CANADIAN OATS FUTURES MARKET:
IMPACT OF REMOVAL OF OATS FROM CANADIAN WHEAT BOARD

by

© Gary Warkentine

A thesis
Submitted to the Faculty of Graduate Studies
in Partial Fulfillment of the Requirements
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MASTER OF SCIENCE

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and Farm Management
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ABSTRACT

As of August 1, 1989, the Canadian Wheat Board (CWB) has shifted marketing responsibilities solely to the open market. Since 1974, producers had the opportunity to deliver oats to the open market or the CWB. The CWB controlled export and human consumption sales with private trade involvement only in domestic feed sales.

The demand for Canadian oats has also increased significantly since 1974. This has resulted from an increase in United States demand for milling and horse feed oats from Canada.

This study examines the shift of oats from CWB marketing to the private trade. The resulting impact on the Winnipeg Commodity Exchange and Canadian oat production will be studied. A supply response model is used to forecast the wheat, barley, oats, flaxseed, canola and sunflower acreage on the Canadian prairies. This model is used to estimate oat supply elasticities and forecast oats acreage into 1995. Oats supply elasticities are found to be generally higher than other cereals. Alberta oats acreage showed large potential increases at average prices and yields. Manitoba and Saskatchewan acreage remained at about 1989 levels.

With the policy change in oats marketing comes a greater role for the Winnipeg Commodity Exchange (WCE) oat market, as it becomes the primary market facility. Previously, the CWB was reluctant to hedge on the WCE to reduce price risk, but relied on a pooled pricing strategy (ie. spreading sales throughout the year). The WCE oats contract now becomes the dominant hedging vehicle for Canadian feed oats and also the centre of price discovery.

An efficiency analysis is conducted of the Winnipeg Commodity

Exchange feed oats contract. A daily time-series analysis is used for the 1977/1978 to 1985/1986 crop years. Since U.S. corn prices have a large impact on Canadian feed grain prices, the WCE oats contract is further analyzed in its ability to reflect international or world feed grain price information. Pricing was found to be efficient in its ability to reflect domestic and international feed grain price information.

Hedging effectiveness for Winnipeg #1 Canada Feed (CF) cash oats and Minneapolis #1 Heavy oats (a food grade) is evaluated using both the Chicago Board of Trade (CBT) oats futures contract and the WCE oats futures contract. The WCE oat contract served as the best hedge for CF oats, and the CBT oat contract the best hedge for Minneapolis #1 Heavy cash oats. Since #1 Canada Western (CW) grade oats are exported partly into the Minneapolis milling market, Minneapolis #1 Heavy is used as a proxy for #1 CW oats. Thus, the hedging effectiveness for CW grade oats is evaluated. Since hedging interest is a large determinant of trading volume, WCE oats contract trading volume is further analyzed.

A model is constructed to forecast the WCE oats contract trading volume. The model uses cash price variability, mean cash prices, and the quantity of cash market sales to explain trading volume. The quantity of cash market sales is a good proxy for the amount of oats commercially hedged in the open market. Thus, given the effectiveness of the WCE oats contract as a hedging vehicle for CF and CW oats, trading volume is forecasted. With the CBT as a better hedging instrument for #1 CW oats, some potential trading volume from Canadian commercial hedging of CW oats may be diverted from the WCE oats contract to the CBT oats contract.

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CHAPTER I

INTRODUCTION

Canadian oats have been declining in consumption and production since the early 1920's. The substitution of farm tractors for horsepower caused much of this early decline in oat production. The low density of oats relative to it's nutritional feed value has further decreased oat demand. This has reduced the importance of oats from the same status as barley forty years ago to the specialty crop oats are today.

However, oats have recently received increased attention, due to Canadian Wheat Board (CWB) policy changes and increased demand. As of August 1, 1989, the CWB has shifted marketing responsibilities solely to the open market (private trade). Since 1974, producers had the opportunity to deliver oats to the open market or the CWB. Traditionally, the CWB has been given control of oats for both export and human consumption sales, with private trade only in domestic feed sales.

This change is due to alleged criticism of the Board's approach and reduced priority given to it's marketing of oats. Oats sales in 1987/1988 by the CWB were only 1.2% of wheat sales, or about 1% of total exports. The CWB has traditionally found export markets only for oats delivered to them. Only limited attention was given to the change in quality desired by importing countries.

Today such markets are less dependent on traditional oats. Instead, they prefer specially cleaned and processed "pony oats" where purity, colour and plumpness are important characteristics. CanMar Grain Inc. of Regina estimates that 80% of Canadian oats is not presently suitable for export sales. Concern has also risen with the competition from Swedish and Argentine oats purchased by the U.S. milling industry. This industry represents the largest oat market in the world, and the largest potential growth market for oats. Therefore, it was determined by the Canadian federal government that the private trade could better service such export markets.

Demand for oats has significantly increased over the last two years. Consumer health markets have given new attention to oats. Recent findings show oats are a better source of fibre than wheat and may also be helpful in reducing human blood cholesterol levels. Cholesterol is believed to increase the risk of heart attacks. With about 75% of the U.S. population considered a high risk or borderline group, there is a large potential demand for oats. In, 1988, U.S. oats for human consumption increased by 15 to 20% (Free Press, Jan. 20, 1989). Large amounts of Canadian oats have also broken into the American "pony oats" market. Both the 1987 and 1988 Kentucky Derby winners were "powered" on Alberta oats (Dietz). The size and longevity for the new oats demand has been the subject of considerable speculation.[1]

This new export market may be attributed to two major factors.

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[1] For a complete analysis of the demand for Canadian oats, see the Peat Marwick Consulting Group study, "Oat Marketing and Processing A Western Canadian and Alberta Perspective for Alberta Agriculture", Feb. 1989.

First, the 1985 U.S. Farm Bill virtually ignored oats. This caused producers to substitute away from oat production, since a higher support payment was possible from other cereals. Further, the U.S. acreage reduction program for oats is at 5% for 1988/1989, but reduced considerably from the 20% level it was in 1987. Secondly, the 1987/1988 U.S. drought, along with declining Scandinavian imports has further reduced available supply. Thus, the U.S. has turned to Canada for oats. This has increased the price of oats relative to other cereals, adding incentive for increased Canadian oat production.

Given the new oat marketing structure and increased demand, some have raised questions regarding the future of the market for oats. Is the decline in Canadian oat production caused by an inadequate market structure or marketing strategies? Will the new market structure better transmit necessary price signals to grow a sufficient quality of oats demanded? Or, will the historic lower profits of oats relative to other crops remain as the status quo?

The policy change in the marketing of oats gives increased importance to the Winnipeg Commodity Exchange (WCE), since it becomes the primary oat marketing institution. Previously, the CWB was reluctant to hedge on the futures market to reduce their price risk, but relied on a pooled pricing strategy (ie. spreading sales throughout the year). The WCE oats contract now becomes the dominant hedging vehicle for Canadian feed oats, and also the centre of Canadian oat price discovery. Without an effective hedging instrument for the private trade, pricing of oats may not be competitive to other crops, and therefore reducing market efficiency.

The increased role of the WCE as the primary marketing facility is likely to result in increased futures trading volume. Oats marketed by the CWB in the past is now marketed by the private trade. This additional grain has the potential to be commercially hedged and thus increase oat futures contract trading volume.

This study will first review the historical background of feed grain policy leading to the present structural in the marketing of oats. Second, the decline in western Canadian oats production is addressed by examining the changes in prices and yields necessary to increase Canadian oat production. A supply response model is constructed which forecasts wheat, oats, barley, canola, flaxseed, and sunflowers acreage in western Canada. Third, the impact of the change in the marketing of oats on the WCE oats contract will be analyzed by evaluating hedging and pricing efficiency of the contract and forecasting future trading volume. Thus, this study will help determine the impact of the oat marketing policy change on the producer and the Winnipeg Commodity Exchange.

1.1 OBJECTIVES

1. Analyze the cause of declined oats production by evaluating the role of prices, yields and inventory in producer allocation decisions.
2. Evaluate the effectiveness of the WCE oats contract.
3. Forecast volume on the WCE oats contract.

CHAPTER II

HISTORICAL REVIEW OF CANADIAN FEED GRAIN POLICY

2.1 Winnipeg Commodity Exchange

One major event in Canadian grain marketing history was the opening of the Winnipeg Grain and Produce Exchange (WGPE) on December 7, 1887. This exchange, later to become the Winnipeg Commodity Exchange (WCE), was the first organized open market facility and futures market for prairie grain producers.

A second major event was the introduction of the Canadian Wheat Board (CWB), identified by two major periods. First, the suspension of futures trading at the WGPE in 1917 under wartime conditions. A board of grain supervisors, later to become the CWB, was appointed by the federal government. This resulted from a dominating British buying monopoly threatening to deplete Canadian supplies, and sending prices up sharply. Britain had become the western Allies' chief negotiator for buying Canadian wheat during World War I. The Board had monopoly power on all wheat sales and in 1919 was succeeded by the first CWB to market that years crop.

The Board introduced three new concepts (Canadian International Grains Institute, p. 26):

1. It paid an initial advance to producers upon delivery of grain to primary elevators.

2. Set prices to sell wheat at best advantage for producers.

3. Paid a final payment after all sales on the 1919 crop.

The board was terminated after the 1919 crop year, but not before producers were given a taste of the price stability of a government marketing system.

2.2 Prairie Wheat Pools

The second period entails the emergence of the three Prairie Wheat Pools as an alternative to the open market. The Pools emerged as a result of many factors, three of which are:

1. The unsuccessful reinstatement of the CWB in 1922 despite heavy pressure from farm organizations.

2. A decrease in the price of wheat.

3. The success of cooperatives in Europe, Australia. and U.S.

The Pools were based on cooperative principles using the initial-final payment scheme introduced previously by the CWB. Their downfall came directly from this payment scheme. In the 1930's, the wheat market crashed, sending wheat prices below initial payments for consecutive years. The Pools sustained heavy financial losses, and forced federal government involvement to pay Pool losses and meet the economic disaster of the Great Depression.

2.3 The Canadian Wheat Board

Although against the federal government's opinion, and against the advice of the private grain trade and the also the WCE, the federal government responded to producer pressure by passing the CWB act in 1935. This allowed the formation of a voluntary CWB for export wheat only. Thus, producers had the option of delivering to the CWB or selling on the open market. The three marketing concepts developed for the 1919 Board were incorporated into the new Wheat Board.

In 1943, under war conditions, the federal government again closed wheat futures trading and gave sole marketing responsibilities for Canadian wheat to the CWB. After the war (1947), under heavy producer pressure, the policy was extended. In 1949, at the insistence of farm organizations, CWB monopoly powers were extended to barley and oats (Wood, p. 12). Although there had been much government involvement in feed grain policy in the 1940's, the placing of coarse grains under compulsory CWB control was a key development in Canadian feed grain policy. Previously implemented floor prices, freight subsidies, and the statutory rates (Crows Nest) remained in effect. There was little controversy in this transition and the policy operated until 1974 without much criticism, but not without problems.

Problems arose with respect to the adequacy of feed grain supplies and price variation in eastern Canada relative to those in terminal markets (Wood, p.18). These problems were related to pricing anomalies associated to the surplus producing prairie regions and deficit importing eastern regions and British Columbia. These problems are further traced back to:

1. The establishment of the statutory rates on grain shipment from prairie points to Thunder Bay (TB).
2. Compulsory marketing of feed grains under the CWB.
3. The Feed Freight Assistance program (FFA).

2.4 Feed Freight Assistance Program

The FFA program was installed in 1943 to encourage production of livestock and related products for domestic use and export into Britain in aid of the war effort. It also served to expand western Canadian feed grain markets when surpluses were high. This program essentially paid part of the freight on feed grains moving east of Thunder Bay to user areas and also from Alberta to British Columbia.

The policy became permanent after the war and in 1966 the direction of the program became explicitly to ensure "fair equalization of feed grain prices in Eastern Canada and in B.C." (Food Prices Review Board, p.42).

Soon after, the CWB began to introduce policies to solve the inequitable pricing and inadequate feed grain supplies in eastern Canada. The first was to allow shippers to move oats and barley into eastern storage prior to the close of navigation while the CWB carried the price risk until grains were sold. The second policy consisted of the CWB paying accrued storage charges in eastern elevators, and thus helping assure supply security.

In 1969 the Board encountered difficulties when it failed to assure that in selling coarse grains to the best advantage of producers, it did not take advantage of eastern livestock producers. Thus, a two price system was created in which price discounted policies were used to increase exports, whereas in the domestic market, prices were high and in competition with U.S. corn. However, on the prairies uncontrolled inter-farm sales were taking place at much lower prices than to eastern users who were forced to buy from the CWB.

These distortions and inequities generated much criticism from the eastern users forced to pay the higher prices, although some advantage was received via the Feed Freight Assistance program. The policy was endorsed by western producers who not only obtained higher returns from the Board than from off-Board markets, but also had access to local disposal outlets for surpluses. Dissatisfaction also plagued prairie livestock producers when demand increased in one province, with almost no demand existing in another province. This caused inequities as inter-provincial sales were restricted through the CWB at a higher price, and intra-provincial sales could be made without CWB intervention at a lower price.

2.5 Dual Marketing System

By 1973, these inequities increased political pressure until change became unavoidable. For the 1974-1975 crop year, the option of either delivering to the CWB or the open market was restored for domestic feed grains with the following objectives:

1. To provide a fair and equitable base price for feed grains across Canada.
2. To provide relief for the producer against depressed feed grain prices.
3. To encourage the growth of livestock and feed grains across Canada according to natural factors and natural potential.

The federal government then formulated the following package to meet these objectives (Lang, pp. 4-6):

1. The CWB would, in consultation with the Canadian Livestock Feed Board, price feed grains at levels competitive with prices of other grains in the domestic and export markets.
2. The monopoly of the Wheat Board in the domestic market would be

terminated.

3. The CWB would have the power to set quotas for non-Board grains but would be required to assure delivery of domestic feed grains within a certain minimum period by actual delivery or by switching board grain with that of others.

4. Discrimination in freight rates between livestock meat and grain would be progressively reduced, but freight assistance to eastern Quebec and the Atlantic provinces would not be changed unless those areas achieved a high level of self-sufficiency.

5. The CWB would retain its monopoly in the export market for feed grains.

Initially these was no change in the freight rate discrimination between livestock meat and grain, and since the Board domestic selling price was now set by formula, the Board could not allow for the feed freight assistance payment to set a competitive price. The result was a reduction in price to eastern users that was not available in the west. Thus, the first objective of providing a fair and equitable base price was not fulfilled. Futures trading was restored for feed wheat, barley and oats as the private trade re-entered the domestic feed grain industry.

In the following years, feed grain prices were considerably higher than U.S. corn prices. This indicated a failure of the divergent policy objective "to encourage livestock and grain production across Canada".

2.6 Corn Competitive Policy

Feed grain policy was modified in 1976 to better achieve the 1974 objectives in the so called "Corn Competitive Policy". The modifications included (Whelan and Lang, p. 1):

1. The provision that the CWB would offer western feed grain to the domestic market at U.S. corn competitive prices on a daily basis at Thunder Bay and western country elevator points.
2. Feed Freight assistance would be eliminated in parts of Ontario and Quebec, reduced in some parts of those provinces and in B.C., but remain unchanged in most of eastern Quebec and all of the Maritime.
3. The Canadian Livestock Feed Board would monitor markets to ensure that prices and supplies meet policy objectives and intervene directly in the market if necessary to eliminate bad pricing or supply practices. Competitive prices were based on energy and protein content of each feed grain relative to corn and soybean meal. Prices also included exchange premiums and tariffs.

The weakness of formula pricing resulted when export prices were strong, and producers delivered grains to the Board. Since the Board is required to supply the domestic market at the lower formula price, it cannot realize the high export price for it's producers. Thus, the corn competitive formula acted as a ceiling for domestic feed prices. This occurred in 1976 and thus reversed the situation to where the eastern users were subsidizing the western producers. Further, in 1978/1979 crop year, supplies exceeded the capacity of the transportation system to move enough grain to equalize prices between eastern and western Canada. Off-Board prices on the prairies were depressed relative to eastern Canada despite the open market. Thus, the problem was shifted from pricing in the dual market, to regulating access to grain handling and transportation between Board and non-Board grain. The manner in which movement is regulated bears directly on the price in both markets and in the two regions of Canada (Wood, p.49).

Under the corn competitive pricing scheme, the CWB faced a situation where the corn formula was not the highest price, thus deliveries increased to the open market. Since deliveries to the open market reduced delivery opportunities to the Board, the CWB continued to have problems generating sufficient deliveries at the right times. The CWB withdrew from the Thunder Bay corn formula barley market in the 1984/1985 crop year.

Feed freight assistance was also revised to realign the net transportation costs within the eastern region. All feed grains, millfeeds and fish became eligible for assistance. Eastern producers benefited as a result of the increased level of assistance with decreased prices and greater long run supply security. This program still has an influence on the structure of the feed grain market in Western Canada.

2.7 Corn Countervailing Duty

After a review by the Canadian Import Tribunal, a countervailing duty of $1.10/bu. was applied to corn imports from the U.S. on November 7, 1986. The tribunal found that subsidized corn exported from the U.S. to Canada was causing material injury to the production of like goods in Canada (Canada Import Tribunal, 1987).

The effects of the duty was a decrease in U.S. corn imports, and a resulting increase in the domestic price of corn. This reduced the Canadian corn market share of the feed grain market to other coarse grains, and also reduced sales to industrial users (Lermer, 1987).

Thus, public hearings were held and concerns were heard from the agricultural users, corn producers, industrial users and other interested parties. Users expressed concerns regarding supply security of feed grains and industrial users expressed fear of losing corn fructose market share to the United States.

Thus, the tribunal decided it was in the public best interest to reduce the level of corn countervailing duty. In February 1988, the tribunal lowered the duty to $.46/bu, where it stands today (Canadian Department of Finance, Feb. 1988).

2.8 Removal of oats from jurisdiction of the CWB

In February 1989, effective August 1, 1989, the Canadian federal government announced the shifting of marketing responsibility for oats solely to the open market. Due to the declining consumption and production of oats, its primary importance has declined from the same status as barley forty years ago to the specialty crop it is today. With oats sales a relatively insignificant portion of total CWB sales, the federal government felt that specialty crop markets such as oats are best serviced by the private trade.

2.9 Present overview of oats production and marketing

The structure of the feed grains market has changed dramatically since the mid 1970's. Eastern Canada has moved from a feed deficit to a feed surplus area. In the past decade, volume constraints in the feed grain transportation system unintentionally gave prairie livestock producers greater supply security at occasional lower prices than in eastern Canada. The handling capacity has much improved so that eastern grains, prairie grains, and U.S. grains compete freely within eastern Canada. Thus, price stability and adequate supplies are reasonable insured in eastern Canada.

Western livestock producers are now more vulnerable as supply is less secure and they are forced to pay a premium to offset the crow benefit grain farmers receive by using the rail network. For western producers, the historical eastern feed market has vanished and oats must compete head on with corn and barley as a feed substitute.

On-farm and local feeding account for a large part of total oat demand. This is because the nutritional value of oats relative to it's weight makes it uneconomical to transport feed oats large distances. Further, more progress in higher yielding varieties of barley have made oats less competitive, although some recent new varieties may somewhat offset this. There is also some interest in recent hull-less oats varieties which reduce it's weight and bulk by 20 to 30%, although with reduced yields.

Canadian oat yields have been relatively constant over the last five years at about 58 bu./acre (Peat Marwick Consulting Group, Feb. 1989. p.9). However, these yields are much lower than if more advanced agronomic practices are used. Farmers who specialize in oats production consistently obtain over 100 bu./acre (Dietz). Thus, there is a significant potential for increased oats acreage from a purely agronomic perspective.

Oats is used mainly as a substitute in dairy rations and in horse rations where there is no close substitute. With dairy herds tied to supply management, domestic feed demand is relatively stable. With domestic livestock demand relatively constant, the avenue for increased oats demand is domestic and foreign human consumption and the U.S. "pony oats" market. Since these markets require Canada Western grade oats, potential demand increases will be this food grade oats.

PART 1: REGIONAL CROP FORECASTING MODEL

The section analyzes the first objective of analyzing the role of prices, yields and inventory on crop acreage seeded in Western Canada. It is further reduced to the estimation of a supply elasticity for oats with respect to expected revenues.

$$\text{Supply Elasticity (Ep)} = \frac{\text{\% change in quantity.}}{\text{\% change in expected revenue.}}$$

Dynamic supply elasticities indicate the speed and magnitude of output adjustments in response to changes in product prices. Thus, supply elasticities measure the ability of producers to adjust production in a dynamic environment (Nerlove).

This supply response model follows the adaptive expectations theory, and implies that agricultural producers base future crop revenue expectations of crop i on past revenues of crop i only. Adaptive expectation models have been popular in many past agricultural supply response models. In the face of an uncertain environment, such as weather, this adapting behavior is logical. Further, they seem to work well in an environment which changes gradually, such as primary agriculture production.

The opposing rational expectations theory suggests that agricultural producers make informed predictions on future crop revenues using all available information (Fisher, p.260). Thus, rational expectations theory criticizes adaptive expectations theory, which implies that agriculture producers do not use all available information in making revenue forecasts of crop i, but use only past information. Further, it would seem likely that if producers only use past information, better revenue forecasts of crop i could be possible if all other past crop revenues were taken into consideration. This hypothesis is intuitively appealing. Since the supply response model used in this study implies an adaptive behavior by Canadian agricultural producers, some caution should be taken in the interpretation of these results.

CHAPTER III

REVIEW OF SUPPLY RESPONSE RELATED MATERIAL

3.1 Meilke

Meilke (1976) analyzed the short and long run acreage response of Board grains (wheat, barley and oats) over the period 1949 to 1974. This paper focuses on differentiating the impacts of the CWB initial and final payments on producer cropping decisions. Final CWB payments are lagged one year (t-1) as a proxy for expected final payments in year t. Since final CWB payments for crop t-1 are received only after crop t has been sown, this implicitly assumes that producers correctly forecast final CWB payments for crop t-1 at seeding time in year t.

3.2 Paddock, Ulm

Paddock (1971) analyzed the short run acreage response of rapeseed aggregated across the prairies between 1951 and 1967, while Ulm (1975) examined both the short and the long run responses of rapeseed at the prairie and provincial level. Paddock includes lagged rapeseed prices and it's substitutes in the specification of the model. Ulm's model specification includes both rapeseed yield and price variables, and also the price of wheat. Both models exhibited good statistical fit.

3.3 Pietryk

Pietryk (1976) analyzed the short and long run responses of sunflowers in Manitoba between 1955 and 1973. Gross receipts, (price * yield) divided by a base crop lagged one year are used as a proxy for expected profits. A lagged endogenous variable is used to improve goodness of fit.

3.4 Lowe and Petrie

Lowe and Petrie (1978) analyze acreage responses of wheat, barley, oats, rapeseed and flaxseed in the prairies between 1959 and 1977. Separate price and yield variables are specified in some equations and not others. Further, prices of substitutes are not included in all equations. Another shortcoming is the lack of constraints on total forecasted acreage. This allows for a greater level of acreage to be forecasted than exists.

3.5 Coleman

Coleman further developed the Lowe and Petrie model by experimentation with alternative specification and exogenous variables. Simultaneous and constrained estimation techniques are introduced with some success. However, this specification does not guarantee positive residuals for each crop.[2]

3.6 Lam

Lam adapted the Coleman model to explain the allocation of total acreage in the prairies. The primary purpose of this study is to differentiate producer allocation between crops sown on stubble and summerfallow land. This model distinguishes between stubble and summerfallow land, and also between provinces. This separation was performed to reduce aggregation bias, which impairs parameter estimation,

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[2] For a full analysis and critique of these articles see Lam, Syu-Yi, "A Regional Crop Forecasting Model for the Prairies", unpublished M. Sc. thesis, University of Manitoba, 1984.

and thus improve forecasting ability. A distributed lag form of the model is tested for each crop and accepted in some cases but not in others. This leaves some equations in static and others in distributed form.

Lam uses a multinomial logit supply response model. This model consists of a system of equations, one for each crop correlated through the residuals. An exponential function $Ai=e^{fi}$ was postulated to be the acreage response of crop i, where fi is a linear function of the predetermined variables. Each crop is then estimated as an acreage ratio of crop i to flaxseed. Thus, flaxseed becomes the deflator. Based on the estimation of $[Ai/A_{flax}]$, acreage shares for each crop were derived, with flaxseed as the residual. This constrains acreage shares to one and allows total acreage to be predetermined. This causes the residuals from each equation to become contemporaneously correlated. Three Stage Least Squares (3SLS) is used to account for this cross equation correlation. The main explanatory variables used in this model are relative expected revenues of crop i to each competing crop. With flaxseed used as the denominator in each equation, relative revenue variables of flaxseed to each competing crop are also included.[3]

Some inconsistencies are noted with respect to variables removed from the model. Some variables are removed in one province and not in others, or in the stubble and not summerfallow equations. Due to the sensitivity of 3SLS to specification errors, there is some concern with the technique or criteria used for the removal of variables from the system.

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[3] The model used in this study is adapted from Lam's model and thus a complete discussion on the specification, it's advantages, estimation techniques, as well as exogenous variables will be dealt with in the model specification section.

Specification errors in one equation are transmitted to all other equations. Since no objective technique is cited for the removal of variables, there may be some bias in the estimated parameters. Further, with each equation specified differently, parameters cannot be compared as readily as Lam suggests.

Since this model estimates acreage shares, an estimation of total available acreage for crops seed on stubble and summerfallow is required. Land summerfallowed in year t-1 is assumed to be cropped in year t. Thus, Lam uses land summerfallowed in year t-1 as an estimation of land seeded on summerfallow in year t. For the estimation of land seeded to stubble, the previous year is used. This is a naive forecast and decreases the value of the model for forecasting purposes.

3.7 Reynolds

Reynolds (1986) makes a contribution to Lam's model by developing a model to forecast total acreage seeded on stubble land. A logistic function of the ratio of stubble to total cropland in year t-1 is hypothesized. A trend variable is included to account for increased land cleared and decreasing levels of summerfallow. A dummy variable specifies the Lower Inventories For Tomorrow (LIFT) government program in 1970, and a dummy variable for the period after the LIFT program to account for the indirect effects of the program. A dummy variable is also used to account for years of excess on-farm stocks. Equations for each province are estimated with reasonable forecasting ability. However, the explanatory power of these equations are limited because the model specifies only dummy and trend variables.

CHAPTER IV

SUPPLY RESPONSE MODEL SPECIFICATION

4.A Introduction to Supply Response Model

Supply response models are constructed for Manitoba, Saskatchewan, and Alberta, and estimate wheat, barley, oats, canola, flaxseed, and sunflower acreage. The models are constructed in two parts. The first stage estimates the total acreage seeded to the above crops in each province. The second stage estimates the share of the total acreage seeded to each of the above crops. The total acreage estimated in the first stage is then used to calculate an estimate of the acreage of each individual crop.

The supply response model is also used to estimate short and long run supply elasticities with respect to increases in the expected revenue of each crop. Oat acreage forecasts to the year 1995 are also made with this model.

4.B Specification of Landbase Model

The total landbase is defined as the total area seeded to wheat, barley, oats, canola, flaxseed, and sunflowers in Manitoba, Saskatchewan, or Alberta. This includes acreage seeded on previously stubble acreage or summerfallowed land. The following relationship is hypothesized.

$$Y_{t,a} = f(\ Y_{t-1}, TREND_t, LIFT_t, POST70_t, WSTOCKS_t) \quad (1)$$

The specification then takes on the following form in estimation.

$$Y_{t,a} = B_0 + B_1{*}Y_{t-1} + B_2{*}TREND_t + B_3{*}LIFT_t + B_4{*}POST70_t + B_5{*}WSTOCKS_t + E_{t,a} \quad (2)$$

Where: Y is the ratio of Total Cultivated Land to a three year moving average of land previously summerfallowed.
a is Manitoba, Saskatchewan, or Alberta.
Trend a linear trend variable.
Lift is a dummy variable for the Lower Inventory For Tomorrow Program, if Trend = 1970 then Lift =1, otherwise Lift = 0.
Post70 is a dummy variable for a shift in the function, if Trend > 1970 the Post70 = 1, otherwise Post70 = 0.
Wstocks is the absolute level of on-farm wheat stocks.
E is the error term.
t is the year.

Ordinary Least Squares estimation technique is used.

4.B.1 Landbase Model Endogenous Variable

The ratio of total cultivated land to a three year moving average of land previously summerfallowed is estimated for each prairie province.[4] It is hypothesized that producers have a base amount of land that they normally set aside for summerfallow based on current moisture levels, weed problems, and crop rotation constraints. Producers then make decisions based on farm inventories, etc. to increase or decrease this

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[4] A typical formulation would have been the ratio of fallow to cultivated area. But the above formulation provides superior results, due to past behaviour of producers accounted for by the moving average process.

"base" level of summerfallow acreage. Thus, the ratio of cultivated land to crop in the current period over a three year moving average of previous summerfallowed land is used to account for this relationship. Land not cropped is assumed to be summerfallowed, and thus this specification includes both decisions producers make. Area seeded to wheat, barley, oats, canola, flaxseed, and area summerfallowed are obtained from Statistics Canada: Field Crop Reporting Series, (cat. no. 22-002). Sunflower acreage are obtained from Manitoba Agriculture Yearbooks (various years).

4.B.2 Landbase Model Predetermined Variables

a. Lagged Endogenous (Y_{t-t})

A lagged endogenous variable is hypothesized to account for the rigidity of cropping decisions with respect to moisture, weed and crop rotation constraints, and producer habits. For example, a lack of moisture or a weed problem may not allow producers to crop all land in a given year. Further, some special crops may force producers to incorporate some level of summerfallow into their crop rotation. Thus, producers make cropping/summerfallow decisions only on incremental changes in total cultivated acreage and not on their entire landbase. The sign on this variable should be positive, and maybe quite large. This suggests a slow deviation from core summerfallow-stubble cropland acreage. The lagged endogenous coefficient is interpreted as the short run impact of pervious cultivated land to fallow ratio on present cropland. A long run impact multiplier (1/(1-a)), where a is the estimated coefficient of the lagged endogenous variable, shows the total impact of previous cropping decisions on future cropping decisions.

b. Trend

A trend variable is included to account for the shift to less summerfallow acreage as a result of technology advancement and also new cropland that is cleared into production. Technology in herbicides and moisture conservation (zero-till) have lowered the need for summerfallowing as a means of increasing soil moisture and weed control. The sign on this variable is postulated to be positive. Thus, this variable is affected by programs such as the LIFT program designed to reduce levels of inventories held on farm by increasing summerfallow acreage.

c. Lift

The LIFT dummy variable is used to account for the direct increase in summerfallow area in 1970 as a result of the federal government program "Lower Inventories for Tomorrow". Incentives were given to shift wheat acreage to summerfallow, without a switch to other crops (Sahi and Craddock, p.2). This program is expected to cause a reduction in wheat acreage, and thus a decrease in the total cultivated acreage, and an increase in summerfallow acreage. Therefore, this variable should have a negative sign.

d. Post70

The POST70 variable is used to account for indirect effects of the LIFT program in years following the program. The variable is 0 previous to 1972, and 1 from 1972 on.

e. Wstocks

Wstocks are on-farm wheat stocks as of March 31 (Statistics Canada: Quarterly Bulletin of Agriculture Statistics, cat. no. 21-003) and are postulated to have a negative effect on the ratio of cropland to fallow.

