.60	180.45	227.49	141.62	236.54
MD Westlock No. 92	44.94	51.59	59.85	45.75	72.99	78.18	65.75	89.22	70.41	72.29	95.48	90.43
MD Smoky River No. 130	28.13	37.04	45.63	46.30	46.94	51.62	42.11	41.99	45.14	43.58	53.28	85.35
MD Spirit River No. 133	31.13	35.84	37.89	43.82	63.94	59.22	66.04	60.75	93.55	55.27	63.28	179.19
MD Peace No. 135	37.01	42.00	44.86	48.23	51.56	50.23	62.93	44.59	49.76	42.89	64.70	84.71
MD Fairview No. 136	35.38	49.33	62.40	59.29	80.74	75.40	46.56	39.06	71.99	61.96	61.45	84.99
ID No. 1 Medicine Hat	37.98	45.52	40.79	37.40	50.77	50.48	87.97	50.01	80.08	58.03	102.97	160.97
ID No. 10 Rocky Mtn House	35.28	43.94	48.84	52.57	77.32	56.13	59.17	65.57	64.44	82.67	99.56	145.17
ID No. 14 Edson	22.09	28.73	31.55	24.30	22.98	34.02	33.40	27.07	52.21	72.18	40.04	62.96
ID No. 17 High Prairie	32.18	47.53	44.81	45.12	47.14	42.28	22.55	37.45	45.86	53.49	45.65	63.82
ID No. 18 Lac La Biche	20.66	11.63	18.07	9.26	17.20	41.51	35.24	32.67	36.77	37.95	36.19	57.96
ID No. 19 Spirit River	30.82	34.39	43.30	40.59	49.96	60.98	41.89	36.23	54.67	54.32	59.62	69.12
ID No. 20 Spirit River	33.47	35.40	38.36	44.89	47.81	50.49	42.89	38.28	40.38	31.44	52.70	59.86
ID No. 21 Spirit River	26.12	28.21	41.79	28.65	26.85	38.15	35.39	32.40	29.42	33.25	51.33	57.28
ID No. 22 Spirit River	33.44	38.88	38.94	18.66	34.08	39.47	14.80	34.31	35.64	36.26	46.47	52.64
Special Areas No's 2-4 Hanna	36.60	33.96	31.84	36.85	43.17	57.33	55.03	57.57	41.31	61.44	59.66	114.08

Table 10a. Continued.

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
MD Cardston No. 6	258.84	221.48	317.46	358.95	533.82	340.85	803.33	843.85	647.21	721.77	541.71
MD Pincher Creek No.9	308.50	306.28	311.09	345.96	578.13	593.62	1398.06	722.92	640.84	612.11	650.34
MD Taber No. 14	281.35	443.13	388.56	523.74	616.88	919.74	1239.35	1439.19	1136.51	927.54	849.02
MD Willow Creek No. 26	265.80	268.02	318.53	333.59	441.75	722.34	928.72	702.13	534.64	771.69	594.18
MD Foothills No. 31	449.82	524.26	795.20	504.76	705.13	1058.94	967.29	890.20	945.17	794.74	717.42
MD Rockyview No. 44	521.92	563.98	513.79	588.54	1289.76	1187.69	1537.21	1160.27	1027.99	936.64	715.72
MD Starland No. 47	206.94	240.77	367.21	313.09	398.79	581.11	646.84	524.25	637.50	375.02	450.91
MD Kneehill No. 48	298.50	352.96	399.13	431.75	574.85	751.36	873.31	1184.72	1112.15	792.15	793.87
MD Provost No. 52	151.48	145.79	184.34	120.00	302.82	406.43	674.16	840.38	599.24	539.10	452.45
MD Wainwright No. 61	155.65	232.16	224.96	265.94	315.59	365.57	595.82	470.35	403.99	452.20	434.77
MD Bonnyville No. 87	98.99	140.30	205.92	221.46	261.15	487.86	411.37	363.55	370.05	310.57	328.27
MD Sturgeon No. 90	293.79	272.38	473.24	737.55	620.25	850.90	729.22	713.65	730.77	649.72	613.90
MD Westlock No. 92	133.49	202.49	258.14	275.43	337.64	534.76	470.11	442.38	496.18	447.26	392.53
MD Smoky River No. 130	82.25	139.78	172.43	239.73	277.93	276.30	465.44	342.19	326.79	305.47	300.65
MD Spirit River No. 133	95.22	111.49	149.58	156.68	178.91	390.68	331.29	360.33	287.64	345.20	277.50
MD Peace No. 135	167.46	161.75	234.38	392.57	614.80	726.63	867.85	408.65	297.91	450.21	346.27
MD Fairview No. 136	110.46	118.00	154.85	215.54	313.23	321.82	477.07	296.88	345.66	389.80	433.85
ID No. 1 Medicine Hat	156.17	326.98	316.00	242.32	303.25	385.54	838.49	905.06	422.09	481.16	462.53
ID No. 10 Rocky Mtn House	212.40	287.66	227.84	338.54	484.14	707.92	812.77	535.94	717.13	594.65	598.73
ID No. 14 Edson	100.30	130.05	130.33	178.75	247.80	226.97	289.10	275.59	276.12	226.81	162.35
ID No. 17 High Prairie	87.54	135.59	163.74	181.59	233.25	225.30	252.80	326.13	277.28	249.04	271.10
ID No. 18 Lac La Biche	65.92	94.22	103.93	155.54	193.78	270.49	253.69	257.81	314.57	267.99	260.63
ID No. 19 Spirit River	85.27	92.99	165.89	178.08	189.77	162.67	361.42	380.26	304.40	284.00	256.45
ID No. 20 Spirit River	89.62	96.82	120.80	155.32	144.04	203.91	323.06	311.33	230.14	230.52	228.61
ID No. 21 Spirit River	65.73	97.07	112.97	132.32	171.96	251.15	259.74	303.93	226.32	248.69	241.19
ID No. 22 Spirit River	80.57	102.61	113.74	170.96	197.35	176.83	402.19	422.87	252.84	270.80	221.53
Special Areas No's 2-4 Hanna	144.08	155.48	221.03	183.40	154.84	194.56	216.05	309.50	193.94	219.98	203.84

