AN ECONOMIC PROFILE OF THE ONTARIO GRAIN CORN INDUSTRY

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PREFACE

The purpose of this paper is to present an overview of the Ontario grain corn industry as it evolved between the early 1970's and the middle of 1983. In addition, projections of the growth potential of the Ontario grain corn industry, and the international feed grain market, over the next five to ten years, are analyzed and discussed. Most of the data and information contained in the report are taken from published sources. Nevertheless, to the best of the author's knowledge no single report contains information on the production, marketing and processing of Ontario grain corn, as well as its relationship to the international feed grain market. As such this report should be of interest to all participants in the Ontario grain corn industry.

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Special thanks are due Dr. John Meek (Agriculture Canada) who developed the broad outline of this study and made many useful observations on its content. As well, Dr. Harry deGorter (Agriculture Canada) and Professor Ellen Goddard (University of Guelph) reviewed the manuscript and provided numerous useful comments prior to its publication. The author is, however, responsible for any remaining errors of fact or interpretation.

Karl Meilke
Sept. 1984

EXECUTIVE SUMMARY

1. Measured in terms of farm cash crop receipts corn is the second most important crop produced in Ontario. Between 1960 and 1981 corn's share of Ontario cash crop receipts grew from 4.0 to 19.9 percent.

2. Corn production in Ontario increased from 0.168 million metric tonnes in 1947 to a record 5.235 mmt in 1981 as a result of both area and yield increases. Under favorable economic and weather conditions Ontario corn production could reach 6.777 mmt by 1990, based on 2.5 million acres harvested and an average yield of 106.4 bushels per acre.

3. Grain corn acreage in Ontario has expanded primarily at the expense of oats and mixed grains, and as a result of the addition of about one million acres of field crops between 1971 and the early 1980's.

4. Ontario is the major corn producing province in Canada but its market share has declined from 90 percent in the early 1970's to around 80 percent in the early 1980's. The decline in Ontario's share of total corn production, even in light of substantial output expansion, is due to the very rapid production increases in Quebec and Manitoba.

5. Historically corn production in Ontario has been located in Southern Ontario but future area increases are likely to be concentrated outside Southern Ontario. Southern Ontario's share of Ontario corn production may fall from its current level of 56.1 percent to 50.0 percent by 1990.

6. In 1981, eight Ontario counties contained over 100,000 acres of grain corn and 13 counties had over 25 percent of their cropland devoted to corn.

7. The average size of grain corn farms in Ontario has increased substantially since 1971. In 1971, 19.7 percent, and in 1981, 32.1 percent of Ontario corn farms contained more than 78 acres of corn.

8. In 1973, Ontario's production of grain corn was 0.234 mmt less than its use of grain corn for animal feed. By 1981, Ontario produced 1.58 mmt more corn than was consumed by Ontario livestock. Ontario's corn production in 1990 may exceed its use as a livestock feed by 2.9 to 3.0 mmt.

9. In 1973/74 Ontario had a net deficit in corn use of 0.242 mmt, or 7.8 percent of total corn use. In 1980/81 Ontario had a net surplus in corn use of 0.926 mmt, or 23.9 percent of total corn use. By 1990 Ontario's net surplus could reach 1.8 mmt.

10. Feed grain production in Quebec is expected to double by 1990. This coupled with slow growth in livestock production will result in Quebec's feed grain deficit declining from its current level of approximately 2.0 to 2.5 mmt to 1.4 mmt.

11. Canada has traditionally been a net importer of corn but net imports have declined substantially since the early 1970's. Between 1973 and 1975 Canada's net corn imports averaged 1.05 mmt per year. In 1981/82, Canada was a net exporter of 0.3 mmt of corn, and gross exports reached 1.131 mmt.

12. The variable costs of producing corn in Southern Ontario and the United States, on a per bushel basis, are very similar. In 1980, total variable costs of corn production in Southern Ontario were estimated to be $1.59/bu. and in the United States $1.60/bu.

13. Average corn yields in both Ontario and the United States are projected to increase by 12.9 percent between 1981 and 1990. Average corn yields in Ontario are projected to equal 106.4 bu./acre and yields in the U.S. 115.6 bu./acre by 1990.

14. Corn prices in Ontario generally follow world price trends as established on the Chicago futures market. The difference between the Chatham cash price and the Chicago futures price is influenced by five major factors: (1) seasonality; (2) the corn supply-demand balance in eastern Canada; (3) western Canada feed grain availability; (4) the U.S. corn supply; and (5) the value of the Canadian dollar.

15. On average, corn prices increase from their harvest low in November, to their peak in the following July or August. However, this price pattern is not consistent from one year to the next which creates marketing problems for corn producers.

16. Corn producers can choose from a wide variety of marketing alternatives, represented by, but not restricted to, (a) cash sales, (b) fixed price forward contracts, (c) deferred pricing, basis or option contracts, (d) hedging and (e) replacing physical corn with a long position in the futures market. However, for producers to benefit from the selection of marketing options available, research and educational programs are needed to help producers select the marketing strategy that best fits their financial and risk bearing situation.

17. On average, simple hold and store strategies for marketing corn were not very successful in increasing the price producers could receive for their corn. More sophisticated marketing strategies, such as those analyzed by Martin and Hope, however, have the potential to substantially increase producers returns. More research on farmer marketing strategies is clearly warranted.

18. The corn wet milling industry, in Ontario, has expanded its capacity from less than 50,000 bushels per day in the mid 1970's to 123,000 bushels per day in 1983. Corn used for industrial purposes has increased from 0.613 mmt in 1976/77 to 0.870 mmt in 1981/82. By 1990 the industrial demand for corn in Ontario could reach 1.2 to 1.5 mmt.

19. The demand for corn for livestock feed, in Ontario and Quebec, is expected to increase only moderately by the end of the decade. Consequently, offshore exports of corn by Ontario may reach 1.5 mmt by 1990.

20. Between 1960 and 1980 international trade in coarse grains increased from 24.0 mmt to a record 105.7 mmt. However, in 1981/82 trade declined by 1.5 mmt and in 1982/83 by 15.5 mmt, both declines occurring in the face of low world prices, thus raising questions with regard to the long term health of the industry.

21. Corn is the principle coarse grain produced in the world, representing 56.4 percent of total world coarse grain production and 69.9 percent of trade in 1982/83.

22. The U.S. is the world's largest producer of corn, with 48.4 percent of world production, and dominated world corn exports with a market share of 74.3 percent, in 1982/83. Canada is a small trader in the world corn market.

23. The U.S.S.R., Japan, Spain, East Europe and a number of developing countries are the major importers of corn. Japan is the world's largest single country corn importer, with a market share of 17.7 percent in 1981/82.

24. In considering the possible path of corn prices over the next decade the historical evidence suggests that <u>real</u> corn prices declined, on average, 1.5 cents per bushel, per year, between 1950 and 1981. There appears to be little evidence to support the "scarcity syndrome", however, corn prices in the future may be quite volatile as a result of poor weather and individual countries isolating their domestic prices from world markets.

25. World corn prices are determined by supply/demand factors, represented by the stock/utilization ratio, and the U.S. loan rate for corn. The U.S. loan rate tends to set a floor price for world corn prices. Consequently, corn prices will remain close to the loan rate with stock/utilization ratios above 0.17. However, when the stock/utilization ratio falls below 0.17 there are sharp increases in corn prices.

26. The U.S.D.A. has projected world coarse grain imports to equal 157.1 mmt in 1991/92, a 42.7 percent increase from the 1979-81 level, while Steadman has projected an increase to 140 mmt by 1991/92. Both the U.S.D.A. and Steadman agree that most of the

trade growth will occur in developing countries. Demand growth in the developing countries is, however, conditional on a world-wide economic recovery and a satisfactory solution to their debt problems. World imports in the range of 140 to 160 mmt by the end of the decade should be accommodated without large price increases.

27. Supply control programs in the U.S. will be necessary to keep feed grain stocks at acceptable levels, in some years, over the next decade.

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CHAPTER 1

INTRODUCTION

1.1 Background

Grain corn is a commodity of growing importance within Ontario's agricultural economy. This is illustrated by its rise from sixth place, in 1960, to second place in 1981, in terms of its contribution to Ontario's farm cash crop receipts (table 1.1). Grain corn's share of cash crop receipts has advanced from 4.0 percent in 1960, to 11.0 percent in 1970, to 19.9 percent in 1981, only slightly less than tobacco's share of 20.8 percent. Moreover, these figures understate corn's importance because nearly one-half of all corn produced, in 1981, was utilized on the farm where it was produced, and hence is not included in farm cash receipts.

The enhanced importance of corn in Ontario has resulted from both area and yield increases. Between 1960 and 1983 the area planted to corn increased from 450,000 to 2,000,000 acres and yields advanced from less than 75 to about 95 bushels per acre.

This major increase in Ontario's corn supply has been matched by changes in its disposition. As late as 1974/75 Ontario was a net importer of corn, even though small quantities of Ontario corn were shipped into Quebec and the Maritimes. Exports on the international market were minuscule at 3900 metric tonnes (mt) in 1974/75, however, in just seven years, by 1981/82, Ontario was a net exporter of 1.271 million metric tonnes (mmt) of corn and shipments onto the international market exceeded one million metric tons. Growth in the use of corn within Ontario, while not as dramatic as that for export, was nonetheless impressive. Between the early 1970's and early 1980's the use of corn, both for feed and industrial purposes, expanded by approximately 50 percent.

The picture painted by the preceding discussion is of a vibrant rapidly growing industry; which, in less than twenty years has advanced from rather minor status to the second most important cash crop in Ontario. In addition, corn provides the major energy source for Ontario's three billion dollar livestock industry.

The growth of Ontario's corn industry, from its small scale in the early 1960's, to its present size presents challenges as well as opportunities for those involved in the industry. For many cash crop farmers the financial viability of their enterprises are directly related to corn prices and their marketing ability. In addition, the Ontario grain trade is becoming increasingly integrated into the international coarse grain market and adopting an export orientation rather than the traditional import orientation. This increased openness to the international market, which evolved over the 1970's, occurred at a time of rapidly expanding world trade in coarse grains, and generally

Table 1.1: Ontario Farm Cash Receipts by Commodity, Selected Years

	1960		1965		1970		1975		1981	
	$'000	Percent	$'000	Percent	$'000	Percent	$'000	Percent	$'000	Percent
Corn	9949	4.0	24775	8.4	49214	11.0	148114	16.8	346004	19.9
Wheat	15284	6.1	16951	5.7	23371	5.2	82689	9.4	134178	7.7
Oats	4024	1.6	3785	1.3	1878	0.4	2637	0.3	2781	0.2
Barley	686	0.3	1735	0.6	3412	0.8	7395	0.8	14797	0.8
Soybeans	10035	4.0	14120	4.8	23732	5.3	44925	5.1	163810	9.4
Potatoes	17983	7.2	23268	7.9	21852	4.9	34754	3.9	44631	2.6
Fruits	23528	9.5	29576	10.0	41185	9.2	63851	7.2	90000	5.2
Vegetables	43467	17.5	56435	19.1	77443	17.2	158688	17.9	215002	12.3
Tobacco	91697	36.9	84105	28.4	147313	32.8	186429	21.1	361845	20.8
Other Crops	31923	12.9	40938	13.8	59657	13.2	154130	17.5	366836	21.1
Total Crops	248576	100.0	295688	100.0	449057	100.0	883612	100.0	1739884	100.0

Source: O.M.A.F., Agricultural Statistics for Ontario 1981. Toronto.

favorable price relationships. In contrast, the early 1980's have been characterized by a decline in world grain trade and declining commodity prices. Many commentators feel the world grain markets have entered a period of general oversupply, and if this is true it will have serious implications for Ontario's corn industry.

The purpose of this study is to document the evolution of the Ontario corn industry over the past ten years and to project the potential growth of the industry over the next five to ten years. An important aspect of this assessment is a survey of the growth potential of the international coarse grains market.

1.2 Objectives

The objective of this study is to describe the evolution of the Ontario grain corn industry over the decade of the 1970's and to provide a profile of the industry as it exists in the early 1980's. This overview of the corn industry will include an assessment of (1) Ontario's grain corn production potential; (2) the marketing of corn in Ontario; (3) Ontario's corn processing sector; and, (4) the international market for coarse grains. Following from this description of the industry will be an analysis of the opportunities and constraints facing Ontario's grain corn industry over the next decade.

1.3 Outline of the Study

Chapter two deals with Ontario grain corn production in terms of (a) its geographical distribution; (b) its cost of production in comparison with the United States; (c) the number and size of farms producing corn; (d) the trend in corn yields in comparison with the United States; and, (e) the production of corn in Quebec.

Chapter three is concerned with the marketing of Ontario grain corn and includes a detailed discussion of the disposition of Ontario corn and corn price patterns.

Chapter four is concerned with the processing of Ontario corn and provides a general description of the processing sector.

Chapter five deals with the international market for corn and other feed grains. In this chapter the supply and demand characteristics of the major participants in the international feed grain market are analyzed and projections of future growth in world trade are discussed.

In chapters six and seven the information and analyses contained in the report are summarized and opportunities and constraints to the expansion of the Ontario corn industry are identified.

CHAPTER 2

ONTARIO GRAIN CORN PRODUCTION

2.1 Grain Corn Production

Grain corn production in Ontario has expanded rapidly in the post-war period from 6.6 million bushels in 1947 to a record 206.1 million bushels in 1981 (figure 2.1). The area planted to grain corn also rose rapidly, from 171,000 acres in 1947, to 565,000 acres in 1955. During the late 1950's the area planted to corn declined with only 396,000 acres harvested in 1961. Following this, however, corn acreage increased in each of the next ten years to reach 1,263,000 acres in 1971. Following small area declines in 1972 and 1973, acreage increased again for eight consecutive years reaching 2,171,800 acres in 1981 (table 2.1). Acreage in 1983 is estimated to be 2,000,000 acres. This more than five fold increase in grain corn area between 1961 and 1981 is the result of three primary factors: (1) plant breeding activities resulting in higher yielding, earlier maturing varieties; (2) improved chemical weed control; and, (3) the growing demand for a relatively cheap high energy livestock feed.

In considering whether the rapid growth in the grain corn growing area, which occurred between 1961 and 1981, can be repeated in the future it is important to consider how the expansion was accomplished. This question is partly answered by the information contained in table 2.2, where it is shown that the acreage of corn and soybeans has grown at the expense of oats, mixed grains and other crops. In 1970, grain corn and soybeans accounted for 18.7 percent of Ontario's field crop area, but by 1981 this percentage had grown to 33.6. The expansion in grain corn production also benefitted from the addition of 1,016,000 acres of principal field crops between 1971 and 1981.

Based on past experience it seems likely that the area sown to corn will continue to expand. However, in the future economic forces will play a much larger role in corn planting decisions than in the 1960's and 1970's, and the trend expansion in corn area may slow down.

Grain corn competes most directly with soybeans for land in Southern Ontario, and with other feed grains in other parts of the province. The price of corn relative to the price of soybeans is a key factor in determining which crop a farmer will grow. Table 2.3 compares changes in the price of corn, relative to the price of soybeans, with changes in grain corn area for crop years 1970/71 through 1981/82. It is clear from table 2.3 that changes in corn area have been dominated by a large upward trend. In only two years 1972/73 and 1973/74 has there been a year-to-year area decline. However, around the trend increase, the corn/soybean price ratio has played a role. This can be seen by separating the data into two groups: (1) six years when the corn/soybean price ratio was relatively low (.30 to .42); and, (2) five

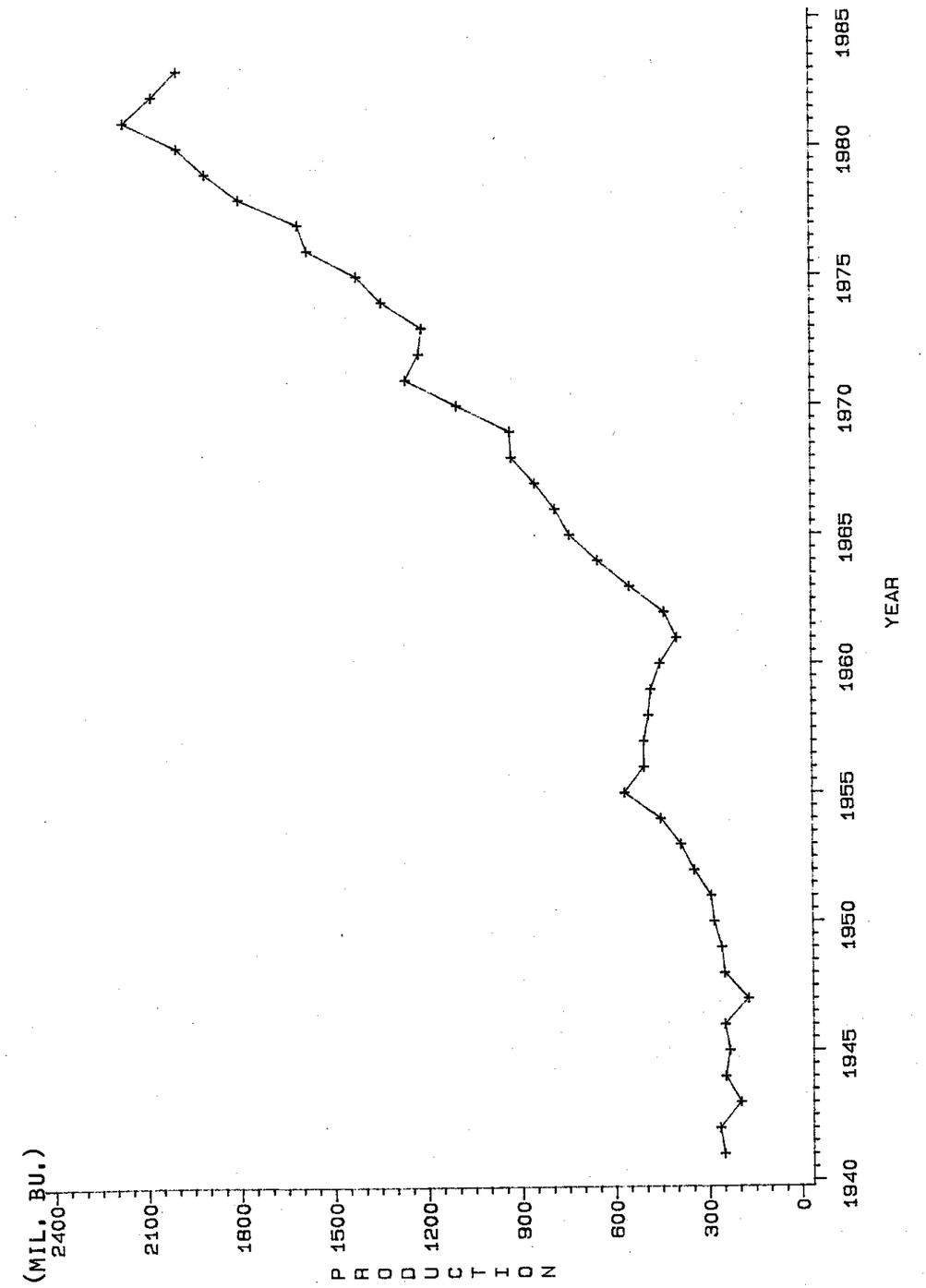

FIG. 2.1: ONTARIO GRAIN CORN PRODUCTION, 1941-1982, ('000 BU.)