Wheat stocks are included in the model specification because wheat is the largest crop in western Canada and thus should have the largest impact on total landbase decisions. An increase in on-farm wheat inventories should increase fallow as producers substitute away from cropping land as storage and financial constraints become binding.[5]

4.C Specification of Acreage Share Model

Stubble and summerfallow acreage are aggregated together in the specification of the acreage share model. The acreage of crop i, where i equals wheat, barley, oats, canola, and sunflower acreage, is assumed to be determined by a simple exponential function of crop relative revenues and other factors below. A benefit of the exponential function is that it imposes a positive minimum acreage for each crop. Producers tend to maintain a minimum acreage for each crop grown in their area for rotation purposes and livestock feed. The exponential function is specified as follows:

$$\mathbf{A_i = exp\ f_i(R_i/R_j, Z, e_i)} \tag{3}$$

where $\mathbf{A_i}$ is the acreage of crop **i** in each province.
$\mathbf{f_i}$ is a linear function of $\mathbf{R_i/R_j}$ and **z.**
$\mathbf{R_i/R_j}$ is a vector of expected revenue of crop i relative to each competing crop **j. j = 1 to n. j ≠ i.**
Z refers to all other factors.
$\mathbf{e_i}$ is a random disturbance term.
exp = exponential.
All variables are in time **t.**

5 An aggregated measure of on farm stocks, all stocks summed, was dropped in favor of wheat stocks because of a superior goodness of fit.

Each provincial model is specified as follows:

$$Aw_a = \exp f(Aw_{t-1}, Rw/Rfl, Rw/Rb, Rw/Ro, Rw/Rr, GIW, GIFL, LIFT) \quad (4)$$

$$Ab_a = \exp f(Ab_{t-1}, Rb/Rfl, Rb/Rw, Rb/Ro, Rb/R^r, GIW, GIFL, GIB) \quad (5)$$

$$Ao_a = \exp f(Ao_{t-1}, Ro/Rfl, Ro/Rw, Ro/Rb, Ro/Rr, GIW, GIFL, GIO) \quad (6)$$

$$Ar_a = \exp f(Ar_{t-1}, Rr/Rfl, Rr/Rw, Rr/Rb, Rr/Ro, RP, GIW, GIFL, GIR) \quad (7)$$

$$Afl_a = \exp f(Afl_{t-1}, Rfl/Rw, Rfl/Rb, Rfl/Ro, Rfl/Rr, GIW, GIFL) \quad (8)$$

$$As_a = \exp f(As_{t-1}, Rs/Rfl, Rs/Rw, Rs/Rb, Rs/Ro, Rs/Rr, GIW, GIFL) \quad (9)$$

where **W** is wheat, **b** is barley, **o** is oats, **r** is rapeseed and **fl** is flax and s is sunflowers.
Ai is the acreage of crop **i**, where **i = w, o, b, r, fl,s.**
Ri is the expected revenue of crop **i** where **i is w, o, b, r, fl,s.**
GIW is on farm stocks of wheat as of March 31.
GIFL is on farm stocks of flax as of March 31.
GIB is on farm stocks of barley as of March 31.
GIR is on farm stocks of rapeseed as of March 31.
GIO is on farm stocks of oats as of March 31.
LIFT is a dummy variable for the Lower Inventory For Tomorrow Program, if Trend = 1970 then Lift =1, otherwise Lift = 0.
RAPE is a trend variable for rapeseed only.
a is Manitoba, Saskatchewan, and Alberta.
Note: The Manitoba model includes an equation for sunflowers.

The multinomial logit model explains total crop production acreage in terms of a set of percentage shares for each crop. The acreage percentage share of crop **i** (S_i) is given by

$$S_i = A_i \,/\, \text{Total Cultivated Acreage } (Y_{t,a}) \quad (10)$$

where Total Cultivated Acreage equals the sum of acreage shares **Ai.** This makes it possible to constrain acreage to a predetermined amount.

thus
$$S_i = \frac{[\exp f_i(R_i/R_j, Z, e_i)]}{[\sum f_k(R_k/R_j, Z, e_k)]} \quad (11)$$

The acreage ratio of crop **i** (S_i) to a common crop **m** (S_m) is equal to

$$\frac{S_i}{S_m} = \frac{A_i}{A_m} * S_m = \frac{\exp f_i(R_{ij}, Z, e_i)}{\exp f_m(R_{mg}, Z, e_m)} \quad (12)$$

where **j = w, b, o, r, fl and j ≠ i and g = j and g ≠ m.**

The acreage share of any crop (S_j) can be derived from the set of n-1 acreage ratios of A_i to one common denominator (A_m) for wheat, barley, oats, and rapeseed where the common denominator (Am) is flaxseed. The acreage share of crop j (A_j) is then obtained by multiplying S_j to the predetermined total cultivated acreage ($Y_{t,a}$). The denominator flaxseed becomes the residual after all acreage shares have been estimated. To facilitate empirical estimation, the exponential form is translated into linear form by taking natural logarithms.

$$\mathrm{Ln}\ \frac{A_i}{A_{fl}} = \ln \frac{\exp f_i}{\exp f_{fl}} = f_i(R_i/R_j, Z, e_i) - f_{fl}(R_{fl}/R_g, Z, e_{fl}) \qquad (13)$$

where
- A_i is the acreage of crop i
- f_i is a linear function of R_{ij} and z
- R_i/R_j is a vector of expected returns of crop i relative to each competing crop j. j = g and j= w, b, o, r, fl. j ≠ i.
- Z refers to all other factors.
- E_i is a random disturbance term.

The equations to be estimated then take on the following form:

$$\ln(Aw/Afl)_t = B_0 + B_1(\ln(Aw/Afl)_{t-1} + B_2(Rw/Rfl) + B_3(Rw/Rb) + B_4(Rw/Ro) + B_5(Rw/Rr) + B_6(LIFT) + B_7(GIW) + B_8(GIFL) + Ew \qquad (14)$$

$$\ln(Ab/Afl)_t = B_0 + B_1(\ln(Ab/Afl)_{t-1} + B_2(Rb/Rfl) + B_3(Rb/Rw) + B_4(Rb/Ro) + B_5(Rb/Rr) + B_6(GIW) + B_7(GIFL) + B_8(GIB) + Eb \qquad (15)$$

$$\ln(Ao/Afl)_t = B_0 + B_1\ln(Ao/Afl)_{t-1} + B_2(Ro/Rfl) + B_3(Ro/Rw) + B_4(Ro/Rb) + B_5(Ro/Rr) + B_6(GIW) + B_7(GIFL) + B_8(GIO) + Eo \qquad (16)$$

$$\ln(Ar/Afl)_t = B_0 + B_1\ln(Ar/Afl)_{t-1} + B_2(Rr/Rfl) + B_3(Rr/Rw) + B_4(Rr/Rb) + B_5(Rr/Ro) + B_6(GIW) + B_7(GIFL) + B_8(GIR) + Er \qquad (17)$$

$$\ln(As/Afl)_t = B_0 + B_1\ln(As/Afl)_{t-1} + B_2(Rs/Rfl) + B_3(Rs/Rw) + B_4(Rs/Rb) + B_5(Rs/Ro) + B_6(Rs/Rr)+ B_7(GIW) + B_8(GIFL) + Er \qquad (18)$$

The estimates $\ln(\widehat{A_i/A_{fl}})$ are first obtained and then antilogs are taken to get $(\widehat{A_i/A_{fl}})$. The percentage acreage shares for crop **i** (S_i) are estimated with the equation.

$$\hat{S}_i = \widehat{A_i/A_{fl}} * \hat{S}_{fl} \tag{19}$$

where $\hat{S}_{fl}$ is the acreage share of flax and is equal to

$$\hat{S}_{fl} = (1/(\widehat{Aw/Afl} + \widehat{Ab/Afl} + \widehat{Ao/Afl} + \widehat{Ar/Afl} + 1) \tag{20}$$

The acreage of crop **i** ($\hat{A}_i$) is then obtained as follows.

$$\hat{A}_i = \hat{S}_i * \textbf{Total Cultivated Acres } (\hat{Y}_{t,a}) \tag{21}$$

Where $\hat{Y}_{t,a}$ is the Total landbase estimated from the previous model.

Flaxseed acreage becomes the residual in the estimation of the complete model for each time period t. This constrains the sum of the error terms to zero for the complete system in each time period t. Three Stage Least Squares (3SLS) estimation technique is used to account for this contemporaneous correlation.

4.C.1 Acreage Share Model Endogenous Variable

As in Lam's model, flaxseed is chosen as the base acreage because it is the only crop that exhibited little if any trend in the past. If a crop with a trend is chosen for the deflator, the estimates may become biased as the trend changes over time. Acreage of wheat, barley, oats, canola, and flaxseed are obtained from Statistics Canada: Field Crop Reporting Series, (cat. no. 22-002). Sunflower acreage are obtained from Manitoba Agriculture Yearbooks (various years).

4.B.2 Acreage Share Model Predetermined Variables

a. Lagged Endogenous Variable

A lagged endogenous variable is hypothesized for all crops. This variable is used to account for non-economic factors, such as habits and preferences. Particular crops may also be better suited to specific land types, drainage, location, etc., further accounting for rigidity in cropping decisions. Other factors could include crop rotation requirements or the difficulty in planting a new crop that requires added equipment. Hence, justification for seeding previous year's crops. As in the landbase estimation, short and long run multipliers are calculated.

b. Relative Revenue Variable (Ri/Rj)

Firm theory suggests that producers make decisions on the allocation of resources (capital and labour) for profit maximization. If this optimizing behaviour is accepted, shadow prices and opportunity costs are crucial determinants of supply (Nerlove). It follows that changing prices for outputs and inputs becomes a key element in understanding agriculture production. However, in agriculture production there is little difference in average costs of growing alternative crops, thus a comparison of alternative crops can be made on the basis of expected revenue (Craddock, 1975, p. 684). Each crop competes with alternative crops for the same inputs, and hence revenues from alternative crops are important variables in the specification of the competitive nature of cropping alternatives. This system of relative expected returns also includes changes in technology (i.e.higher yielding varieties among alternative crops) over time which influences the long term direction of crop production. As in Lam's model, relative revenue ratios will be used by incorporating ratios of the expected returns of alternate crops. The benefit of this specification, is it displays revenue in real terms and thus eliminates the need to deflate variables.

Coleman, Lowe and Petrie include a trend variable to account for the steady shift of oats acreage to barley acreage over the last two decades. This trend is attributed to less success in the development of higher yielding oat varieties than barley. Since this has made oats less competitive than barley, no trend variable is included as the relative revenue variable is hypothesized to reflect this substitution.

The specification of the expected returns variables is identical with that used by Lam and is justified with Coleman's assumptions that (Coleman, pp. 12-13):

1. It is the expected return per acre [Expected price * Expected yield] which is most relevant to producer responses and are thus used as proxies for farmer expected profits.

2. Rather than incorporating each expected return from each competing crop, relative returns are incorporated by using ratios of the crop in question to each competing crop. This specifies the returns in real terms and should better reflect inter-crop competition.

Prices are specified in dollars per bushel and yields in bushels per acre. Thus, expected revenues are in dollars per acre.

(i) Expected Prices

Wheat prices are based entirely on CWB payments because most Canadian wheat is sold via the CWB. Before 1971, initial payments were not known to producers prior to seeding each year. However, initial payments have been announced prior to seeding since 1971. Since final payments are generally announced about six months after the close of each marketing year, final payments would not be know until January, in the second year after seeding of that crop. It is assumed that producers formulate production decisions on the most recent decisions, and thus the expected price of wheat is specified as the initial price lagged one period plus the final payment lagged two periods for the period prior to 1971 and the current initial price plus the final payment lagged two years for the period since 1971 (Lam, p.43). Wheat prices are obtained from Canadian Wheat Board Annual Reports (various years).

Oats, barley, canola, and flaxseed prices have been established on the WCE cash market. It is postulated that producers base their expectations of prices on the average prices of the above crops in the six month period prior to seeding. Thus, the average daily closing cash price for the six months prior to seeding (Oct., Nov., Dec., Jan., Feb., March) is used as a proxy for the expected future price in all priced determined by the open market.[6] WCE cash market prices are obtained from Winnipeg Commodity Exchange Statistical Annuals (various years).

The expected price of sunflowers is specified as in Lam's model until 1983. It is based on CSP Foods Ltd. prices because they are the dominant buyer. CSP Foods Ltd. has had contractual relationships with producers since 1950. Under these contracts, producers were paid an initial plus a pooled final payment much like the CWB strategy. The initial price was announced prior to seeding in each crop year from 1959 to 1974. From 1974 to 1983 a flexible initial price equivalent to 80% of the rapeseed price at the time of delivery was adopted. Final payment is received within 6 months of the close of the marketing year. From 1983 to the present, an open market system has been adopted where they

[6] Before, 1974 all barley and oats were marketed through the CWB. The model was run using CWB initial and final prices in the manner that wheat prices are specified, but the model proved superior using the WCE cash prices for both oats and barley.

announce daily prices. Since producers formulate price expectations on most current information, specification between 1959 and 1974 is the initial price plus the final price lagged two years. Between 1975 and 1983, the variable is specified as the initial price lagged one year plus the final price lagged two years. After 1983, producers receive an initial total payment as in the non-Board market, and thus it is postulated that producers base there expectations of price on an average of cash prices for the six months prior to seeding. Thus, specification after 1983 is an average of the cash price for the six months prior to seeding (Oct., Nov., Dec., Jan., March, April) in dollars per bushel. Sunflower prices are obtained directly from CSP Foods Ltd.

(ii) Expected Yields

Because crop yields tend to be largely affected by weather, expected yields from the previous year only would not be an adequate proxy of true expected yields. It is hypothesized that producers base yield expectations on a number of previous years' yields. Thus, the specification of expected yields is a three year moving average of previous yields in bu./acre. Crop yields for wheat, oats, barley, canola, and flaxseed are obtained from Statistics Canada: Field Crop Reporting Series, (cat. no. 22-002). Manitoba sunflower yields are obtained from Manitoba Agriculture Yearbooks (various years).

The difference between the specification of the relative revenue variable in this model and Lam's model is the number of variables included. Lam included all relative return variables of crop i to all competing crops and also the relative revenue variables of flaxseed to all competing crops. For example, in the oats equation, Lam includes the relative revenue variables Ro/Rfl, Ro/Rw, Ro/Rb, Ro/Rr, Ro/Rfl, Ro/Rs and also Rfl/Rw, Rfl/Rb, Rfl/Rr, Rfl/Rs. This model includes only the direct effects in the oats equation, Ro/Rfl, Ro/Rw, Ro/Rb, Ro/Rr, Ro/Rfl, and Ro/Rs. It is felt that including the indirect relative return variables only results in a loss of degrees of freedom.

c. Lift

The Lift dummy variable is used to account for the direct impact of this program to wheat acreage in 1970. The variable is 1 in 1970 and 0 all other years. The program was designed to decrease wheat acreage without a switch of acreage to other crops. Thus, the LIFT variable is included only in the wheat equations. This variable should be negative since the purpose of the program was to encourage farmers to reduce wheat acreage while holding this land out of production (Sahi, and Craddock, 1971, p.2).

d. Stocks of Grain (GIW, GIB, GIO, GIR, GIFL)

On farm wheat stocks are included for all equations because it is the largest crop on the prairies and therefore considered an alternative to all other crops. A buildup of on-farm wheat stocks is expected to cause producers to allocate away from crop production.

On farm flax stocks are also included in each equation because flax is the denominator in all equations. Increases in flax stocks are hypothesized to affect flax acreage negatively, and thus affecting the acreage share estimation of each equation. Stocks of barley (GIB), oats (GIO), and rapeseed (GIR) are included in each respective equation because large on-farm inventory surpluses should discourage production of that crop as storage and financial constraints become binding.[7] All on-farm stocks are obtained from Statistics Canada: Quarterly Bulletin of Agriculture Statistics, (cat. no. 21-003).

e. Rapeseed Trend Variable (RP)

RP is a trend variable included in the rapeseed equation. This variable reflects increases in canola acreage due to producers' gradual learning process and higher levels of management required for canola production. This process is hypothesized to existed when canola production was relatively new, between 1960 and 1970. Thus, a trend variable is specified as 1 in 1960 and increased by 1 each year between 1960 and 1970. After 1970, the learning process is postulated to end and the variable remains at 1970 levels.

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[7] Stocks of sunflowers are assumed to be zero because most sunflowers are contracted to CSP Foods Ltd and delivered upon harvest.

CHAPTER V

SUPPLY RESPONSE MODEL RESULTS

5.A Total Landbase Estimation Results

5.A.1 Parameter Estimation Results

The models generally exhibited good statistical fit. R^2's ranged from .92 to .95 showing the percentage of variation in total cultivated acreage explained by the predetermined variables. All variables exhibited the correct sign. All variables were significant at the 5% level. A D-H statistic was calculated for each equation and revealed no autocorrelation problems. The Lift program, on-farm wheat stocks, and the Post70 dummy variable all correctly have a negative effect on the ratio of total cultivated cropland to summerfallow.

The lagged endogenous variables, total cultivated acreage over a lagged three year moving average of summerfallow acreage, exhibited the highest t statistics. This shows that a large part of the explanatory power of these models is in the lagged endogenous variable. The Manitoba lagged acreage coefficient (0.896) was the largest, Alberta (0.786) second, and Saskatchewan (0.631) the smallest. This lagged acreage ratio coefficient "a" is interpreted as the short run impact of previous year total cultivated acreage on current total cultivated acreage. Thus, Manitoba and Alberta total acreage is more rigid than Saskatchewan. This may be a partial result of the higher percentage of land that is utilized for animal feed in Manitoba and Alberta than in

Saskatchewan. A long run multiplier (1/1-"a") is calculated. This shows the total impact of the previous year's total cultivated acreage on all future total cultivated acreage. The Manitoba coefficient is 9.7, Saskatchewan 2.71, and Alberta 4.67. This reflects asset fixity in agriculture. Table 5.1 summarizes parameter estimation.

Table 5.1

Coefficient Estimation Results of Total Annual Landbase Acreage Model in Western Canada from 1960 to 1988.[a]

	ENDOGENOUS VARIABLES		
	Ratio of Total Cultivated Acres to a 3 year moving Average of Summerfallow Acreage		
Exogenous Variables	**Manitoba**	**Saskatchewan**	**Alberta**
INTERCEPT	**-109.285** (-3.01)*	**-36.014** (-3.57)*	**-67.500** (-2.76)*
LAGGED ENDOGENOUS	**0.897** (21.88)*	**0.631** (6.63)*	**0.786** (9.59)*
TREND	**0.0559** (3.01)*	**0.0186** (3.59)*	**0.0346** (2.76)*
LIFT	**-0.329** (-2.07)	**-0.369** (-6.17)*	**-0.336** (-3.68)*
POST70	**-0.440** (-2.45)*	**-0.222** (-3.31)*	**-0.346** (-2.68)*
WHEAT STOCKS	**-0.0060** (-3.25)*	**-0.0004** (-2.94)*	**-0.0017** (-2.69)*
R^2	**0.932**	**0.885**	**0.949**
F VALUES	**1287**	**166**	**484**

* significant at the 5% level.
T ratios are given in parentheses.
[a] The five largest crops include wheat, barley, oats, flaxseed, and canola. Sunflower acreage is included in the Manitoba equation only.

5.A.2 Total Landbase Simulation and Forecasting Results

Summary graphs are given in figures 5.1 to 5.3. The models were simulated from 1962 to a forecast of the 1989 crop year. Simulation results were generally excellent. The dramatic effect of the 1970 LIFT program is quite evident in each province.

Manitoba total cultivated acreage generally shows an increasing trend until 1986 when acreage dropped .35 million acres from a record high of 9.35 million acres. Saskatchewan acreage declined 1 million acres in 1987 and another .7 million in 1988 from a record 29.3 million acres in 1985. Alberta acreage also declined by .3 million acres in 1987 and another .3 million in 1988. These acreage reductions are hypothesized to be the result of sustained low prices and high inventories, and the accompanying financial constraints.

The 1986 decline in total cropland acreage in the Manitoba model is forecasted well. This decline in total acreage is not forecasted as well in the Saskatchewan and Alberta models, although some decline is forecasted.

Each provincial model forecasts an increase in total acreage for 1989. This is mainly due to a decrease in the level of on farm wheat stocks. The Manitoba forecast for 1989 is for a record 9.5 million acres, Saskatchewan, a near record 28.9 million acres, and Alberta, a record 17.9 million acres.

Forecasting performance is further evaluated with Theil's U_1 statistic. Where: A_t = the actual value of a variable in period t.
MSE = Mean Square Error.

$$U_1 = \frac{MSE}{A_t^2 / N} \quad (22)$$

A lower coefficient reflects increased performance, a 0 coefficient constitutes a perfect forecast, and coefficients greater than 1 are considered poor forecasts. A turning point measure is also used, this measures the models ability to forecast the direction of acreage, whether up or down.

Table 5.2

Forecasting Performance of Total Annual Landbase Acreage Model in Western Canada from 1960 to 1989.

	Manitoba	Saskatchewan	Alberta
Total # of turning pts.	**13**	**13**	**15**
# of turning pts. missed	**7**	**5**	**5**
Theil's U_1 Statistic	**0.0334**	**0.0345**	**0.0287**

The magnitude of Theil's U_1 statistic shows that forecasts are excellent for all provinces while some turning points were missed. However, the summary graphs (figure 5.1 to 5.3) show no serious forecasting errors. Thus, Theil's U_1 statistic is a better indication of the forecasting ability of the model than the turning point measure.

FIGURE 5.1
MANITOBA ACTUAL AND SIMULATED ANNUAL ACREAGE OF WHEAT, BARLEY, OATS, CANOLA, FLAXSEED, AND, SUNFLOWERS (1962 TO 1989)

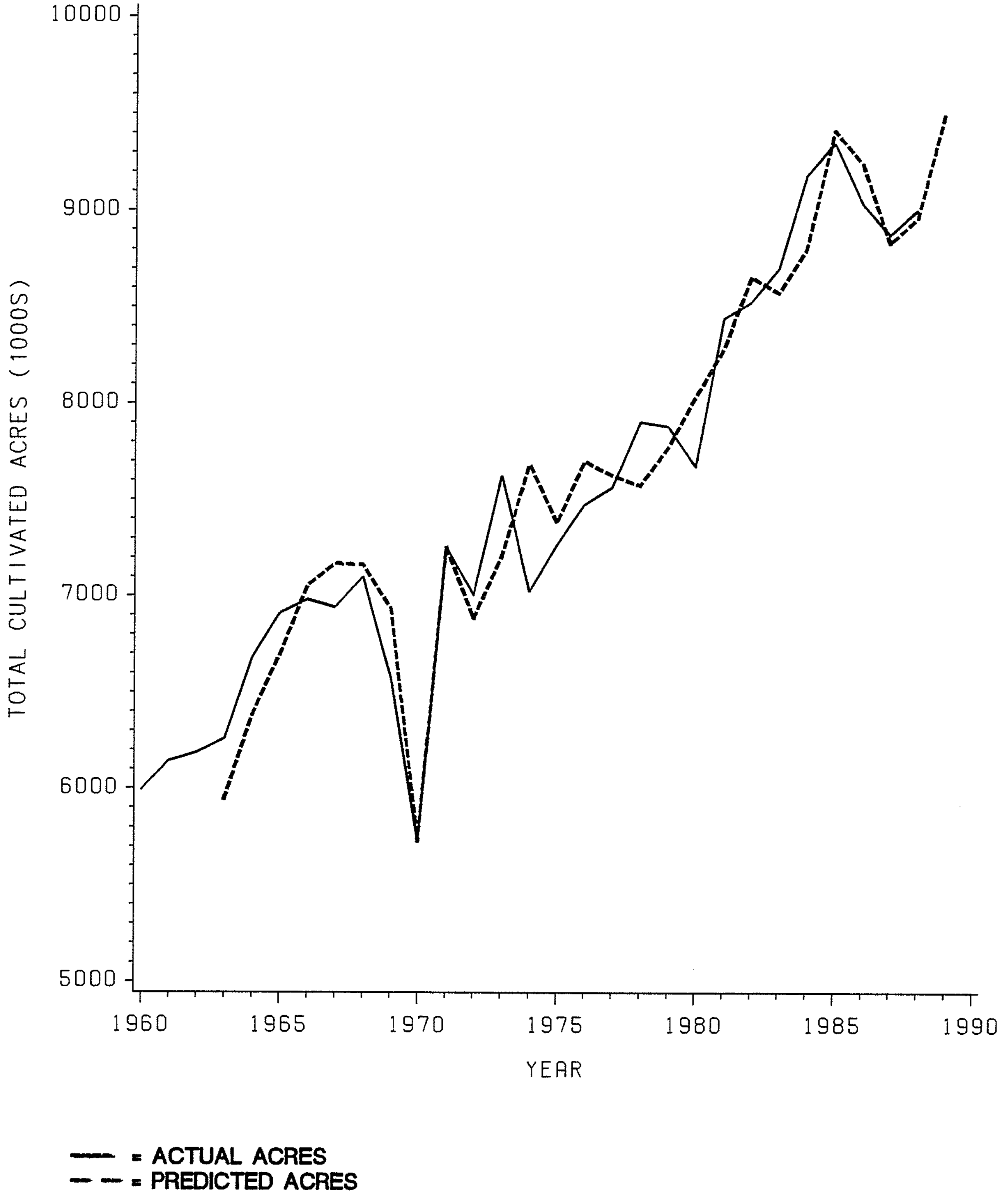
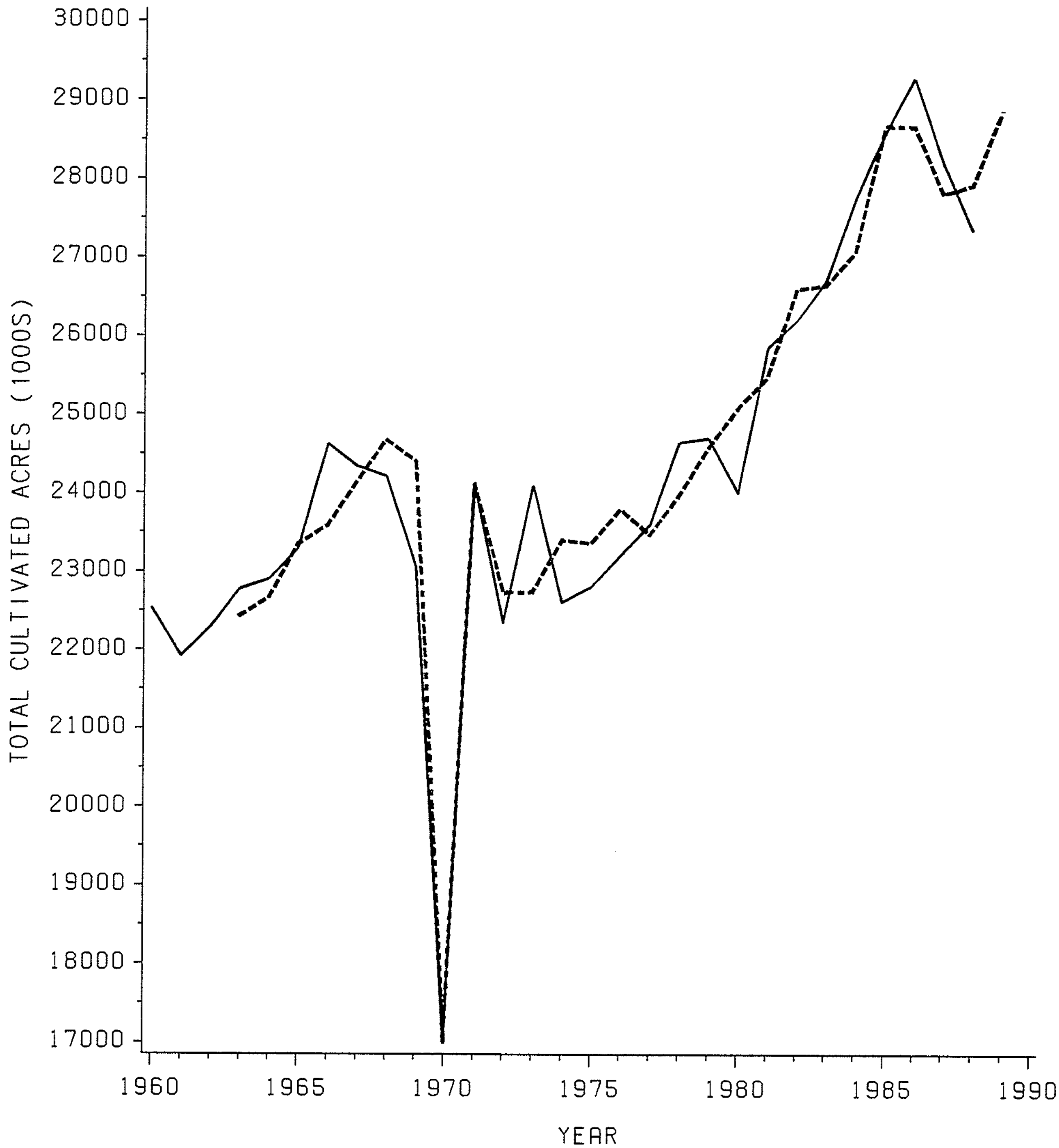
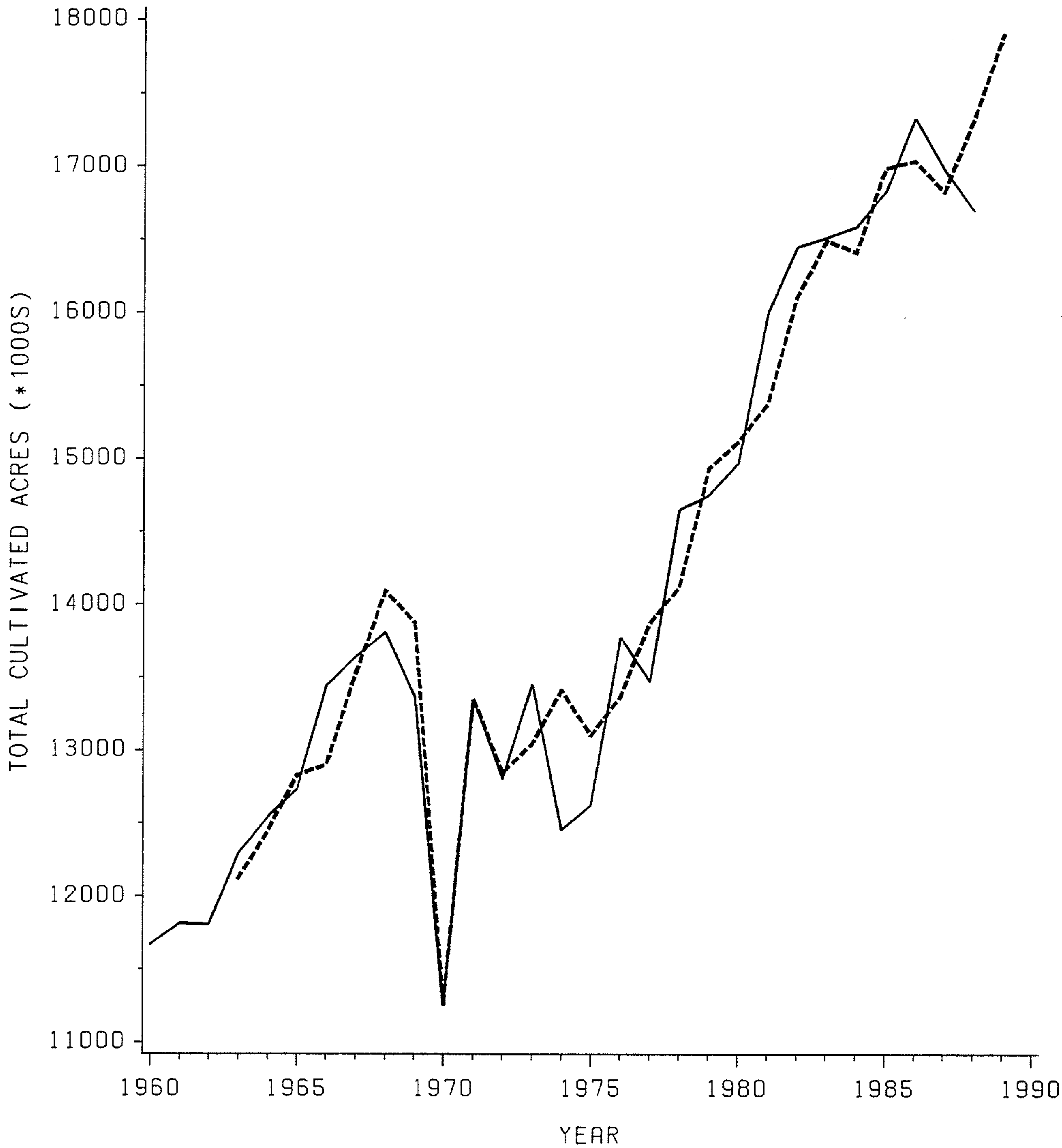


FIGURE 5.2
SASKATCHEWAN ACTUAL AND SIMULATED ANNUAL ACREAGE OF WHEAT, BARLEY, OATS, CANOLA, AND FLAXSEED (1962 TO 1989)



—— = ACTUAL ACRES
– – = PREDICTED ACRES

FIGURE 5.3
ALBERTA ACTUAL AND SIMULATED ANNUAL ACREAGE OF WHEAT, BARLEY, OATS, CANOLA, AND FLAXSEED (1962 TO 1989)



—— = ACTUAL ACRES
— — = PREDICTED ACRES

5.B Crop Acreage Forecasting Results

5.B.1 Crop Acreage Parameter Estimation Results

Many of the estimated parameters for the relative revenue variables were statistically insignificant. This is because a complete set of relative revenue variables included in each equation are largely correlated. No variables were deleted from the model when very low t ratios were encountered or when parameters displayed wrong signs. A complete set of relative return variables is hypothesized to correctly specify the acreage allocation decisions of producers. There is also no theoretical basis for the removal of some relative return variables and not others because all the major crops are considered alternatives, at least on an aggregated provincial basis. Further, Three Stage Least Squares (3SLS) is extremely sensitive to specification errors. A specification error in the first equation is carried throughout the other equations and thus may bias other equations. Thus, the complete system is retained despite the multicollinearity problems. Since the correlation between relative return variables is expected to be ongoing, forecasting performance is not expected to be jeopardized.