Table 11a. Average Annual Rental Income per Acre by County, 1963 - 1985.

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Province	6.40	5.70	6.21	7.95	4.75	6.11	4.86	4.70	4.26	9.70	19.22	16.67
Grande Prairie No. 1	6.70	6.20	6.36	8.15	4.28	5.79	4.85	4.74	4.22	10.43	19.43	16.71
Vulcan No. 2	5.23	4.16	5.25	6.48	3.86	5.33	3.73	3.46	3.37	6.16	13.27	11.05
Ponoka No. 3	7.36	6.67	7.03	8.88	5.96	6.86	5.70	5.76	4.97	11.57	22.68	20.93
Newell No. 4	5.57	4.54	5.74	7.18	4.23	6.31	4.33	4.05	3.68	7.59	14.95	12.09
Warner No. 5	5.57	4.54	5.74	7.18	4.23	6.31	4.33	4.05	3.68	7.59	14.95	12.09
Stettler No. 6	6.48	5.32	6.85	8.45	5.15	7.50	5.04	5.04	4.33	8.67	18.27	15.12
Thorhild No. 7	7.16	6.52	6.51	8.49	5.63	6.49	5.50	5.33	4.76	10.85	21.87	19.13
Forty Mile No. 8	5.05	4.07	5.13	6.60	3.84	5.34	3.65	3.19	3.37	6.21	13.22	10.41
Beaver No. 9	6.01	5.43	5.67	7.60	3.96	5.21	4.45	4.17	4.00	10.00	19.63	16.85
Wetaskiwin No. 10	7.29	6.69	6.98	8.83	5.87	6.73	5.64	5.56	4.94	11.59	22.50	19.95
Barrhead No. 11	7.16	6.52	6.51	8.49	5.63	6.49	5.50	5.33	4.76	10.85	21.87	19.13
Athabasca No. 12	7.16	6.52	6.51	8.49	5.63	6.49	5.50	5.33	4.76	10.85	21.87	19.13
Smoky Lake No. 13	6.60	6.04	6.17	8.12	4.16	5.66	4.94	4.64	4.29	10.54	20.08	17.45
Lacombe No. 14	7.36	6.67	7.03	8.88	5.96	6.86	5.70	5.76	4.97	11.57	22.68	20.93
Wheatland No. 16	5.23	4.16	5.25	6.48	3.86	5.33	3.73	3.46	3.37	6.16	13.27	11.05
Mountain View No. 17	6.37	5.95	6.30	8.21	5.53	6.40	5.18	5.11	4.60	10.75	21.60	20.04
Paintearth No. 18	6.48	5.32	6.85	8.45	5.15	7.50	5.04	5.04	4.33	8.67	18.27	15.12
St. Paul No. 19	6.60	6.04	6.17	8.12	4.16	5.66	4.94	4.64	4.29	10.54	20.08	17.45
Strathcona No. 20	7.29	6.69	6.98	8.83	5.87	6.73	5.64	5.56	4.94	11.59	22.50	19.95
Two Hills No. 21	6.01	5.43	5.67	7.60	3.96	5.21	4.45	4.17	4.00	10.00	19.63	16.85
Camrose No. 22	6.01	5.43	5.67	7.60	3.96	5.21	4.45	4.17	4.00	10.00	19.63	16.85
Red Deer No. 23	7.36	6.67	7.03	8.88	5.96	6.86	5.70	5.76	4.97	11.57	22.68	20.93
Vermilion River No. 24	6.01	5.43	5.67	7.60	3.96	5.21	4.45	4.17	4.00	10.00	19.63	16.85
Leduc No. 25	7.29	6.69	6.98	8.83	5.87	6.73	5.64	5.56	4.94	11.59	22.50	19.95
Lethbridge No. 26	5.57	4.54	5.74	7.18	4.23	6.31	4.33	4.05	3.68	7.59	14.95	12.09
Minburn No. 27	6.01	5.43	5.67	7.60	3.96	5.21	4.45	4.17	4.00	10.00	19.63	16.85
Lac Ste. Anne No. 28	7.16	6.52	6.51	8.49	5.63	6.49	5.50	5.33	4.76	10.85	21.87	19.13
Flagstaff No. 29	6.48	5.32	6.85	8.45	5.15	7.50	5.04	5.04	4.33	8.67	18.27	15.12
Lamont No. 30	6.01	5.43	5.67	7.60	3.96	5.21	4.45	4.17	4.00	10.00	19.63	16.85
Parkland No. 31	7.29	6.69	6.98	8.83	5.87	6.73	5.64	5.56	4.94	11.59	22.50	19.95