Table 2.1: Ontario Grain Corn Area, Yield, Production, Average Farm Price and Farm Value, 1970 to 1983

Year	Area ('000 acres)	Yield (bu./acre)	Production (mil. bu.)	Ave. Farm Price ($/bu.)	Farm Value (mil. dol.)
1970	1100.0	85	93500	1.36	127160
1971	1263.0	81	102303	1.15	117648
1972	1220.0	76	92720	1.63	151134
1973	1210.0	86	104060	2.53	263272
1974	1340.0	70	93800	3.03	284214
1975	1420.0	92	130632	2.52	329193
1976	1580.2	85	134926	2.12	286043
1977	1610.0	95	152244	2.15	327325
1978	1800.0	84	151213	2.79	421884
1979	1910.0	90	171900	3.03	520857
1980	2000.0	93	185424	3.84	712028
1981	2171.8	95	206120	2.87	591282
1982	2080.0	98	204511	2.84	580800
1983	2000.0	92	184874	3.97	733958

N/A = not available

Source: O.M.A.F. Agricultural Statistics for Ontario. Various issues, Toronto.

Table 2.2: Ontario Field Crop Acreage, Total and Selected Crops, 1970-1983, ('000 acres)[a/]

Year	Pricipal Field Crops	Grain Corn	percent	Soybeans	percent	Barley	percent	Oats and Mixed Grains	percent	Other Crops	percent
1970	7676	1100	14.3	335	4.4	335	4.4	1670	21.7	4236	55.2
1971	7511	1263	16.8	367	4.9	386	5.1	1579	21.0	3916	52.1
1972	7560	1220	16.1	405	5.4	375	5.0	1515	20.0	4045	53.5
1973	7669	1210	15.8	470	6.1	350	4.6	1450	18.9	4189	54.6
1974	7961	1340	16.8	415	5.2	340	4.3	1345	16.9	4521	56.8
1975	8037	1420	17.7	390	4.9	360	4.5	1370	17.0	4497	55.9
1976	8265	1580	19.1	378	4.6	371	4.5	1371	16.6	4565	55.2
1977	8279	1610	19.4	550	6.6	320	3.9	1260	15.2	4539	54.8
1978	8363	1800	21.5	705	8.4	360	4.3	1255	15.0	4243	50.7
1979	8459	1910	22.6	690	8.1	336	4.0	1196	14.1	4327	51.2
1980	8508	2000	23.5	685	8.1	405	4.8	1170	13.8	4248	49.9
1981	8527	2172	25.5	689	8.1	466	5.5	1109	13.0	4091	48.0
1982[p/]	8502	2080	24.5	900	10.6	580	6.8	1110	13.0	3832	45.1
1983[e/]	8528	2000	23.4	930	10.9	525	6.2	1015	11.9	4058	47.6

p/ = preliminary
e/ = estimated

a/ Acreage estimates for grain corn incorporate changes as a result of the 1981 Census but estimates for other crop areas do not.

Source: O.M.A.F. Agricultural Statistics for Ontario. Various issues, Toronto.

Table 2.3: Ontario Corn/Soybean Price Ratios and Corn Acreage and Production Changes, 1970/71 to 1981/82

Crop Year	Average Farm Price of Corn ($/bu.)	Average Farm Price of Soybeans ($/bu.)	Corn Price / Soybean Price	Percentage Change in Corn Area (percent)	Percentage Change in Corn Production (percent)
1970/71	1.36	2.78	0.49	+18.3	+33.9
1971/72	1.15	2.96	0.39	+14.8	+ 9.4
1972/73	1.63	3.90	0.42	- 3.4	- 9.4
1973/74	2.53	5.45	0.46	- 0.8	+12.2
1974/75	3.03	6.34	0.48	+10.7	- 9.8
1975/76	2.52	4.92	0.51	+ 6.0	+39.3
1976/77	2.12	7.05	0.30	+11.3	+ 3.3
1977/78	2.15	6.54	0.33	+ 1.9	+12.8
1978/79	2.79	7.64	0.37	+11.8	- 0.7
1979/80	3.03	7.12	0.42	+ 6.1	+13.7
1980/81	3.84	8.53	0.45	+ 4.7	+ 7.9
1981/82	2.87	7.13	0.40	+ 8.6	+11.2

Source: O.M.A.F. Agricultural Statistics in Ontario. Various issues, Toronto.

years when the corn/soybean price ratio was relatively high (.45 to .51). The average percentage increase in corn area following years of low corn/soybean price ratios was 3.4 percent, versus a 10.3 percent increase in years following high corn/soybean price ratios. Clearly, corn/soybean price ratios close to 0.50 result in large corn area increases.

Statistical support for the above conclusion is provided by the following estimated acreage response function,

2.1 ACO2 = -4333.1 + 457.3 FPCO2(-1)/FPSO2(-1) + 42.8 Trend
t value (-1.64) (1.35) (1.54)
elasticity [.12]

+ 0.65 ACO2(-1)
(2.14)

R^2 = 0.97 D.W. = 1.80 Sample period 1971 to 1981

where, ACO2 is Ontario corn acreage ('000 acres); FPCO2 is the farm price of corn ($/bu.); FPSO2 is the farm price of soybeans ($/bu.); and, Trend is a linear time trend with 1971 = 106, 1971 = 107 etc. The short-run price elasticity estimated from equation 2.1 is 0.12 and the long-run elasticity is 0.34 (Nerlove). The short-run elasticity indicates that a one percent change in the corn/soybean price ratio will lead to a 0.12 percent change in the acreage of corn harvested in the next crop year. The average annual trend increase in corn area, over the eleven years 1971-1981, after adjusting for price variations was 42,837 acres per year.

Using equation 2.1 to project Ontario's corn area to 1990, beginning with 1983's estimated acreage of two million, and assuming a stable corn/soybean price ratio of 0.42 results in an acreage estimate of 2.5 million acres. This is probably an upper estimate of expected corn acreage, except under very favorable corn/soybean price relationships, given the fact that the historical trend in acreage expansion is expected to decline. However, the 1990 estimate is only 15 percent above 1980's record corn acreage and consequently appears within the realm of possibility.

Corn production in Ontario has increased not only because of area increases but also as a result of yield improvements. Corn yields in the early 1950's averaged slightly more than 58 bushels per acre. By the early 1960's average corn yields had increased to 75 bushels per acre, and by the early 1980's to over 90 bushels per acre.

A complete discussion and analysis of Ontario's corn yields is contained in section 2.6. Using the estimates calculated there for Ontario's average corn yield in 1990, of 106.4 bushels per acre, results in a potential Ontario corn crop of 266 million bushels (6.777 mmt) in

1990 under favorable economic and environmental conditions.

2.2 Spatial Distribution of Production

Ontario is the major corn producing province in Canada but its share of Canadian grain corn production has declined from more than 90 percent in the early 1970's to around 80 percent in the early 1980's (table 2.4). The decline in Ontario's share of total production, even in light of substantial output expansion, is due to the very rapid production increases in Quebec and Manitoba.

Within Ontario grain corn production has been concentrated, historically, in Southern Ontario. However, during the 1970's there was a rapid expansion of corn production in both Western and Eastern Ontario (table 2.5). During the decade of the 1970's Southern Ontario's share of provincial corn production fell from nearly 75 percent to around 55 percent, while Western Ontario's share increased from approximately 14 to 28 percent, and Central Ontario's from less than 5 to nearly 10 percent. Eastern Canada's share of provincial production has been fairly constant at 5-6 percent.

Table 2.6 shows the distribution of grain corn production in Ontario, for 1976 and 1981, by county. In 1976, five counties (Kent, Middlesex, Huron, Oxford, Elgin) had over 100,000 acres planted to grain corn and eight counties had more than 25 percent of their cropland devoted to corn (table 2.7). By 1981, eight counties had corn acreage in excess of 100,000 acres and thirteen counties had over 25 percent of their cropland devoted to corn. Large area increases occurred between 1976 and 1981 in Huron, Middlesex, Oxford, Perth, Simcoe and Wellington counties.

2.3 Number of Farm Production Units and Trends in Their Size

Information on the number of farms growing grain corn and the percent of crop farmers in each Ontario county who grew corn, in 1976 and 1981, is contained in tables 2.6 and 2.7. In seven Ontario counties (Brant, Elgin, Huron, Kent, Lambton, Middlesex, Oxford) more than 50 percent of the farmers reported growing corn in both 1976 and 1981. In 1981, Perth county also had more than 50 percent of its farmers raising corn. Between 1976 and 1981 the number of farmers raising corn across the Province increased from 23,628 to 26,616 or roughly one-third of the total number of crop farmers in each year. In 1976, 30 counties, and in 1981, 38 counties reported more than 10 percent of the farmers raising corn.

The average area planted to grain corn varies widely across counties (table 2.6). In York county the average corn grower planted 140.1 acres of corn in 1981, up from 111.2 acres in 1976. Seven counties in 1981 contained farms with average corn areas in excess of 100 acres; namely, Elgin (102.9), Halton (121.1), Lennox-Addington

Table 2.4: Canadian Grain Corn Production, Ontario, Quebec and Total, 1970/71 to 1982/83, '000 mt

Crop Year	Ontario prod.	Ontario percent	Quebec prod.	Quebec percent	Other[a/] prod.	Other[a/] percent	Canada prod.
1971/72	2598.6	88.4	331.3	11.3	11.2	0.3	2941.1
1972/73	2355.2	91.7	194.0	7.6	17.8	0.7	2567.0
1973/74	2643.2	91.8	214.3	7.4	22.4	0.8	2879.9
1974/75	2382.6	91.0	232.3	8.9	4.8	0.1	2619.7
1975/76	3318.2	91.0	307.6	8.4	19.1	0.6	3644.9
1976/77	3427.3	81.2	303.0	8.1	29.0	0.7	3759.3
1977/78	3867.3	91.0	342.9	8.1	39.3	0.9	4249.5
1978/79	3841.0	85.7	491.5	11.0	147.0	3.3	4479.5
1979/80	4366.5	82.8	701.0	13.3	208.6	3.9	5276.1
1980/81	4710.0	81.9	838.2	14.6	205.0	3.5	5753.2
1981/82	5236.0	78.4	975.4	14.6	462.0	7.0	6673.4
1982/83[p/]	5195.0	81.4	910.0	14.3	277.9	4.3	6382.9

a/ primarily Manitoba
p/ preliminary

Sources: Canada Grains Council. Statistical Handbook 81. Winnipeg.
Statistics Canada. Supply and Disposition of Major Grains. Mimeo, May 1983.

Table 2.5: Ontario Grain Corn Production, by Region, 1970 to 1982, '000 bushels

Year	Region[a/] Southern Ontario prod.	percent	Central Ontario prod.	percent	Eastern Ontario prod.	percent	Western Ontario prod.	percent	Ontario Total prod.
1970	69862	74.7	5128	5.5	5117	5.5	13392	14.3	93500
1971	70155	68.6	6374	6.2	6617	6.5	19156	18.7	102303
1972	65774	70.9	6516	7.0	2505	2.7	17925	19.3	92720
1973	70549	67.8	7146	6.9	4049	3.9	22316	21.4	104060
1974	64855	69.1	6744	7.2	3376	3.6	18825	20.1	93800
1975	86877	66.5	8264	6.3	6622	5.1	28869	22.1	130632
1976	77546	57.5	8437	6.3	5383	4.0	28657	21.2	134926[b/]
1977	94646	62.2	12089	7.9	7083	4.6	38426	25.2	152244
1978	89435	59.1	11456	7.6	9041	6.0	41281	27.3	151213
1979	95058	55.3	15869	9.2	9686	5.6	51287	29.8	171900
1980	103864	56.0	18300	9.9	10833	5.8	52427	28.3	185424
1981	116576	56.5	19997	9.7	13342	6.5	56205	27.3	206120
1982	114651	56.1	20703	10.1	14452	7.0	54750	26.8	204511

a/ Regional production figures have been adjusted to equal census revised provincial production figures.

b/ Includes 14,903,000 bushels grown in Northern Ontario according to the 1976 census.

Table 2.6: Grain Corn Production in Ontario by County, 1976 and 1981[a/]

Country & Region	Grain Corn Area (acres)		# of Farms Growing Grain Corn		Average Grain Corn Acreage per Farm	
	1976	1981	1976	1981	1976	1981
Southern Ontario:						
Brant	50891	57202	601	597	84.7	95.8
Elgin	120126	142454	1505	1385	79.8	102.9
Essex	78351	62495	1490	1175	25.5	53.2
Haldimand-Norfolk	83586	108215	1532	1570	54.6	68.9
Hamilton-Wentworth	19805	30607	360	437	55.0	70.0
Kent	219193	204082	2598	2310	84.4	88.3
Lambton	92548	110615	1606	1572	57.6	70.4
Middlesex	147374	204979	2138	2267	68.9	90.4
Niagara	19982	41720	437	606	45.7	68.8
Oxford	127997	158831	1657	1774	77.2	89.5
Total	959853	1121200	13924	13693	68.9	81.9
Western Ontario:						
Bruce	29907	50448	574	769	52.1	65.6
Dufferin	4132	7173	63	103	65.6	69.6
Grey	9907	19511	288	446	34.4	43.7
Halton	7490	19500	88	161	85.1	121.1
Huron	129116	199739	1923	2240	67.1	89.2
Peel	9427	15171	70	131	134.7	115.8
Perth	71411	116211	1238	1545	57.7	75.2
Simcoe	43424	77052	512	701	84.8	109.9
Waterloo	49880	56906	703	734	71.0	81.6
Wellington	37676	60029	615	758	61.3	79.2
Total	392370	621740	6074	7588	64.6	81.9

Table 2.6 cont'd.

Country & Region	Grain Corn Area (acres)		# of Farms Growing Grain Corn		Average Grain Corn Acreage per Farm	
	1976	1981	1976	1981	1976	1981
Central Ontario:						
Durham	39567	71953	525	773	75.4	93.1
Hastings	5760	14075	126	247	45.7	57.0
Muskoka	8	148	2	6	4.0	24.7
Northumberland	24474	52152	400	575	61.2	90.7
Parry Sound	7	12	2	4	3.5	3.0
Peterborough	9022	21518	183	352	49.3	61.1
Prince Edward	11165	20947	229	289	48.8	72.5
Toronto	868	1412	4	13	217.0	108.6
Victoria	10684	27131	199	344	53.7	78.9
York	27677	45523	249	325	111.2	140.1
Total	129232	259871	1919	2928	67.3	87.0
Eastern Ontario:						
Dundas	11280	24909	230	326	49.0	76.4
Frontenac	2380	2989	44	55	54.1	54.3
Glengarry	12354	27193	273	363	45.3	74.9
Grenville	4778	8313	106	146	45.1	56.9
Lanark	4419	9780	85	150	52.0	65.2
Leeds	3493	7095	80	149	43.7	47.6
Lennox & Addington	5543	11938	59	101	94.0	118.2
Ottawa-Carleton	16868	33259	248	357	68.0	93.2
Prescott	6549	11783	166	214	39.5	55.1
Renfrew	4234	3006	81	72	52.3	41.8
Russell	7689	14166	110	168	69.9	84.3
Stormont	8988	19219	211	286	42.6	67.2
Total	88575	173650	1693	2387	52.3	72.7

Table 2.6 cont'd.

Country & Region	Grain Corn Area (acres)		# of Farms Growing Grain Corn		Average Grain Corn Acreage per Farm	
	1976	1981	1976	1981	1976	1981
Northern Ontario:						
Algoma	16	1550	3	70	5.3	22.4
Nipissing	20	88	4	4	5.0	22.0
Rainy River	0	128	0	5	0	25.6
Sudbury	68	46	5	3	13.6	15.3
Total	104	1812	12	82	8.7	22.1

a/ Counties with less than ten acres of grain corn in 1981 are omitted.

Sources: O.M.A.F. Agricultural Statistics for Ontario 1981. Toronto.

Statistics Canada. Census of Canada 1976, Agriculture: Ontario. Cat. No. 96-806 (Bul. 12-2), Ottawa.

Table 2.7: Grain Corn Production as a Percent of Total Cropland, in Ontario, by County, 1976 and 1981[a/]

	Percent of Total Cropland in Grain Corn		Percent of all Crop Farmers Growing Grain Corn	
	1976	1981	1976	1981
Southern Ontario:				
Brant	36.4	39.9	52.4	52.0
Elgin	42.2	47.5	71.6	69.1
Essex	24.1	19.0	48.6	38.7
Haldimand-Norfolk	22.7	26.7	43.3	42.0
Hamilton-Wentworth	17.8	25.6	30.0	30.9
Kent	44.8	40.3	81.0	73.8
Lambton	22.8	24.1	53.5	52.2
Middlesex	32.6	41.9	64.1	69.3
Niagara	12.0	22.6	15.5	18.5
Oxford	38.7	45.5	64.6	70.2
Total	31.2	34.1	53.6	51.6
Western Ontario:				
Bruce	9.4	14.3	20.9	28.1
Dufferin	3.0	5.4	5.8	9.3
Grey	3.1	5.8	8.7	12.8
Halton	10.0	23.8	12.4	19.2
Huron	25.1	36.0	54.3	64.0
Peel	9.5	16.4	9.3	15.9
Perth	18.9	29.0	41.2	52.2
Simcoe	12.5	20.5	17.5	22.7
Waterloo	26.8	30.0	44.7	44.8
Wellington	11.2	16.6	22.4	25.9
Total	14.4	21.6	27.1	32.9

Table 2.7 cont'd.

	Percent of Total Cropland in Grain Corn		Percent of all Crop Farmers Growing Grain Corn	
	1976	1981	1976	1981
Central Ontario:				
Durham	18.7	31.4	26.3	35.5
Hastings	4.4	10.1	9.4	17.1
Muskoka	0.1	1.7	1.5	3.3
Northumberland	15.5	29.4	26.6	35.9
Parry Sound	*	*	0.5	1.0
Peterborough	7.7	16.9	13.9	24.8
Prince Edward	11.3	20.4	30.3	38.9
Toronto	29.2	22.0	9.8	11.7
Victoria	7.7	18.1	12.5	20.7
York	17.7	28.4	18.3	21.8
Total	12.3	23.0	18.4	26.0
Eastern Ontario:				
Dundas	10.3	21.6	24.9	36.1
Frontenac	2.9	3.6	5.3	6.3
Glengarry	12.3	24.2	31.6	39.2
Grenville	8.4	14.8	17.9	22.5
Lanark	4.7	1.0	7.9	13.7
Leeds	3.5	7.3	7.8	14.4
Lennox & Addington	6.1	13.1	7.0	12.2
Ottawa-Carleton	9.6	17.4	16.0	19.5
Prescott	5.4	9.2	18.7	23.8
Renfrew	3.0	2.0	5.7	4.5
Russell	11.1	18.9	19.1	29.6
Stormont	11.2	23.4	30.2	40.2
Total	7.3	13.6	15.0	26.2

Table 2.7 cont'd.