As theorized, wheat inventories have a negative effect on all acreage equations, except for the Manitoba sunflower equation. Most of the coefficients were significant at the 5% level. This indicates the large effect that wheat has on allocation decisions of other crops. Flax inventories had a positive sign in all equations. Since flaxseed is used as the denominator in the endogenous variable specification, an increase in flaxseed stocks also has a negative effect on acreage decisions on other crops. Wheat, barley, and oats inventories in there respective equations had negative coefficient signs. The increase of on-farm inventory of a commodity discourages production of that crop. Canola inventory has a negative sign in Manitoba and Saskatchewan, and a positive sign in the Alberta equation, although it was highly insignificant. Given the relative small size of the coefficient in the Alberta, it is not removed. This helps retain completeness of the model and allows accurate comparisons to be made with other equations.

The lagged endogenous acreage ratio variable for each equation is significant in all equations. This reinforces the earlier hypothesis regarding the rigidity of producer planting decisions. Barley lagged endogenous variables are generally the highest, with Alberta and Manitoba coefficients higher than in Saskatchewan. This may be attributed to the large percentage of barley that is used for feed either on or off-farm in Alberta and Manitoba. In contrast, canola is not used for feed and exhibited the lowest lagged endogenous coefficients.

Oats lagged endogenous coefficients are smaller than barley and larger than wheat in Manitoba, and smaller than wheat or barley in both Alberta and Saskatchewan. The oats coefficients are also smaller in Saskatchewan and Alberta than in Manitoba. Since most oats are used for dairy and horse rations, the higher coefficient in Manitoba and Alberta corresponds to the higher levels of livestock production in these provinces.

The time trend variable (TR) in the rapeseed equation is significant in each provincial equation. This reflects producers' learning process in canola production between 1960 and 1970.

The major **"a priori"** expected results of this model are that short run supply elasticities must be generally positive. Thus, individual coefficients with "wrong" signs are not sufficient criteria for the removal of a variable. Dropping variables to reduce multicollinearity is also hypothesized to impair the completeness of the specification of the model. Thus, no variables are removed from equations. One benefit of this is that each equation's coefficients can be compared between provinces and crops. This increases the information available in these models.

Table 5.3

Wheat Acreage Parameter Results in Western Canada from 1960 to 1988.

	Endogenous Variables		
	ACREAGE RATIO OF WHEAT TO FLAXSEED		
Exogenous Variables	Manitoba	Saskatchewan	Alberta
Intercept	-0.074 (-0.23)	0.326 (0.42)	-0.821 (-1.01)
Lagged Endogenous	0.736 (7.49)*	0.677 (6.81)*	0.853 (5.66)*
Revenue of Wheat to Flax	0.921 (4.61)*	1.167 (2.66)*	1.558 (2.54)*
Revenue of Wheat to Barley	-0.268 (-0.88)	0.184 (0.31)	0.574 (0.61)
Revenue of Wheat to Oats	-0.161 (-0.77)	-0.084 (-0.19)	-0.074 (-0.10)
Revenue of Wheat to Canola	-0.017 (-0.08)	0.040 (0.09)	-0.412 (-1.00)
Revenue of Wheat to Sun.	-0.007 (-0.06)	-	-
Lift	-0.440 (-3.10)*	-0.771 (-4.16)*	-0.971 (-4.25)*
Flax Inventories	0.147 (7.44)*	0.099 (3.29)*	0.123 (1.37)
Wheat Inventories	-0.014 (-4.98)*	-0.003 (-2.84)*	-0.005 (-1.41)
R^2	0.920	0.921	0.89

T ratios are given in parentheses.
* denotes significance at the 5% level.
Revenue is dollars/bushels * bushels/acre.
Sun. is Sunflowers.

Table 5.4

Barley Acreage Parameter Results in Western Canada from 1960 to 1988.

	Endogenous Variables		
	ACREAGE RATIO OF BARLEY TO FLAX		
Exogenous Variables	**Manitoba**	**Saskatchewan**	**Alberta**
Intercept	**-1.261** (-2.90)*	**0.087** (0.13)	**1.491** (1.53)
Lagged Endogenous	**0.956** (8.59)*	**0.808** (7.54)*	**0.956** (8.58)*
Revenue of Barley to Flax	**1.042** (4.17)*	**0.579** (1.24)	**1.101** (1.66)
Revenue of Barley to Wheat	**0.142** (0.31)	**-0.717** (-1.11)	**-1.875** (-2.41)*
Revenue of Barley to Oats	**-0.082** (-0.25)	**0.297** (0.55)	**-0.023** (-0.03)
Revenue of Barley to Canola	**0.040** (0.12)	**0.363** (0.72)	**-0.217** (-0.46)
Revenue of Barley to Sun.	**0.024** (0.17)	-	-
Flax Inventories	**0.128** (6.28)*	**0.119** (4.57)*	**0.280** (2.86)*
Wheat Inventories	**-0.005** (-1.49)	**-0.002** (-1.83)	**-0.005** (-1.47)
Barley Inventories	**-0.005** (-1.01)	**-0.003** (-1.76)	**-0.002** (-1.46)
R^2	**0.912**	**0.914**	**0.877**

T ratios are given in parentheses.
* denotes significance at the 5% level.
Revenue is dollars/bushel * bushels/acre.
Sun. is Sunflowers.

Table 5.5

Oats Parameter Estimation Results in Western Canada from 1960 to 1988.

Exogenous Variables	Endogenous Variables ACREAGE RATIO OF OATS TO FLAXSEED Manitoba	Saskatchewan	Alberta
Intercept	**-0.579** (-1.33)*	**-0.020** (-0.03)	**0.491** (0.52)
Lagged Endogenous	**0.801** (7.97)*	**0.619** (4.88)*	**0.718** (5.20)*
Revenue of Oats to Flax	**1.242** (3.72)*	**1.324** (2.75)*	**1.680** (2.43)*
Revenue of Oats to Wheat	**-0.714** (-1.26)	**-0.996** (-1.36)	**-1.617** (-2.00)*
Revenue of Oats to Barley	**-0.132** (-0.30)	**0.148** (0.24)	**0.891** (0.94)
Revenue of Oats to Canola	**0.204** (0.52)	**0.670** (1.22)	**-0.266** (-0.58)
Revenue of Oats to Sun.	**0.176** (0.91)	-	-
Flax Inventories	**0.106** (3.94)*	**0.061** (2.11)*	**0.053** (0.72)
Wheat Inventories	**-0.013** (-3.63)*	**-0.002** (-2.40)*	**-0.003** (-1.08)
Oats Inventories	**-0.0002** (-0.04)	**-0.001** (-0.52)	**-0.004** (-1.34)
R^2	**0.971**	**0.885**	**0.870**

T ratios are given in parentheses.
* denotes significance at the 5% level.
Revenue is dollars/bushel * bushels/acre.
Sun. is Sunflowers.

Table 5.6

Canola Acreage Parameter Results in Western Canada from 1960 to 1988.

Exogenous Variables	Endogenous Variables ACREAGE RATIO OF CANOLA TO FLAXSEED Manitoba	Saskatchewan	Alberta
Intercept	-3.068 (-5.52)*	-1.357 (-3.21)*	-1.439 (2.78)*
Lagged Endogenous	0.414 (3.22)*	0.419 (3.03)*	0.490 (3.76)*
Revenue of Canola to Flax	0.108 (0.35)	0.757 (1.72)	1.578 (2.67)*
Revenue of Canola to Wheat	0.245 (0.44)	-0.731 (-1.40)	-1.594 (-2.09)*
Revenue of Canola to Oats	0.388 (1.10)	0.054 (0.17)	0.494 (0.77)
Revenue of Canola to Barley	0.029 (0.43)	0.560 (1.53)	0.924 (1.13)
Revenue of Canola to Sun.	0.281 (1.43)	-	-
Trend Variable	0.150 (3.76)*	0.163 (4.50)*	0.104 (2.43)*
Flax Inventories	0.080 (2.30)*	0.080 (2.67)*	0.004 (0.05)
Wheat Inventories	-0.006 (-1.23)	-0.002 (-2.25)*	-0.002 (-0.48)
Canola Inventories	-0.019 (-1.01)	-0.019 (-2.22)*	0.002 (0.23)
R^2	0.912	0.928	0.889

T ratios are given in parentheses.
* denotes significance at the 5% level.
Revenue is dollars/bushel * bushels/acre.
Sun. is Sunflowers.

Table 5.7

Sunflower Acreage Parameter Results in Manitoba from 1960 to 1988.

Exogenous Variables	Endogenous Variable ACREAGE RATIO OF SUNFLOWERS TO FLAXSEED Manitoba
Intercept	**-2.90** (-5.80)*
Lagged Endogenous	**0.558** (5.44)*
Revenue of Sunflowers to Flax	**0.191** (0.47)
Revenue of Sunflowers to Wheat	**3.165** (3.81)*
Revenue of Sunflowers to Oats	**-0.483** (-0.82)
Revenue of Sunflowers to Canola	**0.313** (0.61)
Revenue of Sunflowers to Barley	**-1.535** (-2.16)*
Flax Inventories	**0.084** (2.19)*
Wheat Inventories	**0.006** (1.02)
R^2	**0.871**

T ratios are given in parentheses.
* denotes significance at the 5% level.
Revenue is dollars/bushel * bushels/acre.

5.B.2 Comparison of Supply Elasticities

Short run supply elasticities are calculated for wheat, barley, oats, canola, and flaxseed acreage. Supply elasticities indicate the percentage increase in acreage given a one percent increase in expected revenue per acre. Since each relative revenue variable includes expected yields and expected prices, elasticities are interpreted to measure either an increase in the expected yield or price per acre. A summary of short run supply elasticities for cereals is given in figure 5.4 (Manitoba), figure 5.5 (Saskatchewan), and figure 5.6 (Alberta), and for oilseeds in figure 5.7 (Manitoba), figure 5.8 (Saskatchewan), and figure 5.9 (Alberta).

Elasticities for oilseeds were generally higher than in cereals. This is partially because a significant portion of cereal grains are used for animal feed. Thus, cereal crop acreage is partially dependent on livestock numbers, and less responsive to increases or decreases in relative revenues than oilseeds. Many of the supply elasticities were greater than one. This implies an unstable long-run relationship between quantity and price. However, the size of the elasticities should only be compared relative to each other.

Flaxseed elasticities were generally the highest and the most variable of all elasticities, with the Manitoba flaxseed elasticity showing the greatest variability. Manitoba flaxseed elasticities ranged from 1.2 to 7.5. This may be partially because flaxseed acreage is used as the denominator in each equation. Further, flaxseed prices have been highly variable in the past, and thus causing the large variance in it's supply elasticity.

Elasticities for cereals were generally positive with some exceptions in the Alberta model for the wheat and barley equations. The negative relative revenue variables in these equations, which are the wrong sign, are the cause of these negative supply elasticities. For example, in the Alberta barley equation (table 5.4), the relative revenue variables barley to wheat, barley to oats, and barley to canola have negative signs. The relative revenue of barley to flaxseed is the only positive correct relative revenue variable. In years when the revenue of flaxseed, either price or yield increases, the impact of the positive relative revenue variable barley to flaxseed is reduced. This reduces the probability of a positive supply elasticity. The impact of the negative relative revenue variables may then offset the reduced impact of the relative revenue variable barley to flaxseed, and cause a negative supply elasticity in that period. The opposite scenario, low flaxseed prices or yields, may cause elasticities to be over one.[8] Flaxseed prices have historically been highly variable in western Canada, thus supply elasticities for crops other than flaxseed somewhat follow the price of flaxseed.

In general, the elasticities vary for each equation other than flaxseed with the nature of each relative revenue variable. Each equation, has some correct positive relative revenue variables, and some "wrong" negative relative revenue variables. Short-run supply elasticities decrease when the revenue of the crops in the denominator of the positive relative revenue variables increases (ie. increasing the denominator of a fraction reduces the fraction), and vice versa. Further,

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[8] Different specifications of the relative revenue variables were tried with little success. The specification presented here provided the best goodness of fit.

short-run supply elasticities increase when the revenue of the crops in the denominator of the negative relative revenue variables increases. This decreases the negative impact of the negative relative return variables, and thus increases supply elasticities. Average supply elasticities for the latest 20 year period are given in table 5.8.

Supply elasticities for oats are generally higher in Saskatchewan and Alberta than in Manitoba. Thus, potential oats acreage increase in Alberta and Saskatchewan are greater than in Manitoba, given increased relative revenues. Oats supply elasticities are generally higher than other cereals. This indicates a high responsiveness of Western Canadian oats to increases in relative revenues.

Table 5.8

Estimated Average Annual Short Run Supply Elasticities with Respect to Expected Revenues for Western Canadian Grains.

	Oats	Barley	Wheat	Canola	Flaxseed
Manitoba	**.50**	**.60**	**.25**	**1.35**	**2.00**
Saskatchewan	**.60**	**.60**	**.15**	**1.00**	**0.90**
Alberta	**.75**	**.55**	**.30**	**1.50**	**1.40**

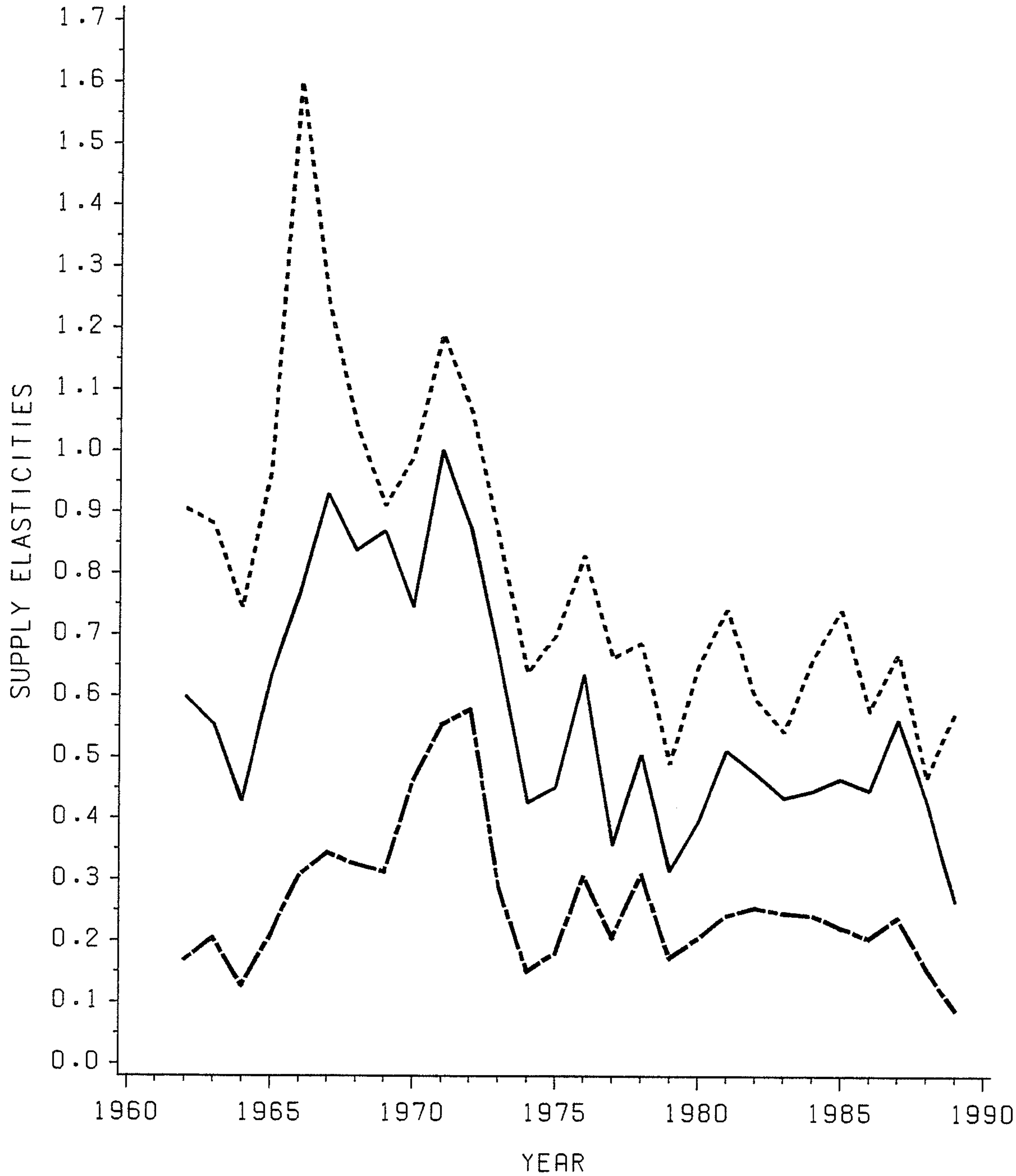
The average acreage response of each crop is calculated given a $1.00 increase in it's expected revenue per acre (table 5.9). This scenario assumes average revenues, and an average acreage of each crop over the last five years. Acreage responses are calculated given the average elasticities in table 5.8.

Table 5.9

Estimated Average Annual Acreage Responses with Respect to a $1.00 per Acre Increase in Expected Revenue for Western Canadian Grains.

	Wheat	Barley	Oats	Canola	Flaxseed
Manitoba	8,928	8,533	2,256	10,445	11,945
Saskatchewan	28,571	21,333	5,714	18,056	4,255
Alberta	18,320	28,009	9,375	29,013	496

FIGURE 5.4
MANITOBA COMPARISON OF ANNUAL SHORT RUN SUPPLY ELASTICITIES FOR CEREALS (1962 TO 1988)

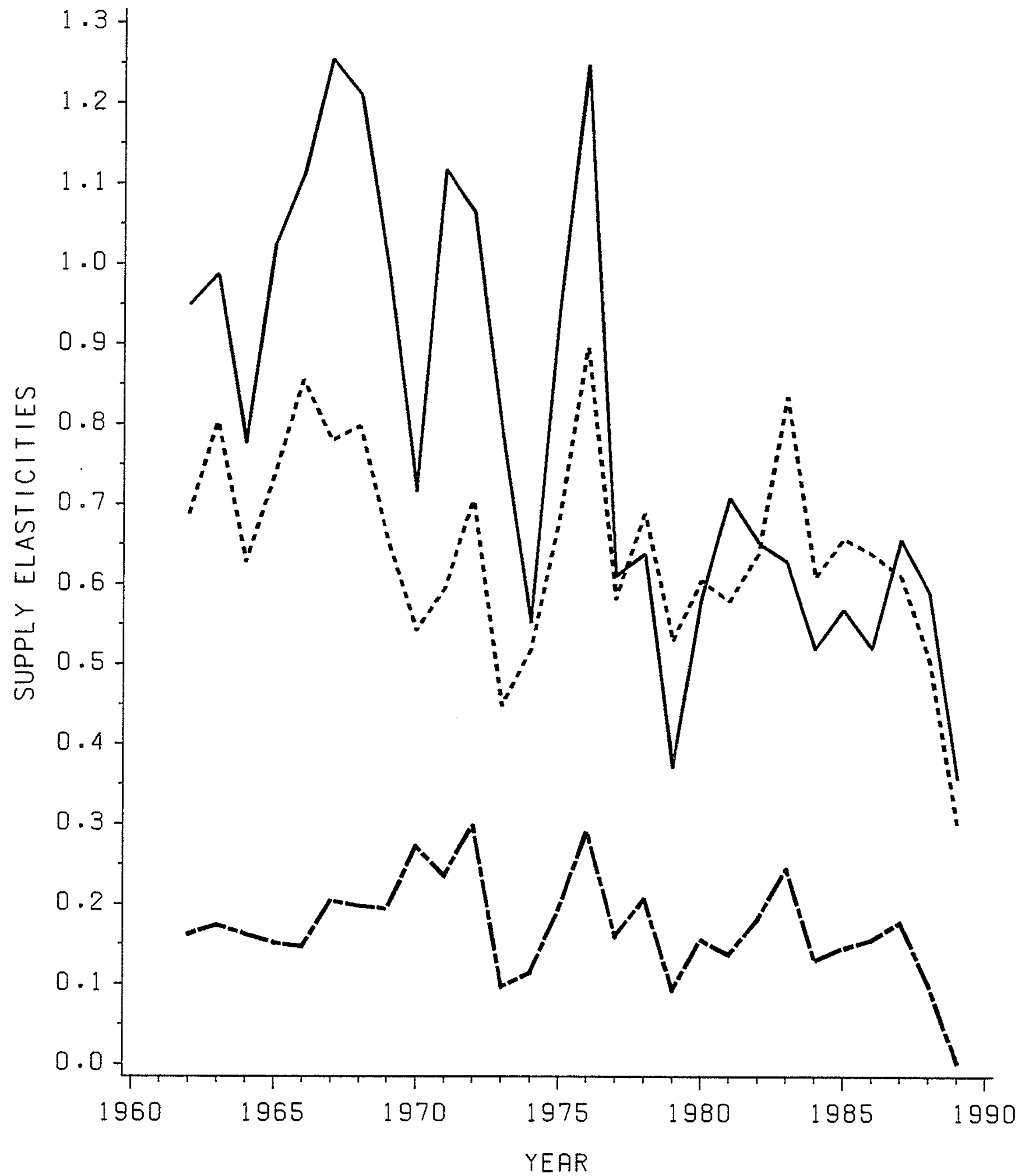


NOTE: ELASTICITIES ARE WITH RESPECT TO EXPECTED REVENUE

——— = OATS
— — = BARLEY
— - — = WHEAT

FIGURE 5.5

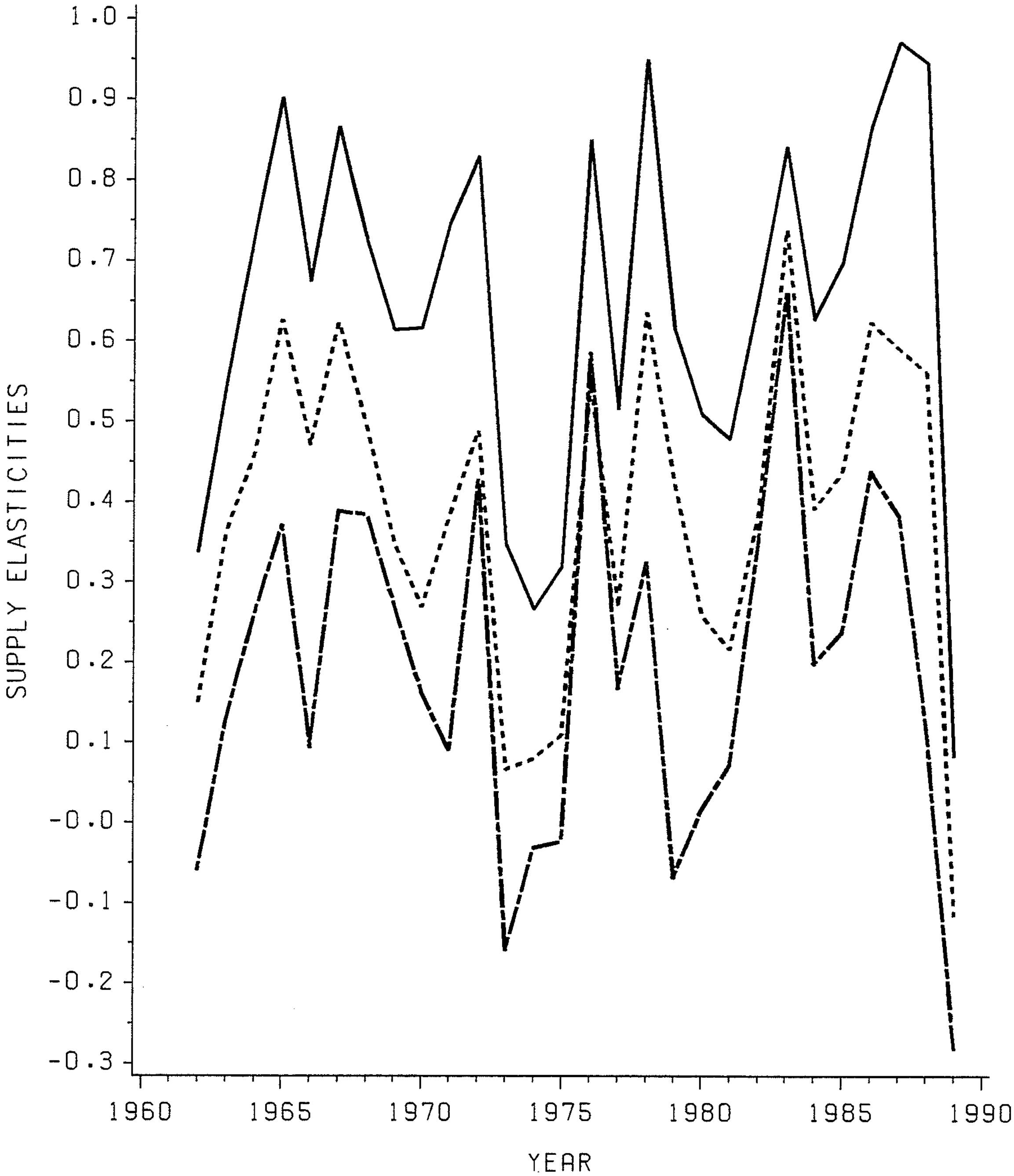
SASKATCHEWAN COMPARISON OF ANNUAL SHORT RUN SUPPLY ELASTICITIES FOR CEREALS (1962 TO 1989)