Table 11a. Continued.

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Province	13.32	16.36	14.71	18.57	21.49	25.48	25.65	21.22	24.15	18.36	16.37
Grande Prairie No. 1	12.93	18.51	14.64	18.15	22.23	26.77	25.90	18.12	25.10	19.76	16.44
Vulcan No. 2	9.66	10.22	7.66	12.45	14.21	17.15	17.41	12.37	16.60	10.89	10.66
Ponoka No. 3	15.89	18.80	19.10	23.01	26.04	29.90	30.82	30.75	28.86	22.76	20.53
Newell No. 4	10.80	11.72	8.67	14.19	16.49	19.37	19.05	13.41	17.72	11.50	11.39
Warner No. 5	10.80	11.72	8.67	14.19	16.49	19.37	19.05	13.41	17.72	11.50	11.39
Stettler No. 6	13.47	13.84	10.41	16.39	18.72	22.96	22.36	15.97	20.90	13.80	13.46
Thorhild No. 7	15.09	17.76	18.23	21.75	24.43	28.49	29.88	29.83	27.79	21.99	20.05
Forty Mile No. 8	8.86	9.29	7.64	12.24	13.84	16.11	15.94	10.73	14.83	9.57	9.44
Beaver No. 9	13.21	18.16	16.27	18.48	22.23	26.54	26.81	18.24	24.95	19.46	16.16
Wetaskiwin No. 10	15.52	18.51	18.84	22.91	24.95	29.39	29.79	30.02	27.82	22.13	20.16
Barrhead No. 11	15.09	17.76	18.23	21.75	24.43	28.49	29.88	29.83	27.79	21.99	20.05
Athabasca No. 12	15.09	17.76	18.23	21.75	24.43	28.49	29.88	29.83	27.79	21.99	20.05
Smoky Lake No. 13	13.91	18.63	17.45	19.79	23.95	28.64	27.98	19.55	26.35	20.70	17.06
Lacombe No. 14	15.89	18.80	19.10	23.01	26.04	29.90	30.82	30.75	28.86	22.76	20.53
Wheatland No. 16	9.66	10.22	7.66	12.45	14.21	17.15	17.41	12.37	16.60	10.89	10.66
Mountain View No. 17	15.26	17.66	17.76	21.18	23.76	28.11	28.95	28.91	27.28	21.62	19.49
Paintearth No. 18	13.47	13.84	10.41	16.39	18.72	22.96	22.36	15.97	20.90	13.80	13.46
St. Paul No. 19	13.91	18.63	17.45	19.79	23.95	28.64	27.98	19.55	26.35	20.70	17.06
Strathcona No. 20	15.52	18.51	18.84	22.91	24.95	29.39	29.79	30.02	27.82	22.13	20.16
Two Hills No. 21	13.21	18.16	16.27	18.48	22.23	26.54	26.81	18.24	24.95	19.46	16.16
Camrose No. 22	13.21	18.16	16.27	18.48	22.23	26.54	26.81	18.24	24.95	19.46	16.16
Red Deer No. 23	15.89	18.80	19.10	23.01	26.04	29.90	30.82	30.75	28.86	22.76	20.53
Vermilion River No. 24	13.21	18.16	16.27	18.48	22.23	26.54	26.81	18.24	24.95	19.46	16.16
Leduc No. 25	15.52	18.51	18.84	22.91	24.95	29.39	29.79	30.02	27.82	22.13	20.16
Lethbridge No. 26	10.80	11.72	8.67	14.19	16.49	19.37	19.05	13.41	17.72	11.50	11.39
Minburn No. 27	13.21	18.16	16.27	18.48	22.23	26.54	26.81	18.24	24.95	19.46	16.16
Lac Ste. Anne No. 28	15.09	17.76	18.23	21.75	24.43	28.49	29.88	29.83	27.79	21.99	20.05
Flagstaff No. 29	13.47	13.84	10.41	16.39	18.72	22.96	22.36	15.97	20.90	13.80	13.46
Lamont No. 30	13.21	18.16	16.27	18.48	22.23	26.54	26.81	18.24	24.95	19.46	16.16
Parkland No. 31	15.52	18.51	18.84	22.91	24.95	29.39	29.79	30.02	27.82	22.13	20.16