	Percent of Total Cropland in Grain Corn		Percent of all Crop Farmers Growing Grain Corn	
	1976	1981	1976	1981
Northern Ontario:				
Algoma	*	4.0	0.9	15.8
Nipissing	*	0.2	1.0	1.0
Rainy River	*	0.2	*	1.2
Sudbury	0.2	0.2	1.4	0.7
Total	0.1	1.1	0.8	4.9

a/ Counties with less than ten acres of grain corn in 1981 are omitted.

* = less than 0.05.

Sources: O.M.A.F. Agricultural Statistics for Ontario 1981. Toronto.

Statistics Canada. Census of Canada 1976, Agriculture: Ontario. Cat. No. 96-806 (Bul. 12-2), Ottawa.

(118.2), Peel (115.8), Simcoe (109.9), Toronto (108.6) and York (140.1). This is up from only three counties (Peel, Toronto, York) with grain corn farms averaging more than 100 acres in 1976.

The average area planted to grain corn, per farm, has increased markedly since 1971. As shown in table 2.8, in 1971, only 19.7 percent of Ontario corn farms had more than 78 acres of corn. By 1976 this percentage increased to 25.3 percent and by 1981 to 31.1 percent. The number of farms with more than 128 acres of corn nearly doubled between 1971 and 1981, increasing from 9.4 percent to 16.9 percent. Table 2.9 indicates that the size distribution of corn farms across Ontario was very similar in 1981, although corn farms in Eastern Ontario tended to be slightly smaller than those in the South, West and Central regions. The very few corn farms in Northern Ontario tended to be quite small.

2.4 Production and Utilization of Grain Corn by Major Region in Ontario

Table 2.10 contains estimates of the regional consumption of grain corn, for animal feed from 1973 through 1981. Consumption estimates were calculated by (1) estimating the consumption of total feed grains in each region based on the number of grain consuming animal units in the region; (2) adjusting the total consumption data so that it equaled the total estimated disappearance of feed grains in Ontario; and (3) subtracting the production of feed grains other than corn, in each region from total consumption.[1/] Although the procedure used to calculate the feed consumption of corn is fairly crude it does result in clear evidence that Ontario has moved from a deficit position in 1973 to a substantial surplus position in 1981.

All regions in Ontario have become increasingly self-sufficient in grain corn production, over the study period. Southern Ontario was a surplus producer of grain corn over the entire period, while Western Ontario switched from a substantial deficit position, of 401,000 mt in 1973, to a surplus position of 115,000 mt in 1981. Similarly, Central Ontario moved from a small deficit (122,000 mt) in 1973 to a small surplus (177,000 mt) in 1981. Only, Eastern Ontario remains a deficit producing region, but the deficit has been cut by more than 85 percent between 1973 and 1981, declining from 337,000 mt to 43,000 mt.

Data on corn production in Northern Ontario is incomplete with 378,000 mt of production reported in 1976 and none for all other years. In any case production of other feed grains in Northern Ontario are sufficient to meet most of the region's feeding requirements. Regional

1/ The adjustments necessary to make the estimated consumption figures equal the estimated disappearance figures were generally less than 10 percent. The corn consumption figures reported in table 2.10 include the consumption of Western feed grains. It was impossible to subtract the consumption of Western feed grains since the region in which they were consumed was unknown. All feed grains were converted to corn equivalents based on their relative energy values.

Table 2.8: Distribution of Farms Growing Corn in Ontario, by Size, 1971, 1976 and 1981

Farm Size	1971		1976		1981	
(acres)	No.	Percent	No.	Percent	No.	Percent
1-7	2061	9.2	1446	6.1	1411	5.3
8-32	10045	44.7	9261	39.2	8772	33.0
33-77	5916	26.4	6959	29.4	7891	29.6
78-127	2304	10.3	2986	12.6	4036	15.2
128 & over	2105	9.4	2976	12.7	4506	16.9
Total	22431	100.0	23628	100.0	26616	100.0

Sources: O.M.A.F. Agricultural Statistics for Ontario 1981. Toronto.

Statistics Canada. Census of Canada 1976, Agriculture: Ontario. Cat. No. 96-806 (Bul. 12-2), Ottawa.

Statistics Canada. Census of Canada 1971, Agriculture: Ontario. Cat. No. 96-707, Vol. IV - Part 2 (Bulletin 4.2-2), Ottawa.

Table 2.9: Distribution of Farms Growing Corn in Ontario, by Size and Region, 1981

Farm Size	Region							
	Southern Ontario		Western Ontario		Central Ontario		Eastern Ontario		Northern Ontario	
(acres)	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent
1-7	698	5.1	402	5.3	153	5.2	147	6.2	11	55.0
8-32	4296	31.4	2458	32.4	1083	37.0	930	39.0	5	25.0
33-77	4141	30.2	2255	29.7	798	27.3	693	29.0	4	20.0
78-127	2167	15.8	1206	15.9	386	13.2	277	11.6	0	0.0
128 & over	2391	17.5	1267	16.7	508	17.3	340	14.2	0	0.0
Total	13693	100.0	7588	100.0	2928	100.0	2387	100.0	20	100.0

Source: O.M.A.F. Agricultural Statistics for Ontario 1981. Toronto.

Table 2.10: Ontario Corn Consumption and Production, by Region, 1973 to 1981[a/]

Region	1973	1974	1975	Crop Year 1976	1977	1978	1979	1980	1981
					- '000 mt -				
Southern Ontario:									
Feed Consumption	1121	898	959	995	1237	1243	1445	1442	1631
Production	1792	1647	2207	1970	2404	2272	2415	2638	2961
Surplus (Deficit)	671	749	1248	975	1167	1029	970	1196	1330
Western Ontario:									
Feed Consumption	968	698	855	845	1049	1010	1176	1205	1313
Production	567	478	733	728	976	1048	1303	1332	1428
Surplus (Deficit)	(401)	(220)	(122)	(117)	(73)	38	127	127	115
Central Ontario									
Feed Consumption	304	177	214	244	274	277	286	293	331
Production	182	171	210	214	307	291	403	465	508
Surplus (Deficit)	(122)	(7)	(4)	(30)	33	14	117	172	177
Eastern Ontario:									
Feed Consumption	440	291	339	321	376	340	319	339	382
Production	103	86	168	137	180	230	246	275	339
Surplus (Deficit)	(337)	(205)	(171)	(184)	(196)	(110)	(73)	(64)	(43)
Northern Ontario:									
Feed Consumption	44	42	33	16	23	0	4	0	0
Production	0	0	0	378	0	0	0	0	0
Surplus (Deficit)	(44)	(42)	(33)	362	(23)	0	(4)	0	0
Ontario:									
Feed Consumption	2877	2107	2400	2422	2959	2865	3230	3278	3656
Production	2643	2383	3318	3427	3867	3841	4367	4710	5236
Surplus (Deficit)	(234)	274	918	1005	908	976	1137	1432	1580
Industrial Use	638	645	596	643	613	749	852	888	870
Surplus (Deficit)	(872)	(371)	322	362	295	227	285	544	710

a/ The corn consumption figures also include the consumption of Western feed grains. See footnote 1.

trends in grain corn production indicate that if Ontario production expands to 6.777 mmt by 1990 approximately 3.39 mmt will be Southern Ontario, 2.03 mmt in Western Ontario, 0.810 mmt in Central Ontario and 0.542 mmt in Eastern Ontario.

Grain corn is, of course, used for purposes other than animal feed, but since 1975 Ontario production has been large enough to meet both its need for corn, used in animal feed, and for industrial purposes. The surplus production is available for storage, exports and shipments to other provinces.

Agriculture Canada has projected little change in Ontario consumption of feed grains, for animal feed, between 1980 and 1990. Given grain corn production increases of the magnitude discussed above, the production of feed grains, other than corn, will probably remain near current levels of 1.6 mmt. With corn production of 6.777 mmt, production of other feed grains of 1.6 mmt, and feed grain utilization of 5.4 mmt, Ontario's corn surplus above animal feed requirements could reach 2.9-3.0 mmt by 1990, roughly double its current level.

2.5 Cost of Production

Data collected by Fisher and Davies and O.M.A.F. (1981) can be used to compare the cost of producing corn in Southern Ontario in 1973, 1974 and 1980 (table 2.11). In 1980, 42.0 percent of the cost of growing corn was attributed to operating costs and 58.0 percent to fixed costs; the major item of which is the opportunity cost for land, accounting for more than 60 percent of total fixed costs and 35.3 percent of total costs. Within the operating cost category, the cost of seed, fertilizer, sprays and drying fuel was estimated to account for 27.9 percent of total costs and 66.4 percent of total variable costs.

Total operating costs increased by 222.2 percent between 1973 and 1980, with nearly 30 percent of this increase occurring between 1973 and 1974. Variable costs have increased more rapidly than fixed costs with estimated increases of 233.3 percent and 214.7 percent, respectively, between 1973 and 1980.

It is of some interest to compare the costs of producing corn in Ontario with its major competitor the United States. Since Ontario's corn prices are determined primarily by developments in the United States (see section 3.6) higher variable costs of production in Ontario are likely to be reflected in lower land prices and/or lower returns to capital, management and labor.

In table 2.12 a comparison of grain corn production costs in the United States with costs estimated for Elgin, Essex and Kent counties are presented. All costs are presented on a per acre, and a per bushel basis. United States prices are converted to their Canadian dollar equivalents by multiplying each price by the (C/US) dollar exchange rate. From table 2.12 it is clear there are significant differences in

Table 2.11: Cost of Grain Corn Production, Essex, Kent and Elgin Counties, 1973, 1974 and 1980

	1973		1974		1980	
	$/acre	Percent of total costs	$/acre	Percent of total costs	$/acre	Percent of total costs
Labor:						
Hired, operating	.69	.5	.23	.1	5.06	1.5
Operator, fixed	9.04	5.9	10.15	4.8	34.46[a]	10.1
Total	9.73	6.4	10.38	4.9	39.52	11.6
Tractor:						
Operating	3.65	2.3	4.64	2.2	12.13	3.5
Fixed	5.47	3.6	6.95	3.3	13.92	4.1
Total	9.12	5.9	11.59	5.5	26.05	7.6
Machinery:						
Operating	5.82	3.8	5.45	2.6	12.97	3.8
Fixed	23.29	15.1	21.82	10.4	23.96	7.0
Total	29.11	18.9	27.27	13.0	36.93	10.8
Custom work, operating	3.63	2.4	4.71	2.3	3.10	0.9
Materials, operating:						
Seed	7.20	4.7	9.49	4.5	16.12	4.7
Fertilizer	20.80	13.5	39.75	19.0	62.82	18.4
Sprays	6.44	4.2	7.40	3.5	9.30	2.7
Drying fuel	2.00	1.3	4.43	2.1	7.07	2.1
Total	36.44	23.7	61.07	29.1	95.31	27.9
Land use, fixed	49.17	32.0	78.30	37.3	120.73	35.3
Buildings:						
Use, fixed	5.22	3.4	4.51	2.2	4.91	
Repairs, operating	.35	.2	.30	.1	NI	
Total	5.57	3.6	4.81	2.3	4.91	1.4
Interest, operating:						
Stored grain	8.88	5.8	8.23	3.9	NI	
Operating capital	1.88	1.2	3.07	1.5	10.37	
Total	10.76	7.0	11.30	5.4	10.37	3.0
Crop insurance, operating	.18	.1	.36	.2	4.60	1.3
Total operating	61.52	40.0	88.06	42.0	143.54	42.0
Total fixed	92.19	60.0	121.73	58.0	197.98	58.0
TOTAL COSTS PER ACRE	153.71	100.0	209.79	100.0	341.52	100.0

Sources: Fisher, G. A. and L. L. Davies. Grain Corn and Soybean Production in Southern Ontario. Economics Branch, O.M.A.F., 1976.

O.M.A.F. Grain Corn: Updated Cost of Production, per hectare, Southern Ontario, 1980. Agdex 111/821, 1981.

Table 2.12: Estimated Grain Corn Production Costs Ontario and the United States, 1980

	Ontario (C$/acre)	United States (US$/acre)	United States (C$/acre)
Variable Costs:			
Seed	16.12	14.23	16.65
Fertilizer	62.82	49.04	57.38
Chemicals	9.30	15.72	18.39
Custom work	3.10	4.51	5.28
Labour	5.06	12.95	15.15
Fuel and lubrication	7.21	17.15	20.07
Repairs	17.89	10.02	11.72
Drying	7.07	6.49	7.59
Interest on operating capital	10.37	6.31	7.38
Irrigation water	NI	.09	.11
Crop insurance	4.60	NI	NI
Total variable costs per acre	143.54	136.51	159.72
Total variable costs per bu.[a]	1.59	1.37	1.60
Fixed Costs: (Excluding Land)			
Machinery ownership	42.79	48.96	57.28
Management allowance	22.91	8.66	10.13
Overhead	11.55	19.41	22.71
	77.25	77.03	90.12
Land[b]	120.73	132.01	154.45
Total costs per acre (including land)	341.52	345.55	404.29
Total costs per bu. (including land)	3.79	3.46	4.04

a/ Based on an assumed yield of 90 bu./acre in Ontario and 100 bu./acre in the United States.

b/ Land charge based on 1980 values.

Sources: O.M.A.F. Grain Corn: Updated Cost of Production, per hectare, Southern Ontario, 1980. Agdex 111/821, 1981.

U.S.D.A. Costs of Producing Selected Crops in the United States - 1978, 1979, 1980 and Projections for 1981. Prepared for E.S.C.S. for the Committee on Agriculture, Nutrition and Forestry, U.S. Senate, Washington D.C., 1981.

costs for particular production items, however, the total variable costs of production in the two countries are nearly identical on a per bushel basis, $1.59/bu. in Canada and $1.60/bu. in the United States. Variable costs per acre in the United States are higher than in Ontario, but so are average yields per acre.

Fixed costs, excluding land, are estimated to be five cents a bushel higher, and imputed land costs two cents a bushel higher in the U.S. than in Ontario. Not too much should be made of this difference, however, since the cost estimates were prepared by different researchers, undoubtedly using different assumptions with regard to depreciation allowances and the allocation of joint overhead costs. Similarly, there are a number of methods which can be used to calculate the opportunity cost of land. Nevertheless, having recognized the measurement problems, from a cost standpoint it appears that corn production not only has a comparative cost advantage in Southern Ontario, but total production costs in Southern Ontario and the U.S. are essentially the same.

2.6 Ontario and United States Grain Corn Yields

Table 2.13 presents data on average grain corn yields in Ontario, the United States, and for seven individual States while table 2.14 shows Ontario corn yields by geographic region. Over the eleven year period, ending in 1981, Ontario's average grain corn yield was 86.1 bushels per acre, or 7.5 percent lower than the average yield in the United States of 93.1 bushels per acre. The average yields in Ontario and the United States increased by 11.5 and 13.4 percent, respectively between 1971-1975 and 1976-1981.

Corn yields in Southern Ontario are considerably higher than in other regions of the Province (table 2.14). Yields in Southern Ontario, between 1976 and 1981, averaged 111.7 percent of yields in Western Ontario, and 122.4 percent, and 126.8 percent of average yields in Central and Eastern Ontario, respectively. Average yields in Southern Ontario are well below yields in the major Corn Belt states of Illinois, Indiana, Iowa and Ohio, but above yields in Michigan and similar to those in Minnesota and Wisconsin.

A regression of corn yields against a linear time trend, over the period 1971 to 1981, indicates yields in Ontario have been increasing by 1.37 bushels/acre/year, and by 1.47 bushels/acre/year in the United States (table 2.15). In calculating these results the data for 1974 was excluded, using a zero-one dummy variable (D74), because of very poor weather induced yields in that year.[2/] The trend analysis for the four Ontario regions and seven individual states gives mixed results. Large

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2/ Including 1974 in the analysis results in larger estimates of the trend in yields.

Table 2.13: United States and Ontario Grain Corn Yields, 1971 to 1981

Year	Ontario	U.S.	Ill.	Ind.	Iowa	Mich.	Minn.	Ohio	Wisc.
				bushels per acre					
1971	81.0	88.1	106.0	101.0	102.0	69.0	83.0	91.0	98.0
1972	76.0	97.1	110.0	104.0	116.0	83.0	93.0	92.0	95.0
1973	86.0	91.2	103.0	102.0	103.0	79.0	83.0	79.0	83.0
1974	70.0	71.4	83.0	71.0	83.0	61.0	61.0	73.0	68.0
1975	92.0	86.3	116.0	98.0	90.0	80.0	70.0	93.0	83.0
1976	85.4	87.9	107.0	110.0	91.0	69.0	59.0	103.0	68.0
1977	94.6	90.8	105.0	102.0	88.0	85.0	100.0	105.0	104.0
1978	84.0	100.8	111.0	108.0	115.0	81.0	104.0	105.0	98.0
1979	90.0	109.7	128.0	112.0	127.0	95.0	100.0	115.0	103.0
1980	92.7	91.0	93.0	96.0	110.0	95.0	97.0	113.0	104.0
1981	94.9	109.9	129.0	109.0	127.0	96.0	110.0	96.0	108.0
Averages									
1971-1975	81.0	86.8	103.6	95.2	98.8	74.4	78.0	85.6	85.4
1976-1981	90.3	98.4	112.2	106.2	109.7	86.8	95.0	106.2	97.5
1971-1981	86.1	93.1	108.3	101.2	104.7	81.2	87.3	96.8	92.0

Sources: O.M.A.F. Agricultural Statistics for Ontario. Various issues, Toronto.
Statistics Canada. Supply and Disposition of Major Grains. Memo, May 1983, Ottawa.
U.S.D.A. Agricultural Statistics. Various issues, Washington, D.C.

Table 2.14: Ontario Grain Corn Yields, by Region, 1971 to 1981[a/]

Year	Southern Ontario	Western Ontario	Central Ontario	Eastern Ontario
1971	81.1	82.7	74.7	80.0
1972	82.1	71.1	73.7	32.0
1973	87.9	85.7	79.8	70.2
1974	74.3	60.1	67.2	53.0
1975	96.0	92.0	79.0	70.0
1976	89.0	83.0	74.0	69.0
1977	102.0	89.0	81.0	67.0
1978	85.0	80.0	67.0	78.0
1979	95.0	87.0	82.0	79.0
1980	99.0	85.0	87.0	83.0
1981	104.0	90.0	78.0	77.0
Averages				
1971-1975	84.3	78.3	74.9	61.0
1976-1981	95.7	85.7	78.2	75.5
1971-1981	90.5	82.3	76.7	68.9

a/ The Ontario regional corn yields are not directly comparable to the Provincial average because they do not reflect census revisions.