NOTE: ELASTICITIES ARE WITH RESPECT TO EXPECTED REVENUE

—— = OATS
— — = BARLEY
— - — = WHEAT

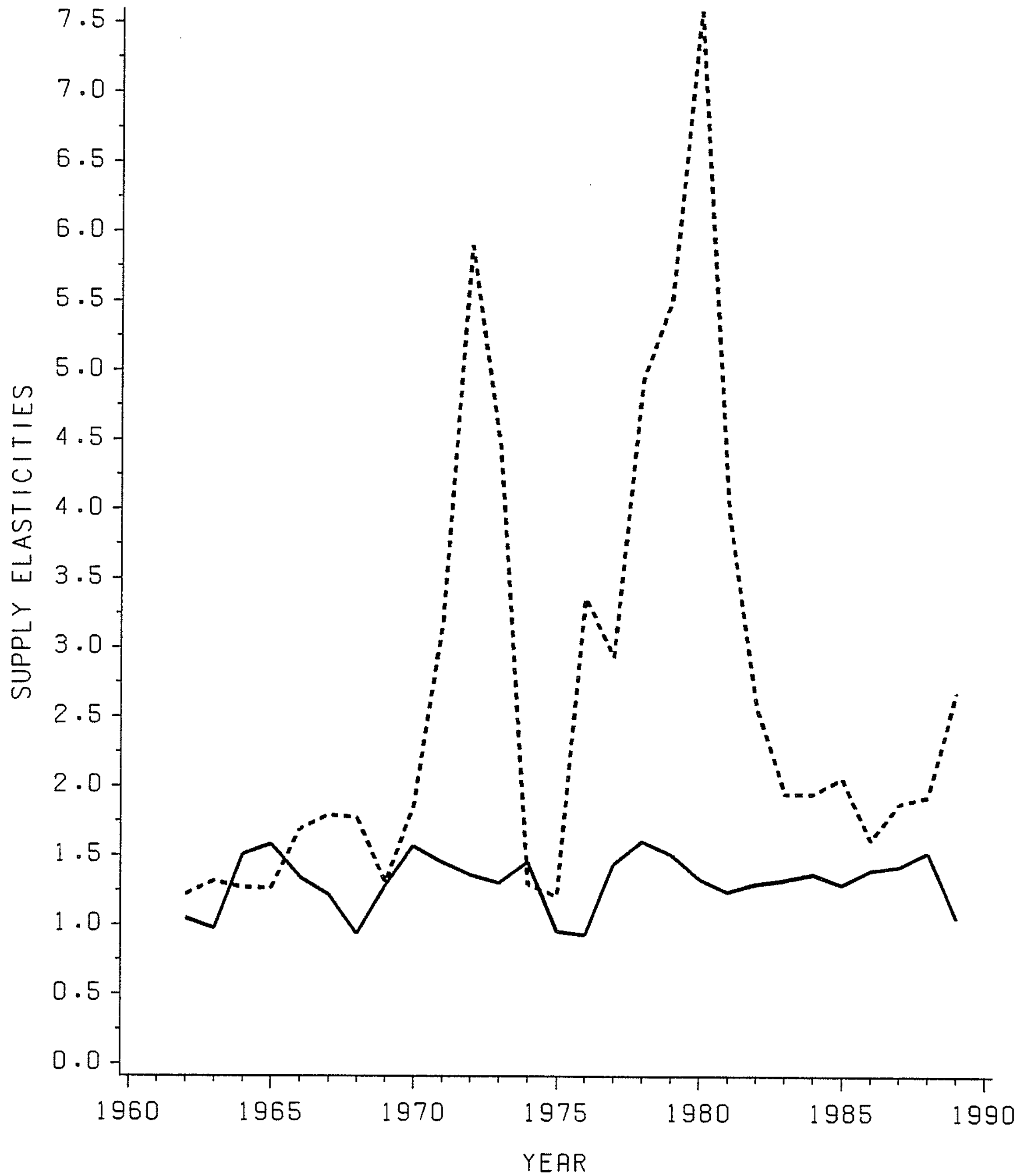
FIGURE 5.6
ALBERTA COMPARISON OF ANNUAL SHORT RUN SUPPLY ELASTICITIES FOR CEREALS (1962 TO 1988)



NOTE: ELASTICITIES ARE WITH RESPECT TO EXPECTED REVENUE

—— = **OATS**
— — = **BARLEY**
— - — = **WHEAT**

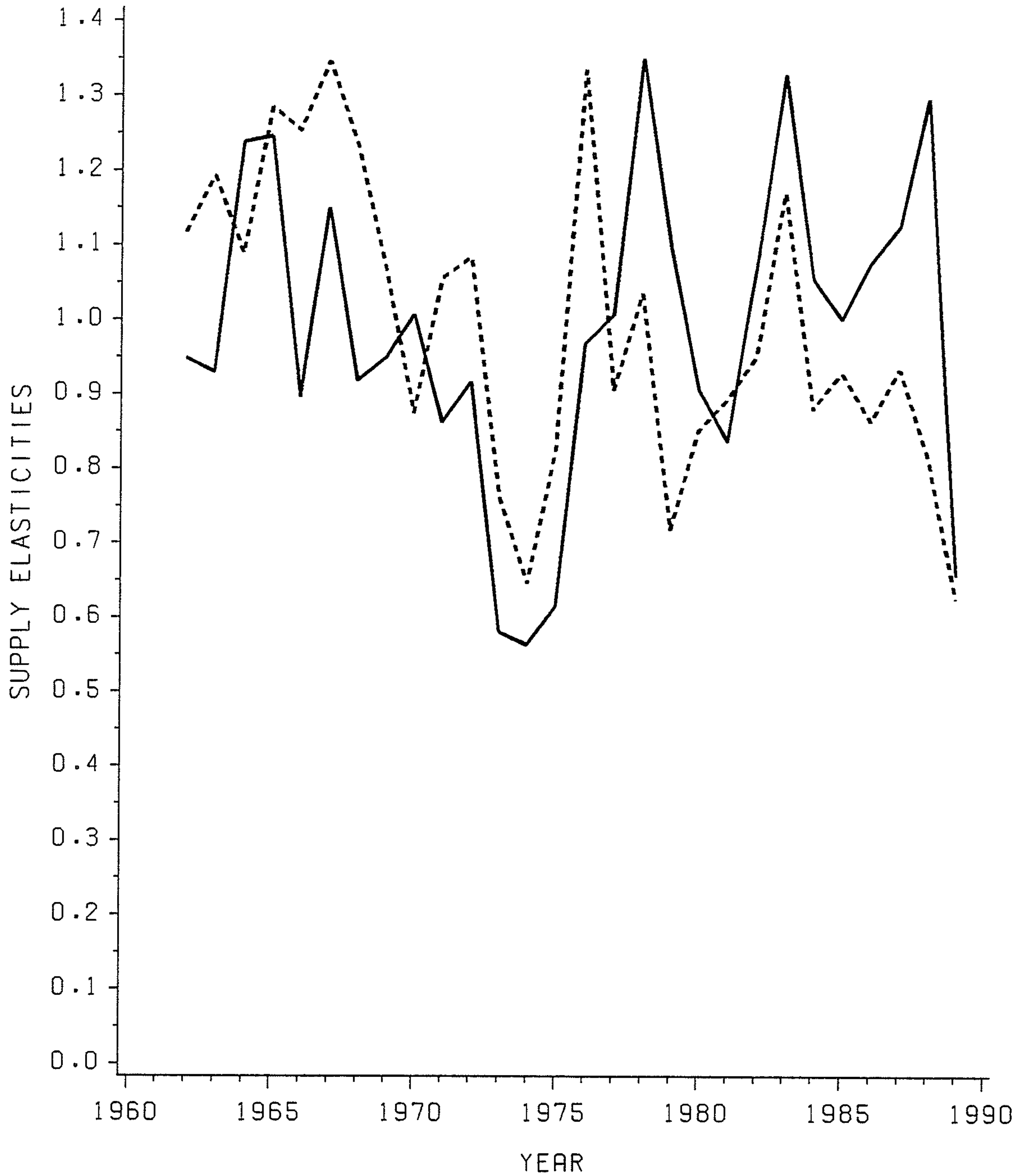
FIGURE 5.7
MANITOBA COMPARISON OF ANNUAL SHORT RUN SUPPLY ELASTICITIES FOR OILSEEDS (1962 TO 1988)



NOTE: ELASTICITIES ARE WITH RESPECT TO EXPECTED REVENUE

—— = CANOLA
– – = FLAXSEED

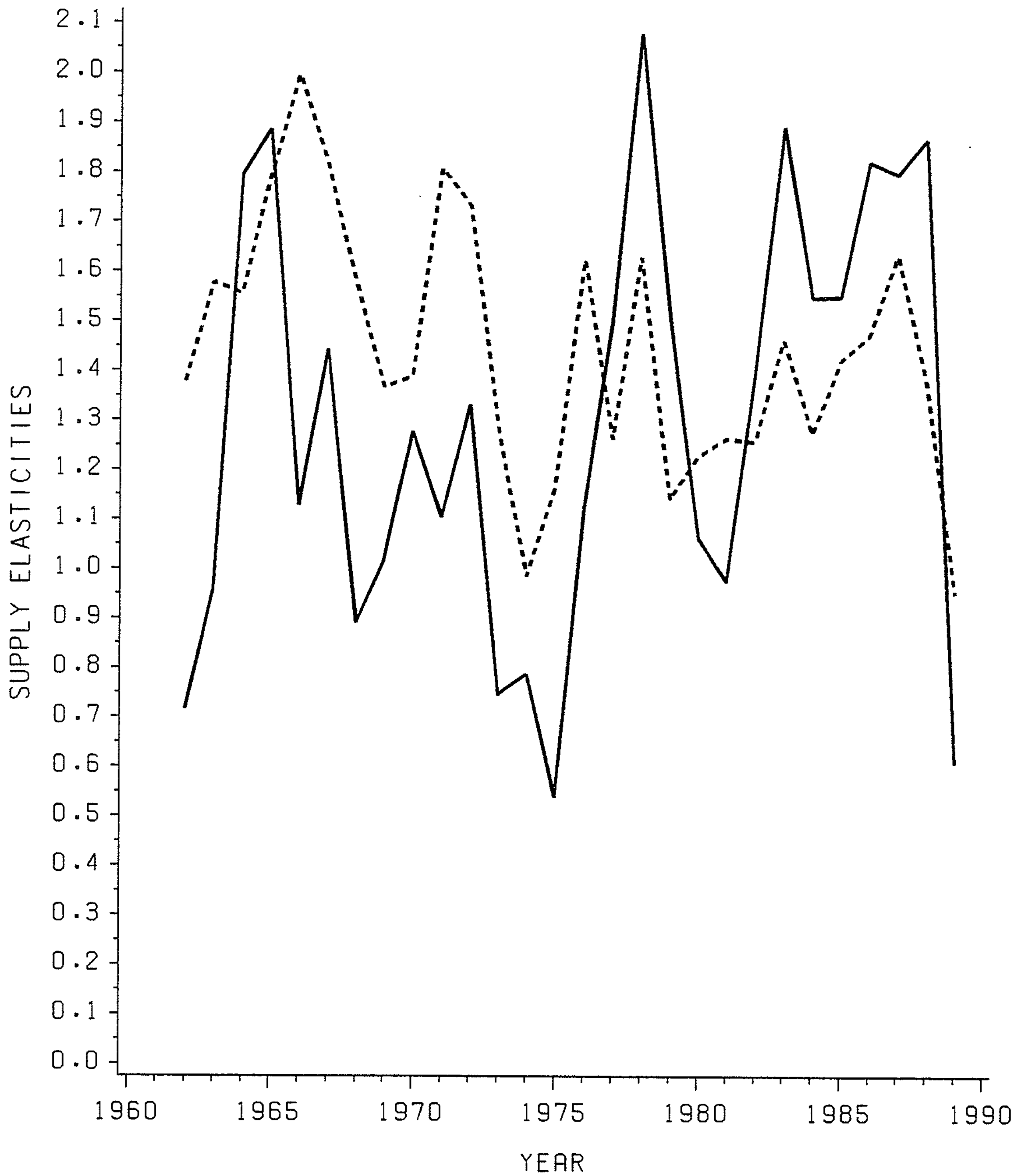
FIGURE 5.8
SASKATCHEWAN COMPARISON OF ANNUAL SHORT RUN SUPPLY ELASTICITIES FOR OILSEEDS (1962 TO 1989)



NOTE: ELASTICITIES ARE WITH RESPECT TO EXPECTED REVENUE

—— = CANOLA
– – = FLAXSEED

FIGURE 5.9
ALBERTA COMPARISON OF ANNUAL SHORT RUN SUPPLY ELASTICITIES FOR OILSEEDS (1962 TO 1988)



NOTE: ELASTICITIES ARE WITH RESPECT TO EXPECTED REVENUE

—— = CANOLA
— — = FLAXSEED

5.B.3 Acreage Forecasting and Simulation Results

Figure 5.10 through 5.25 summarizes the models forecasting ability. Since oats is the focus of this study, only oat acreage is discussed and it is left up to the reader to examine the other crops.

Three statistics were used to compare the forecasting ability of the oats models, turning point measures, Theil's U_1, and Theil's U_m statistic.

Where: A_t = the actual value of a variable in period t.
P_t = the predicted value of a variable in period t.
MSE = Mean Square Error.

$$U_1 = \frac{MSE}{A_t^2 / N} \tag{23}$$

Theil U^m statistic utilizes a portion of the MSE, where MSE equals

$$MSE = 1/N\,(P_t - A_t)^2 = 1/N \sum [(P_t - A_t)/(A_{t-1})]^2 \tag{24}$$

A further rearrangement of this equation yields

$$MSE = (P_t - A_t)^2 + S^2{}_{p-a} \tag{25}$$

where: $S^2{}_{p-a}$ = the variance of predicted errors.

The first term is interpreted as the bias in the forecast and the second the variance. Thus the statistic U_m becomes the bias component.

$$U_m = \frac{(A_t - P_t)^2}{MSE} \tag{26}$$

This statistic indicates the extent to which the magnitude of the MSE is the consequence of a tendency to estimate to high or too low a level of the forecast variable. If U_m is large, the average predicted change deviates significantly from the average actual change (Maddala,

1977. pp. 344-345).[9] This is a serious error as it should be reduced over time. It is recognized that as a result of using 3SLS, some bias is expected in the estimates because bias is a property of the estimator. A lower coefficient reflects increased performance of the model and thus is desired for all statistics. A 0 coefficient in Theil's U_1 constitutes a perfect forecast, and coefficients over 1 indicate a poor forecast. A 0 coefficient in Theil's U_m statistics reflects no bias in the estimate over time. The forecasting ability of the oats equations is given in table 5.9.

This summary shows mixed results. The number of turning points missed shows the Saskatchewan model as the best model and Alberta as the worst, although summary graphs show the turning points missed do not significantly decrease the overall forecasting ability of the models. Theil's U_1 shows Manitoba and Alberta as better forecasts than Saskatchewan. Theil's U_m statistic reveals little bias in the models with Saskatchewan having no bias.

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[9] It should be noted that the flaxseed graphs show poor forecasting performance and some divergence between actual and predicted acreage. This is because errors in both the acreage share estimates and the total acreage estimates appear in the flax equations because it is the residual in these models. Theil's U_m statistic for flax is as high as 0.352 in Manitoba. This indicates some bias in flaxseed forecasts.

Table 5.10

Forecasting Performance of Annual Oats Acreage Models in Western Canada from 1962 to 1989.

	Manitoba	Saskatchewan	Alberta
# of Total turning pts.	16	14	16
# of turning pts. missed	7	2	11
Theil's U_1	0.0694	0.1102	0.0808
Theil's U_m	0.075	0.000	0.002

Note: A correct turning point is when the model forecasts the same direction (up or down) of acreage movement from the previous year as actual acreage.

A steady decline in oats acreage in most periods is evident in all provinces. Lowe and Petrie attribute this to the historic uncompetitiveness of oats relative to other crops because of increased success in development of higher yielding barley varieties. Further, the prominent weed "Wild Oats" has also decreased oat acreage. Wild Oats can not be controlled in oats, but can be in other crops. Other practices such as summerfallowing have been traditionally used in conjunction with planting oats. Thus, as summerfallowing decreases so has oats acreage. The decline in oat acreage seems to hit a minimum level in the mid 1980's. This may be partially explained by the nature of oats demand. A portion of the demand by the milling industry, and horse feed industry has no suitable substitute. Further, demand for dairy rations is also very stable. This minimum level is about .425 million acres in Manitoba, .8 million acres in Saskatchewan, and 1.2 million acres in Alberta.

Forecasts for 1989 show increased oats acreage in each province. This is caused by increased oat prices relative to other cereals. Manitoba acreage is forecasted at 577,712 acres, up 128,000 acres, Saskatchewan at 1.122 million acres, up 260,000 acres, and Alberta at 1.555 million acres, up 100,000 acres. These acres are compared to Statistics Canada's March survey of producer intentions. Manitoba at 600,000 acres, Saskatchewan at 1.3 million acres and Alberta at 2 million acres. All provincial forecasts are less than those predicted by Statistics Canada in their March Intentions of Field Crops report, but the turning points are correct.

FIGURE 5.10
MANITOBA ACTUAL AND SIMULATED WHEAT ACREAGE (1962 TO 1989)

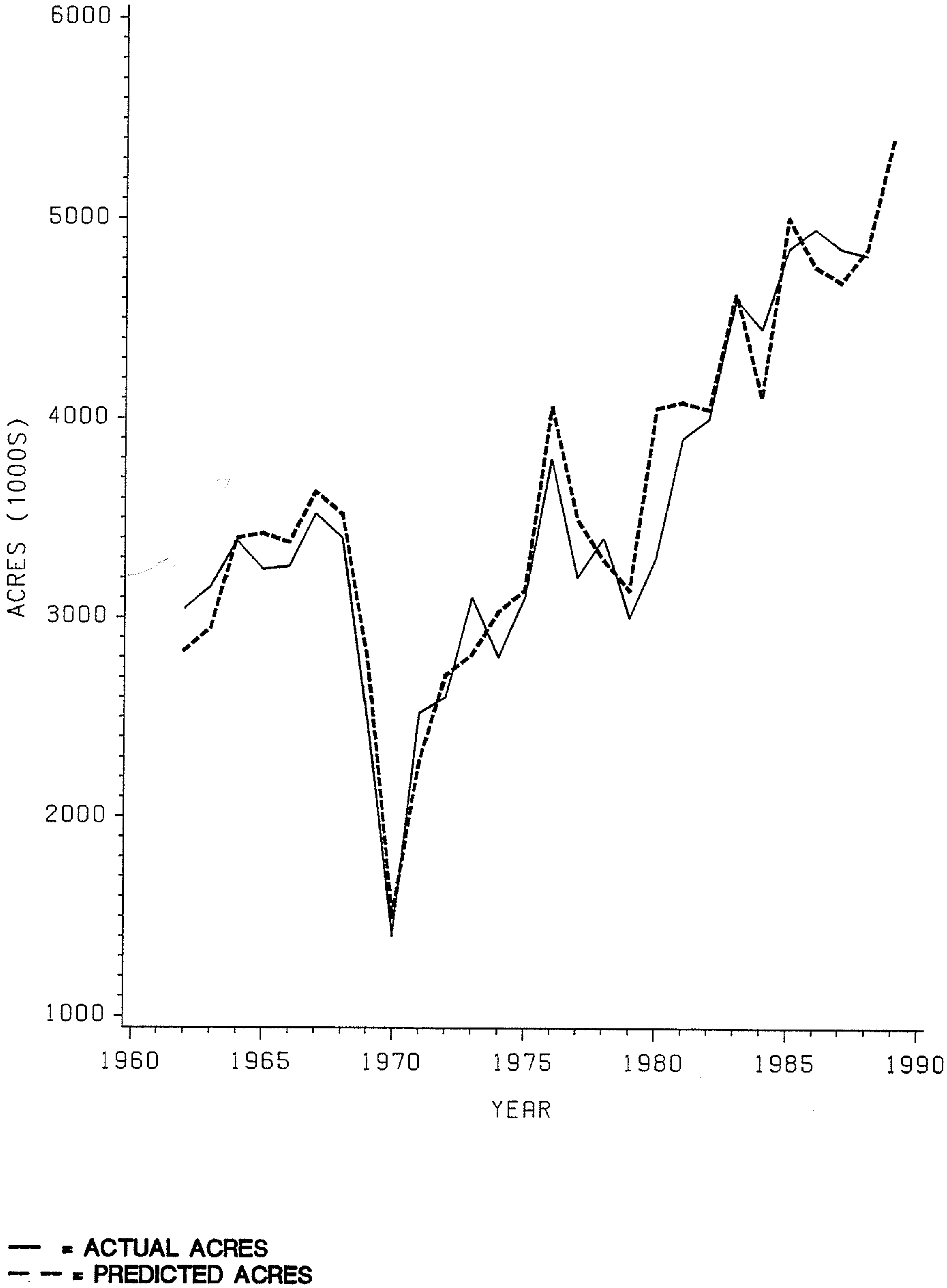
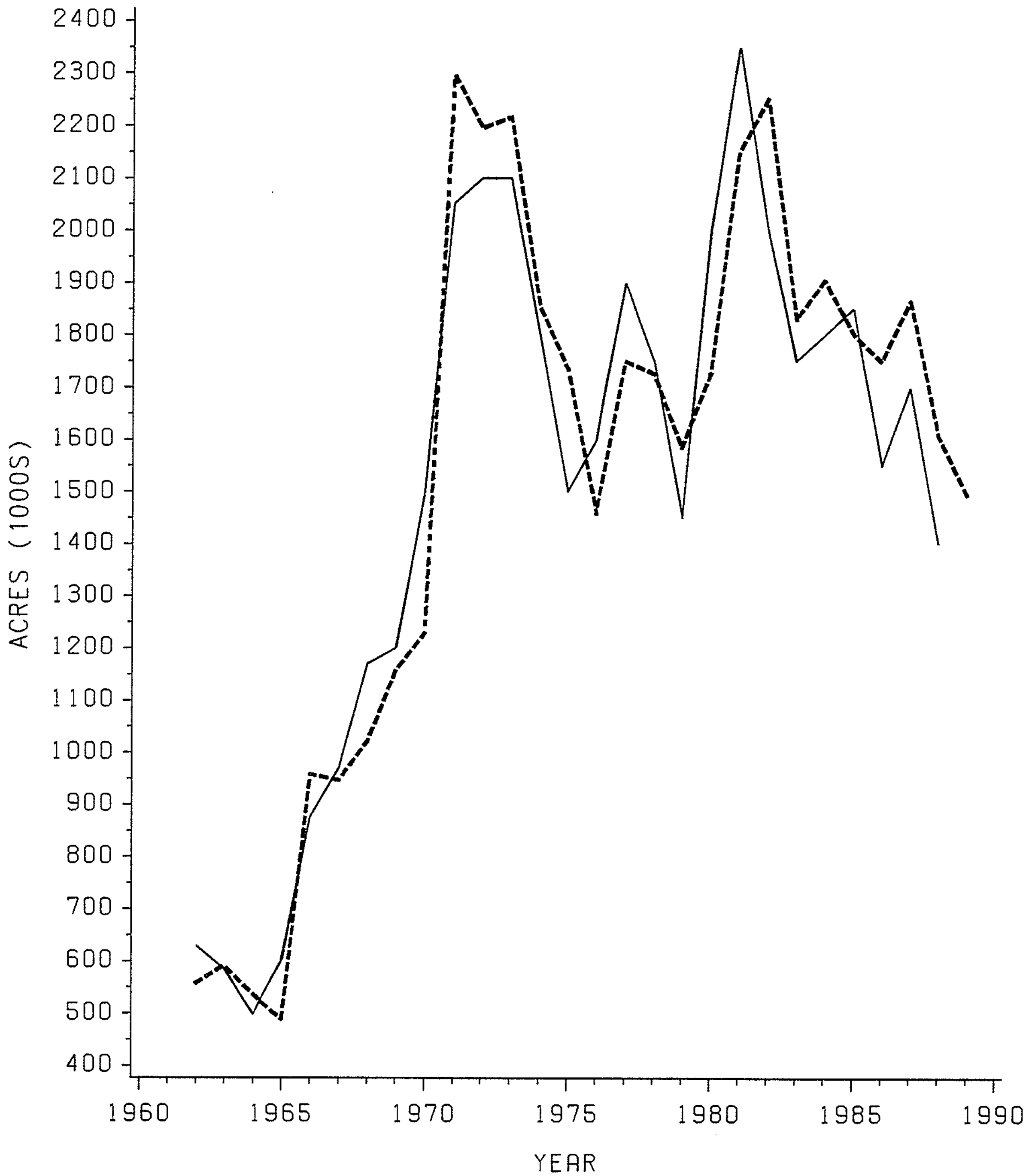


FIGURE 5.11
MANITOBA ACTUAL AND SIMULATED BARLEY ACREAGE (1962 TO 1989)



— = ACTUAL ACRES
– – = PREDICTED ACRES

FIGURE 5.12
MANITOBA ACTUAL AND SIMULATED OATS ACREAGE (1962 TO 1989)

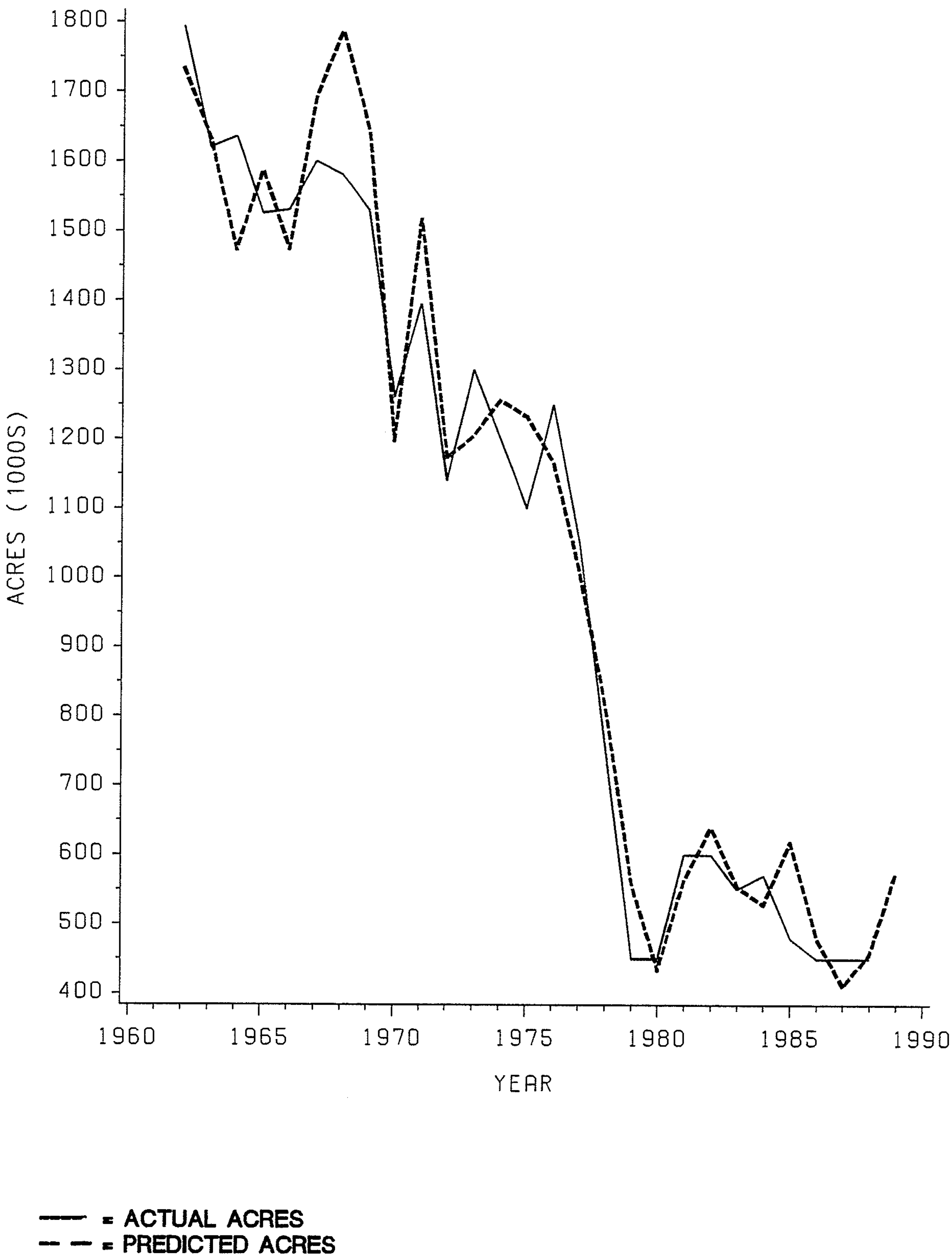
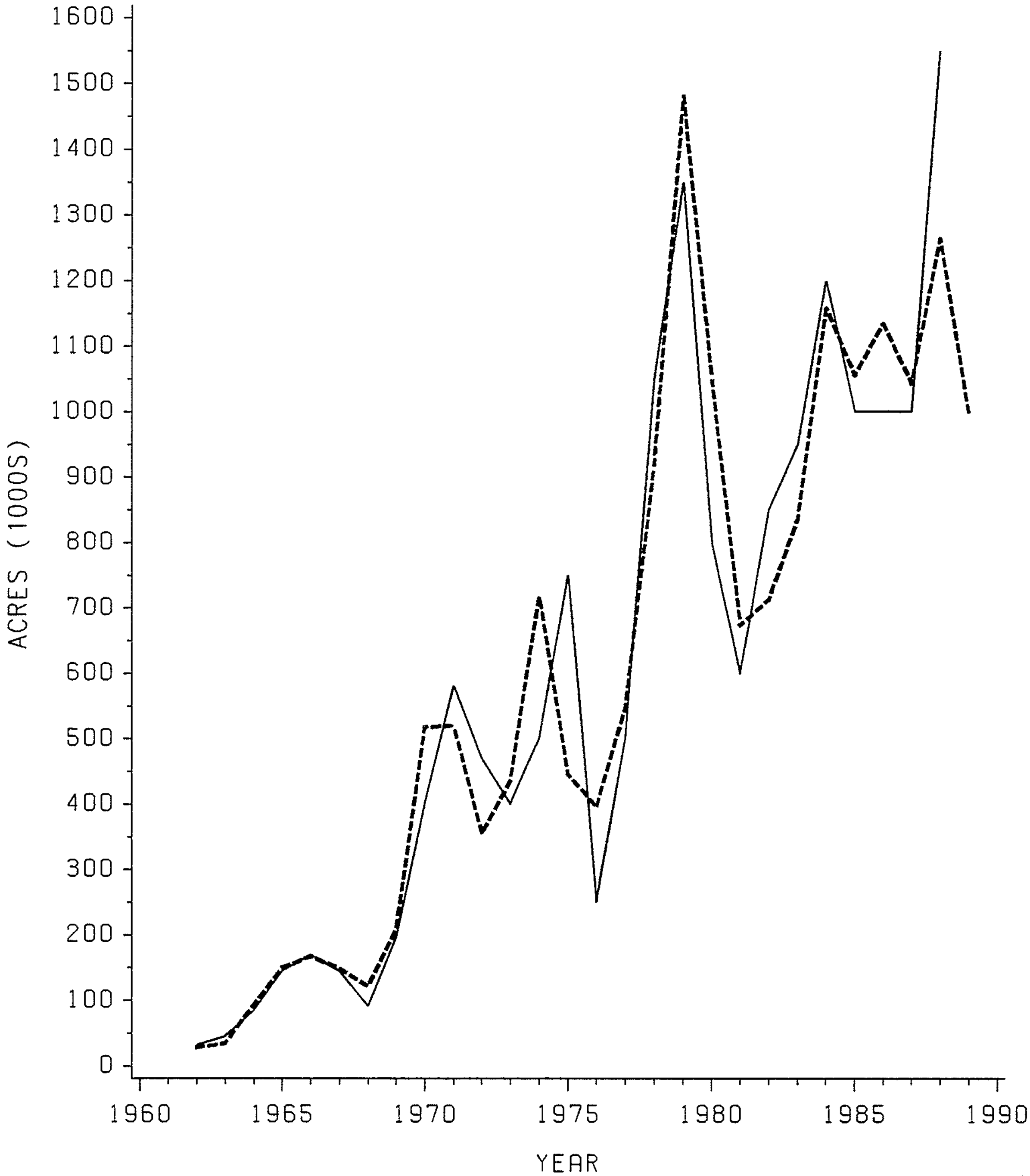
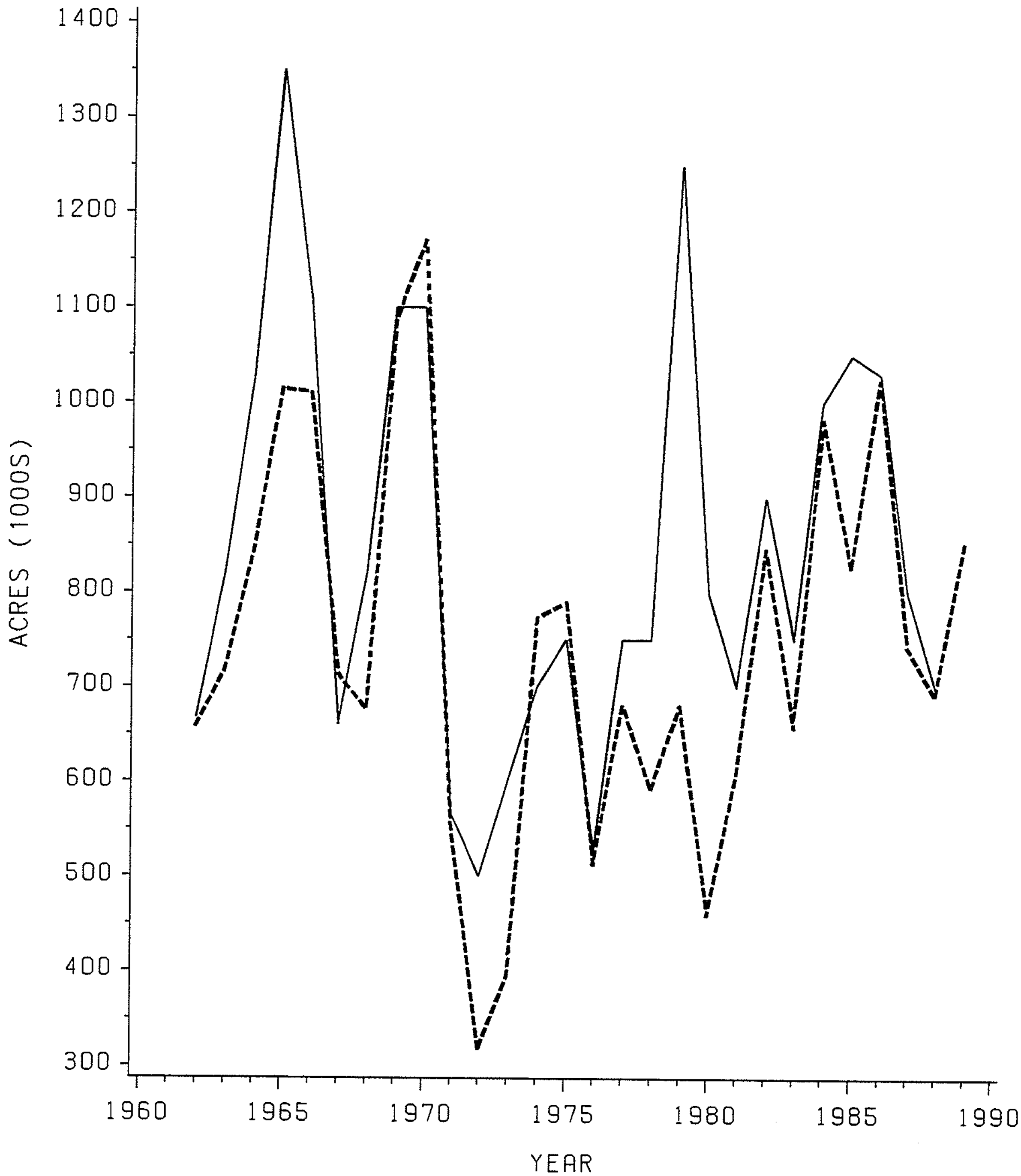