Table 11a. Continued.

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
MD Cardston No. 6	5.59	5.24	5.51	7.19	4.64	5.68	4.65	4.36	4.23	9.09	19.91	18.10
MD Pincher Creek No.9	5.59	5.24	5.51	7.19	4.64	5.68	4.65	4.36	4.23	9.09	19.91	18.10
MD Taber No. 14	5.57	4.54	5.74	7.18	4.23	6.31	4.33	4.05	3.68	7.59	14.95	12.09
MD Willow Creek No. 26	5.59	5.24	5.51	7.19	4.64	5.68	4.65	4.36	4.23	9.09	19.91	18.10
MD Foothills No. 31	6.37	5.95	6.30	8.21	5.53	6.40	5.18	5.11	4.60	10.75	21.60	20.04
MD Rockyview No. 44	6.37	5.95	6.30	8.21	5.53	6.40	5.18	5.11	4.60	10.75	21.60	20.04
MD Starland No. 47	5.23	4.16	5.25	6.48	3.86	5.33	3.73	3.46	3.37	6.16	13.27	11.05
MD Kneehill No. 48	5.23	4.16	5.25	6.48	3.86	5.33	3.73	3.46	3.37	6.16	13.27	11.05
MD Provost No. 52	6.48	5.32	6.85	8.45	5.15	7.50	5.04	5.04	4.33	8.67	18.27	15.12
MD Wainwright No. 61	6.48	5.32	6.85	8.45	5.15	7.50	5.04	5.04	4.33	8.67	18.27	15.12
MD Bonnyville No. 87	6.60	6.04	6.17	8.12	4.16	5.66	4.94	4.64	4.29	10.54	20.08	17.45
MD Sturgeon No. 90	7.29	6.69	6.98	8.83	5.87	6.73	5.64	5.56	4.94	11.59	22.50	19.95
MD Westlock No. 92	7.16	6.52	6.51	8.49	5.63	6.49	5.50	5.33	4.76	10.85	21.87	19.13
MD Smoky River No. 130	6.70	6.20	6.36	8.15	4.28	5.79	4.85	4.74	4.22	10.43	19.43	16.71
MD Spirit River No. 133	6.70	6.20	6.36	8.15	4.28	5.79	4.85	4.74	4.22	10.43	19.43	16.71
MD Peace No. 135	6.70	6.20	6.36	8.15	4.28	5.79	4.85	4.74	4.22	10.43	19.43	16.71
MD Fairview No. 136	6.70	6.20	6.36	8.15	4.28	5.79	4.85	4.74	4.22	10.43	19.43	16.71
ID No. 1 Medicine Hat	5.05	4.07	5.13	6.60	3.84	5.34	3.65	3.19	3.37	6.21	13.22	10.41
ID No. 10 Rocky Mtn House	7.36	6.67	7.03	8.88	5.96	6.86	5.70	5.76	4.97	11.37	22.68	20.93
ID No. 14 Edson	7.16	6.52	6.51	8.49	5.63	6.49	5.50	5.33	4.76	10.85	21.87	19.13
ID No. 17 High Prairie	6.70	6.20	6.36	8.15	4.28	5.79	4.85	4.74	4.22	10.43	19.43	16.71
ID No. 18 Lac La Biche	6.60	6.04	6.17	8.12	4.16	5.66	4.94	4.64	4.29	10.54	20.08	17.45
ID No. 19 Spirit River	6.70	6.20	6.36	8.15	4.28	5.79	4.85	4.74	4.22	10.43	19.43	16.71
ID No. 20 Spirit River	6.70	6.20	6.36	8.15	4.28	5.79	4.85	4.74	4.22	10.43	19.43	16.71
ID No. 21 Spirit River	6.70	6.20	6.36	8.15	4.28	5.79	4.85	4.74	4.22	10.43	19.43	16.71
ID No. 22 Spirit River	6.70	6.20	6.36	8.15	4.28	5.79	4.85	4.74	4.22	10.43	19.43	16.71
Special Areas No's 2-4 Hanna	5.05	4.07	5.13	6.60	3.84	5.34	3.65	3.19	3.37	6.21	13.22	10.41