Source: O.M.A.F. Agricultural Statistics for Ontario. Various issues, Toronto.

Table 2.15: Trends in Corn Yields, Ontario and United States, by Region, 1971 to 1981[a/]

Region	Estimated Coefficients					R^2	D.W.
	Constant	Linear Trend	t-value	D74	t-value		
Ontario	-63.8	1.37	3.54	-15.0	-3.53	0.80	2.61
United States	-68.6	1.47	1.98	-20.6	-2.52	0.61	2.15	
Southern Ontario	-113.4	1.85	3.41	-13.7	-2.30	0.72	2.80
Western Ontario	-3.8	0.79	1.45	-22.7	-3.76	0.82	2.81
Central Ontario	17.5	0.54	1.00	-9.2	-1.56	0.34	2.69
Eastern Ontario[b/]	13.0	0.55	0.88	-20.3	-3.18	0.89	1.13
Illinois	-6.5	1.05	0.97	-25.5	-2.14	0.45	3.09
Indiana	52.0	0.47	0.89	-32.2	-5.55	0.81	3.08
Iowa	-90.2	1.77	1.30	-20.0	-1.33	0.35	1.24
Michigan	-160.7	2.19	3.29	-17.4	-2.37	0.72	1.97
Minnesota	-184.1	2.46	1.75	-23.5	-1.52	0.46	1.41
Ohio	-154.1	2.28	2.82	-21.2	-2.39	0.68	1.69
Wisconsin	-89.0	1.65	1.42	-22.8	-1.78	0.45	1.64

a/ Yield analysis for Ontario regions is based on data which does not incorporate Census revisions.

b/ The Eastern Ontario equation also includes a dummy variable for 1972 when yields were 40.2 bushels per acre below their trend value.

and significant trends are shown for Southern Ontario (1.85 bushels/acre/year), Michigan (2.19 bushels/acre/year), Minnesota (2.46 bushels/acre/year) and Ohio (2.28 bushels/acre/year). Small and generally insignificant yield trends are indicated for Western, Central and Eastern Ontario, Illinois and Indiana.

The equations presented in table 2.15 were used to project yields in 1990, and the results are presented in table 2.16. Corn yields in both Ontario and the United States were projected to increase by 12.9 percent, between 1981 and 1990. These figures seem quite plausible and are roughly consistent with University of Guelph crop scientists views that Ontario corn yields will increase by one percent a year over the next decade. Some of the results for individual states are less believable, particularly the more than 20 percent yield increases projected for Michigan and Minnesota.

The regression and projection results indicate improvement in Ontario corn yields and point towards average yields in excess of 106 bushels per acre by the end of the decade.

2.7 Major Changes in Grain Corn Growing Technology

Crop scientists at the University of Guelph feel that the rapid expansion in grain corn area is largely completed. There will continue to be some expansion in grain corn area, due to earlier maturing varieties, but this not likely to be a major factor influencing corn area. Increased grain corn production will result primarily from yield improvements, as a consequence of plant breeding activities, improved herbicides and other improved production techniques. Yield advances are projected to average one percent, per year, until the end of the decade. This projection is similar to that obtained using trend analysis in section 2.6.

2.8 Supply and Disposition of Grain Corn in Quebec

Using procedures similar to those followed in calculating feed grain consumption in Ontario, an estimate of total feed grain consumption, based on grain consuming animal units, was calculated for Quebec. These estimates along with the production of feed grains other than corn (oats, barley, mixed grains) give a picture of Quebec's dependence on imported feed grains, a substantial proportion of which are supplied from Ontario (table 2.17)[3/]

It is clear from table 2.17 that Quebec has been in a constant deficit position ranging from 2.0 to 2.5 mmt between 1970 and 1981. The deficit would have been far worse, however, except for the very rapid

3/ In calculating grain consuming animal units for Quebec it was impossible to adjust the figures so that they equaled feed consumption because of data deficiencies.

Table 2.16: Linear Projections of Corn Yields in Ontario and the United States, 1981 and 1990[a/]

Region	Actual Yield 1981	Estimated Yield 1990	Estimated Percentage Increase 1981 to 1990
Ontario	94.2	106.4	12.9
United States	102.4	115.6	12.9
Southern Ontario	101.0	117.6	16.4
Western Ontario	88.4	92.3	4.4
Central Ontario	80.2	85.1	6.1
Eastern Ontario	77.2	82.2	6.5
Illinois	115.9	125.3	8.1
Indiana	106.5	110.7	3.9
Iowa	115.4	131.4	13.9
Michigan	93.7	113.5	21.1
Minnesota	101.7	123.9	21.8
Ohio	110.1	130.6	18.6
Wisconsin	102.3	117.2	14.6

a/ These projections are calculated from the equations contained in table 1.15.

Table 2.17: Supply and Disposition of Feed Grains in Quebec, 1970-1981

Year	Estimated Feed Grain Consumption ('000 mt)	Production of Feed Grains, Excluding Corn[a/] ('000 mt)	Production of Grain Corn ('000 mt)	Deficit ('000 mt)
1970	2887	467	201	2219
1971	2911	499	331	2081
1972	2846	401	194	2251
1973	2848	338	214	2296
1974	2857	418	232	2207
1975	2786	453	308	2025
1976	3005	404	303	2298
1977	3104	398	343	2363
1978	3239	487	492	2260
1979	3576	530	701	2345
1980	3837	538	838	2461
1981	3824	593	975	2256

a/ Includes oats, barley and mixed grains converted to corn equivalents based on energy content.

Sources: Statistics Canada. Supply and Disposition of Major Grains. Memo, May 1983, Ottawa.

Statistics Canada. Livestock and Animal Products Statistics. Various issues, Cat. No. 23-203 annual, Ottawa.

Livestock Feed Board of Canada. Annual Report. Various issues, Montreal.

expansion in corn production. In fact, between 1976 and 1981 grain corn production more than tripled.

Agriculture Canada has projected Quebec feed grain production to increase by 128 percent between 1980 and 1990, while Quebec Agriculture has projected a 117 percent increase between 1979 and 1990. Grain corn and barley areas are projected to increase by 133,000 and 145,000 hectares, respectively, between 1979 and 1990; while oats and mixed grain areas are expected to decline by 65,000 and 8,000 hectares, respectively.

Feed grain consumption (for animal feed) between 1979 and 1990 is projected to increase by 4.8 percent by Quebec Agriculture and by 8.8 percent between 1980 and 1990 by Agriculture Canada.

Estimates of grain production and consumption in 1990 are hazardous at best, but using a projection of a 100 percent increase in feed grain production and a 7.5 percent increase in feed grain consumption results in an estimated 1990 feed grain deficit of 1.4 mmt, slightly more than one-half of the current deficit.

Data with respect to regional production and consumption of feed grains in Quebec are very limited. However, based on Quebec Agriculture information, in 1979, approximately 39, 60 and 1 percent of total feed grain consumption was in the central, intermediate and peripheral zones, respectively. By 1990, feed grain consumption in the central zone is projected to increase to about 42 percent of the total, decline to 56 percent in the intermediate zone and increase slightly to 2 percent in the peripheral zone. Table 2.18 outlines the changes forecast by Quebec Agriculture in feed grain area between 1979 and 1990 by region.

Table 2.18: Quebec Feed Grain Area, 1979, and Estimates for 1990, by Region

	1979	%	1990	%	Percentage Change (1979-1990)
			Grain Corn (hectares)		
Central	69294	85.6	161423	75.3	132.9
Intermediate	11633	14.4	53180	24.8	357.1
Peripheral	0	0	0	0	0
Total	80927	100.0	214603	100.0	165.2
			Barley (hectares)		
Central	11530	36.3	71827	40.5	523.0
Intermediate	12241	38.5	81547	46.0	566.2
Peripheral	8023	25.2	23999	13.5	199.1
Total	31794	100.0	177373	100.0	457.9
			Oats (hectares)		
Central	68899	31.4	30238	19.7	43.9
Intermediate	92055	42.0	72425	47.1	78.7
Peripheral	58225	26.6	51039	33.2	87.7
Total	219179	100.0	153702	100.0	70.1
			Mixed Grains (hectares)		
Central	19600	43.4	16351	43.6	83.4
Intermediate	13349	29.6	9374	25.0	70.2
Peripheral	12168	27.0	11789	31.4	96.9
Total	45117	100.0	37514	100.0	83.1

Source: Ministere de l'Agriculture. Nourrir Le Quebec. No date.

CHAPTER 3

MARKETING OF ONTARIO GRAIN CORN

3.1 Institutional Structure of Primary Production Sector

Two institutions are involved in corn marketing at the producer level, the Ontario Corn Producers' Association and the Ontario Grain Corn Council. Neither institution is directly involved in the handling, marketing or pricing of Ontario corn. Their objectives and activities are described in more detail below.

The Ontario Grain Corn Council was formed in 1971 to represent the interests of Ontario corn producers and the industry. The Council's stated purpose is "to study, advise and make recommendations on all matters relating to the production and marketing of Ontario grain corn to any or all segments of the grain corn industry, and to any level of government, either by itself or in co-operation with any other organization" (Ontario Grain Corn Council). There are currently eight producer and seven industry members on the Council. A Secretary-Treasurer is also appointed by the Minister of Agriculture and Food.

The stated objectives of the Ontario Grain Corn Council are:

(1) To consider present or potential problems facing the grain corn industry in Ontario and to recommend action to appropriate agencies.

(2) To co-operate and maintain liaison with all organizations whose aims and objectives are consistent with the objectives of the Council.

(3) To advise all persons interested in the Ontario grain corn industry on the quantities and qualities of grain corn required to fulfil foreseeable markets.

(4) To study domestic and international factors that may influence present or potential markets for Ontario grain corn.

(5) To produce information for the purpose of enhancing the competitive position of the Ontario grain corn industry, extend the market potential or assist producers to make the most advantageous marketing decisions.

(6) To carry on any other activity which, in its opinion, furthers the interests of the Ontario

grain corn industry with particular reference to market development.

Clearly the Council's role is primarily to provide market information, with regard to the Ontario corn market, and to provide a "voice" for the corn industry with respect to agricultural policy changes affecting the corn industry.

The Ontario Corn Producers' Association was formed in 1983. It is run by a five person executive and eleven directors. The Association's stated objectives are:

(1) To act as a spokesman for corn producers in all aspects of the production, marketing, and/or use of grain and silage corn in Ontario.

(2) To lobby for governmental actions of benefit to corn producers.

(3) To improve the transfer of market and production information to corn producers.

(4) To improve domestic and export market opportunities for Ontario corn.

(5) To encourage research of benefit to the Ontario corn industry.

(6) To administer an Advance Payment Program for corn in Ontario.

The primary reason for the formation of the Ontario Corn Producers' Association was to provide an organization which would make Ontario corn producers eligible for the advance payment program. It is too early in the organization's life to know what other activities the Association will undertake. However, as with the Council it appears the Association will be involved primarily in market facilitating activities rather than market replacing activities.

3.2 Grain Corn and Products Domestic Consumption Patterns

Tables 3.1 and 3.2 provide supply and disposition data for Canadian and Ontario grain corn.[4/] Ontario dominates both the production and consumption of corn in Canada. Since chapter two dealt with the production of Canadian corn this section concentrates on corn consumption.

4/ There is an inconsistency in the Statistics Canada data for all Canada, and the O.M.A.F. data for Ontario, with regard to the industrial use of corn in 1978/79. The reported useage figures for Ontario are larger than for all Canada.

Table 3.1: Supply and Disposition of Canadian Grain Corn, 1976/77 to 1982/83, '000 mt

Crop Year Beginning Aug. 1	Supply				Disappearance				
	Beginning Stock	Production	Imports	Total Supply	Exports	Seed	Industrial Use	Feed Use	Total Disappearance
1976/77	686.7	3759.3	659.9	5106.1	180.3	19.0	733.6	3183.3	4116.2
1977/78	989.9	4249.5	386.1	5625.5	322.7	21.7	777.1	3542.2	4663.7
1978/79	961.8	4479.5	682.0	6123.3	191.7	23.3	740.7	4146.8	5102.5
1979/80	1020.8	5276.1	993.9	7290.8	344.0	23.4	896.9	4640.6	5904.9
1980/81	1385.9	5753.2	1363.5	8502.6	1056.0	27.1	1033.2	5112.5	7228.8
1981/82	1273.8	6673.4	822.2	8769.4	1134.7	25.6	1070.9	5352.9	7584.1
1982/83 p/	1185.3	6512.9	759.2	8457.4	488.8	25.2	1136.4	5189.9	6840.3

p/= preliminary

Source: Statistics Canada. Supply and Disposition of Major Grains. Memo, January 1984, Ottawa.

Table 3.2: Supply and Disposition of Ontario Grain Corn, 1973/74 to 1982/83, '000 mt

Beginning Aug. 1	Supply				Disappearance				
	Beginning Stock	Production	Imports	Total Supply	Exports	Shipments to Quebec	Shipments to Maritimes	Industrial Use	Feed Use[a/]
1973/74	653.9	2643.3	449.7	3746.9	4.4	152.4	51.7	638.3	2453.8
1974/75	446.3	2382.6	329.5	3158.4	3.9	177.8	76.2	646.8	1822.5
1975/76	431.2	3318.2	98.5	3847.9	233.4	355.6	113.8	595.7	1986.7
1976/77	562.7	3427.3	162.6	4152.6	180.3	330.2	102.1	642.6	2047.0
1977/78	850.4	3867.2	101.2	4818.8	322.7	450.3	111.4	612.8	2505.2
1978/79	816.4	3841.0	278.6	4936.0	191.7	345.7	98.2	748.9	2652.3
1979/80	899.2	4366.5	447.2	5712.9	344.0	352.2	101.0	851.9	2976.4
1980/81	1087.4	4710.0	575.1	6372.5	1029.0	353.7	118.6	887.9	2989.2
1981/82	994.1	5235.7	297.9	6527.7	1040.1	368.6	160.6	869.5	3171.4
1982/83[p/]	917.6	5194.8	182.9	6295.3	488.7	300.6	158.1	892.4	3198.6

a/ = includes seed and waste
p/ = preliminary

Source: O.M.A.F. unpublished data, 1984.

By far the largest use of grain corn is for animal feed, representing 70.6 percent of Canadian and 56.5 percent of Ontario total corn disappearance in 1981/82. Much of the grain corn is fed on the farm where it is produced but significant quantities are also used by feed manufacturers in the preparation of formula feeds. In 1980/81, Ontario feed manufacturers purchased 0.755 mmt of grain corn, or about 25 percent of the total corn fed in Ontario. Of total Canadian consumption, of corn for animal feed, 58.5 percent was consumed in Ontario in 1980/81, down from over 70 percent in 1977/78.

Canadian grain corn consumption, for animal feed, is influenced by four main factors (1) the supply of grain corn; (2) the price of grain corn relative to the price of its cereal substitutes (barley, oats, feed wheat, mixed grains); (3) the number of grain consuming animal units; and, (4) the profitability of livestock feeding. Because of the large upward trend in the feed consumption of corn it is difficult to separate, and estimate, the influence of the factors listed above on the domestic feed demand for grain corn. However, equation 3.1 shows that for each one tonne increase in Ontario corn production (QCO2) the feed use of corn in Ontario (DFECO2) has increased by 0.46 tonnes, while equation 3.2 shows that total Canadian feed use of corn (DFECO3) increases 0.65 mt given a one tonne increase in Canadian production (QCO3).

3.1 DFECO2 = 817.7 + 0.45 QCO2
t-value (2.17) (4.62)
elasticity [0.67]

R^2 = 0.75 D.W. = 0.98 sample period = 1973 to 1981

3.2 DFECO3 = 1071.4 + 0.65 QCO3
t-value (3.21) (8.90)
elasticity [0.73]

R^2 = 0.92 D.W. = 1.13 sample period = 1973 to 1981

The industrial use of grain corn in Canada (table 3.1) has expanded rapidly since the mid 1970's. Between 1976/77 and 1980/81 the industrial use of corn in Canada increased by 40.8 percent. Most of the industrial use of corn is located in Ontario (85.9 percent in 1980/81) where usage between 1976/77 and 1980/81 was up by 0.245 mmt or 38.2 percent. After the rapid expansion of the 1970's Ontario's industrial usage has recently stabilized, and for the past three years has averaged 0.87 to 0.89 mmt per year.

The use of corn to produce corn starch grew considerably (46 percent), and quite smoothly, between 1976/77 and 1981/82 (table 3.3). Grain corn is increasingly being used to produce high fructose corn syrup which is particularly well suited for use in soft drinks because

of its high sugar content. This increase in usage shows up in the "other" column of table 3.3.

More details with respect to the Canadian corn processing industry are provided in chapter four.

3.3 Grain Corn and Products Import and Export Patterns, Including Interprovincial Trade

3.3.1 Canada's Grain Corn Trade

Canada has traditionally been a net importer of corn, however, net imports have declined substantially since the early 1970's. Between 1973 and 1975 net imports averaged 1.05 mmt per year. In 1981/82, Canada was a net exporter of 0.3 mmt of corn, and gross exports reached 1.135 mmt. Canada will again be a small net importer of corn in 1982/83. Nevertheless, it appears that Canada is rapidly reaching a position of self-sufficiency in corn production, and export markets will be a far more important corn outlet in the future than in the past.

Table 3.4 shows corn exports by country and/or region of destination. Since 1975/76, Eastern Europe (primarily the U.S.S.R.) and Cuba have been the most consistent and important importers of Canadian corn, although in some years significant quantities have been shipped to Western Europe. All Canadian imports of corn come from the United States.

3.3.2 Ontario's Grain Corn Trade

Ontario's offshore exports exceeded its imports in six of the eight years between 1975/76 and 1982/83 (table 3.2).[5/] In addition to offshore exports Ontario also ships sizable quantities of grain corn to Quebec and the Maritimes (table 3.2). The changing size and structure of Ontario's corn industry, over the past few years, becomes clear when it is realized that in 1973/74 Ontario imported 0.450 mmt of corn, it exported internationally only 0.004 mmt and shipped 0.204 mmt of corn to Quebec and the Maritimes, for a net deficit of 0.242 mmt, representing 7.8 percent of Ontario's corn use. By 1980/81, imports were 0.575 mmt while international exports were 1.029 mmt, plus 0.472 mmt of corn shipments to Quebec and the Maritimes, resulting in a net surplus of 0.926 mmt equalling 23.9 percent of Ontario's corn use. In the five years between 1973/74 and 1980/81 Ontario has moved from a small net deficit position in corn use to its current position where the corn surplus equals nearly 25 percent of its own use. In the future the demand for Ontario corn will be influenced far more by events in Quebec, the Maritimes, and the international market than was the case five years ago.