FIGURE 5.13
MANITOBA ACTUAL AND SIMUALTED CANOLA ACREAGE (1962 TO 1989)



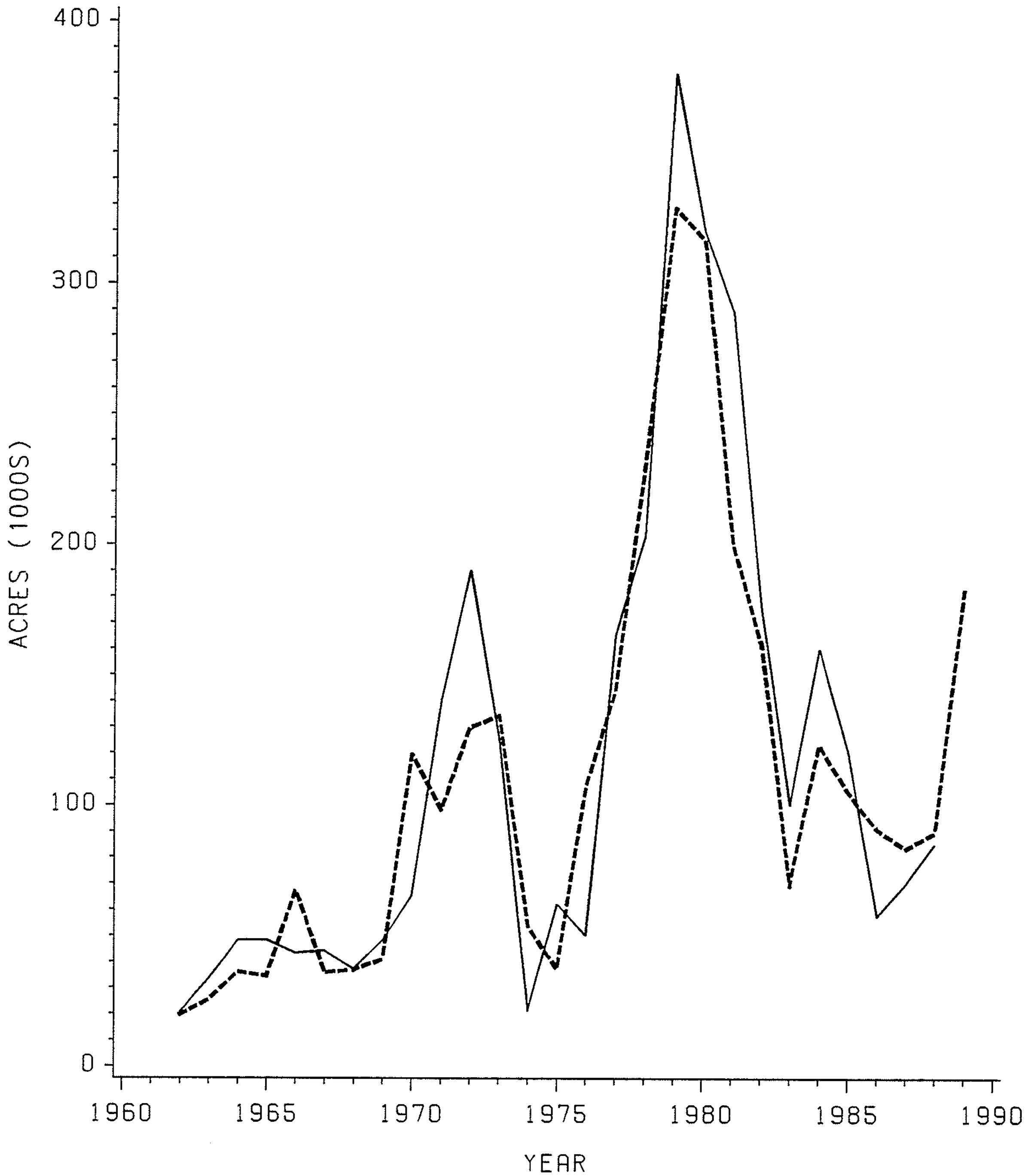
——— = ACTUAL ACRES
— — = PREDICTED ACRES

FIGURE 5.14
MANITOBA ACTUAL AND SIMULATED FLAXSEED ACREAGE (1962 TO 1989)



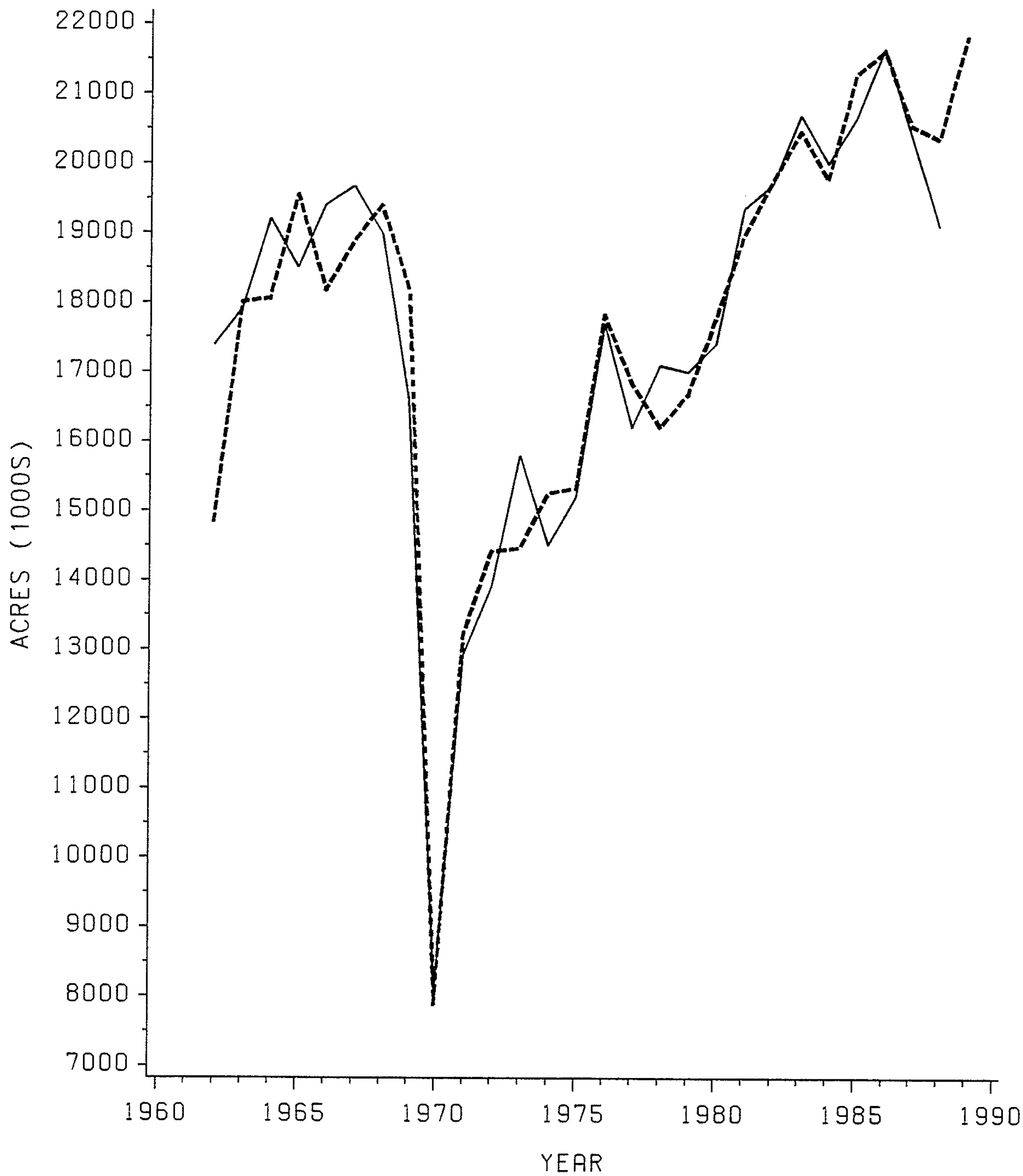
—— = ACTUAL ACRES
– – = PREDICTED ACRES

FIGURE 5.15
MANITOBA ACTUAL AND SIMUALTED SUNFOWER ACREAGE (1962 TO 1989)



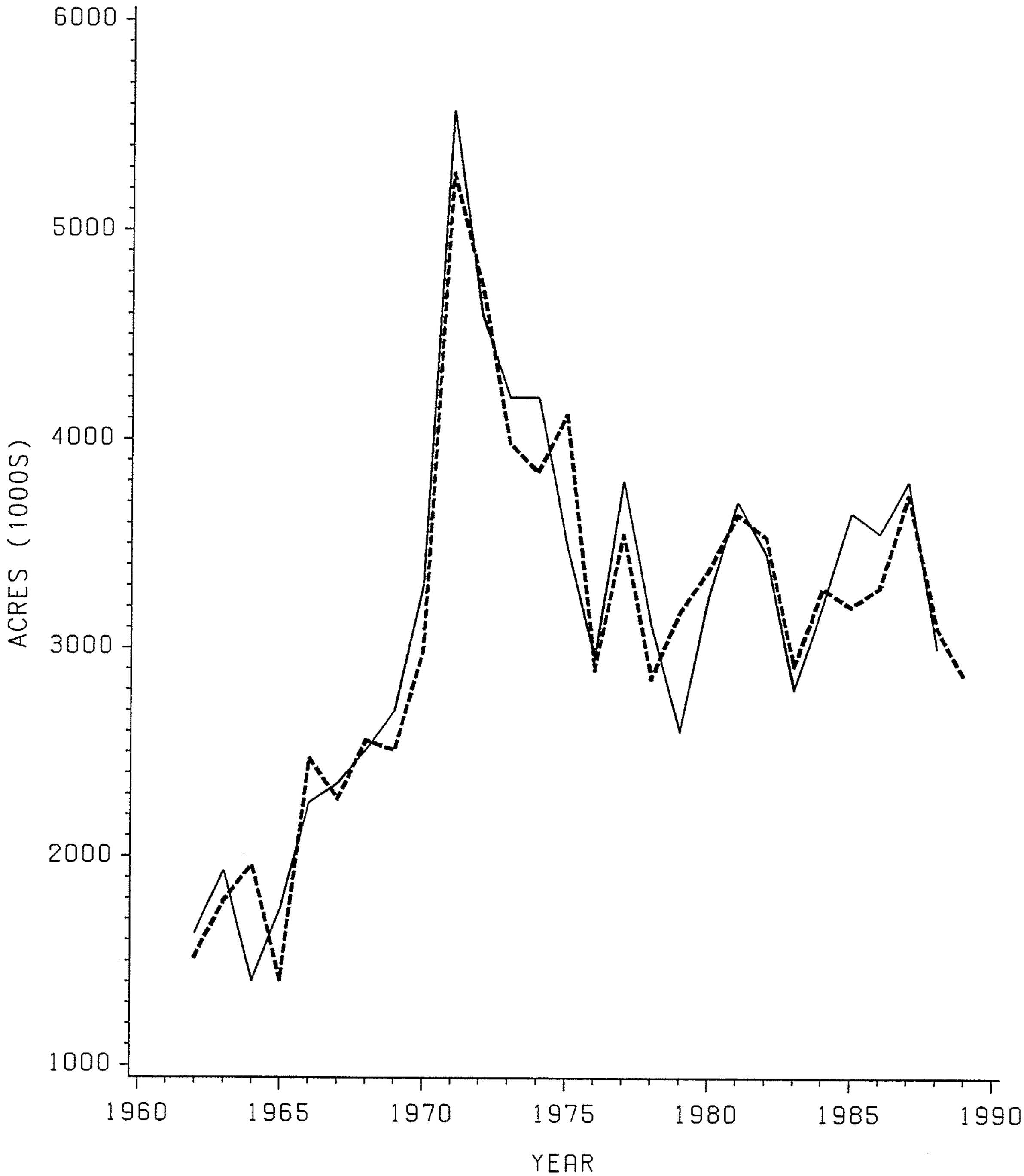
—— = ACTUAL ACRES
— — = PREDICTED ACRES

FIGURE 5.16
SASKACTEWAN ACTUAL AND SIMULATED
WHEAT ACREAGE (1962 TO 1989)



—— = ACTUAL ACRES
– – = PREDICTED ACRES

FIGURE 5.17
SASKATCHEWAN ACTUAL AND SIMULATED BARLEY ACREAGE (1962 TO 1989)



—— = ACTUAL ACRES
— — = PREDICTED ACRES

FIGURE 5.18
SASKATCHEWAN ACTUAL AND SIMULATED OATS ACREAGE (1962 TO 1989)

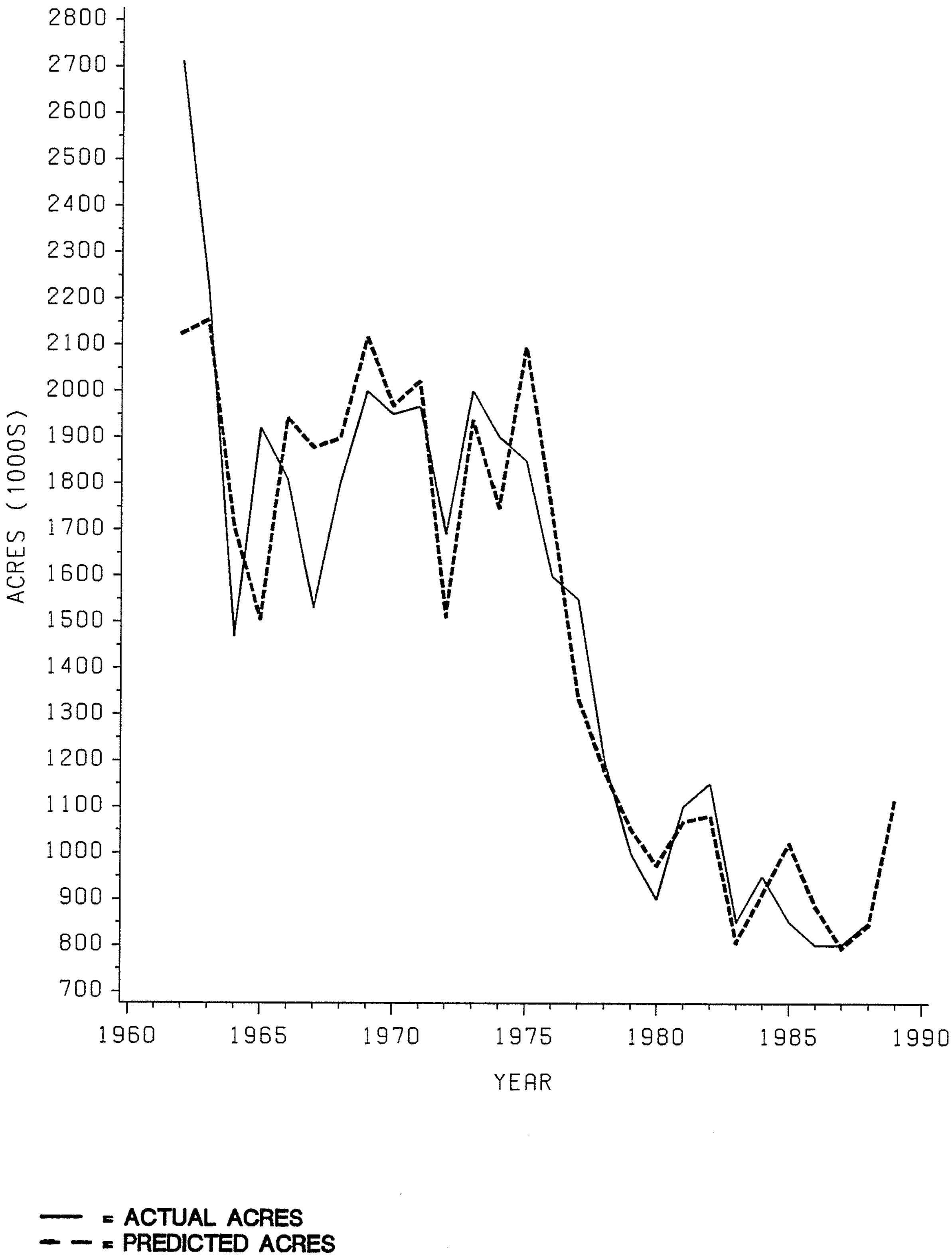


FIGURE 5.19
SASKATCHEWAN ACTUAL AND SIMULATED CANOLA ACREAGE (1962 TO 1989)

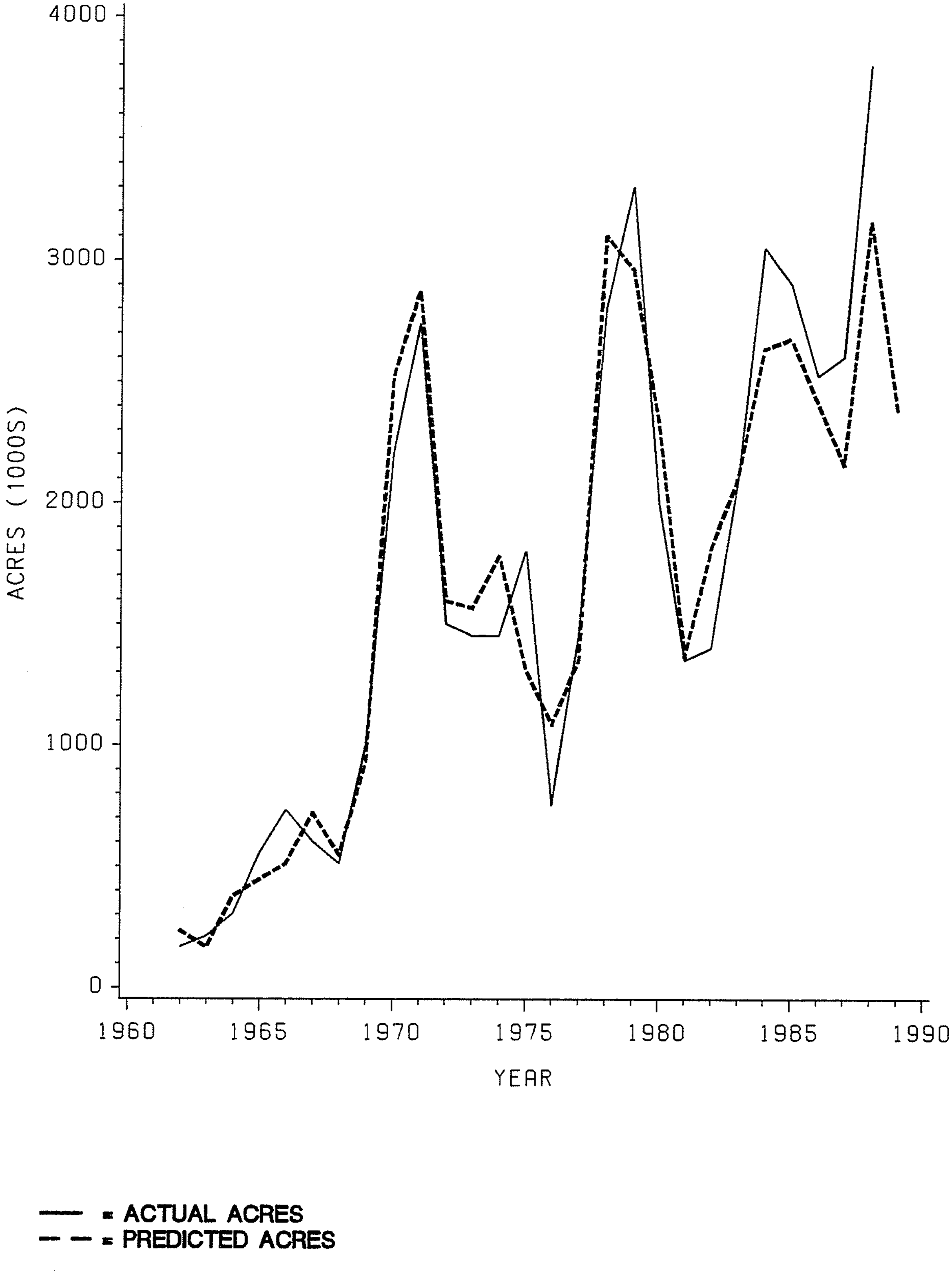
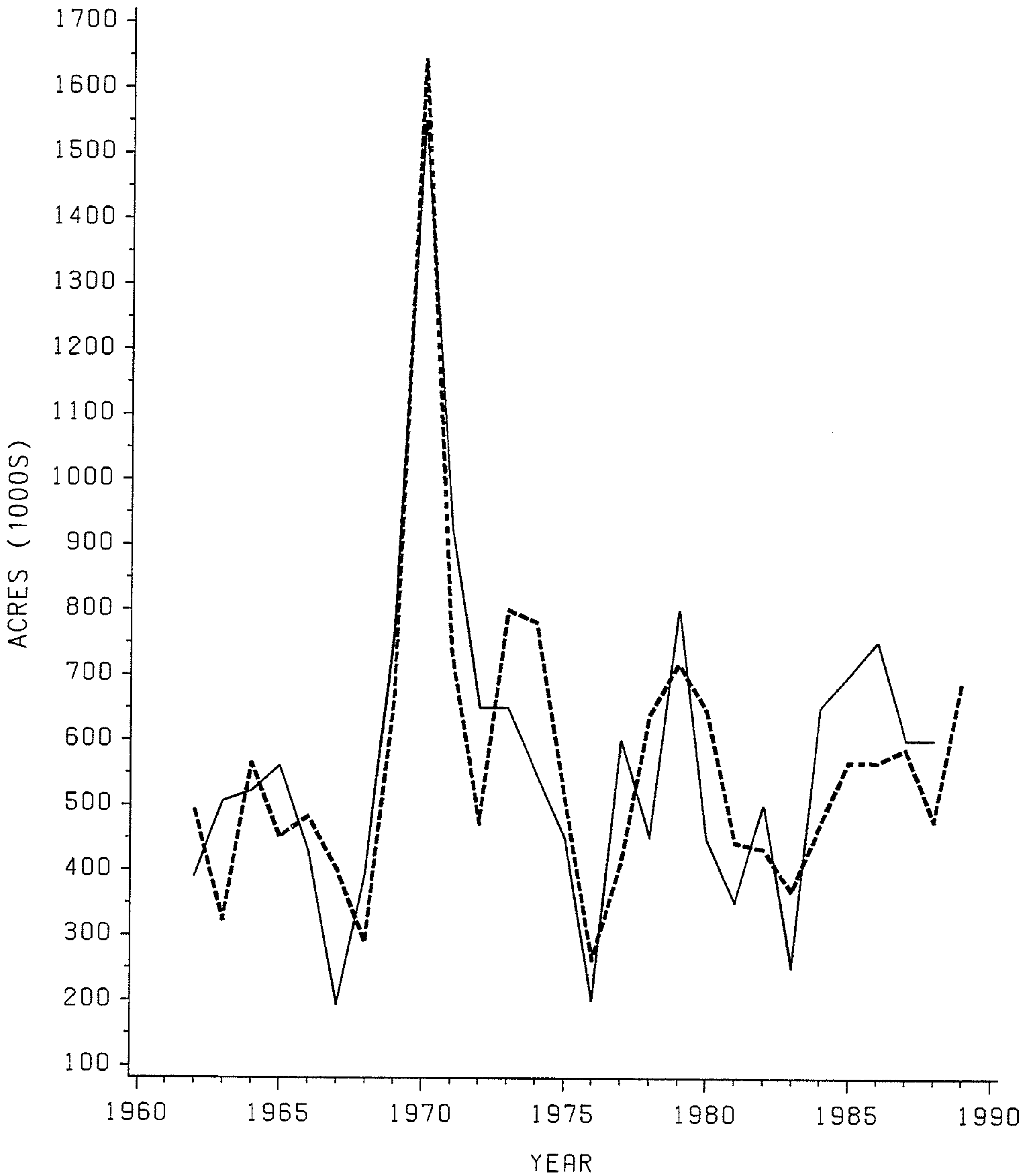
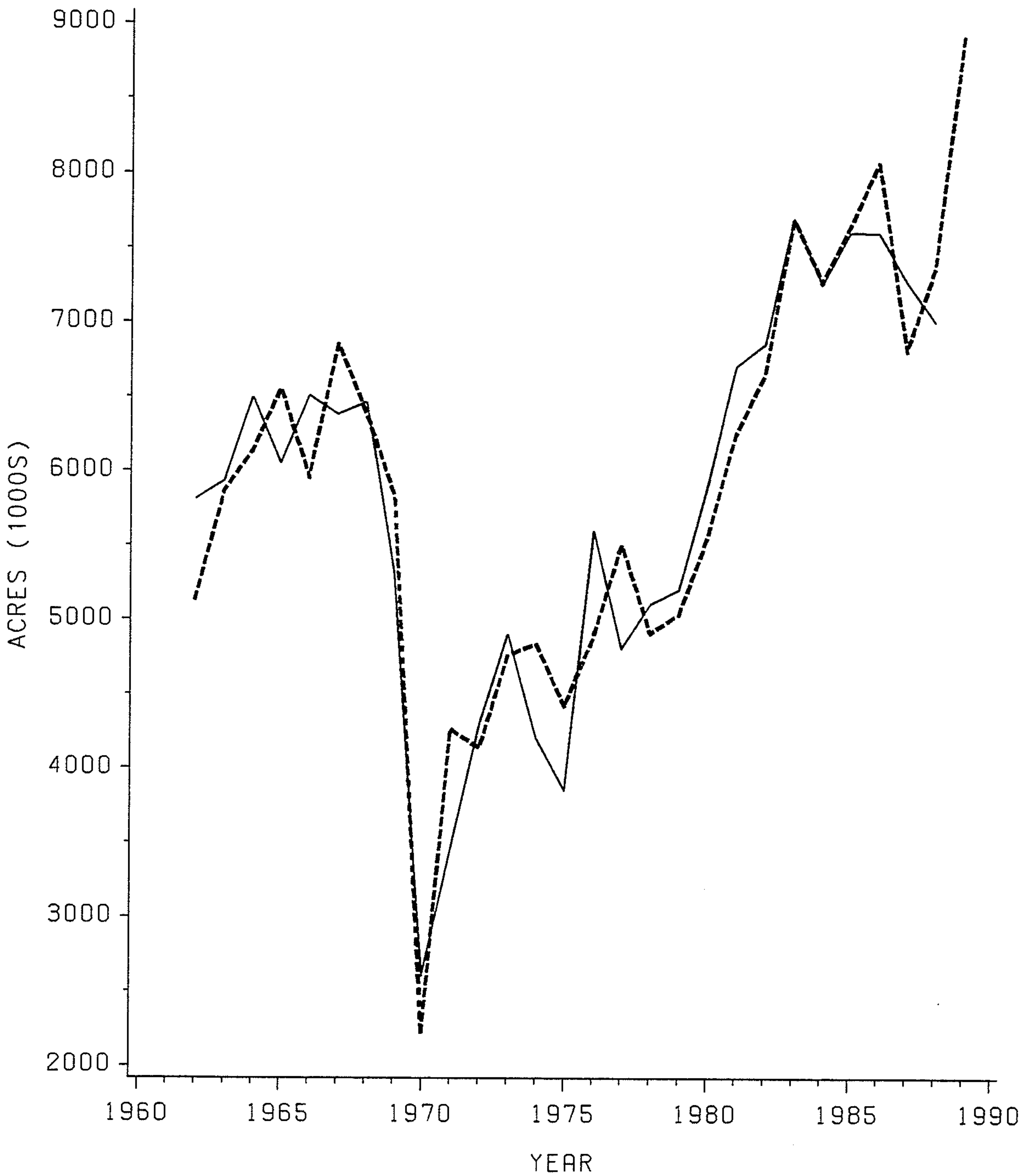