Table 11a. Continued.

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
MD Cardston No. 6	13.73	17.02	16.99	20.34	22.79	26.20	28.69	28.72	27.04	21.13	19.17
MD Pincher Creek No.9	13.73	17.02	16.99	20.34	22.79	26.20	28.69	28.72	27.04	21.13	19.17
MD Taber No. 14	10.80	11.72	8.67	14.19	16.49	19.37	19.05	13.41	17.72	11.50	11.39
MD Willow Creek No. 26	13.73	17.02	16.99	20.34	22.79	26.20	28.69	28.72	27.04	21.13	19.17
MD Foothills No. 31	15.26	17.66	17.76	21.18	23.76	28.11	28.95	28.91	27.28	21.62	19.49
MD Rockyview No. 44	15.26	17.66	17.76	21.18	23.76	28.11	28.95	28.91	27.28	21.62	19.49
MD Starland No. 47	9.66	10.22	7.66	12.45	14.21	17.15	17.41	12.37	16.60	10.89	10.66
MD Kneehill No. 48	9.66	10.22	7.66	12.45	14.21	17.15	17.41	12.37	16.60	10.89	10.66
MD Provost No. 52	13.47	13.84	10.41	16.39	18.72	22.96	22.36	15.97	20.90	13.80	13.46
MD Wainwright No. 61	13.47	13.84	10.41	16.39	18.72	22.96	22.36	15.97	20.90	13.80	13.46
MD Bonnyville No. 87	13.91	18.63	17.45	19.79	23.95	28.64	27.98	19.55	26.35	20.70	17.06
MD Sturgeon No. 90	15.52	18.51	18.84	22.91	24.95	29.39	29.79	30.02	27.82	22.13	20.16
MD Westlock No. 92	15.09	17.76	18.23	21.75	24.43	28.49	29.88	29.83	27.79	21.99	20.05
MD Smoky River No. 130	12.93	18.51	14.64	18.15	22.23	26.77	25.90	18.12	25.10	19.76	16.44
MD Spirit River No. 133	12.93	18.51	14.64	18.15	22.23	26.77	25.90	18.12	25.10	19.76	16.44
MD Peace No. 135	12.93	18.51	14.64	18.15	22.23	26.77	25.90	18.12	25.10	19.76	16.44
MD Fairview No. 136	12.93	18.51	14.64	18.15	22.23	26.77	25.90	18.12	25.10	19.76	16.44
ID No. 1 Medicine Hat	8.86	9.29	7.64	12.24	13.84	16.11	15.94	10.73	14.83	9.57	9.44
ID No. 10 Rocky Mtn House	15.89	18.80	19.10	23.01	26.04	29.90	30.82	30.75	28.86	22.76	20.53
ID No. 14 Edson	15.09	17.76	18.23	21.75	24.43	28.49	29.88	29.83	27.79	21.99	20.05
ID No. 17 High Prairie	12.93	18.51	14.64	18.15	22.23	26.77	25.90	18.12	25.10	19.76	16.44
ID No. 18 Lac La Biche	13.91	18.63	17.45	19.79	23.95	28.64	27.98	19.55	26.35	20.70	17.06
ID No. 19 Spirit River	12.93	18.51	14.64	18.15	22.23	26.77	25.90	18.12	25.10	19.76	16.44
ID No. 20 Spirit River	12.93	18.51	14.64	18.15	22.23	26.77	25.90	18.12	25.10	19.76	16.44
ID No. 21 Spirit River	12.93	18.51	14.64	18.15	22.23	26.77	25.90	18.12	25.10	19.76	16.44
ID No. 22 Spirit River	12.93	18.51	14.64	18.15	22.23	26.77	25.90	18.12	25.10	19.76	16.44
Special Areas No's 2-4 Hanna	8.86	9.29	7.64	12.24	13.84	16.11	15.94	10.73	14.83	9.57	9.44