5/ Exports for 1981/82 in table 3.4 differ from those in table 3.1 because the numbers in table 3.4 are based on revised data.

Table 3.3: Grain Corn Used in Ontario by Industrial Users, 1976/77-1981/82

Crop Year Beginning Aug. 1	Distillery	Starch Metric	Other[a/] Tonnes	Total	Annual Percentage Change (%)
1976/77	265000	318300	59300	642600	
1977/78	195000	350700	67100	612800	-4.6
1978/79	284000	398000	66000	748900	22.2
1979/80	350499	434800	66700	851900	13.8
1980/81	309600	489900	88400	887900	4.2
1981/82	241800	464600	163100	869500	-2.1

a/ Includes breakfast cereals, corn sugar, flour milling, etc.

Source: O.M.A.F. unpublished data obtained from Nick Roller, Statistics Section, Dec. 1982.

Table 3.4: Exports of Canadian Corn by Country of Destination 1972/73-1981/82, metric tonnes

Country or Region	Crop Year 1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82
Netherlands	0	0.1	0	0	12071	11973	22096	0	2028	0	108
United Kingdom	5409	11.6	22.7	0.45	111	3379	95806	4612	26	5528	133
West Germany	N/R	N/R	N/R	N/R	N/R	0	15144	729	51	18	80
Western Europe Total	13932	11.9	51.6	0.66	12444	15715	138476	14955	78482	56675	2213
USSR	0	0	0.5	0	174998	21999	122145	38223	24091	617244	813255
Eastern Europe Total	0	0	0.5	0	174999	21999	152942	38233	39710	617245	813255
Middle East	N/R	N/R	N/R	N/R	N/R	N/R	0	31	113	92	29084
Africa	N/R	N/R	N/R	N/R	N/R	0	10522	43	0	25200	4674
Asia	0	25	0	0	0.33	18	20	40	29725	14	1294
South America	N/R	N/R	N/R	N/R	N/R	N/R	14031	129371	16	306	189
Cuba	13019	18024	0	0	42899	119785	14027	129349	192362	351603	274177
Central America	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	192369	352211	274628
USA	2439	2719	4345	4123	3100.9	3802	6365	9040	3551	4222	5738
North America	N/R	N/R	N/R	N/R	N/R	N/R	6752	9040	3551	4222	5738
Total of all Countries	29404	20792	5006	4132.9	233446	180325	322723	191678	343966	1051357	1131075

N/R = not reported

Sources: Statistics Canada. Grain Trade of Canada. Various issues, Cat. No. 22-201, Ottawa.

3.3.3 Interprovincial Shipments of Grain Corn

Interprovincial shipments of grain corn are primarily from Ontario to Quebec and the Maritimes (table 3.2). Shipments to Quebec increased rapidly between 1973/74 and 1977/78, rising from 0.152 mmt to 0.450 mmt. Since 1978/79 corn shipments to Quebec have been quite stable at around 0.30-0.36 mmt per year. Shipments to the Maritimes averaged 0.108 mmt between 1974/75 and 1980/81. In the past two years, 1981/82 and 1982/83, shipments to the Maritimes have increased to 0.16 mmt.

3.3.4 International Trade in Grain Corn Products

Using data complied by Statistics Canada it is difficult to put together a good picture of Canada's trade in corn products because of the aggregate nature of the commodity codes used in reporting imports and exports, the large number of corn based products, and the small number of firms involved in corn wet milling which restricts data availability for reasons of confidentiality.

Having noted the limitations it is nonetheless possible to identify certain corn products and their trade patterns. Tables 3.5 and 3.6 contain data on Canada's imports and exports of corn meal and flour. Canada is a net importer of corn meal and flour with net imports equalling 0.045 to 0.054 mmt per year between 1973 and 1982. Corn meal and flour imports represented 96 percent of domestic demand in 1975 (West et al.). Nearly all of the imports originate in the United States. Canada exports small quantities of corn meal and flour, primarily to Caribbean countries.

Canada imports relatively small quantities of corn oil (table 3.7) from the United States. In recent years corn oil has represented three to four percent of the Canadian edible vegetable oil market (Meilke, 1983).

Corn starch imports, again primarily from the United States, have declined from 150,229 cwt (0.068 mmt) in 1973 to 65,227 cwt (0.003mmt) in 1982 (table 3.8). The corn starch imports in 1982 represent the equivalent of about 5,400 mt of grain corn.

Canada also imports glucose syrup, the category under which imports of both blended and unblended high fructose corn syrup are reported, but this category may also include glucose syrup produced from products other than corn. Imports were heavy in 1980 and 1981 but declined substantially in 1982 (table 3.9). There have been trade reports of substantial exports of high fructose corn syrup, to the United States, but they do not show up in Canadian trade statistics. 6/ Data obtained from the U.S. Department of Agriculture, shown below, indicate that a substantial increase in Canadian shipments of blended and flavored sugar or syrup to the United States has occurred but it is unclear how much

6/ The data may not be reported because of confidentiality requirements.

Table 3.5: Canadian Imports of Corn Meal and Flour, by Country of Origin, 1973 to 1982

	Calendar Year (cwt)									
	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
United Kingdom	82	5	0	0	0	0	0	0	0	0
West Germany	92	0	0	0	0	0	0	0	0	0
Greece	0	0	100	0	0	0	0	0	0	0
Italy	0	597	119	383	284	0	775	251	579	651
Netherlands	0	6	33	0	0	0	0	0	0	0
Portugal	180	35	42	100	548	732	300	403	8	476
Yugoslavia	0	0	40	0	0	0	0	0	0	0
Taiwan	0	0	0	0	0	0	0	0	0	0
Colombia	0	0	4	0	50	0	0	0	0	2
Venezuela	10	27	36	45	0	0	0	0	0	0
Mexico	600	300	300	499	186	0	0	0	0	0
United States	1198741	1232827	1037282	1003879	1154723	1089903	1187215	1261597	1188171	1247210
Ireland	0	0	0	0	0	288	143	0	0	0
Hong Kong	0	0	0	0	0	0	324	689	0	0
Brazil	0	0	0	0	0	0	0	0	0	3
Total	1199705	1233797	1037956	1004906	1155791	1090943	1188757	1262940	1189481	1248342

Source: Statistics Canada. Imports Merchandise Trade. Various issues, Cat. No. 65-203, Ottawa.

Table 3.6: Canadian Exports of Corn Meal and Flour, by Country of Destination, 1973 to 1982

	Calendar Year (cwt)									
	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Bahamas	0	0	0	12	42	27	86	136	52	146
Bermuda	478	175	486	193	361	110	156	295	317	155
Barbados	13975	7508	10161	5773	0	0	0	0	0	0
Jamaica	14232	5736	447	0	0	0	0	0	0	0
Leew.-Wind Is.	8445	6826	2886	3260	8130	7883	9445	7429	1118	2000
Trinidad-Tobago	1876	380	463	520	1379	1125	1562	1082	485	1019
Fr. West Indies	0	690	1060	800	800	420	600	200	0	0
United States	772	2388	2248	2104	4754	17341	6551	8530	21478	17317
Japan	0	0	0	0	0	319	0	0	0	408
Sweden	0	0	0	0	0	0	74	66	418	772
France	0	0	0	0	0	0	0	200	0	0
Tanzania	0	0	0	0	0	0	0	0	504	0
Haiti	0	0	0	0	0	0	0	0	200	0
United Kingdom	0	0	0	0	0	0	0	0	0	95
Belgium-Luxem	0	0	0	0	0	0	0	0	0	26
Total	39778	27703	17751	12662	15466	27225	18474	17938	24572	21938

Source: Statistics Canada. Exports Merchandise Trade. Various issues, Cat. No. 65-206, Ottawa.

Table 3.7: Canadian Imports of Corn Oil, by Country of Origin, 1973 to 1982

	Calendar Year (cwt)									
	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
United Kingdom	23539	35396	0	0	0	0	0	0	45	0
France	0	11	2	0	0	0	0	0	0	0
West Germany	6830	0	0	0	0	0	0	0	0	0
United States	115229	192956	224259	361865	341311	434458	341311	381043	357642	341271
Total	145598	228363	224261	361865	341311	434458	341311	381043	357687	341271

Source: Statistics Canada. Imports Merchandise Trade. Various issues, Cat. No. 65-203, Ottawa.

Table 3.8: Canadian Imports of Corn Starch, by Country of Origin, 1973 to 1982

	Calendar Year (cwt)									
	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
West Germany	99	328	269	266	329	237	86	173	70	915
Greece	0	0	32	0	0	0	0	0	0	0
Netherlands	2302	0	0	1530	0	0	0	667	0	0
Hong Kong	284	322	1448	81	230	92	52	2	2	671
China	0	10	0	0	0	18	0	0	0	0
Ecuador	0	200	0	0	4	0	0	0	0	0
United States	147544	119507	152374	71527	66138	53508	60394	66239	69972	63636
Colombia	0	0	0	0	0	0	0	0	0	5
Japan	0	0	0	0	0	0	71	0	0	0
Total	150229	120367	154123	73504	66701	53855	60603	67801	70044	65227

Source: Statistics Canada. Imports Merchandise Trade. Various issues, Cat. No. 65-203, Ottawa.

Table 3.9: Canadian Imports of Glucose Syrup, by Country of Origin, 1978 to 1982

Country	Calendar Year (cwt) 1978	1979	1980	1981	1982
United Kingdom	2002	543	2938	985	920
Finland	0	72	19	103	71
France	7	13	0	814	461
West Germany	211	0	210	174	14
Italy	5	107	50	81	10
Netherlands	0	555	6	0	0
Hong Kong	74	0	0	7	125
United States	181219	245804	908389	619345	124960
Brazil	0	0	26	0	30
Ireland	0	0	0	11	0
Belgium-Luxem	0	0	0	63	0
Israel	0	0	321	0	0
India	0	0	0	178	0
Sweden	0	0	0	0	562
Total	183518	247094	911959	621761	127153

high fructose corn syrup is involved, since at least some of it is blended with other products.

United States Imports of Blended or Flavored Sugar or Syrup, from Canada, mt

	1981	1982
January to March	6	30565
April to June	501	55252
July to September	3112	
October to December	7781	

Canada exports sizeable quantities of gluten feed which is a by-product of the corn wet milling industry. Exports have increased from 6731 mt (264,997 cwt) in 1973 to an average of 28,259 mt (1,112,506 cwt) during 1980 to 1982 (table 3.10). The United States is the primary destination for gluten feed but the United Kingdom and the Netherlands have been substantial importers in some years.

3.4 Tariff Structure

Canada's tariff on grain corn imports was eight cents per bushel until January 1, 1980 when a phased reduction to 5 cents per bushel began, as a result of the "Tokyo Round" of trade negotiations. The Canadian corn tariff was scheduled to decline as follows: 1980 - 7.6 cents/bu., 1981 - 7.3 cents/bu., 1982 - 6.9 cents/bu., 1983 - 6.5 cents/bu., 1984 - 6.1 cents/bu., 1985 - 5.8 cents/bu., 1986 - 5.4 cents/bu. and 1987 - 5.0 cents/bu.

In return for the reduction in the Canadian tariff the United States is reducing its tariff on grain corn from 25 cents/bu. to 5 cents/bu. in eight stages.

Corn is the only feed grain which can be imported into Canada without an import license issued by the Canadian Wheat Board.

3.5 Grain Corn Marketing

During the 1950's and 1960's the prices of most North American grain crops were very stable. Farmers normally sold their crop for cash at harvest or stored it for sale at a later date, in effect speculating in the hope of positive price changes. Because price varied little over the course of the crop year there was little risk of large losses and similarly little hope of large profits from storage activities. All of this changed in 1972/73, however, when prices increased from $52/mt in October to $118/mt in August.

Table 3.10: Canadian Exports of Gluten Feed, by Country of Destination, 1973 to 1982

Country	Calendar Year (cwt)									
	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Netherlands	10260	5899	0	42703	36132	171124	44114	266616	29650	0
United States	254717	272610	278595	303827	315991	455159	573196	730870	854890	944373
United Kingdom	0	0	2000	1640	0	2244	1224	235070	130095	1397
Greece	0	0	0	220	1000	0	0	0	0	0
Japan	0	0	0	0	0	0	1596	0	0	0
Ireland	0	0	0	0	0	0	0	141686	0	0
Hong Kong	0	0	0	0	0	0	0	0	878	0
Total	264997	278509	280595	348390	353123	628527	620130	1374242	1017507	945770

Source: Statistics Canada. Exports Merchandise Trade. Various issues, Cat. No. 65-206, Ottawa.

Following 1972/73, prices within a crop year were considerably more variable than previously, and differences in the price received in two different months could mean thousands of dollars to an individual farmer. The marketing system responded to the increased price variability by offering several alternative methods of pricing corn.

To analyze the different pricing methods it is necessary to understand that the price an Ontario producer receives for corn can be broken into two portions: (a) the price of corn on the Chicago futures market; and, (b) the local "basis", where the basis is simply the difference between the current cash price and the nearby futures price. Both of these components of price vary throughout the year and different marketing strategies have different implications with regard to the degree of price risk an individual producer must assume.

A brief description of some of the more common marketing methods are given below.7/

Spot or cash sale is the traditional method of marketing agricultural commodities. With this method the producer either sells his corn at harvest or stores it at home, or in a commercial elevator, for sale at a later date. With this selling method the producer assumes all of the risk of a price decline or a change in the local basis.

Fixed price forward contracts are sales contracts where a producer agrees to deliver a specific quantity of corn, for a specific price, at some future date. This type of marketing arrangement is often made prior to planting. The buyer assumes all of the price risk, although he will offset this risk by making an opposite transaction in the futures market.

Deferred pricing, basis or option contracts are contracts for delivery of a specific quantity of corn for either current or future delivery. The basis is established at the time the contract is signed, but the price level is established at some later date, as specified in the contract. Buyers will normally pay a portion of the commodity's value when the commodity is delivered. With this marketing method the seller has eliminated the basis risk but must still assume the price risk.

Hedging on the Chicago futures market is a method by which producers can protect themselves from price risk. They are, however, still subject to basis risk. Hedging involves selling a futures contract equal to the long position held in the cash market. The long position in the futures market is offset when the cash grain is sold. While protecting the producer from price declines, hedging also prevents a producer from benefiting from price increases.

7/ This discussion is based on the work of Martin and Hope (1983).

Replacing physical corn with a long futures position is a marketing alternative which allows a producer to "lock in" the basis while still speculating on possible price changes. This strategy involves selling cash grain and replacing it with a long position in the futures market. This strategy has several attractive features (a) the producer receives cash for his corn when it is sold, which can then be used to pay off debt or invested; (b) he has no physical storage costs; and, (c) he can still benefit from positive price changes. On the negative side the producer will have to meet margin calls if the market price declines, and he cannot benefit from improvements in the basis.

There are undoubtedly other marketing alternatives and strategies which a producer can use; and, new alternatives which will be introduced in the future. However, for producers to benefit from the selection of marketing options available, research and educational programs are needed which will help a producer to select a marketing strategy that fits his particular financial and risk bearing situation. Research of this type, an example of which is the analysis by Martin and Hope, for corn has been given a top priority by the Ontario Agricultural Economics Research Coordinating Committee for several years, but financial support has been inadequate to mount a major research program.

3.6 Determination of Ontario Grain Corn Prices

The price of Ontario grain corn typically follows price patterns established in the much larger United States market. Figure 3.1 shows the relationship between the Chatham, track, price of corn (PCO2) and the price of corn in Chicago (PCO4), after adjusting for the value of the Canadian dollar (ER34) and the Canadian tariff on corn (TARCO2). This relationship is also represented by equation 3.1, where the Canadian price is regressed on the adjusted United States price; quarterly seasonal dummy variables, JS1, JS2 and JS3 representing the first through third calendar quarters, respectively; and, a linear time trend (Time) used as a proxy for changes in transportation and handling charges.

3.1 PCO2 = -1.75 - 0.41 JS1 + 0.51 JS2 + 5.91 JS3
t-value (-0.25) (-0.31) (0.38) (4.52)

+ 1.02 (PCO4*ER34+TARCO2) - 0.07 Time
(20.82) (-0.59)

R^2 = 0.95 D.W. = 1.81 RHO = 0.58 sample period = 1970(1) - 1982(4)

It is clear from equation (3.1) that Chatham corn prices follow Chicago prices quite closely. A one dollar change in the Chicago corn price results in a $1.02 change in the Chatham corn price (the value of $1.02 is not significantly different from $1.00). The seasonal pattern

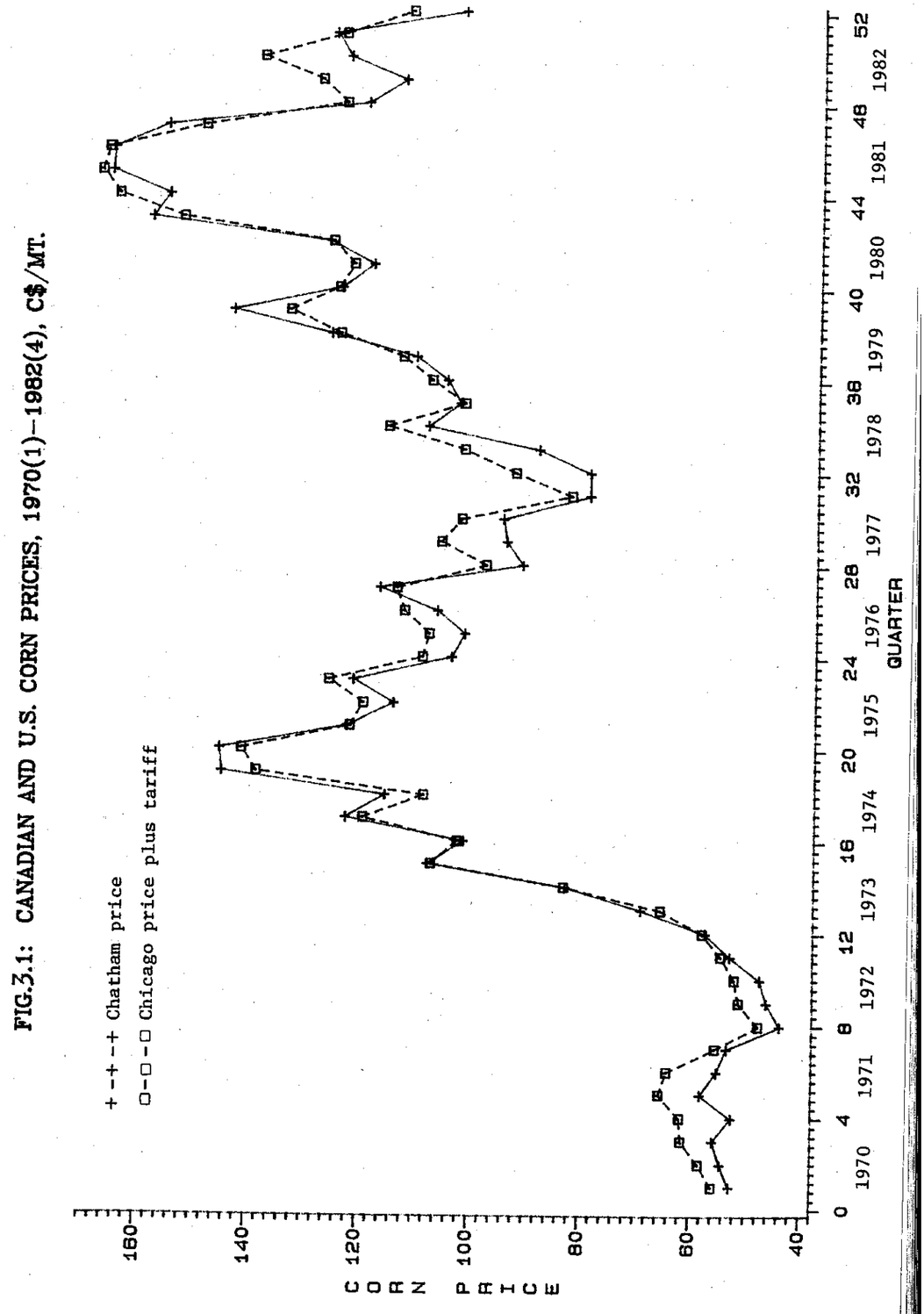

FIG.3.1: CANADIAN AND U.S. CORN PRICES, 1970(1)-1982(4), C$/MT.

in the two corn price series are similar with the exception of the third calendar quarter when Chatham prices increase by $5.91/mt relative to Chicago.