FIGURE 5.20
SASKATCHEWAN ACTUAL AND SIMULATED FLAXSEED ACREAGE (1962 TO 1989)



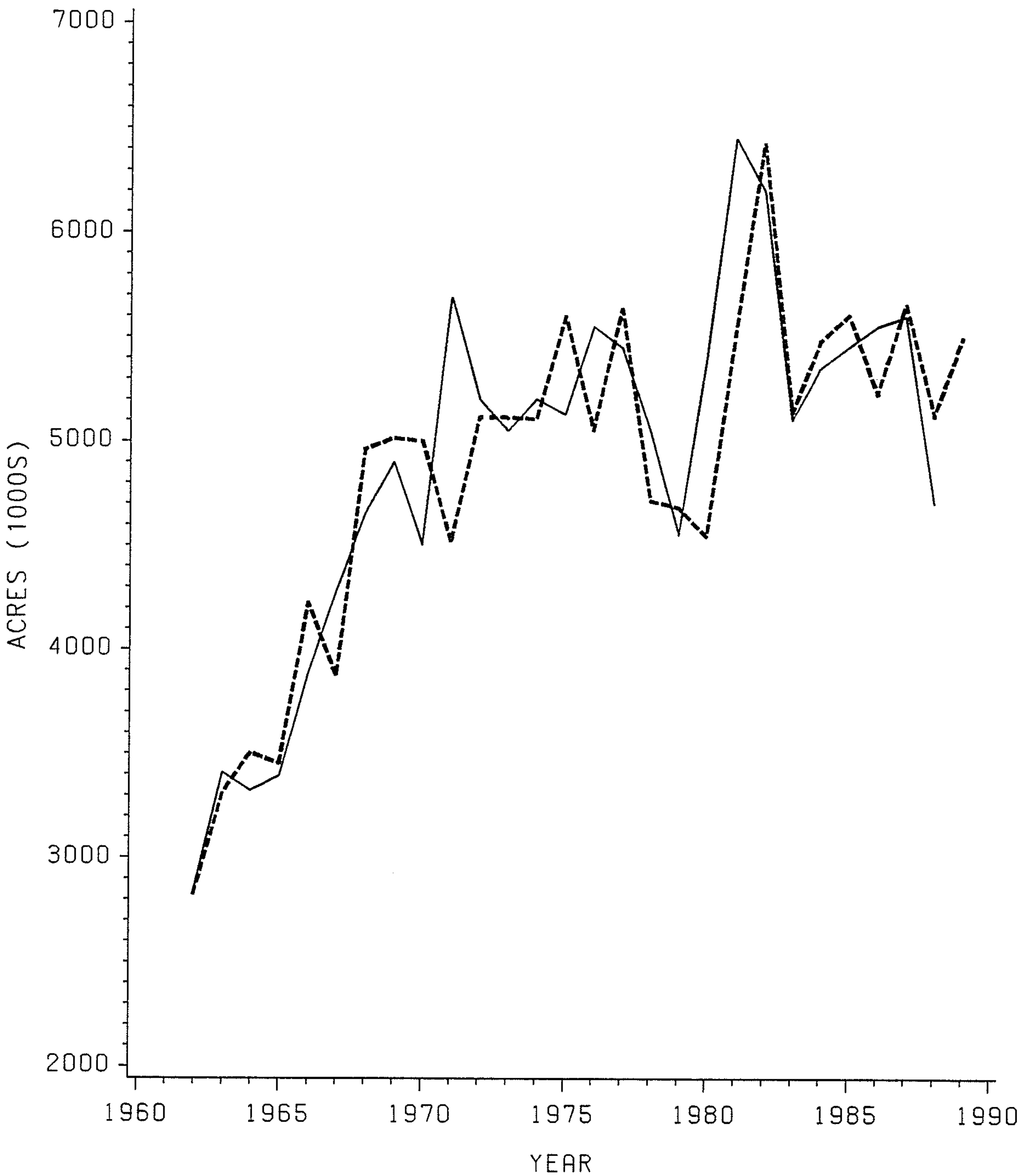
—— = ACTUAL ACRES
– – = PREDICTED ACRES

FIGURE 5.21
ALBERTA ACTUAL AND SIMULATED WHEAT ACREAGE (1962 TO 1989)



— = ACTUAL ACRES
– – = PREDICTED ACRES

FIGURE 5.22
ALBERTA ACTUAL AND SIMULATED BARLEY ACREAGE (1962 TO 1989)



—— = ACTUAL ACRES
– – = PREDICTED ACRES

FIGURE 5.23
ALBERTA ACTUAL AND SIMULATED OATS ACREAGE (1962 TO 1989)

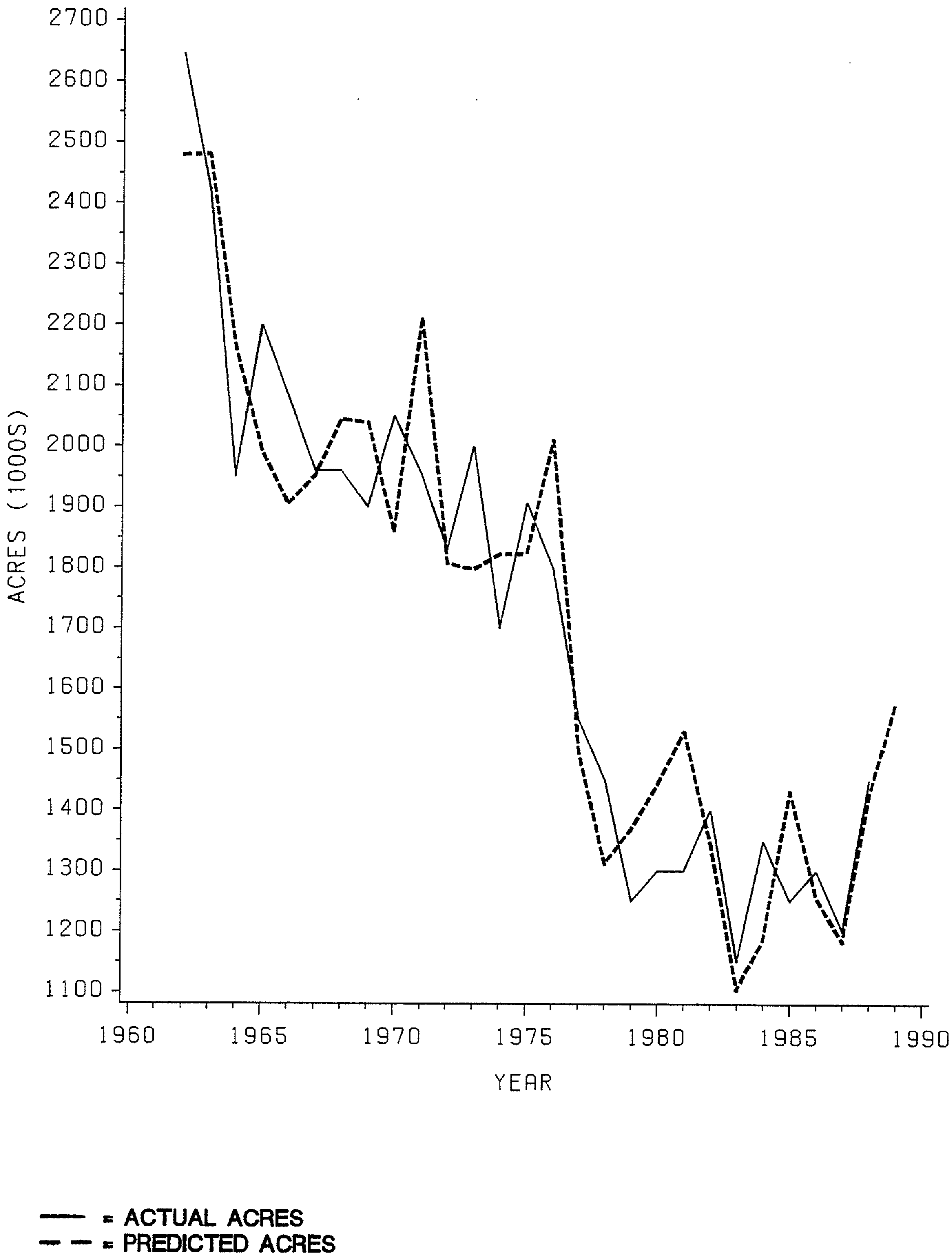


FIGURE 5.24
ALBERTA ACTUAL AND SIMULATED
CANOLA ACREAGE (1962 TO 1989)

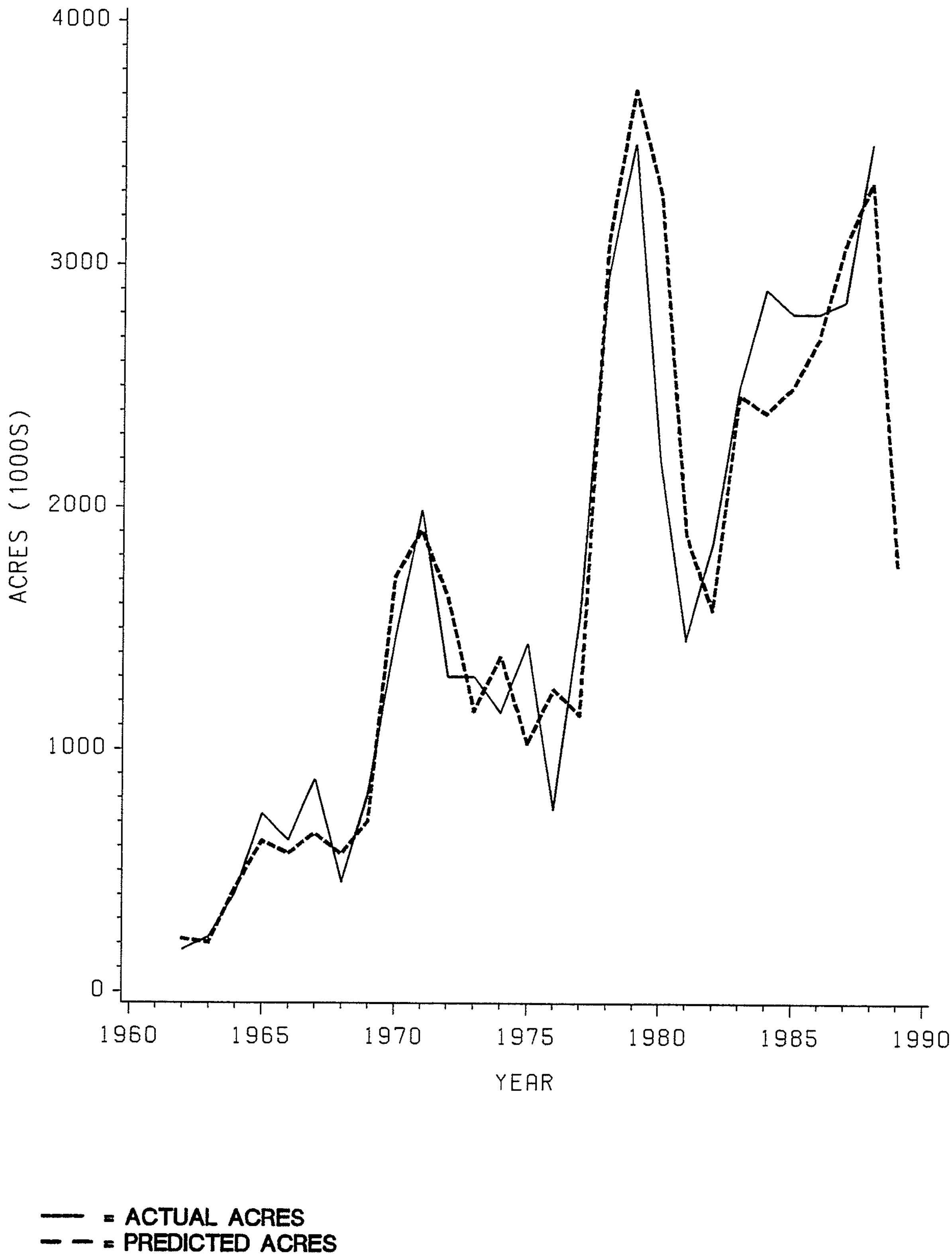
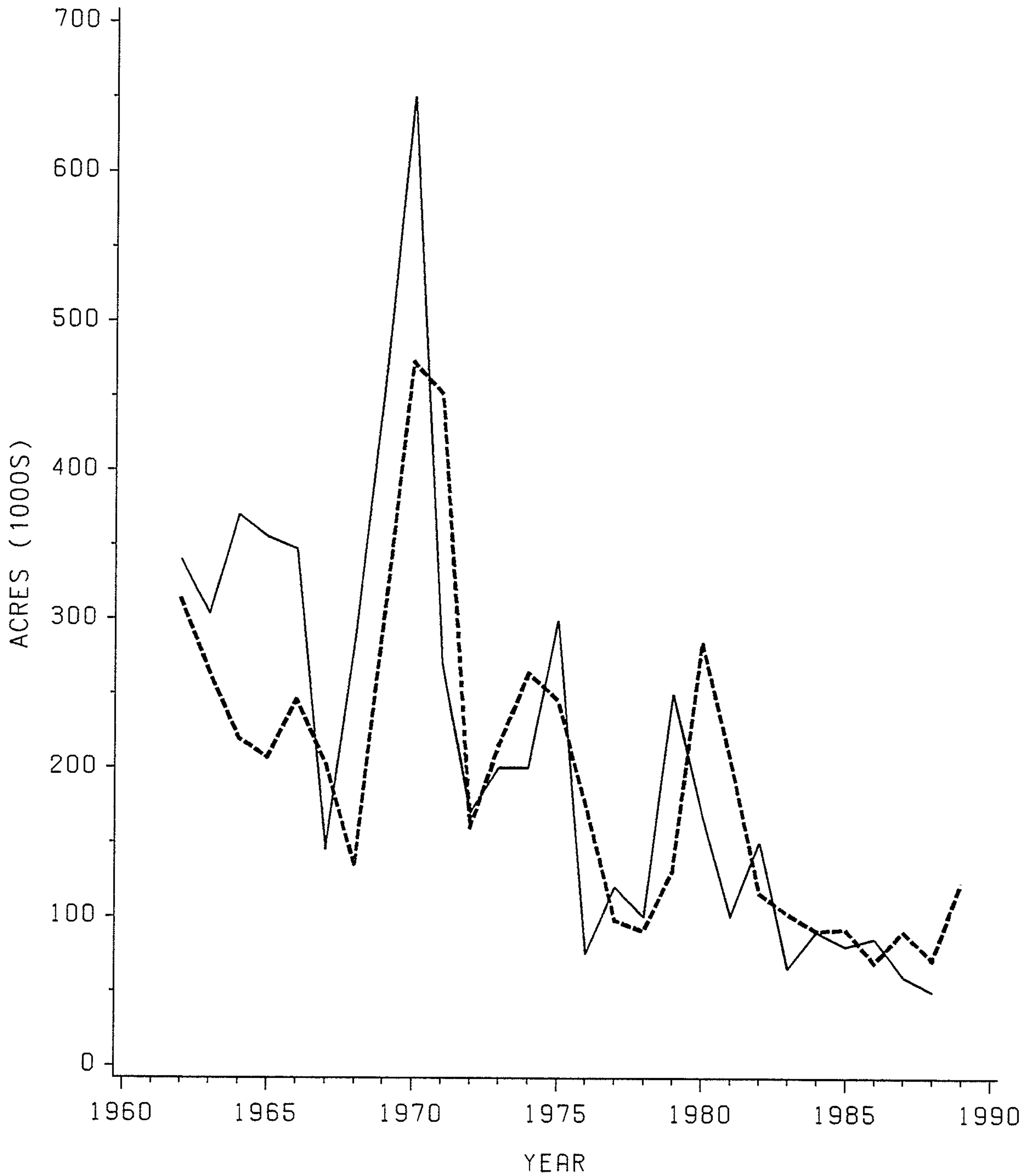


FIGURE 5.25

ALBERTA ACTUAL AND SIMULATED FLAXSEED ACREAGE (1962 TO 1989)



—— = ACTUAL ACRES
– – = PREDICTED ACRES

5.B.4 1995 Oats Acreage Forecast

The supply response model is used to project oat acreage to the year 1995. Since this model uses relative revenues as explanatory variables, only price, yield and inventory relationships need to be forecasted, not actual variable levels. Average prices, yields and inventories of the 1980's are used, with prices equal to: Wheat $4.77, Barley $2.47, Oats $1.82, Canola $7.37, Flaxseed $8.16, and Sunflowers $3.33 per bushel. Total cultivated acreage for each province is increased by increments, as expected in the future. The total cultivated acreage of each province into 1995 is estimated without the use of the total landbase model. The total landbase model is a linear model which is excellent for short run forecasts, but would project increasing total cultivated acreage for each province to 1995. However, total cultivated acreage has a limit in each province, and thus estimates are made keeping in mind the available levels of total cropland. Manitoba total cultivated acreage is increased from 9.5 million acres in 1989 to 9.6 million acres for all remaining years. Saskatchewan total cultivated acreage is increased .2 million acres each year from 28.9 million acres in 1989 to 30 million acres in 1995. Alberta total cultivated acreage is increased 50,000 acres each year from 17.6 million acres in 1989 to 17.95 million acres in 1995.[10]

A summary of results is given in figures 5.23 to 5.25. These results show that Manitoba acreage would increase from about 577,000 acres in

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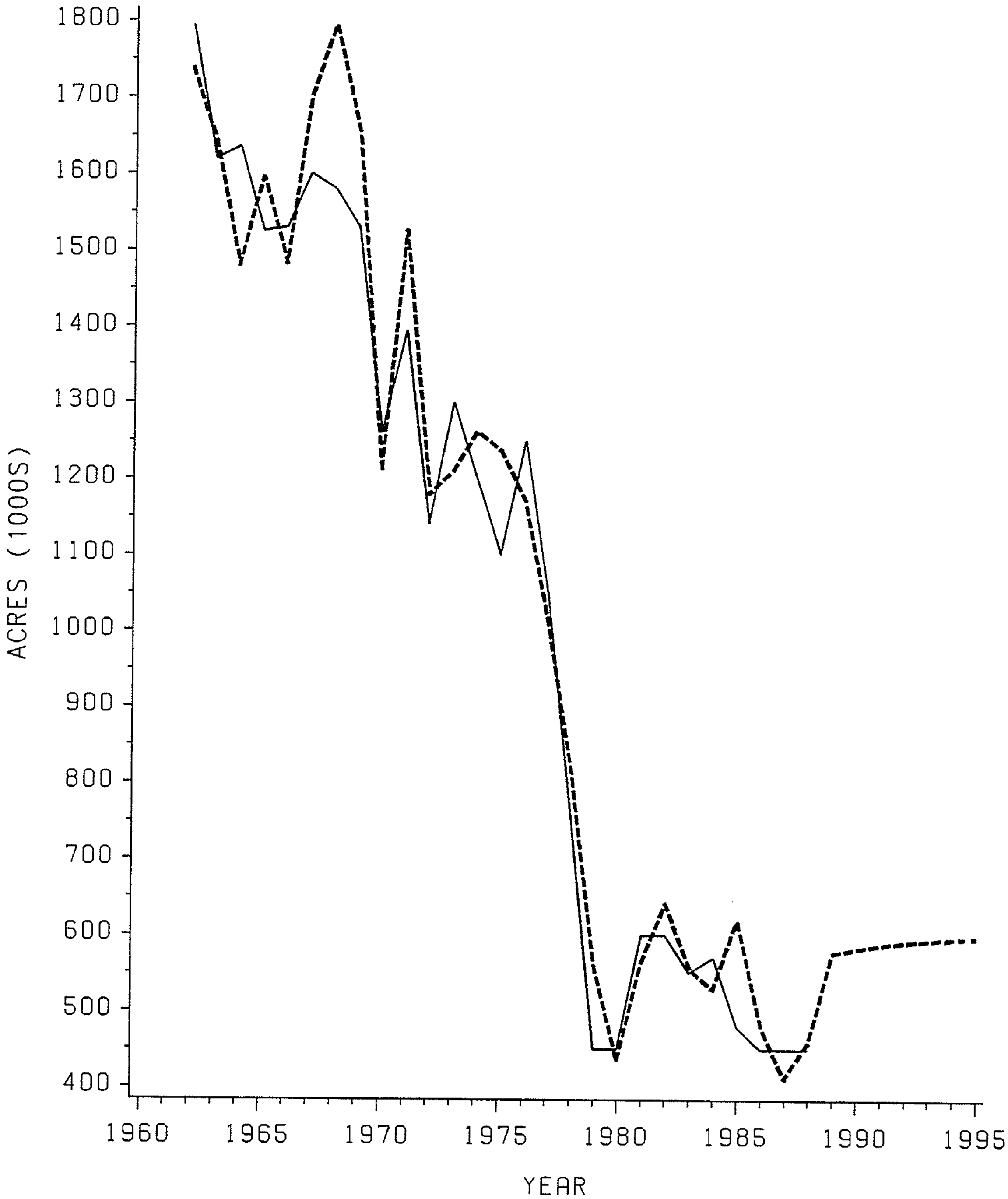
[10] This scenario was run maintaining total cultivated acreage at the 1989 levels for each province to analyze if the increased oats acreage was the result of more acreage coming into the model or other acreage decreasing. The results showed that the increase in oats acreage in Alberta was largely the result of a decrease in the acreage of other crops and not solely due to increases in the total acreage forecast.

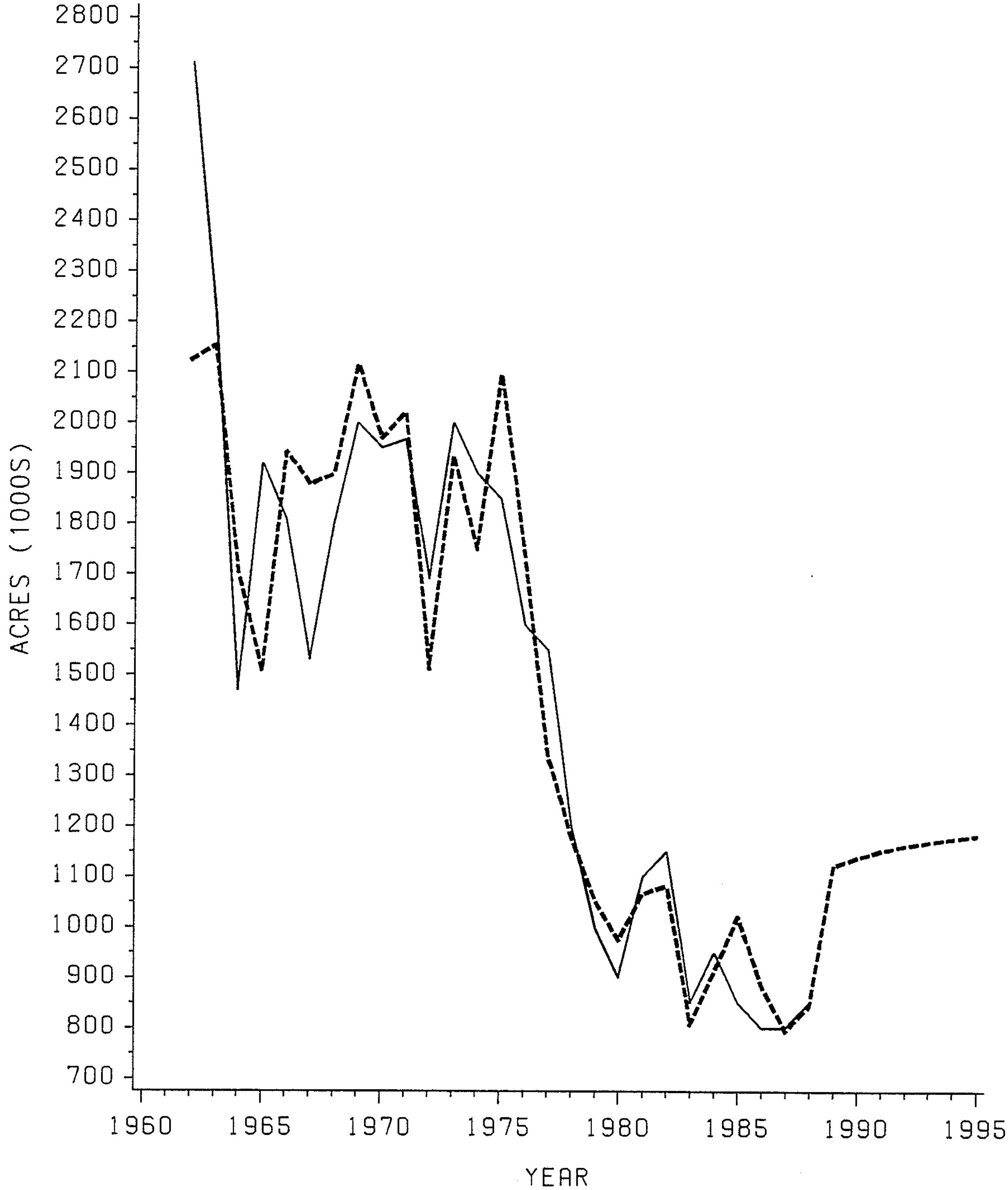
1989 to about 600,000 acres in 1995, or only about a 4% increase. Saskatchewan acreage would increase from 1.12 million acres in 1989 to about 1.18 million acres in 1995, an increase of about 5%. Alberta acreage shows a large increase as oats acreage climb from 1.5 million acres in 1989 to 1.9 million acres in 1995, an increase of 27%. Clearly, the potential for increased oats production is in Alberta. Short run supply elasticities were calculated for oats at average levels of prices, yields, and inventories. The average Manitoba short run supply elasticity with respect to expected revenue was .43, Saskatchewan .57, and Alberta .60. This further reinforcing earlier supply elasticity and parameter estimation results.

FIGURE 5.26
MANITOBA ACTUAL AND SIMULATED ANNUAL OATS ACREAGE (1962 TO 1995)



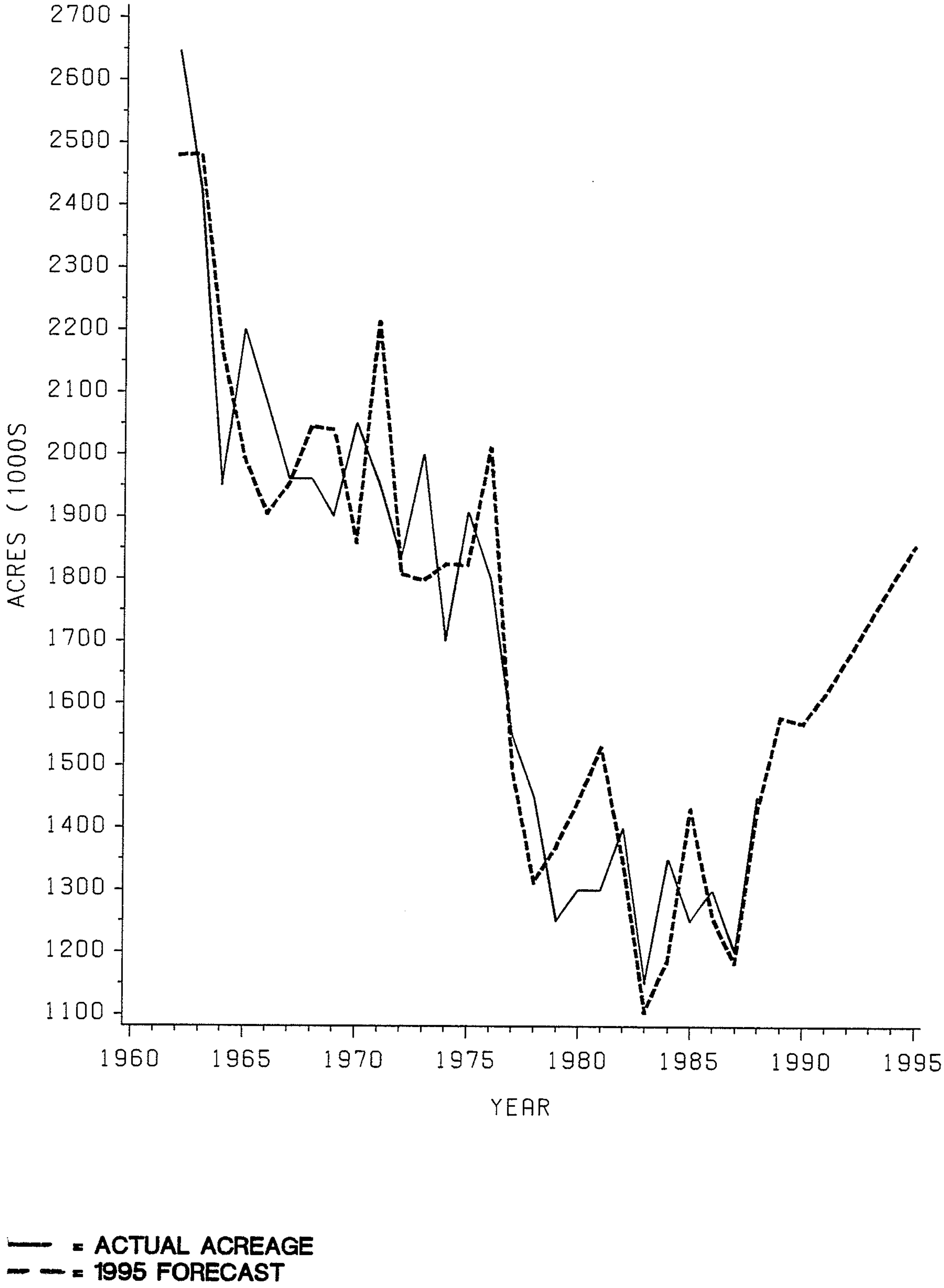
—— = ACTUAL ACREAGE
– – = 1995 FORECAST

FIGURE 5.27
SASKATCHEWAN ACTUAL AND SIMULATED ANNUAL OATS ACREAGE (1962 TO 1995)



—— = ACTUAL AGREAGE
– – = 1995 FORECAST

FIGURE 5.28
ALBERTA ACTUAL AND SIMULATED ANNUAL OATS ACREAGE (1962 TO 1995)



PART 2: EFFICIENCY ANALYSIS OF THE WINNIPEG COMMODITY EXCHANGE OATS FUTURES CONTRACT

This section will analyze the efficiency of Winnipeg Commodity Exchange oats futures contract. Pricing efficiency is evaluated using causality models. Hedging effectiveness for Canadian cash feed oats and Minneapolis #1 Heavy cash oats is evaluated using Ordinary Least Squares (OLS) regression analysis against both Winnipeg and Chicago hedging instruments. Given that a large part of Canadian exports are into the Minneapolis milling market, Minneapolis #1 Heavy cash oats is used as a proxy for Canada Western grade oats (a food grade). Thus, this section evaluates the Winnipeg Commodity Exchange oat futures contract in it's ability to reduce price risk for holders of both cash feed and food grade oats.