Equation 3.1 conceals the fact, however, that Chatham prices do vary around the price established in Chicago. Corn prices in Chatham have varied anywhere from $15.60/mt above to $10.10/mt under the adjusted Chicago price (figure 3.2).[8/]

In order to understand why Chatham corn prices fluctuate around the price established in Chicago it is necessary to understand how prices in Chatham are established. deGorter (pp. 19-23) provides a somewhat dated but clear explanation of the Chatham corn price making process.

"Four distinct regions and prices are relevant to Eastern Canada. Two of these regions are always surplus; Western Canada, pricing feed grains destined to Eastern Canada basis Thunder Bay at United States corn competitive prices in Montreal; and the United States, pricing corn basis Chicago near-futures in Montreal and periodically in Central and/or Eastern Ontario [Groenewegen]. The third region, Quebec and the Maritimes, is always deficit with the Montreal price being relevant. The fourth region is Ontario, with Central-Eastern Ontario varying between surplus and deficit positions, i.e. it often can be supplied sufficient grain from corn surplus Southwestern Ontario (Chatham area) but periodically requires United States corn imports via the St. Lawrence seaway.

In addition, it should be noted that there exists physical and institutional constraints such that trade rarely occurs between: 1) the United States and Southwestern Ontario since the Chatham area is always surplus and there is a prohibitive tariff on corn entering the United States; and, 2) Western Canada and the United States since trade is controlled by the CWB".

"Two alternative pricing situations are presented in Figures 3.3 and 3.4. In Figure 3.3, Central-Eastern Ontario demand for feedgrains (corn) is adequately served by Southwestern Ontario and hence there is no need for United States corn imports except to the Montreal area. If the corn price in Chicago is $2.80 per bushel, and the transportation, handling and tariff costs between Chicago and Montreal are 20 cents, the resulting price in Montreal is $3.00. Similarly, if transportation and handling costs from Chatham to Montreal are 40 cents, the resulting Chatham corn price is $2.60. In this case, Chatham corn is 20 cents below that of Chicago corn."

"In Figure 3.4, Central-Eastern Ontario demand for feedgrains is not adequately met by Southwestern Ontario corn, and hence the need for

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8/ There is also some variation in the difference between Chatham elevator and Chatham track prices.

FIG.3.2: DIFFERENCE BETWEEN CANADIAN AND U.S. CORN PRICES, C$/MT.

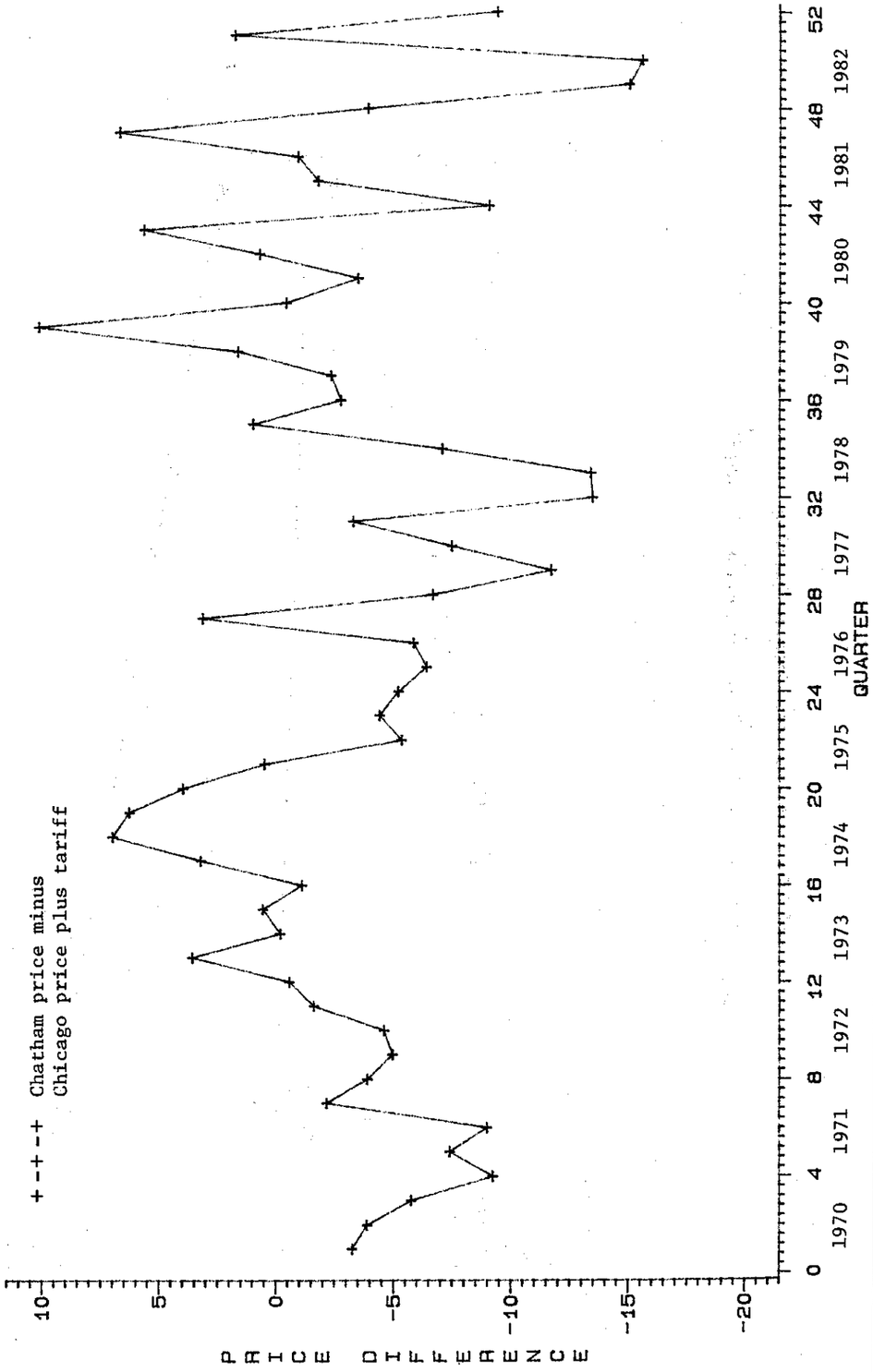
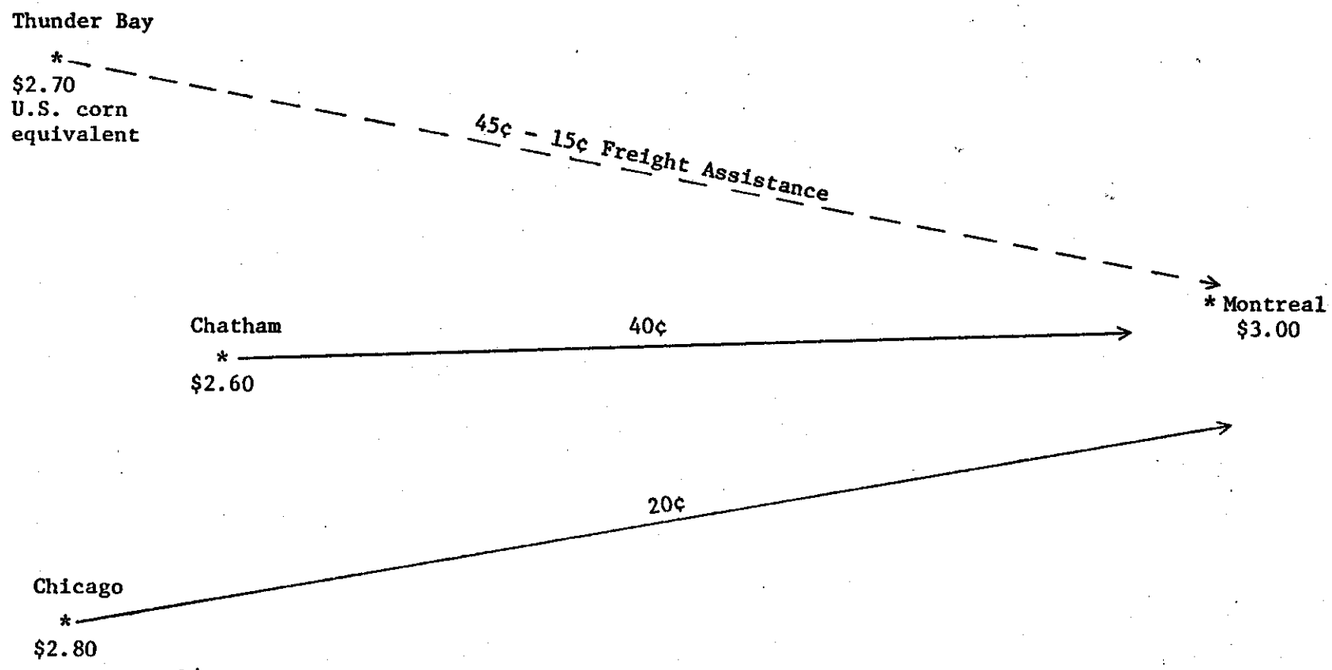


FIGURE 3.3: Central Ontario Surplus

Corn Price Chatham Less Than Corn Price Chicago[1/]

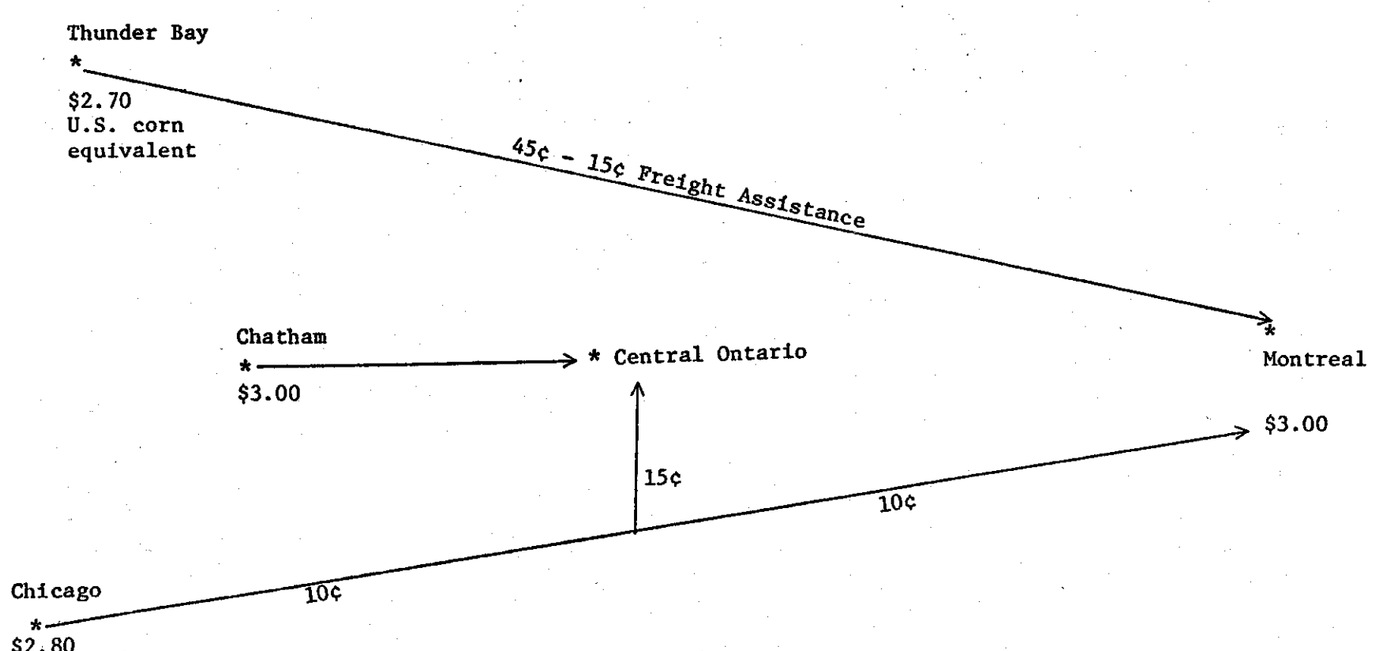


[1/] Prices, transportation, and handling costs are purely arbitrary and for illustrative purposes only.

Source: deGorter, Harry. A Quarterly Econometric Model of the North American Feedgrain Sector. M.Sc. thesis, University of Guelph, 1977.

FIGURE 3.4: Central Ontario Deficit

Corn Price Chatham Greater Than Corn Price Chicago[1/]



[1/] Prices, transportation and handling costs are purely arbitrary and for illustrative purposes only.

Source: deGorter, Harry. A Quarterly Econometric Model of the North American Feedgrain Sector. M.Sc. thesis, University of Guelph, 1977.

United States corn imports into Central Ontario. Using the same prices and costs as in Figure 3.3, with costs from Chicago to Central Ontario, the price at Chatham is well above the Chicago corn price."

"A third possible scenario would occur if Eastern Canada was a net exporter of corn. In this case, Eastern Canada would lose the benefit of the 8 cent per bushel tariff."

Meilke and deGorter (p. 18) relying largely on the analysis of Groenewegen discuss the factors expected to influence the Chatham-Chicago price differential after allowing for differences in currency values.

"As is apparent from the above discussion the Chatham corn price is a key indicator of the surplus-deficit position of eastern Canada. Consequently, it is important to understand the factors that affect the difference between Chatham and Chicago prices. Groenewegen (1976) has recently completed a study explaining the difference between the Chatham cash price and the Chicago futures price. It seems reasonable to expect the same factors to be important in explaining the cash-to-cash-price relationship.

Groenewegen (1976) hypothesized that there are four major factors that influence the Chatham cash-Chicago futures price difference: (1) seasonality; (2) the corn supply-demand balance in eastern Canada; (3) western feed grain availability; and (4) the U.S. corn supply.

Over a crop year, it would be expected that the Chatham-Chicago price differential would widen in the fourth quarter as the Chatham area experiences a harvest glut and must compete with U.S. corn for storage space in eastern Canada excess-demand areas. During the first quarter with navigation on the Great Lakes closed the price at Chatham will rise relative to Chicago, as existing stocks are allocated to satisfy demands in eastern Canada. In the second quarter, navigation re-opens and imports of U.S. corn relieve the pressure on existing supplies in grain storage. Therefore, it would be expected that the price differential would decrease. The price differential is ambiguous in the summer quarter since it depends on the availability of Chatham area corn and on price expectations for the upcoming corn crop.

The supply demand balance for eastern Canadian feed grains will affect the Chatham-Chicago corn price differential. The more the supply of corn in Ontario exceeds demand, the more likely corn will be moved from Chatham to Montreal. Hence, the corn price at Chatham will fall relative to Chicago. The converse holds if demand for corn rises, relative to the supply of corn.

Western Canadian feed grain availability affects the Chatham-Chicago corn price differential since the former are priced in Montreal in competition with imported U.S. corn. If western feed grain prices in Montreal rise relative to the Chicago corn price, reflecting a shortage in availability of western feed grains, it would be expected that the

Chatham corn price would rise accordingly.

The availability of corn supplies in the United States can affect the price difference in two ways. First, if the stocks or production of corn is high in the United States, then the demand for storage and transportation increases and bids up the price for storage and transportation. Hence, U.S. corn becomes more expensive to land in eastern Canada and the Chatham price rises. Secondly, huge stocks of U.S. corn puts downward pressure on Chicago cash corn prices relative to Chatham corn prices."

3.7 Seasonality of Ontario Corn Prices

Table 3.11 shows the monthly price for Ontario corn for crop years 1970/71 through 1981/82. Statistics Canada in compiling supply and disposition data for Ontario corn uses August 1 as the beginning of the crop year but in general no new crop corn is available for sale until October. For this reason October is considered the first month of the crop year in analyzing the seasonal price patterns for corn.

In a perfect market, with production occurring in the fall and consumption spread out over the year prices should increase, from their harvest lows, by enough to cover the cost of storage from the harvest period until the time of sale. Unfortunately, the corn market is not a perfect market because future supply and demand conditions are not known with certainty. This is particularly true in the case of United States production and U.S.S.R. imports.

The seasonality of corn price is highlighted in table 3.12 where the monthly prices are expressed as a percentage of the simple (unweighted) average crop year price. Looking at the average figures for the past twelve years it is clear that prices tend to increase over the crop year, from a low of 91.2 percent of the average price in November to 110.1 percent of the average price in August. However, no regular price increase seems to occur between December and April.

In comparing the average seasonality over the twelve year period with that for the past five years there appears to have been little change. In the more recent period prices peak in July versus August, and there is a more normal seasonal price pattern between January and April in the 1977/78-1981/82 data.

The indices of seasonal averages tend to obscure the fact that price patterns vary greatly between years. For example, in 1972/73 prices rose from 66.1 percent of the average in October to 149.6 percent in August. In 1974/75, nearly the exact opposite happened, when the crop year's highest price occurred in October and the lowest price occurred in May, at 89.2 percent of the crop year average. These examples highlight the fact that a farmer hoping to market his corn for the season's highest price faces a difficult task.

Due to the seasonality in corn prices farmers use various marketing

Table 3.11: Monthly Grain Corn Prices, No. 2 C.E. Chatham Track, ($/mt), 1970/71 to 1981/82

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1970/71	52	51	54	59	58	57	55	54	56	57	52	51
1971/72	42	43	47	48	46	46	47	48	48	48	53	58
1972/73	52	56	64	66	69	72	70	77	102	108	118	97
1973/74	97	92	115	120	127	120	112	113	121	133	147	154
1974/75	155	142	139	132	119	116	116	112	114	116	128	120
1975/76	109	100	102	104	101	99	97	107	115	117	117	116
1976/77	95	85	93	95	93	94	96	97	91	84	76	77
1977/78	75	79	83	84	85	96	104	111	110	103	104	101
1978/79	99	107	109	109	111	112	119	125	134	142	141	148
1979/80	129	120	124	120	121	115	119	127	134	150	161	165
1980/81	149	157	161	166	166	166	168	165	164	165	156	147
1981/82	125	118	117	117	112	111	119	122	129	133	125	121

Source: Livestock Feed Board of Canada. Annual Report. Various issues, Montreal.

Table 3.12: Seasonality of Ontario Grain Corn Prices, 1970/71 to 1981/82

	Monthly Price as a Percent of the Crop Year Average Price											
Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1970/71	94.9	93.5	99.2	107.1	106.8	104.2	100.6	98.5	102.8	103.5	95.6	93.1
1971/72	87.6	89.2	99.1	100.0	95.8	95.8	98.3	100.0	100.8	101.2	110.7	121.4
1972/73	66.1	71.1	80.2	83.0	87.7	90.9	88.0	97.4	128.2	135.7	149.6	122.2
1973/74	80.1	75.8	95.0	98.9	105.1	99.6	92.7	93.1	100.2	110.3	121.4	127.6
1974/75	123.1	112.7	110.8	104.9	94.9	92.1	92.4	89.2	90.5	92.1	101.8	95.5
1975/76	101.9	93.5	95.3	97.2	94.4	92.5	90.6	100.0	107.5	109.3	109.3	108.4
1976/77	105.9	94.8	103.7	105.9	103.7	104.8	107.1	108.2	101.5	93.7	84.7	85.9
1977/78	79.3	83.5	87.7	88.8	89.9	101.5	110.0	117.4	116.3	108.9	109.9	106.8
1978/79	81.6	88.2	89.8	89.8	91.5	92.3	98.1	103.0	110.4	117.0	116.2	122.0
1979/80	97.7	90.8	93.9	90.9	91.6	87.1	90.1	96.2	101.4	113.6	121.9	124.9
1980/81	103.2	103.2	104.4	102.6	101.9	102.6	97.0	91.4	101.9	102.6	97.0	91.4
1981/82	103.6	97.8	97.0	97.0	92.8	92.0	98.6	101.1	106.9	110.2	103.2	99.9
Average 1970/71-1981/82	93.8	91.2	96.3	97.2	96.3	96.3	96.9	99.6	105.7	108.2	110.1	108.2
Average 1977/78-1981/82	93.1	92.7	94.6	93.8	93.5	95.1	98.8	101.8	107.4	110.5	109.6	109.0

strategies in an attempt to obtain the highest price for their crop (see section 3.5). One of the most common strategies is to store corn, at harvest, for sale at a later date. From 1973/74 through 1981/82 the percent of the corn crop marketed between October and December was 39.8 percent, and over the most recent four year period (1978/79-1981/82) the percentage declined to 37.7 percent (table 3.13). Corn marketings are heaviest during the three months following harvest, decline to 6-8 percent of the crop per month for the next six months, and then fall to around 5 percent per month for the final three months.

The profitability of holding corn from harvest for sale at a later date depends on (a) the price change between harvest and the date of sale; (b) the physical cost of storing corn; and, (c) the opportunity cost of the money tied up in corn inventories. In order to judge the profitability of storing corn three different marketing alternatives are compared in table 3.14. The strategies involve delaying the sale of corn (1) until December; (2) until March; and (3) until July.

Over the past twelve years price changes between October and December have averaged 2.49/mt (table 3.14). In three years (1972/73, 1973/74, 1980/81) there were large positive price changes between October and December, and in one year (1974/75) there was a sizeable decline in price. The average cost of holding corn was estimated to be \$3.36/mt, 9/ resulting in a net loss from corn storage of \$0.87. In the first four years analyzed a hold and store strategy, between October and December was always profitable, however, in only three of the past eight years has this been the case.

Turning to alternative two, the average price change between October and March, of \$2.12/mt was smaller than the October-December price difference, primarily because of a large loss in 1974/75. Storage costs were estimated to average \$8.40/mt, consequently this storage strategy also results in a net loss averaging \$6.28/mt over the twelve years. This result is heavily influenced by one year, 1974/75, when the strategy resulted in a net loss of \$50.03/mt, however, omitting this one year would still result in an estimated loss from storage of \$2.11/mt.

Finally, the data for alternative three shows that the average price change between October and July was \$14.74/mt and storage costs were \$13.64/mt, for a net gain from storage of \$1.10. However, storage was only profitable in five of the twelve years, although the gains in all but one of those years were substantial.

In table 3.15 several aspects of corn price behavior are compared. In the first column is the simple average (unweighted) price over the crop year. This price represents the average return a farmer would have received if he marketed one-twelfth of his crop each month. In the

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9/ Physical storage costs were assumed to be \$0.73/mt/month (2 cents/bu./month and the opportunity cost of capital equal to the bank lending rate on prime business loans.

Table 3.13: Percent of Ontario Grain Corn Marketed by Month and Year, 1973/74 to 1981/82

Year	Month									
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
	(percent)											
1973/74	19.5	13.2	5.5	8.5	8.6	8.4	6.6	5.8	7.5	5.9	6.3	4.1
1974/75	12.7	20.0	9.7	5.9	5.9	5.2	9.4	5.7	7.0	4.0	6.4	7.9
1975/76	24.0	16.8	6.6	5.1	5.5	7.2	7.6	7.7	6.8	4.5	3.7	4.3
1976/77	12.9	18.7	9.2	4.9	6.0	7.3	6.3	7.9	9.3	5.9	6.1	5.3
1977/78	14.2	15.1	9.6	5.1	7.9	6.6	12.1	7.8	8.4	4.2	4.9	4.0
1978/79	11.6	15.3	8.2	5.6	7.4	10.5	7.7	8.1	7.6	6.3	7.0	4.4
1979/80	4.8	18.8	9.1	8.1	8.0	7.2	11.3	8.1	9.1	5.6	4.1	5.6
1980/81	16.7	19.0	7.7	7.9	6.5	7.5	8.8	7.2	5.5	4.4	4.6	4.3
1981/82	13.9	18.1	7.4	5.5	6.5	7.0	9.8	9.8	8.9	5.3	4.7	3.0
Average 1973/74-1981/82	14.5	17.2	8.1	6.3	6.9	7.4	8.8	7.6	7.8	5.1	5.3	4.8
Average 1978/79-1981/82	11.8	17.8	8.1	6.8	7.1	8.1	9.4	8.3	7.8	5.4	5.1	4.3

Source: O.M.A.F. unpublished data, 1983, Toronto.

Table 3.14: Estimated Profitability of Storing Grain Corn from October until December, March and July, 1970/71 to 1981/82

Year	Alternative 1: Store until December			Alternative 2: Store until March		
	Price Change Oct. to Dec.	Opportunity Cost of Storage	Net Gain or Loss	Price Change Oct. to March	Opportunity Cost of Storage	Net Gain or Loss
	($/mt)			($/mt)		
1970/71	2.36	2.15	0.21	5.12	5.36	-0.24
1971/72	5.51	1.89	3.62	3.94	4.73	-0.79
1972/73	11.22	1.98	9.24	19.68	4.96	14.72
1973/74	18.10	2.91	15.19	23.62	7.28	16.34
1974/75	-15.35	4.43	-19.78	-38.97	11.06	-50.03
1975/76	-7.00	3.23	-10.23	-10.00	8.07	-18.07
1976/77	-2.00	3.08	-5.08	-1.00	7.71	-8.71
1977/78	8.00	2.49	5.51	21.00	6.20	14.80
1978/79	10.00	3.27	6.73	13.00	8.18	4.82
1979/80	-5.00	4.68	-9.68	-14.00	11.71	-25.71
1980/81	12.00	4.59	7.41	17.00	11.55	5.45
1981/82	-8.00	5.58	-13.58	-14.00	14.02	-28.02
Average	2.49	3.36	-0.87	2.12	8.40	-6.28

Table 3.14 cont'd

Year	Alternative 3: Store until July		
	Price Change Oct. to May	Opportunity Cost of Storage	Net Gain or Loss
	($/mt)		
1970/71	4.72	8.23	-3.51
1971/72	6.49	7.07	-0.58
1972/73	55.11	7.46	47.65
1973/74	36.61	11.65	24.96
1974/75	-38.97	17.87	-56.84
1975/76	8.00	13.08	-5.08
1976/77	-11.00	12.42	-23.42
1977/78	28.00	9.75	18.25
1978/79	43.00	13.28	29.72
1979/80	21.10	19.62	1.48
1980/81	16.00	19.35	-3.35
1981/82	8.00	23.86	-15.86
Average	14.74	13.64	1.10

Table 3.15: Average Grain Corn Price and Price Variation, 1970/71 to 1981/82

Year Beginning Oct.	Unweighted Average Price ($/mt)	Weighted Average Price ($/mt)	Price Range ($/mt)	Coef. of Variation (Percent)	Std. Dev. ($/mt)
1970/71	54.75	N/A	51-59	5.0	2.73
1971/72	47.65	N/A	42-58	9.0	4.28
1972/73	79.23	N/A	52-119	27.1	21.46
1973/74	120.96	115.18	92-154	15.0	18.09
1974/75	125.71	130.17	112-155	10.8	13.54
1975/76	107.00	105.91	97-117	7.1	7.58
1976/77	89.67	89.83	76-97	8.2	7.35
1977/78	94.58	91.94	75-111	13.4	12.66
1978/79	121.33	118.05	99-148	13.4	16.25
1979/80	132.08	128.13	115-165	13.0	17.12
1980/81	160.83	159.74	147-168	4.4	7.04
1981/82	120.67	120.61	111-133	5.4	6.48

N/A = not available.

second column is the crop year average price of corn, weighted by the percent of corn marketed each month. In general, the two price series are quite similar with the largest difference only slightly more than $5.00/mt.

Tables 3.12 and 3.15 indicate that in most crop years the variation in price between months is substantial. In table 3.15 the coefficient of variation (COV) is seen to rise from 5.0 percent in 1970/71 to a huge 27.1 percent in 1972/73.[10/] For crop years 1973/74 through 1979/80 the COV ranged between 7 and 15 percent. In 1980/81-1981/82 the COV has again dropped into the 5 percent range. In dollar terms the range between the highest and lowest monthly price has varied from a low of $7.68/mt in 1970/71 to a high of $66.14/mt in 1972/73 (table 3.16).

If the difference between the highest and lowest monthly price is compared with the difference between the weighted average price and the lowest monthly price a measure of how successful Ontario farmers have been in selling at high prices emerges (table 3.16). Taking a ratio of the two price differences, calculated above, shows that producers generally sell more corn at low prices than at high prices. The difference between the weighted average price and the lowest monthly price is seldom more than 50 percent of the difference between the lowest and highest monthly average price. For example, in 1974/75 if all corn sales had been made during the month with the highest average price (October) producers would have received a price $42.52/mt higher than for sales during the lowest price month (May). As it happened, the average price received by producers was only $17.97/mt above the lowest monthly price, or 42.3 percent of what was potentially possible. On average, over the twelve years, producers only received 45.0 percent of the potentially available return. While it is ridiculous to assume that all corn could be sold in a single month, even small increases in the percent of potential returns received by farmers could mean millions of dollars. This is particularly true because Ontario corn prices are influenced only to a limited extent by the timing of Ontario corn marketings. Prices for Ontario corn generally reflect the Chicago price of corn adjusted for exchange rates and transportation and handling charges (see section 3.6).

10/ The coefficient of variation is a commonly used measure of variability. It is calculated as the standard deviation divided by the mean times 100.

Table 3.16: Comparison of Actual Producer Returns and Potential Returns, by Year

Year	Price Difference ($/mt) Highest Month - Lowest Month (1)	Weighted Average Price - Lowest Month (2)	(2)/(1) Percent
1970/71	7.68	N/A	N/A
1971/72	16.14	N/A	N/A
1972/73	66.14	N/A	N/A
1973/74	65.59	23.45	35.7
1974/75	42.52	17.97	42.3
1975/76	20.00	8.91	44.5
1976/77	21.00	13.83	65.8
1977/78	36.00	16.94	47.1
1978/79	49.00	19.05	38.9
1979/80	50.00	13.13	26.3
1980/81	21.00	12.74	60.7
1981/82	22.00	9.61	43.7
Average (1973/74-1981/82)	36.34	15.07	45.0

N/A = Not Available.

CHAPTER 4

PROCESSING ONTARIO GRAIN CORN

4.1 Institutional Structure of Food and Industrial Users of Grain Corn

The corn wet milling industry is the largest industrial user of grain corn, and the industrial sector where growth in the use of corn is most likely to occur. Only three firms in Canada are involved in corn wet milling and these three firms operate five plants in Ontario. Corn wet milling accounted for approximately 65 percent of the total industrial use of corn in Ontario, in 1981/82 (table 3.3). The other large industrial user of grain corn is the distilling industry which accounted for 27.8 percent of the total industrial use of Ontario grain corn in 1981/82. Other industries, such as the breakfast food and flour milling sectors use small quantities of grain corn, amounting to less than ten percent of total industrial use. Because of its importance, and growth potential, this chapter concentrates on the corn wet milling industry.

Two of the three firms involved in corn wet milling are subsidiaries of other firms. Nacan Corporation with one plant in Collingwood, Ontario is owned by National Starch and Chemical Corporation (USA), which is in turn owned by Unilever which is headquartered in the United Kingdom. Casco Company operates three plants, one in Cardinal, Ontario and the others in Port Colborne and London, Ontario. Casco Co. is jointly owned by Canada Starch Co. (70 percent) and John Labatt Ltd. (30 percent). Canada Starch is owned by CPC International, Inc. (USA). St. Lawrence Starch is a privately owned Canadian[11/] corporation which operates one plant in Port Credit, Ontario.

There were 14 distilleries and 25 flour and breakfast cereal establishments in Ontario in 1980 (West et al.).

4.2 Investment Pattern

There has been considerable investment in the corn wet milling industry in the recent past by all the companies involved in the industry.

11/ Because of the small number of firms in the corn wet milling business there is almost no public information available which documents the industry's input usage, output mix, product flows domestically and internationally, and output prices. For this reason much of the information contained in this chapter is based on information obtained in discussions with representatives of each of the corn wet milling firms during August 1983.

Casco increased the capacity of their Cardinal plant from 30,000 to 45,000 bushels per day and the Port Colborne plant was opened late in 1982. The London plant was opened in 1981 and has recently expanded to produce both 42% and 55% high fructose corn syrup. The reported cost of the London plant was $130 million. St. Lawrence Starch has doubled its capacity since 1978, while the size of the Nacan plant has tripled since 1975.

4.3 Grain Corn Processing Capacity

Table 4.1 shows the approximate capacities of the five plants milling corn in Ontario. An attempt was made to ascertain the 1983 level of capacity utilization, in the industry, but company spokesmen were reluctant to divulge this information. There was, however, a general consensus that 85 percent utilization based on 330 work days would represent a good level of capacity utilization. The author's impression is that the industry was operating somewhat below the 85 percent utilization rate in 1983, perhaps in the range of 65 to 75 percent of capacity.

The distilling industry is running well below capacity with a utilization rate of 46 percent in 1982 and an estimated utilization rate of 42 percent for 1983.

4.4 Technology Employed

The following description of the corn wet milling process is taken directly from information provided by the Casco Co. Other descriptions of the wet milling process are contained in Carman and Thor, and Inglett.

The corn wet milling process begins with the shelled corn being cleaned and soaked in a weak sulfurous acid water known at steepwater (figure 4.1). Following this the corn is ground to separate it into four major components (a) starch - the starting point for syrup production; (b) corn gluten feed - a 21 percent protein product used for animal feed; (c) corn gluten meal - a 60 percent protein animal feed product; and, (d) corn germ - which can be further processed to make corn oil. Casco reports the following recovery coefficients for corn wet milling but these proportions will vary somewhat according to plant size, manufacturer and the moisture content of the corn (Carman and Thor).