CHAPTER VI

REVIEW OF PRICING EFFICIENCY RELATED MATERIAL

6.1 Carter

Carter evaluates the pricing efficiency of the off-Board market for wheat, barley and oats for the period 1977 to 1981. A weak form analysis, an information set utilizing only past price information, is used to conclude that the Winnipeg Commodity Exchange (WCE) feed grain pricing (wheat, barley and oats) is efficient in the weak form and is thus adequate in it's ability to reflect domestic price information.

Classified as a semi-strong efficiency test, a cross correlation analysis of WCE barley and Chicago corn market was performed. A semi-strong efficiency test includes past prices and all relevant public information in the information set. Thus, in this sense the U.S. corn market is considered a world market which reflects all public information. In some periods a lead lag relationship between these markets is established and reasoned to be caused by a lack of arbitrage between these markets. Thus, it is concluded that the Winnipeg Commodity Exchange feed grain market was at times inefficient in its ability to reflect world prices.

6.2 Gilmour and Fawcett

Gilmour and Fawcett examine the relationship between Canadian and U.S. wheat prices using weekly data. This study focuses on the institutional constraints in the formulation of a price information model.

No robust price information model was found, but a lead-lag relationship from U.S. to Canadian wheat was found in varying periods. They conclude that transportation, storage, and transaction costs isolate the Canadian domestic feed grain market from international events to some extent. Further, the institutional pricing of Canadian wheat serves to isolate and distort linkages between U.S. and Canadian markets.

6.3 Spriggs, Kaylen and Bessler

Spriggs, Kaylen and Bessler did a similar study, but used daily data. They argue that with modern information flow, a lead-lag relationship would certainly be less than a week. U.S. prices are found to lead Canadian wheat prices over the period 1974 to 1976. Prior to 1972 no significant relationship was found. This was attributed to the effectiveness of the U.S. export subsidy program. After 1972, prices were found to be at least instantaneously discovered.

6.4 Bessler and King

Bessler and King state that in theory markets will be related by arbitrage through transportation of commodities from market to market. If markets respond instantaneously to new pricing information, they are considered efficient. This implies these markets are part of a single competitive market.

In the domestic market, oats trades in competition with barley, corn and wheat mainly in dairy rations, although some on farm feeding exists by feedlot owners. The corn competitive scheme of 1976 is indicative of the substitutability of corn for feed grains. This pricing formula priced feed wheat, barley and oats relative to nutrient content in comparison to corn.

As evidenced by the corn countervailing duty applied to corn in 1986, U.S. corn is imported into eastern Canada (5 year average is 517,000 tonne) and competes head on with Canadian corn and feed grains. This establishes the linkage between U.S. corn and Canadian feed grains. Thus, the relationship between the U.S. corn market and the Canadian oats market is analyzed with respect to the flow of price information.

The U.S. corn market is their largest feed grain market and thus should be a good proxy for a world feed grain market. This allows the Canadian oats market to be linked to world feed grain markets and analyzed in its ability to reflect international feed grain prices.

The concept of efficiency has many different meanings to economists. Fama developed efficiency tests for futures market with respect to three information sets: 1) a strong form test including all information, 2) a semi-strong form test including publicly held information, and 3) a weak form test including only past prices as the information set. Market efficiency results relate the time and direction of information movement to fully flow from one market to another (Blank). Prices which are slow to adjust to exogenous shocks reflect inefficiencies in the market (Boyd and Brorsen). This study will incorporate both the weak and semi-strong form analysis. To analyze the direction of price information, causal relationships are determined.

The entire concept of causality is based on the predictability of some series. Granger's concept of causality is used to determine the direction of information flow or price adjustment. Y is said to cause X, if X can be better predicted using all available information, than if Y information is not used. When Y does cause X and X does not cause Y, unidirectional causality is said to occur. This implies that prices are discovered in market Y. If X causes Y and Y also causes X, feedback or instantaneous causality is said to be occurring. In this situation, direction of causality cannot be determined, and markets are considered efficient.

The objective of this section is to determine the relationship between U.S. and Canadian feed grains. The Canadian oats market is evaluated with respect to price discovery and the flow of price information. This is done using a time-series model which emphasizes price discovery or the process of reaching equilibrium.

CHAPTER VII

PRICING EFFICIENCY MODEL SPECIFICATION

7.A Theoretical Causality Model

If world prices were always in equilibrium, it would be possible to analyze price behavior using excess demand (ED_t) and excess supply (ES_t) in time t as follows:

$$ES_t = f(P_t, U_t) \quad (1)$$

$$ED_t = f(P_t, V_t) \quad (2)$$

$$ES_t = ED_t \quad (3)$$

where P_t are prices, U_t are supply shifters, and V_t are demand shifters in time t. An equilibrium trading price is then determined from equations (1-3) as follows:

$$P_t^e = f(U_t, V_t) \quad (4)$$

However, markets are not always in equilibrium (ES $\neq$ ED). Both present and past supply and demand shifters would have to be included to make this process dynamic, while making this model difficult to implement. A superior approach is to assume price is determined by some random underlying stochastic process relating to V_t and U_t. This process is modelled as follows

$$P_t^e = f(D_t, S_t) + E_t \quad (5)$$

where D_t represents the deterministic component, while S_t and E_t are considered the stochastic components. The deterministic component, representing trend and seasonality must be removed. The stochastic process is then identified and estimated using time-series methods, similar to Boyd and Brorsen.

7.B Causality Model Data and Procedure

Canadian oats prices for cash and futures are obtained from the Winnipeg Commodity Exchange (WCE) closing quotations from their yearly summaries.[11] U.S. oats and corn futures prices are daily Chicago Board of Trade closing quotations obtained from Dunn and Hargitt Commodity Data Bank. The period of this analysis is 1977/1978 through the 1985/1986 crop years.

The first difference of the natural logarithm of the data are taken. This convert prices to percentage price changes, and helps avoid statistical estimation problems such as autocorrelation and heteroskedacticity. First differences remove linear time trends, and logarithms reduce prices to percentages. A number of bivariate autoregressive models are constructed to be used for the causality and multiplier procedures following. Akaike's Information Criterion (AIC) (Akaike, 1976) is used to determine the optimal number of lags to use in the models. These are considered the information lags between markets. The bivariate model is written as follows:

$$P_t = \quad AP_{t-i} + e_t \tag{6}$$

where:

$$P_t = \begin{bmatrix} P_{1t} \\ P_{2t} \end{bmatrix} \quad A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \quad \text{and } e_t = \begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix} \tag{7}$$

where P_t is the matrix of commodity prices, p the number of lags, A the

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[11] A crop year is from August 1 to July 31, and is designed to encompass all sales from one crop.

matrix of coefficients to be estimated, and e_t the matrix of residuals. Residuals are tested for white noise using Bartlett's Kolmogorov-Smirnov and Fisher's Kappa statistic. If tests do not reject the null hypothesis of white noise, residuals are considered random and no explanatory power remains, and they are considered white noise. Consistent and efficient results are then obtained through the Ordinary Least Squares (OLS) estimation technique.

The Wald F statistic is used to test the significance of causality. Testing the relation of X and Y is performed by testing the significance of coefficients as a group and not individually.

$$\frac{(\widetilde{RB}-r)^T\,[Var\,R(X^TX)^{-1}R^T]^{-1}(\widetilde{RB}-r)}{N} \sim F(N, T-(2N+1)) \qquad (8)$$

Where $(\widetilde{RB}-r)$ is the relevant restriction, Var is the variance of the unconstrained B's, and N is the number of observations.

In order to obtain more information on the relative strength of these relationships, multipliers are calculated on the bivariate autoregressive models. These dynamic multipliers are interpreted slightly different than a measure of the change in Y given a change in X. These multipliers assume a one time stochastic shock in the error term in either demand or supply. This shock results in immediate and longer run effects. The delayed run multiplier (DRM) shows the impact of this unspecified one time shock in time t+m.

$$DRM(m)_{ij} = \frac{E(dP_i(t+m))}{P_j(t)} \qquad (9)$$

$DRM(m)_{ij}$ measures the impact in the change in expected price P_i in term t+m of a change in price P_j in time t. The intermediate run multiplier (IRM(m)) is the sum of $DRM(m)_{ij}$ and represents total expected change in time m. Long run multiplier (LRM) is the sum of impacts on expected price when a new equilibrium is reached.

$$\mathbf{LRM} = \sum \mathbf{DRM^*(m)_{ij}} \qquad \mathbf{(10)}$$

The period of adjustment is normally higher than the lagged period. The period of adjustment is measured with two approaches. Adjustment period I can be viewed as the number of days for the IRM to reach and remain within 5% of the LRM. Adjustment period II is the number of days for the delayed run multiplier to become insignificant from zero at the 5% level of significance. The first measure tells when the impact is small and the second when the multipliers are no longer significant. Thus, the best approach is the minimum of the two methods.

7.C Theoretical Hedging Model

The purpose and benefit of hedging on the futures market is to minimize revenue losses due to adverse cash price movement. The concept of hedging hinges on the positive correlation between the futures and cash market. This allows one to take an equal but opposite position in the futures market, and reduce price risk. This positive correlation is calculated as the nearby futures price minus the cash price and is called the basis. Thus, hedging trades price risk for a much reduced basis risk.

To formally test the effectiveness of hedging Canadian cash oats, an optimal hedge ratio (X^*_f) is calculated. The optimal hedge ratio minimizes price risk. This is done by minimizing the sum of squared errors when cash prices are regressed on the hedging vehicle (Kolb, pp. 121-122). Results are compared with estimates using U.S. oats futures and U.S. corn futures contracts as hedging vehicles.

Once the crop has been planted, the risk adverse producer's objective is to minimize price variability or risk.

$$\textbf{Min Var(Pf,Pc)} = \textbf{Var(Pc)} + \textbf{X}^2\textbf{fVar(Pf)} + \textbf{2Xf[Cov(Pc,Pf)]} \qquad \textbf{(11)}$$

Where: **Var** is the Variance
Cov is the Covariance
Pf is the futures price
Pc is the cash price
Xf is the % of cash commodity to hedge.

The hedging problem is to chose Xf to minimize the variance of the combined futures and cash prices. The first derivative is taken of equation 11 with respect to **Xf** and then set to zero. The optimal hedge ratio then becomes

$$\textbf{Xf}^* = \textbf{-[Cov(Pc,Pf)/Var(Pf)]} \qquad \textbf{(11)}$$

The optimal hedge ratio equals the beta coefficient in standard regression analysis. Further, the R^2 is interpreted as a measure of hedging effectiveness given the hedge was implemented during the period the hedge ratio is estimated. This gives the proportional percentage reduction in price risk (Kolb p. 122).

CHAPTER VIII

CAUSALITY AND HEDGING RESULTS

Fisher's Kappa and Bartlett's white noise tests fail to reject the null hypothesis of white noise in the residuals in all equations (Table 8.1). Thus, it is concluded that the modelling procedure is appropriate.

Table 8.1

Residual White Noise Tests of Daily Causality Equations for the 1978/1979 through 1985/1986 Crop Years.[a]

Commodity	Bartlett's Kolmogorov-Smirnov Statistic	Fisher's Kappa Statistic
Chicago oats^f to Winnipeg oats^f	.0160	6.80
Winnipeg oats^f to Chicago oats^f	.0194	11.89
Winnipeg oats^f to Chicago corn^f	.0169	7.09
Chicago corn^f to Winnipeg oats^f	.0152	6.68
Chicago corn^f to Chicago oats^f	.0206	11.39
Chicago oats^f to Chicago corn^f	.0172	7.32
Chicago corn^f to Winnipeg oats^c	.0188	7.06
Winnipeg oats^c to Chicago corn^f	.0158	7.36

f and **c** designate futures and cash prices respectively.
[a] A crop is from August 1, to July 31.

Causality F statistics, lead-lag relationships, equation F statistics and R^2 are shown in table 8.2. All causality results are unidirectional with no feedback relationships. Four equations show significant F statistics at the 5% level, and indicate significant explanatory power in past prices. All causality results are unidirectional, with no feedback relationships.

Using this study's definition of causality, U.S. feed corn futures prices lead U.S. oats futures prices by 2 days and U.S. feed corn futures prices lead the Winnipeg cash and futures oat prices by 1 day. Further, the Chicago oat futures prices lead the Canadian oat futures prices by 2 days. Nothing leads U.S. corn prices, thus price discovery is expected to originate here.

It should be noted that there is a difference in the specification of the futures contracts. The Winnipeg oats and U.S. corn futures contracts are feed contracts (ie. deliverable grades are feed grade), and the U.S. oats futures contract is a food grade contract (deliverable grades are #2 Heavy oats, and #1 Heavy oats may be substituted at a premium).

Because Canadian feed grains are priced via the U.S. corn market, the relationship between Winnipeg oat prices and U.S. corn prices is stronger than between the Winnipeg oat prices and U.S. oat prices. The difference in the contract specifications further explains the weaker relationship of the U.S. oat futures prices to both the CBT feed corn futures prices and Winnipeg feed oat futures prices.

Equations 5 and 6 have a zero order lag selected by AIC and thus no causality equations could be constructed. This instantaneous causality between the WCE oats cash and futures prices suggests that domestic price discovery is assumed by both markets. Thus, using this study's narrow definition of efficiency, the flow of pricing information is considered efficient in the weak form.[12] Since the Winnipeg oats futures contract is a domestic feed contract, it may be concluded that the oats contract is efficient in it ability to price domestic feed oats. This result is consistent with Carter's evaluation of Canadian wheat, barley and oats.

Table 8.2

Daily Causality Lead-Lag Relationships and Equation Results for Oats and Corn for the 1977/1978 through 1985/1986 Crop Years.[a]

Commodity	Causality Wald F-stat.	Equation F-stat.	R^2
1. Chicago oats^f to (2) Winnipeg oats^f	3.48*	4.95*	.008
2. Winnipeg oats^f to (2) Chicago oats^f	0.35	3.00	.005
3. Winnipeg oats^f to (1) Chicago corn^f	1.42	0.02	.001
4. Chicago corn^f to (1) Winnipeg oats^f	5.14*	8.77	.007
5. Winnipeg oats^f to (0) Winnipeg oats^c	no equation		
6. Winnipeg oats^c to (0) Winnipeg oats^f	no equation		
7. Chicago corn^f to (2) Chicago oats^f	10.04*	7.89*	.013
8. Chicago oats^f to (2) Chicago corn^f	1.79	1.13	.002
9. Chicago corn^f to (1) Winnipeg oats^c	7.36*	12.88*	.011
10. Winnipeg oats^c to (1) Chicago corn^f	0.50	0.43	.000

f and **c** denote futures and cash prices respectively.
Numbers in parentheses denote lagged number of days
* Denotes significance at the 5% level.
[a] A crop year is from August 1 to July 31.

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[12] There may be causality within the day, but using daily data, causality cannot be determined.

The causality results relating the Chicago Board of Trade (CBT) corn contract to the WCE oats contract may be viewed as a semi-strong efficiency test if it is agreed that the U.S. corn contract is an "international market".

Using this study's narrow definition of efficiency, the 1 day information flow between the WCE oats contract and the U.S. corn contract is interpreted as a relatively efficient flow of information. Gilmour and Fawcett conclude that the Canadian feed grain market is physically isolated by transportation, storage and transaction costs. Thus, the Canadian feed grain market and the U.S. feed grain market are considered separate markets in which instantaneous causality is not expected for results to be considered efficient in the semi-strong form. Carter opposes this by concluding that the Canadian barley market was inefficient in some periods when lags are found.

Considering only significant multipliers, results were generally consistent with causality results (table 8.3). Positive multipliers imply commodities are substitutes, negative multipliers imply complements or weak substitutes (Boyd and Brorsen, p.209).

The signs on all significant multipliers are positive with the exception of equation 5, and thus consistent with prior expectations that feed corn and oats are considered substitutes. Equation 5 indicates that feed corn is a weak substitute for U.S. export oats. This shows a stronger substitutability of U.S. export oats for U.S. feed corn and Canadian feed oats than vise versa.

The length of information flow, given by the number of adjustment periods, reflects the proximity between markets and also the substitution relationship(Boyd and Brorsen). A close market is hypothesized to have a short adjustment period. The range of information flow between markets is 1 to 3 days. A 1 day adjustment period between the Canadian oats and Chicago corn market again reflects their close substitutability. The 3 day adjustment period between the U.S. oats contract and both Canadian and U.S. corn feed contracts indicates the weak relationship between food grade oats and feed oats and corn.

Table 8.3

Long Run Impact Multipliers for Corn and Oats Daily Price Changes for the 1977/1978 through 1985/1986 Crop Years.[a]

Commodity	Impact Mult.	t value	Adj. Period 1	Adj. Period 2
1. Chg. oats^f to Wpg. oats^f	0.04*	2.95	3	11
2. Wpg. oats^f to Chg. oats^f	-0.01	-0.48	4	0
3. Wpg. oats^f to Chg. corn^f	0.05	1.20	1	0
4. Chg. corn^f to Wpg. oats^f	0.03*	2.26	1	1
5. Chg. corn^f to Chg. oats^f	-0.06*	-2.98	3	1
6. Chg. oats^f to Chg. corn^f	0.01	0.18	4	14
7. Chg. corn^f to Wpg. oats^c	0.04*	2.72	2	1
8. Wpg. oats^c to Chg. corn^f	-0.02	-0.07	2	0

f and **c** denote futures and cash prices respectively.
* denotes significance at the 5% level.
[a] A crop year is from August 1 to July 31.
Chg. is Chicago and **Wpg.** is Winnipeg.

A set a correlation coefficients of daily price changes are presented in table 8.4. All are significant at the .01% level. The size of the coefficients indicate the relative strength of relationships between commodities. The correlation coefficient of .59 between Chicago oats futures price and Chicago corn futures prices, and .74 between Chicago oats futures price and WCE oats futures price should be regarded as the substitutability of U.S. oats for feed corn and feed oats respectively, not vice versa given previous multiplier results.

Table 8.4

Correlation Coefficients of Daily Price Changes Between Oats and Corn markets for the 1977/1978 through 1985/1986 Crop Years.[a]

Commodity	Wpg. oats[c]	Wpg. oats[f]	Chicago oats[f]
Chicago corn[f]	0.28	0.38	0.59
Chicago oats[f]	0.11	0.74	
Winnipeg oats[f]	0.30		

f and **c** denote futures and cash prices respectively.
a A crop year is from August 1 to July 31.

Long and short run hedging and cross hedging results are given in table 8.5. Results are given for the first difference of the natural logarithm of data. Durbin-Watson statistics show extreme autocorrelation when data is not first differenced. This may cause an upward bias of t values and R^2 estimates. Thus, data is first differenced to remove trends and natural logarithms are taken to reduce heteroskedacticity. The long run R^2 of .39 for the regression of Winnipeg cash feed oats on WCE oats futures is compared to Carter's estimates of .73 for barley and .17 for wheat over the period 1977 to 1981. The R^2 estimates shows the amount of the correlation between cash and futures prices, and thus shows the level of the reduction in price risk attainable by hedging over the period of the analysis. Thus, the opportunity for a long run reduction in price risk is not as high in oats and wheat as in barley.[13]

Table 8.5

Long and Short Run Daily Hedge and Cross Hedge Coefficient Estimates for Winnipeg #1 Canada Cash Feed Oats.

	Winnipeg Cash #1 Canada Feed oats First Differenced Data					
	Long Run			Short Run		
Futures Instrument	**DW**	**Beta**	**R^2**	**DW**	**Beta**	**R^2**
WCE oats futures	**2.23**	**0.76** (39.06)*	**0.39**	**2.59**	**0.88** (12.56)*	**0.55**
CBT oats futures	**1.88**	**0.19** (11.29)*	**0.05**	**2.00**	**0.40** (4.02)*	**0.12**
CBT corn futures	**1.89**	**0.31** (13.20)*	**0.07**	**2.03**	**0.75** (5.63)*	**0.21**

T values are given in parentheses.
* Denotes significance at the 5% level.
DW is the Durbin - Watson statistic.
Beta is the estimated cross hedge coefficient representing the optimal cross hedge ratio.
Short Run is August 1, 1977 to January 31, 1978.
Long Run is for the 1977/1978 through 1985/1986 crop years. Where a crop year is from August 1 to July 31.
CBT is the Chicago Board of Trade.
WCE is the Winnipeg Commodity Exchange.

Most commercial and primary hedging takes place over 6 months, and not over a continuous 8 crop year period (log run). Regressions are run on various 6 month periods with varying results. Results for the first 6 months of the 1977/1978 crop year are given in table 8.5 as an

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[13] Carter took first differences and the natural log of weekly prices and not daily prices as this study does. This impairs the ability to compare these results, since weekly results will result in smaller error term estimates than daily data.

approximation for the various periods. Non-differenced data still exhibited autocorrelation, thus first differences were taken of data.

Comparing results in the long and short run shows the WCE as the best hedging vehicle for Canadian cash feed oats. The effectiveness of the hedge (R^2) improved in the short run from being able to reduce 39% of price risk in the long run to 55% in the short run. The optimal hedge ratio, or the percentage of the cash commodity to hedge, (beta coefficient) to minimize price risk increased from 76% in the long run to 88% in the short run. As expected, the CBT corn futures contract is a better hedge for Canadian cash feed oats than the CBT oat futures contract by providing an increased level of price risk reduction.

CHAPTER IX

FUTURE PRICING AND HEDGING CONSIDERATIONS

Given the change in the oat marketing structure, the increased role as the primary market facility is likely to result in increased volume for the WCE oat contract. Oats marketed by the CWB in the past will now be marketed by the private trade. Thus, the potential for increased commercial hedging should increase oat contract trading volume. Increased volume increases the liquidity of the contract and lowers transaction costs. This increases trading volume further as more speculators are drawn to the contract, and also increasing pricing efficiency (Black p.66). Further, the oats contract may now be considered an international futures contract and not only the domestic contract it was in the past. Grain destined for either export or domestic use can be potentially hedged.

The CWB historically handled mainly export oats and human consumption sales, with little interference in the domestic feed market. The domestic feed market was largely serviced by the private trade, and thus justification for the current WCE feed oats futures contract. The increased grain marketed by the open market will largely be Canada Western (CW) grade oats, a food grade. Some recent arguments suggest that since export oats moving through Thunder Bay terminals destined for the Minneapolis milling market are CW grade oats, the deliverable grade for the WCE oats futures contract should be changed to CW grade oats.

The question that remains is whether the current feed contract will serve as an adequate hedging instrument for CW and Canada Feed (CF) grade oats?

If the basis between these grades were constant, the present contract would be an effective hedge for both grades as this would imply a constant premium for CW over CF oats. Observation between CWB sales of "Designated oats" (#1 or #2 CW) and average WCE cash #1 CF oats prices shows that the basis varies widely from year to year. The basis has a low of $4/tonne in the crop year 1975/1976. But there is a high basis level of $56/tonne in the crop year 1980/1981. This may suggest that these two grades identify two distinct markets. Annual correlation coefficients of price changes are calculated to examine the correlation between WCE cash feed oats and CWB "Designated Oats" prices. Designated Oats are high quality #1 or #2 Canada Western grade oats for processing and milling established in the 1981/1982 crop year. The correlation coefficient of annual price changes between these oat grades is .85.[14] Although these coefficients are high, these results may not indicate that both markets for feed and food grade oats are highly correlated. There may be a high degree of variability between these prices within years. The nature of agriculture production causes a high degree of correlation between the production of different crops, and thus affecting prices in a similar manner. Since most hedging takes place within a year, these results do not indicate that the current WCE oat contract would be an effective hedge for CW grade cash oats.

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[14] Annual price changes will result in smaller error terms than daily price changes. Thus, correlation coefficients are higher in annual data than daily data.

Since the U.S. is a major export market for Canadian CW grade oats, some of it to the Minneapolis milling market, the Minneapolis cash market for #1 Heavy oats is used as a proxy for Canadian CW grade oats. This is used to evaluate the effectiveness of the WCE oats contract in reducing price risk for holders of CW cash oats.[15] Minneapolis cash prices for #1 Heavy (38 lb.) are taken from the Minneapolis Grain Exchange, Statistical Annuals (Various years) for the 1977/1978 to 1985/1986 crop years. As in the previous section, logarithms and first differences are taken of the data. Short and long run regressions are run. Short run estimations imply hedging over six month periods, and long run estimations over the entire period. Hedging results are given in table 9.1.

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[15] Different geological locations may cause the Minneapolis #1 Heavy cash oats market to be an inadequate proxy for Canadian #1 C.W. oats.

Table 9.1

Long and Short Run Daily Hedge and Cross Hedge Coefficient Estimates for Minneapolis Cash #1 Heavy Oats.

	Minneapolis Cash #1 Heavy Oats First Differenced Data					
	Long Run			Short Run		
Futures Instrument	**DW**	**Beta**	**R^2**	**DW**	**Beta**	**R^2**
WCE oats futures	**1.84**	**0.22** (9.20)*	**0.036**	**1.81**	**0.47** (3.48)*	**0.09**
CBT oats futures	**1.99**	**0.24** (14.69)*	**0.086**	**1.83**	**0.28** (5.55)*	**0.20**

T values are given in parentheses.
* Denotes significance at the 5% level.
DW is the Durbin - Watson statistic.
Beta is the estimated cross hedge coefficient representing the optimal cross hedge ratio.
Short Run is August 1, 1977 to January 31, 1978.
Long Run is for the 1977/1978 through 1985/1986 crop years. Where a crop year is from August 1 to July 31.
CBT is the Chicago Board of Trade.
WCE is the Winnipeg Commodity Exchange.

Results show that optimal hedging ratios and hedging effectiveness varies from year to year, although generally consistent. Minneapolis #1 cash Heavy oats is best hedged on the CBT oat futures market. This was expected, as the CBT futures contract has a deliverable grade corresponding to the Minneapolis oat cash market. Both the WCE and CBT hedging vehicles show a low reduction in price risk available (R^2).[16]

[16] Minneapolis cash prices are given as a range, thus, an accurate daily measure was difficult to interpret. Simple averages of the range were taken, this may account for the relative poor results of hedging effectiveness of the CBT oats contract on Minneapolis cash oats.

However, short run results show a much improved reduction in price risk available (R^2=.20) by the CBT oat futures contract. The important result is that the CBT oats contract is a better hedging vehicle for Minneapolis #1 Heavy oats than the WCE oats contract. Thus, if Minneapolis #1 Heavy oats is a good proxy for Canadian #1 CW oats, the WCE feed oats contract will not service hedging needs for CW cash oats as well as the CBT oats futures contract. Only 3.6% in the short run and 8.6% of price risk in the long run can be reduced by hedging on the WCE oats futures contract.

This suggests that if the private grain trade minimizes price risk, they may hedge their holdings of CW cash oats on the CBT oats contract and hedge on the WCE oats contract for holdings of feed oats. The CBT has a further advantage of being a more liquid market. This is preferred by hedgers as the bid-ask price is smaller. This reduces hedging costs by decreasing price increments when sales or purchases are made (Black p. 40).

This analysis assumes that pricing of feed oats does not change in the future, when it fact it may as a result of the WCE oat futures contract becoming an international market. Thus, changes in the pricing of WCE oat futures prices may change the hedging effectiveness of the WCE oat contract for both Canada Western and Canada Feed cash oats.

PART 3: WCE OATS CONTRACT VOLUME FORECAST

CHAPTER X

REVIEW OF VOLUME FORECASTING MATERIAL

10.1 Rutledge (1979)

Rutledge examines whether volatile prices cause increased futures trading volume. Causality tests developed by Sims (1972) are used to examine four month trading periods for 136 futures contracts for 13 commodities during the 1970's. Only modest evidence was found that increased futures trading is a response to increased price volatility. Most of the relationships were insignificant and or instantaneous.

10.2 Telser (1981)

Telser analyzes the relationship between cash price variability and futures trading volume. He concludes that cash price variability is the cause not the effect of futures trading. He argues that as cash price variability decreases, so will the demand for futures contracts as the need for hedging is reduced.

10.3 Cornell (1981)

Cornell studies the relationship between futures trading volume and price variability using a standard regression model. He argues that the two causes of increased futures trading are increased price uncertainty and differing information beliefs. A significant, positive contemporaneous relationship is found between the average daily volume and the change in the standard deviation of the logarithm of daily cash prices in 14 of 18 commodities tested. The other four commodities exhibited insignificant, although positive relationships.

10.4 Garcia, Leuthold and Zapata (1986)

This study attempts to identify the lead lag relationship between trading volume and price variability in a sample of 120 four month trading periods for five agricultural commodities in 1979 and the early 1980's. Simultaneity existed in the majority of cases but some variation is found when the daily price range was used instead of the percentage change in the closing price. This suggests that the measure of price variability used is also important.

10.5 Black (1985)

Black examines the success and failure of futures contracts based on volume and open interest as the measure of success. Standard regression analysis using a cross-sectional time-series model is used to forecast futures volume of a newly innovated futures contract not yet traded. A number of exogenous variables were used to explain trading volume. Two variables, the size of the cash market, and cash price variability are of interest in this study. The size of the cash market indicates the potential market participants, and cash price volatility indicates the necessity of cash market holders to hedge.

CHAPTER XI

OATS CONTRACT TRADING VOLUME MODEL SPECIFICATION

The following annual relationship is hypothesized.

Futures Volume = f(Cash Quantity, Mean Cash Price,

and Cash Price Variability) **(19)**

11.A Oats Futures Trading Volume Model Exogenous Variables

1. Cash Market Quantity

The cash quantity variable refers to the level of oats traded on the cash market and indicates the potential of product to be hedged. Portfolio theory explains the optimal amount someone will hedge to minimize price risk is a portion of the cash commodity they hold (Bond and Thompson). Thus, oats futures trading volume should be positively related to the volume of cash market sales.

2. Mean Cash Price

The mean absolute cash price refers to the mean annual price levels in the cash market. Casual observation shows a strong correlation between many agricultural cash prices and trading volume. Although only a small portion of direct hedgers are primary agricultural producers, intuitively one can see that if the cash price of oats is very low, there is no need for producers to hedge if cash price volatility is very low and prices are expected to increase. Since considerable futures market trading is done by speculators, it is hypothesized that there is also a positive correlation between the level of absolute oat prices and speculation interest. The general public may often enter the futures market as new long speculators when prices are high because they prefer to go long by buying futures contracts in expectation of price increases rather than go short by selling futures contracts in expectation of price decreases. In agriculture commodities, high price levels are often associated with droughts and poor crops. The resulting price increases attract speculative interest, since potential profits are possible, and increase futures trading volume.

3. Cash Price Variability

Cornell stresses that the "true" relationship between volume and price variability is stronger than estimates show. Price limits, scalping, and spread trading distort data and reduce the estimated correlation.

Speculators require futures market price changes in order to profit. Telser concludes that cash market variability is the cause, not the effect of increased trading volume. The value of hedging also hinges on price variability. When future cash prices are known with certainty, there is no need for a futures market because there is no price risk. Thus, an increase in price variability increases the demand for a hedging vehicle. This increases liquidity as speculators enter the futures market and trade the excess supply of contracts. This lowers the incremental cost of trading (margins and commissions), attracting new interest to the futures contract and further increasing volume (Black p.25).

All measures of price variability are imperfect. The measure used in this analysis is the monthly cash price coefficient of variation.[17]

The cash market quantity, annual mean oat price, and the cash price variability are postulated to be positively related to oats futures trading volume. To allow for non-linear effects of each variable, a logarithm-logarithm model is postulated much like Black's. This specification reduces heteroskedasticity and also provides the best goodness of fit. Because each estimated coefficient is in natural logarithm form, the coefficients are further interpreted as elasticities with respect to each exogenous variable.

$$\mathbf{Ln(Volume) = Bo + B1^* Ln(Q) + B2^* Ln(P) + B3^* Ln(CV) + e} \qquad \mathbf{(20)}$$

where **Q** is the Cash Market Quantity.
P is the Cash Market Price.
CV is the Coefficient of Variation for the Cash market Price.
e is the error term.

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[17] The coefficient of variation is calculated using daily and monthly data. Results are almost identical, and thus monthly figures are used.

CHAPTER XII

OATS CONTRACT TRADING VOLUME MODEL PROCEDURE AND RESULTS

The model is estimated on an annual basis for the crop years 1974/1975 (beginning of the oats futures contract) to 1987/1988. Oat price and oats contract trading volume data are obtained from various issues of the Winnipeg Commodity Exchange Statistical Annual. Oat cash market prices, in dollars per tonne, are the average daily cash market close of each crop year. The Coefficient of Variation is calculated using the average monthly close of WCE cash market prices. Contract trading volume is quoted and used in 20 tonne contracts. The oat cash market quantity variable is obtained from the Canada Grains Commission "Visible Grain Supplies and Disposition" various issues. The "Total Domestic Disappearance of Non-board Oats" is used as a proxy for the volume sold through the WCE oats cash market. This quantity is an approximation of the amount handled by the private trade, and probably hedged, and thus representative of the amount commercially hedged on the WCE oats contract.[18]

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[18] The model was also run using western Canadian oat production plus the available inventories as the quantity variable but the "Total Domestic Disappearance of Non-Board Oats" was a much better fit. This is partially due to the previous Wheat Board involvement in oats marketing. In the past, oats could be delivered both to the open market and the private trade, and since the amount marketed by the Board is not hedged, it is not available to be commercially hedged either.

12.A Oats Trading Volume Model Parameter Estimation Results

$$\mathbf{Ln(Volume) = 0.017 + 1.073^{*}\,Ln(Q) + 0.889^{*}\,Ln(P) + 0.293^{*}\,Ln(CV) + e} \qquad \textbf{(21)}$$
$$(0.01) \quad (7.84)^{*} \quad (3.19)^{*} \quad (2.03)^{**}$$

$R^2 = .89$
DW = 2.11
F value = 26*

* denotes significance at the 5% level.
** denotes significance at the 7% level.
Ln is the natural Logarithm.
Volume is contract trading volume (20 tonne).
Q is the Cash market quantity (1000's tonnes).
P is the mean annual Winnipeg cash market price (dollars/tonne).
CV is the coefficient of variation of monthly Winnipeg cash market average closes.
DW is the Durbin - Watson statistic.
e is the error term.

The F value of 26 shows that trading volume as a function of the above explanatory variables can not be rejected. All variables have the correct hypothesized positive relationship to trading volume. The quantity and price variables are both significant at the 5% level and the Coefficient of Variation is significant at the 7% level. The cash market quantity shows the highest level of significance and thus the greatest explanatory power of oat futures trading volume is in the size of the cash market. A Durbin-Watson statistic of 2.11 reveals no autocorrelation problem. An R^2 of .89 shows very good explanatory power with almost 90% of the total variation in volume explained with the above exogenous variables.

The estimated coefficients are also interpreted as elasticities. The estimated coefficients show the percentage increase in trading volume resulting from a 1% increase in the exogenous variable. Trading volume shows the highest level of responsiveness to the volume cash market sales, with a 1% increase in cash market quantity resulting in a 1.073% increase in trading volume on average. Thus, the cash market quantity has the greatest impact on trading volume, and also shows the highest level of significance.

12.B Oats Futures Trading Volume Model Simulation Results

1. Historical Simulation

A summary of the simulation results are given in table 8.1 and graphed in figure 8.1. The model is simulated historically and the volume for the 1988/1989 crop year is also forecasted. The model generally follows actual volume levels remarkably well considering the nature of futures trading. A general decline in volume is evident until 1985 notwithstanding the 1980/1981 and 1983/1984 crop years. This is consistent with decreasing Canadian oats acreage. The model forecasted the 1988/1989 crop year volume at 39,906 contracts, whereas the actual volume was higher at 43,266 contracts, an under forecast of 7.7%.

2. Historical Simulation of Oats Contract Volume given no Canadian Wheat Board Involvement

This scenario assumes that grain marketed by the CWB and the private trade can be hedged in an equal manner. But, the CWB historically marketed largely food grade oats and the private trade only feed grade oats. For both grades of oats to be hedged equally, the basis between feed oats and the food grade oats would have to be constant. Given the differences between these grades cited earlier, similar to two different product markets, this model is likely to over estimate trading volume. Previous cross hedging results showed that the CBT oats futures contract is a better hedging instrument than the WCE oats futures contract for Minneapolis #1 Heavy oats. Since some oats exports are into the Minneapolis milling market, we may approximate CW grade oats with the Minneapolis #1 Heavy cash oats. Thus, some hedging of Canada Western grade oats would be expected to be on the CBT oats contract.

The model is used to simulate the projected past volume on the WCE given no CWB involvement, all of the other factors held constant. This is done by increasing the non-Board cash market quantity variable in the model to include total oat marketings by the open market and the CWB.[19] In the Board market, producers are guaranteed an initial price and in this sense, have no need to hedge. Thus, grains marketed by the Board are not likely hedged.

Non-Board grains can be potentially hedged by the producer and also commercially. This combined quantity variable of Board and non-Board grains reflects the impact of all hedging on trading volume. Thus, by increasing the quantity variable by the amount marketed historically by the CWB, a complete non-Board market is simulated. Actual and forecasted values are given in table 8.1. The summary graph (figure 8.2) shows quite a variation in the increased trading volume that would have taken place. The pattern basically follows the level of CWB oats exports, as involvement in the domestic feed market has been limited in the last decade. Further, domestic human consumption, the CWB's other involvement, has been relatively stable (10 yr. average of 76,000 tonne), although it does show some recent increase in demand (85,000 tonne in the 1987/1988 crop year).

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[19] Total producer delivers to the CWB in a given year are used. Sales would have been more accurate, but sales into futures accounts and purchases from previous accounts distorts these figures. Thus, producer deliveries are used, although not all deliveries are necessarily marketed. Therefore, only the accumulated result is accurate.

The 1986/1987 and 1987/1988 crop year shows the largest increase in oats volume corresponding to the recent surge of exports to the U.S. "pony oats" market (about 750,000 tonnes in the 88/89 crop year). With base estimates of about 40,000 contracts for both the 1986/1987 and 1987/1988 crop years, the estimated trading volume given not involvement by the CWB is 124,000 and 247,000 contracts respectively for the two crop years. This indicates a massive 300% and 600% increase in volume in the oats contract for 1987/1988 and 1988/1989 crop years respectively.

But again, these figures may be overestimated because it is assumed that all Canadian oats would have been hedged on the WCE oats contract. When in fact, evidence suggests that the majority may have been hedged on the CBT oats contract.

3. 1995 WCE Oats Contract Trading Volume Forecast

A forecast of trading volume is constructed into the 1994/1995 crop year. This corresponds to the acreage forecast in the regional crop forecasting section. Oats acreage are taken from the acreage forecasting model and multiplied by a 5 year average of yields (Manitoba 57 bu./acre, Saskatchewan 51 bu./acre, and Alberta 65 bu./acre: Source, Statistics Canada) to obtain the tonnes of production for these years. Since historically a large part of oats grown in Western Canada are used on farm or marketed locally in dairy and horse rations, an estimate of this amount must be made into 1995. Given the rigidity of this demand, a constant estimate of 1.5 million tonnes is made for oats not marketed through the licenced elevator system.[20] Further, exports are assumed to be perfectly elastic, oats prices $117/tonne and the coefficient of variation is assumed to be 5 (an average of the last decade under normal conditions). As in the previous section, all oats marketed in the future is assumed to be hedged on the Winnipeg Commodity Exchange oats contract equally as feed oats has been in the past. Table 12.1 lists values of actual forecasts and quantities used. Trading volume increases follow the increase in Western Canadian oats acreage. Although possible somewhat unrealistic, this scenario shows the strong correlation between production and contract trading volume.

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[20] It should be noted that the amount used on-farm and locally has varied widely in the past. An estimate of 1.5 million tonnes is used and is equal to the 1988/1989 crop year quantity.

Table 12.1

Summary of Annual Quantities, Actual and Estimated Winnipeg Commodity Exchange Oats Futures Contract Volume for the 1974/1995 Crop Years.[a]

Crop Year	Open Mkt. Cash Oats Quantity only (20 tonne)	Estimated Actual Contract Volume (20 tonne units)	Actual Oats Contract Volume (20 tonne units)	Open Mkt. and CWB Cash Oats Quantity (20 tonne)	Est. CWB + Open Mkt. Contract Volume (20 tonne)
1974/1975	1,953	79,069	84,742	3,706	157,189
1975/1976	1,902	63,019	58,302	4,147	145,643
1976/1977	2,059	59,930	47,614	4,697	145,220
1977/1978	1,944	55,262	59,201	3,930	117,584
1978/1979	1,650	57,684	59,625	1,800	63,328
1979/1980	1,688	57,469	66,820	1,813	62,029
1980/1981	1,684	76,161	82,026	1,782	80,926
1981/1982	1,160	44,530	51,428	3,215	132,937
1982/1983	1,051	30,519	32,732	2,059	62,825
1983/1984	1,336	56,325	54,191	1,813	78,164
1984/1985	1,078	40,406	34,267	1,571	60,524
1985/1986	687	20,445	14,938	1,863	59,609
1986/1987	626	17,265	23,167	2,174	65,640
1987/1988	884	39,972	37,006	2,546	124,426
1988/1989	985	39,906	43,266	5,400	247,772
1989 1990	-	-	-	7,250	276,811
1990/1991	-	-	-	7,555	289,315
1991/1992	-	-	-	8,065	310,306
1992/1993	-	-	-	8,450	326,216
1993/1994	-	-	-	8,830	341,971
1994/1995	-	-	-	9,130	354,444

Note: [a] A crop year is from August 1 to July 31.
All figures given in 20 tonne units.(both trading volume and grain quantities).

Data Source: Canada Grain Commission "Visible Grain Supplies and Disposition", various issues.
Canadian Wheat Board annual reports, "Producer Deliveries", various issues.

FIGURE 12.1

WINNIPEG COMMODITY EXCHANGE OATS FUTURES CONTRACT TRADING VOLUME (1974/1975 TO 1988/1989)

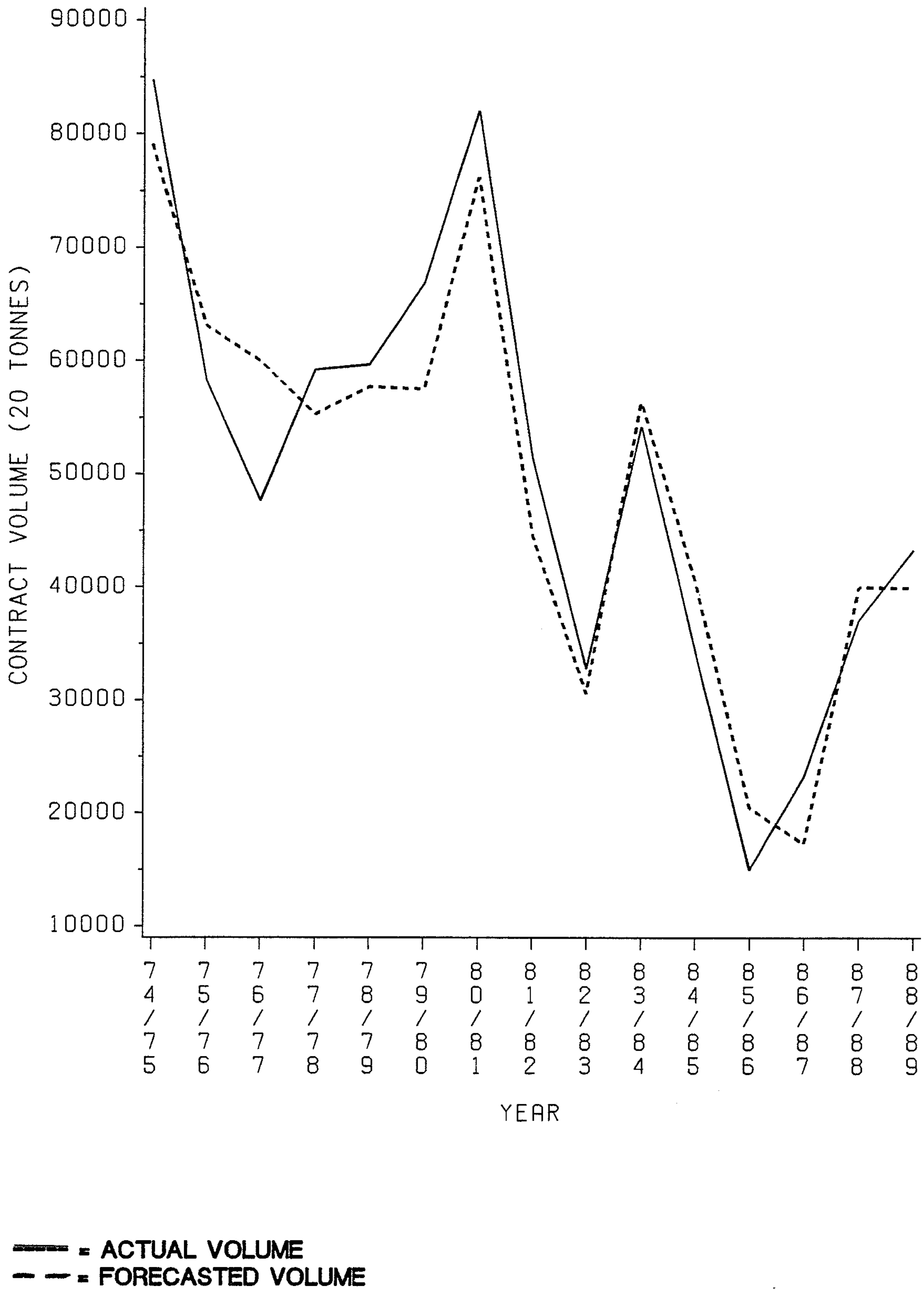
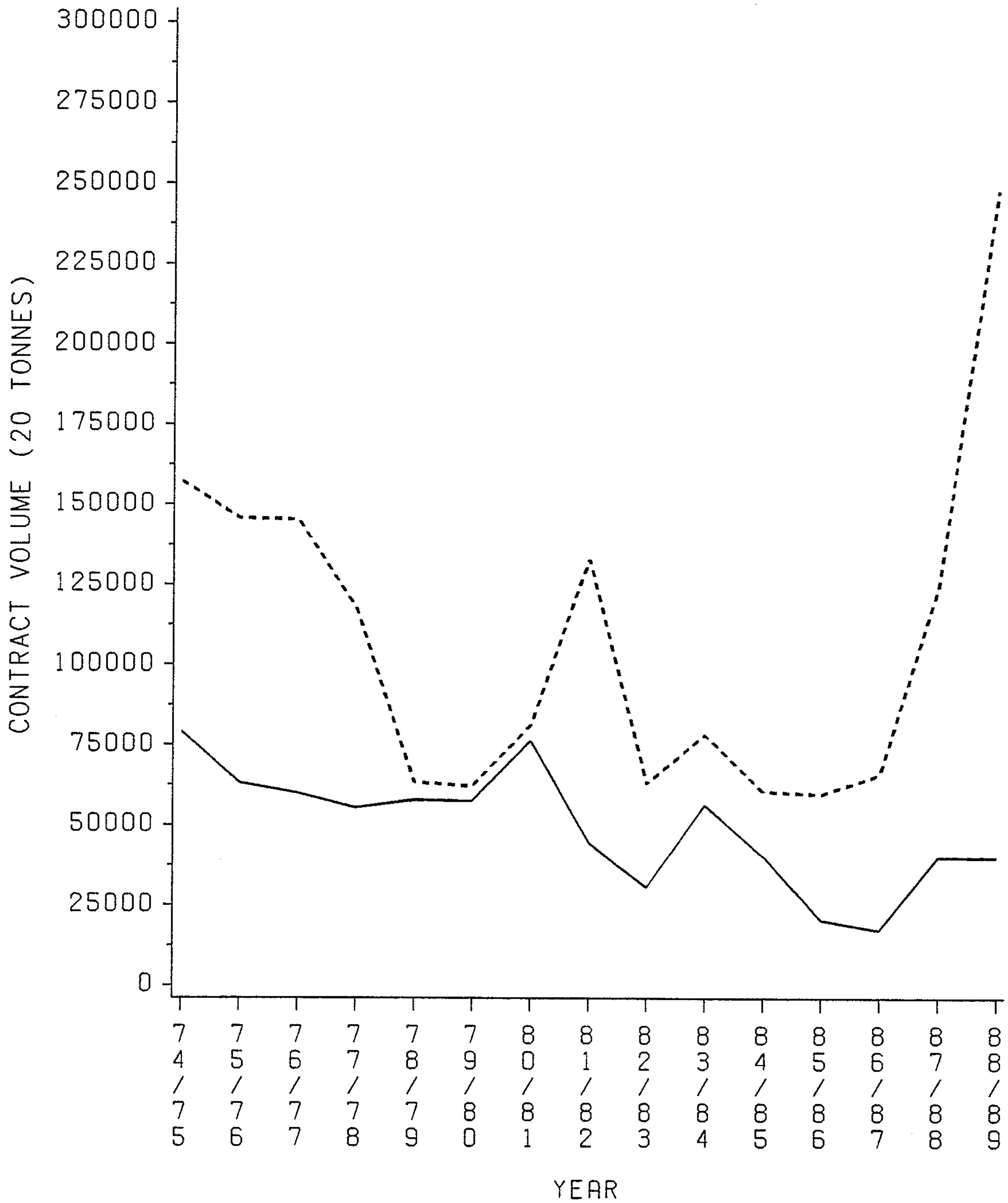


FIGURE 12.2

WINNIPEG COMMODITY EXCHANGE OATS CONTRACT VOLUME WITH NO CANADIAN WHEAT BOARD INVOLEMENT IN OATS MARKETING (1974/1975 TO 1988/1989)

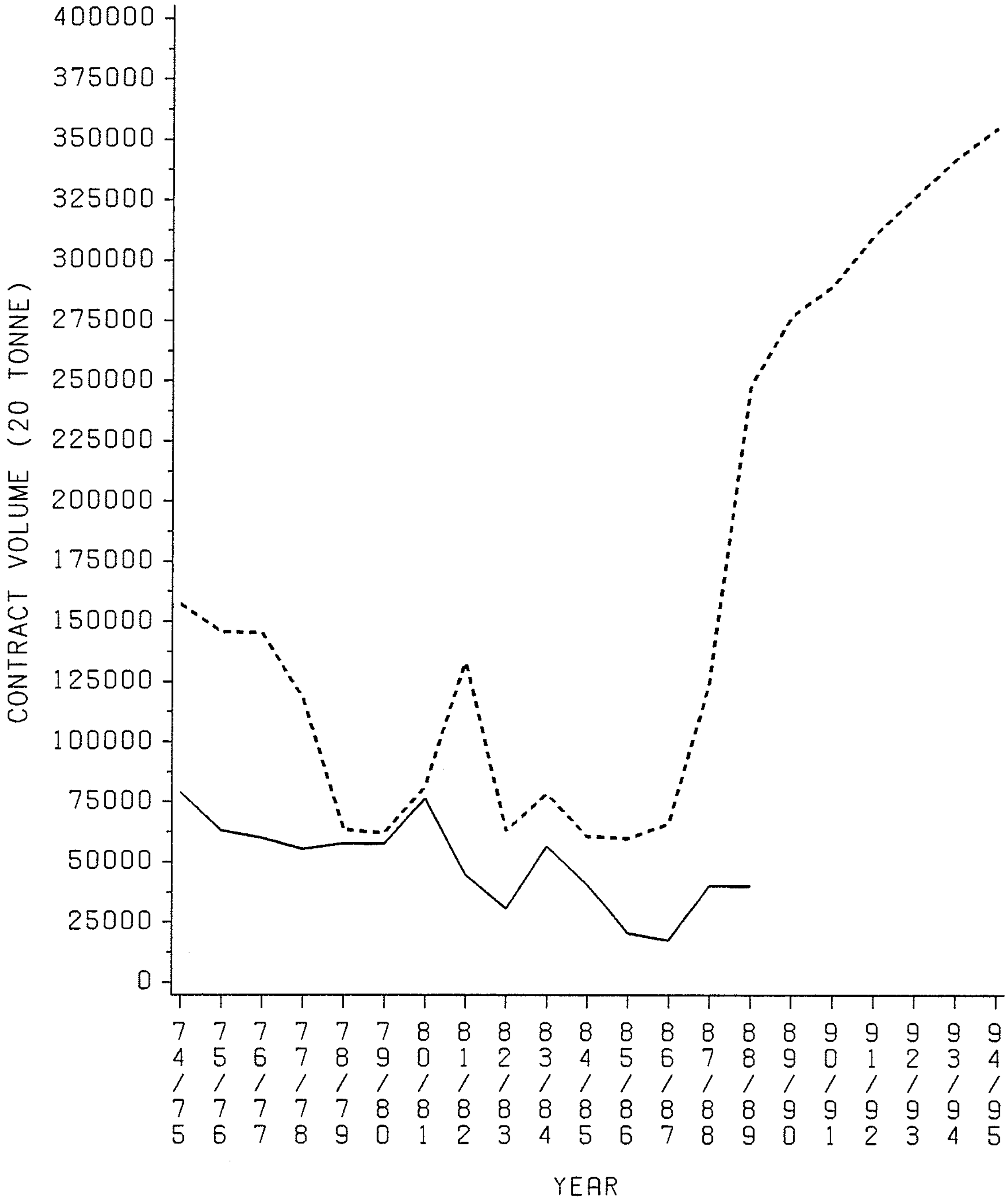


——— = FORECASTED BASE VOLUME

— — = FORECASTED VOLUME WITH NO CWB INVOLEMENT

FIGURE 12.3

WINNIPEG COMMODITY EXCHANGE OATS FUTURES CONTRACT VOLUME WITH NO CANADIAN WHEAT BOARD INVOLEMENT (1974/1975 TO 1994/1995)



—— = FORECASTED BASE VOLUME

– – = FORECASTED VOLUME WITH CWB NO INVOLEMENT

CHAPTER XIII

FUTURE WCE OAT CONTRACT VOLUME CONSIDERATIONS

Given the change in the oat market structure, increased contract volume hinges on the ability of the contract to price Canada Western (CW) and Canada Feed (CF) grade cash oats effectively. In chapter 12, an indication is given for the potential oat futures trading volume increase possible under the present marketing scheme if pricing of both grades is adequate. On the other hand, the difference between these CF and CW markets is expected to deter increased hedging activity on the WCE oats contract for CW grade oats.

Black (pp. 39-46) provides a theoretical base for designing contracts to appeal to hedgers. Contending that the trading volume in futures markets is determined by hedging business. Thus, if the WCE oats contract is an inferior hedging instrument for CW oats than the CBT oats futures contract, hedgers may hedge on the CBT oats contract. This CBT oats futures contract not only decreases the level of price risk compared to the WCE oats contract, but also has the benefit of much larger volume. Larger trading volume generally indicates increased liquidity and thus a lower bid-ask spread. Markets with these features facilitate large orders with little price change. This allows hedgers to sell or buy contracts at small price increments, lowering hedging costs.

Speculators also desire liquid markets. When speculators perceive an opportunity for profit, they maximize revenues if their entire position is accomplished at one price. Profits decrease if market illiquidity causes prices to rise or fall as a result of the execution of an order (Black p. 66). Thus, speculators and hedgers desire high trading volume in a contract.[21] With CBT oats futures contract volume about six times the WCE oats contract volume, the CBT oats contract may be more appealing.

Another source of increased volume may be arbitrage from the CBT oats futures contract to the WCE oats contract. As the Winnipeg oats futures market becomes an international market, pricing efficiency may also increase, and attracting more interest from foreign hedgers and speculators. Northern U.S. feed oat growers and commercial hedgers may find it more effective and more convenient to hedge on the Winnipeg Commodity Exchange for U.S. cash oats holdings. It is also possible that U.S. food grade (#1 Heavy) oat growers hedge on the WCE, although this is unlikely because the CBT oats futures contract is a better hedge. Increased speculation would be expected to accompany any increased hedging. This would in effect be a transfer of trading activity from the CBT oats futures contract to the WCE oats futures contract. The Chicago Board of Trade oats contract trading volume was 108,000 in 1986, 225,000 in 1987 and 273,000 in 1988 (converted into W.C.E. 20 tonne contract size). This indicates the potential WCE oats volume through transfers from the CBT.

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[21] Black points out a potential conflict of exchange members. Both hedgers and speculators desire a narrow bid-ask spread, but scalpers' profits depend on a high bid-ask spread. But scalpers also desire high volume, and the only way to keep trading action in the exchange is to maintain a low bid-ask spread. Thus, other exchange professional traders do not receive adequate compensation if they quote as low of a bid-ask spread on a newly innovated contract.

CHAPTER XIV

SUMMARY AND CONCLUSIONS

Canadian oats have been declining in consumption and production since the early 1920's. Oats' low weight compared to it's nutritional value, and limited success in higher yielding varieties have caused feed producers to switch to more competitive feed grains.

More recently, oats have received increased attention due to changes in oat feed grain policy and increased demand. As of August 1, 1989, all Canadian oats are marketed through the open market, instead of a portion by the CWB. Demand for Canadian oats has increased significantly over the last two years. The United States has turned to Canadian oats for their milling and "pony oats" markets. These markets prefer Canada Western grade oats, not the traditional feed oats produced by the majority of Canadian producers. The policy change comes during recent criticism of the marketing approach and marketing strategies used by the CWB in oat marketing. The scope of this study was to evaluate the impact of this policy change on the Winnipeg Commodity Exchange and primary oat producers.

A crop forecasting model was developed for each prairie province to forecast future oat production. Supply elasticities showed oats acreage to be highly sensitive to increases in expected revenue. Oats production was forecasted into 1995, assuming average prices, average yields, and average on-farm stocks over the 1980's. Production in Manitoba was forecasted to plateau at around 600,000 acres, Saskatchewan acreage also plateaus at about 1.8 million acres. Alberta showed an increase from about 1.5 million acres to about 19 million acres in 1995 (27% increase). Thus, the potential for increased oats acreage is in Alberta and will be Canada Western grade oats.

An efficiency analysis was conducted for the Winnipeg Commodity Exchange feed oats contract. A daily time-series analysis is used for the 1977/1978 to 1985/1986 crop years. Causality results show the WCE oats futures and cash prices are simultaneously determined. Thus, using this study's narrow definition of efficiency, the WCE is considered efficient in its ability to reflect domestic price information.

Since the U.S. corn market prices Canadian feed grains, the WCE oats contract is analyzed in its ability to reflect international or world feed grain price information. The CBT corn futures price was found to lead the WCE oats futures price by one day. In light of geographical, transportation, and transaction costs isolated the Canadian feed grain market from international markets, this one day lag was considered relatively efficient.

Hedging effectiveness for Canadian #1 cash feed oats and Minneapolis #1 Heavy oats (a food grade) was evaluated using both the CBT oats futures contract and the WCE oats futures contract. Price risk was reduced for both cash commodities best by their own respective futures hedging instruments. If it is accepted that Minneapolis #1 Heavy oats is a good proxy for #1 Canada Western oats, then the Canadian private trade is likely to hedge their holdings of Canada Western oats on the CBT oats futures contract. This will have a negative impact on future trading volume increases on the WCE oats contract. The CBT oats futures contract has an added benefit of increased liquidity. This lowers the bid-ask spread. Thus, hedgers can make transactions at small price increments, which lowers their hedging costs.

This analysis assumes that pricing of feed oats does not change in the futures, when it fact it may as a result of the WCE oat futures contract becoming an international market. Thus, changes in the pricing of WCE oat futures prices may change the hedging effectiveness of the WCE oat contract for both Canada Western and Canada Feed cash oats. This would also affect oat contract trading volume.

A model was constructed to forecast the WCE oats contract trading volume. The model explained 89 percent of the variation in oat contract trading volume. The potential for WCE oats contract volume to increase depends largely on the level of cash oats commercially hedged. The amount of cash oats commercially hedged depends on the ability of the WCE oats futures contract to price both CF and CW grade oats. Thus, the ability for the market to price both feed and food grade oats is directly related to trading volume. If the WCE oats contract prices both feed and food grade oats efficiently, the increase in commercial hedging could increase oat contract trading volume to 250,000 contracts, at a minimum. Commercial hedging for CW grade oats would be expected for at least the total of exports (750,000 tonnes in 1988/1989 crop year) and domestic food consumption of 85,000 tonnes. Whereas, current oats commercially hedged on the WCE feed oats contract is under 200,000 tonnes. On the other hand, if pricing is efficient only for CF grade oats, oat contract volume may not increase much above current volume. Other sources of increased volume may be increased speculative or hedging interest because the oats contract is now trading internationally.

CHAPTER XV

FUTURE RESEARCH

One area of future research is the regional supply response model. The estimation of the total landbase for each province is specified as a linear model. The exogenous variable used in this study is the ratio of the total landbase over a three year moving average of previous summerfallow acreage. This specification appears accurate when summerfallow acreage continues to decline as it has until 1986. Summerfallow acreage in western Canada is expected to reach theoretical minimum levels some time in the near future. Thus, a non-linear specification of the total landbase model after 1986 may be the appropriate functional form for future forecasts.

Negative supply elasticities were encountered in various years (ie. when high flaxseed prices relative to other prices were encountered). Some relative revenue variables exhibited large negative coefficients, and causing the negative supply elasticities. Negative supply elasticities and negative relative revenue coefficients imply irrational behavior by agricultural producers. Thus, some further research is required in the specification of expected prices and yields in the relative revenue variables.

More research is also required in the area of future Winnipeg Commodity Exchange contract innovations. Cross-hedging results showed that Canada Western grade oats is likely to be commercially hedged on the Chicago Board of Trade oats futures contract. Further, there is a greater need for a Canadian commercial hedging instrument for Canada Western grade oats than Canada Feed grade oats. Commercial sales of Canada Western Sales in the 1988/1989 crop year were about 835,000 tonne (total exports 750,000 tonne, and domestic food consumption 85,000 tonnes), and domestic feed sales were under 200,000 tonnes. This suggests a possible need to innovate a new Canada Western grade oat futures contract. However, a food grade oat futures contract already exists at the CBT, and has the advantage of a higher level of liquidity than the WCE oat contract. Thus, more research is required for future WCE oat contract innovations.

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