Table 4.1: Corn Wet Milling Capacity, bushels per day, 1983

Company	Location	Total Grind	Products			
			Starch	Glucose	HFCS	Alcohol
Casco Co.	Cardinal	45,000	15,000	20,000	10,000	-
	Port Colborne	18,000	1,000	-	17,000	-
	London	30,000	5,000	6,300	18,700	-
St. Lawrence	Port Credit	20,000	6,700	8,300	-	5,000
Nacan	Collingwood	10,000	10,000	-	-	-
All Companies	Ontario	123,000	46,700	34,600	45,700	5,000

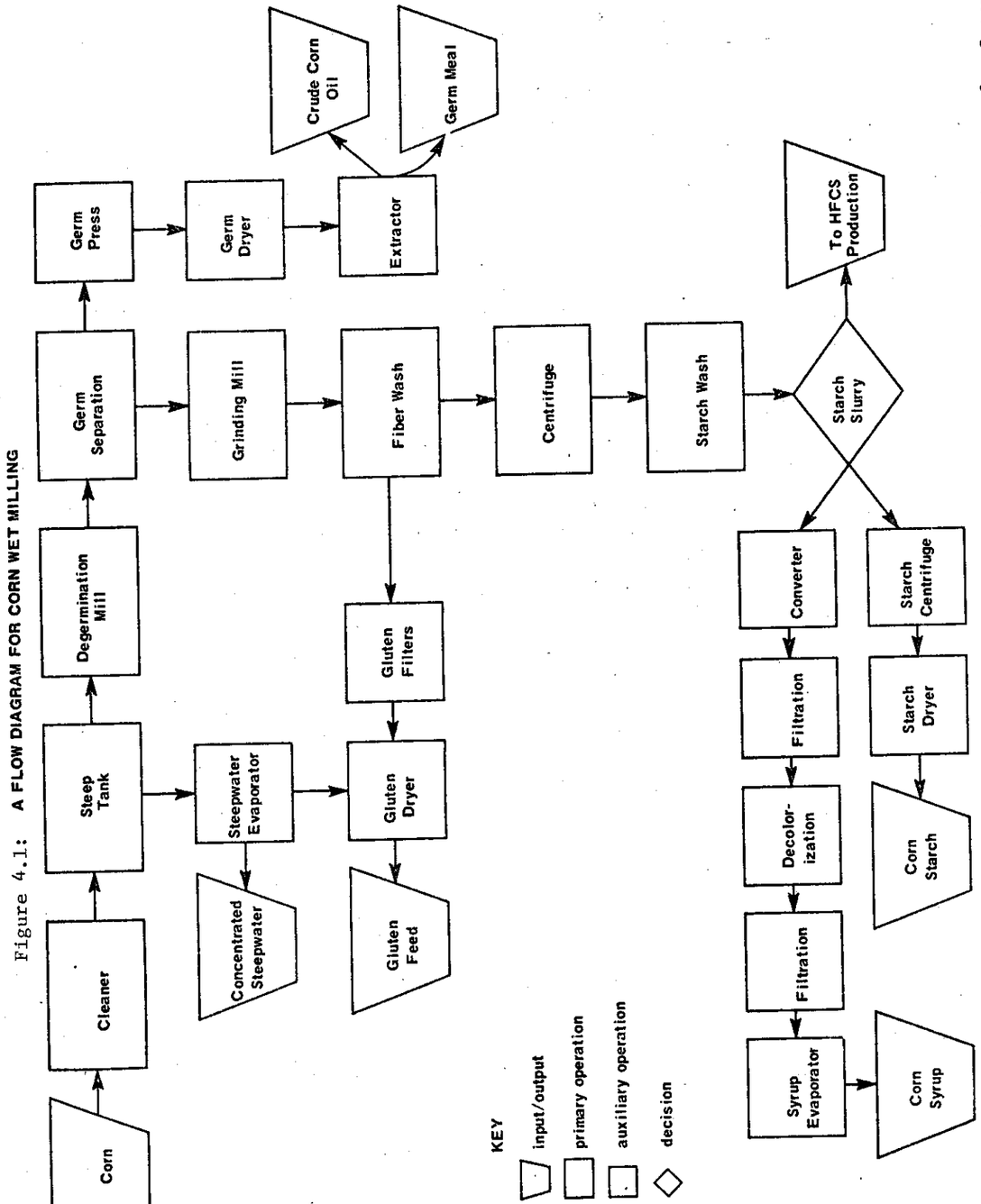

Figure 4.1:

Source: Carman, H. F. and P. K. Thor (1979). High Fructose Corn Sweeteners: Economic Aspects of a Sugar Substitute. Information Series 79-2, Giannini Foundation, University of California.

Typical Recovery of Product
From a Corn Wet Milling Operation

From one bushel of Clean Corn - 56 lbs./bu.

Corn Gluten feed[a/]	-	10.2 lbs. dry solids basis
Corn Gluten meal	-	2.5 lbs. dry solids basis
Corn Germ	-	3.7 lbs. dry solids basis

a/ Includes 1.5 lbs. of corn screenings.

The starch produced during the first stage of the wet milling process is washed many times, de-watered and then dried to commercial moisture levels for sale.

Corn starch slurry is the primary ingredient in the production of corn syrup (glucose) and high fructose corn syrup. Glucose is produced by partially breaking down the long chain starch molecule, by first the action of acid and then possibly by an enzyme. The converted syrup is filtered, decoloured and evaporated to a final solid level of approximately 80 percent.

To produce high fructose corn syrup (HFCS) the long chain molecules are broken up by the application of several enzymes. In the first stage the starch is cooked and its viscosity is reduced with a liquifying enzyme (alpha amylase). The resultant high viscosity syrup is then treated with a second enzyme (glucoamylase) which breaks down the liquified starch to dextrose in a process called saccharification. The dextrose syrup is filtered, decoloured and ion-exchanged, before passing through isomerization columns containing an immobilized enzyme where some of the dextrose is converted to fructose (42% fructose). The resulting liquid has approximately the same sweetness as sugar. After further decolouring and ion-exchanging HFCS-42 is sold as an industrial sweetener to replace liquid sugar. HFCS-42 can be further enriched to produce HFCS-55 which is used extensively in the soft drink industry.

4.5 Performance of the Processing Industry

4.5.1 Corn Usage

Most of the corn used by Ontario corn wet millers is Canadian corn. The major exception is the plant at Cardinal, Ontario where the use of Canadian corn is dependent on the quantity of corn produced in Eastern Ontario. Some waxy corn is imported by the industry, from the United States, and grain corn is occasionally imported if there is a short supply of No. 2 Canadian corn, particularly at the end of a crop year.

Only one of the corn wet millers also operates grain elevators and the industry purchases most of its corn on the open market. Some

contracting is done with producers but it does not appear to be a common practice.

Most of the corn used in the London, Port Credit and Collingwood plants is delivered by truck while water shipments are important at Cardinal and Port Colborne.

The corn wet millers were generally satisfied with the operation of the corn market but they all expressed some concern with regard to corn quality, particularly corn that has been improperly dried. Corn which has been dried at too high a temperature cannot be separated into its component parts and this causes considerable problems for the industry. Some of the millers in an attempt to circumvent the potential problem of improperly dried corn are accepting delivery of wet corn (up to 28% moisture). Wet corn, however, must be milled immediately and this probably limits the market for this type of corn.

Several of the corn wet millers mentioned that they work with corn plant breeders in testing corn varieties for characteristics important in corn milling. They felt, however, that milling characteristics were given a rather small weight in plant selection decisions because of the small quantity of corn used industrially in comparison with what is used for animal feed.

4.5.2 By-Products

The corn wet milling process results in three by-products (a) corn gluten meal; (b) corn gluten feed; and, (c) corn germ. None of the corn wet millers are involved in feed manufacturing, which is the major user of corn gluten feed and meal. They are, however, in constant touch with grain elevator firms as a result of their corn purchasing activity; and, many elevator companies are in the feed manufacturing business. Two of the three corn wet millers crush their own corn germ and refine the crude corn oil to produce a branded corn oil sold at the retail level. The by-product markets are important in the wet milling industry because they can return more than 50 percent of the cost of corn. Estimates prepared by Carman and Thor for the U.S. show that the value of by-products equaled 53 to 73 percent of the corn price between 1971 and 1977.

4.5.3 Corn Products

The primary products produced in corn wet milling are (1) starch, (2) glucose, (3) HFCS and (4) alcohol. These products are incorporated into a wide variety of consumer goods. Corn starch is used in fine papers, textiles, corrugated cartons, wallboard and many other industrial and food products. Glucose (corn syrup) is used in ice cream, jams and jellies, canned foods, beer, confectionary products plus many others. HFCS-42 is used in canned foods, jams and jellies, catsup, pickles and baked goods. HFCS-55 is used in soft drinks, ice cream and jam production. The alcohol produced is used in the distilling industry.

Most of the starch and glucose produced in Ontario is used in Eastern Canada. Industry spokesmen agreed that 75 to 80 percent of the starch and glucose produced is used in Ontario and Quebec, with approximately equal shares of the total market in each province. About 60 percent of the alcohol produced is used in Ontario with most of the remainder moving to Western Canada, particularly British Columbia.

Until recently substantial quantities of HFCS were being shipped to the United States but the exact quantity is impossible to determine (see section 3.3.4). The reasons for the exports of HFCS are twofold. First, Canada follows world sugar prices while the United States is currently supporting sugar prices above world market levels; and, second it will require some time for Canadian food manufacturers to switch from using cane sugar to HFCS. Industry participants stated that the HFCS exports are a short-run phenomena and that to be viable in the long run they will need to develop and supply the Canadian market.

There is currently enough milling capacity to supply approximately 18 lbs. of HFCS, per capita, in Canada. Carman, Schnittker Associates and, Niall and Smith have estimated that HFCS can capture 25-30 percent of the U.S. sweetener market.[12/] Per capita sweetener use in the U.S. was 134.3 lbs. in 1980 of which 83.2 lbs. was cane or beet sugar and 19.2 lbs. was HFCS (Schnittker Associates). Comparable figures are not available for Canada except for cane and beet sugar whose consumption was 84.5 lbs/capita in 1982. Assuming that toal per capita sweetener use in Canada is not much different than in the U.S., and that HFCS might capture 25 percent of the market, the potential use of HFCS could reach 35 lbs/person, roughly twice the existing capacity. The consumption and market penetration of HFCS will, however, be highly dependent on the price of cane and beet sugar. Schnittker Associates have estimated the net cost of producing HFCS-42 at 14.8 U.S. cents per pound, dry basis, and 16.1 U.S. cents per pound, dry basis for HFCS-55. These cost estimates are, of course, highly dependent on the assumed corn cost, by-product prices and the size and capital structure of the firm.

4.6 Financial Performance

Direct information on the profitability of Ontario's wet corn processors is not available because the firms involved are either subsidiaries of large corporations or privately owned. Indirect evidence on industry profitability which might be obtained from a comparison of input and output prices is also difficult because publically reported prices for starch, glucose and HFCS are not available.

12/ Carman and Niall and Smith provide estimates of the potential for HFCS adaption in the U.S. by end use.

Industry spokesmen stated that prices for their products, during 1982/83, were depressed as a result of industry expansion and the recession. Clearly, profitability in the industry depends on the demand for end products which use starch and glucose as ingredients, while the profitability of HFCS production is highly dependent on the price of corn and cane sugar.

4.7 Major Changes in the Processing Industry

Future growth in certain segments of the corn processing industry seems certain to be slow, particularly in the breakfast cereal and flour milling sectors where sales increases are likely to be limited to population growth, currently estimated to increase by 6.7 percent between 1983 and 1990 (Hassan and Karamchandani). Consequently, corn usage in these areas may rise from its current level of approximately 68,000 mt to 72,500 mt by 1990.

Use of corn by the distilling industry has declined from a peak of 350,499 mt in 1979/80 to only 241,800 mt in 1981/82. This consumption decline is the direct result of ever increasing taxes on alcoholic beverages and a possible shift in consumers' preferences away from hard liquors to wine and beer. The Association of Canadian Distillers has made a representation to the federal government to point out the impact of tax increases on their industry but it seems unlikely that the taxes will be eliminated or rolled back. Perhaps the most that can be hoped for is that future tax increases will be moderate. In any case rapidly expanding demand for corn used in distilling seems unlikely and usage by 1990 may well be less than 300,000 mt.

The future demand for corn used by the corn wet milling industry is extremely difficult to project. Projections of industry participants ranged from estimates that growth would be limited to population growth to one forecast that demand would increase 50 percent by 1990. Corn usage by wet millers in 1981/82 was approximately 560,000 mt. The industry presently has the capacity to process 875,000 mt of corn and this probably sets a lower bound for corn usage in 1990. An upper bound for corn use in 1990 is difficult to establish because it will be highly dependent on the market penetration of HFCS. However, as stated in section 4.2 under current constraints imposed by soft drink manufacturers the maximum use of HFCS is about 35 lbs/person,[13/] which would imply a doubling of the current HFCS processing capacity. This coupled with modest growth in the demand for starch and glucose could push total corn usage to 1.25 mmt/year by 1990. However, as pointed out by one industry participant, some of the growth in corn wet milling is

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13/ Since preparation of this report Coca-Cola (U.S.) increased the maximum use of HFCS-55 in its bottles and cans to 75 percent and in its fountain products to 100 percent. Pepsi-Cola (U.S.) increased the maximum content of its products to 80 percent (Milling and Baking News).

likely to occur in Western Canada where it will be supplied with Western Canadian and United States corn.

A reasonable estimate of grain corn use for industrial purposes, in Ontario, by 1990 may be 1.2 to 1.5 mmt. This projection could turn out to be very conservative if (1) oil prices increase to the point where the production of alcohol, from corn, as a fuel replacement becomes viable; or, (2) cane sugar prices increase to the point that soft drink manufacturers increase the allowable level of HFCS use in their products.

CHAPTER 5

AN ASSESSMENT OF THE INTERNATIONAL FEED GRAIN MARKET

5.1 Quantity of Coarse Grains and Corn Traded Internationally

Table 5.1 contains estimates of the world's production, consumption and trade in coarse grains.[14/] Looking at the trade figures the story is one of rapid growth during the 1960's, averaging 1.5 mmt per year, explosive growth during the 1970's, averaging 5.55 mmt per year, and stagnation during the early 1980's. Between 1960 and 1980 trade in coarse grains increased from 24.0 mmt to a record 108.8 mmt; and, during that time there were only three years (1966/67, 1967/68, 1974/75) when trade declined from one year to the next. From 1960 to 1980 the maximum year-to-year decline in coarse grain trade occurred in 1974/75, of 6.1 mmt (8.6 percent), largely as a result of very high prices. However, in 1981/82 trade declined by 10.1 mmt (9.3 percent), and in 1982/83 by 7.2 mmt (7.3 percent), both declines occurring in the face of extremely low world prices. This decline in trade has raised serious questions with regard to the long term health of the international coarse grain economy and this question is addressed in more detail in sections 5.3 and 5.4.

Corn is the principal coarse grain produced in the world, representing 56.1 percent of total coarse grains production in 1982/83, and dominates world trade in coarse grains with a 67.6 percent market share in 1982/83 (tables 5.2 and 5.3).

Canada's share of world coarse grain production was a modest 3.4 percent in 1982/83, while its share of world coarse grain exports was somewhat larger at 7.0 percent (table 5.3). Most of Canada's coarse grain exports are barley, and Canada's role in the international corn market, at present, is small.

The United States is the world's largest producer of corn, with 48.4 percent of the world's total production, in 1982/83, and completely dominates world exports of corn with a market share of 74.3 percent, in 1982/83, down from 83.7 percent in 1979/80.

In addition to the United States, the U.S.S.R., China, Western Europe and Eastern Europe are also large producers of coarse grains. On the export side, however, only Argentina, Australia, South Africa and Thailand join the U.S. and Canada as significant exporters. As with Canada, though, Australia exports primarily barley (table 5.3).

14/ The data contained in most of the tables in chapter 5 was updated using information available in July 1984. The major exceptions to this procedure are tables 5.2 and 5.3 which are based on figures published in July 1983. Dates are given in the source for each table to provide guidance as to the vintage of the estimates.

Table 5.1: World Coarse Grain Supply and Utilization, 1960 to 1982

Crop Year	Production (mmt)	Utilization (mmt)	Ending Inventory (mmt)	Stock/ Utilization (percent)	Trade (mmt)
1960/61	447.9	437.2	109.7	0.25	24.0
1961/62	434.2	449.3	94.7	0.21	30.0
1962/63	459.5	461.5	92.7	0.20	31.0
1963/64	467.7	462.5	97.9	0.21	34.0
1964/65	472.6	479.5	90.9	0.19	35.0
1965/66	484.7	500.5	75.1	0.15	42.0
1966/67	521.2	520.2	76.1	0.15	40.0
1967/68	551.4	542.3	85.2	0.16	39.0
1968/69	552.6	548.6	89.2	0.16	37.0
1969/70	576.7	576.6	89.2	0.15	39.0
1970/71	576.3	593.3	72.2	0.12	46.0
1971/72	629.1	615.4	87.0	0.14	49.0
1972/73	609.9	626.9	69.9	0.11	59.0
1973/74	669.7	673.0	65.9	0.10	71.0
1974/75	628.1	633.6	58.9	0.09	64.9
1975/76	645.0	645.6	58.3	0.09	75.1
1976/77	704.2	684.8	78.2	0.11	82.7
1977/78	700.7	692.2	86.6	0.13	84.0
1978/79	754.2	748.6	91.9	0.12	90.4
1979/80	741.8	741.2	92.6	0.12	101.5
1980/81	732.0	741.2	83.6	0.11	108.8
1981/82	771.1	741.8	112.8	0.15	98.7
1982/83	785.2	758.6	139.4	0.18	91.5

Source: U.S. Department of Agriculture. Foreign Agriculture Circular: Grains. Various issues, Foreign Agriculture Service, Washington, D.C., June 1984.

Table 5.2: World Corn Production, Exports and Imports, by Region, July/June Crop Year, 1976/77 to 1982/83, mmt

Region	Crop Year						
	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
Production:							
United States	159.2	163.2	180.0	201.7	168.8	208.3	213.3
China	35.4	49.0	55.9	60.0	62.6	59.2	60.3
Argentina	8.3	9.7	9.0	6.4	12.9	9.6	8.3
EC-10	N/R	N/R	16.9	18.1	17.5	18.4	19.5
East Europe	29.9	29.7	27.7	34.5	29.6	29.7	36.1
South Africa	9.7	10.2	8.2	10.8	14.6	8.4	4.2
Thailand	2.7	2.0	3.0	3.3	3.2	4.3	3.3
Brazil	18.8	13.9	16.3	20.2	22.6	22.9	22.0
Other	78.3	84.1	69.0	69.1	75.5	76.9	73.4
World Total	342.3	361.8	386.0	424.1	407.3	437.7	440.4
Imports[a/]:							
Japan	8.9	9.7	10.9	11.9	14.0	13.0	14.5
USSR	5.0	10.9	9.6	14.5	11.8	17.3	6.3
EC-10	N/A	N/A	N/A	12.7	11.0	8.7	5.3
Spain	3.7	4.6	4.2	4.5	4.3	5.6	4.5
East Europe	4.9	4.3	5.2	8.4	8.1	5.7	2.0
China	0.0	0.1	3.0	2.0	0.8	1.1	2.6
Other	31.2	28.4	32.0	20.2	28.5	21.9	26.7
World Total	53.7	58.0	64.9	74.2	78.5	73.3	61.9
Exports:							
United States	42.3	45.1	51.4	62.1	63.7	52.1	46.0
South Africa	1.4	2.7	2.7	2.7	3.4	4.9	3.3
Thailand	2.1	1.2	2.1	2.1	2.1	3.3	2.1
Argentina	4.4	6.0	6.7	4.1	5.9	8.2	5.3
Other	3.5	3.0	2.0	3.2	3.4	4.8	5.2
World Total	53.7	58.0	64.9	74.2	78.5	73.3	61.9

a/ Excludes intra-EC trade.

Source: U.S. Department of Agriculture. Foreign Agriculture Circular: Grains. Various issues, Foreign Ag. Service, Washington, D.C., July 1983.

Table 5.3: World Coarse Grain Production, Exports and Imports, by Region, July/June Crop Year, 1975/76 to 1982/83, mmt

	Crop Year							
	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
Production:								
United States	185.1	193.9	205.7	222.1	238.7	198.4	249.0	255.5
USSR	65.8	115.0	92.6	105.3	81.1	80.5	72.0	86.0
China	68.9	70.5	70.7	79.1	83.0	83.1	84.2	80.8
East Europe	59.4	59.5	59.3	60.5	63.4	61.2	62.0	71.5
West Europe	81.5	73.1	87.6	94.0	91.1	94.9	87.8	93.1
Canada	20.0	21.1	22.3	20.3	18.9	22.1	26.0	26.6
Argentina	12.4	16.9	18.3	17.2	10.6	21.0	18.4	17.4
Australia	5.6	5.1	4.3	7.1	6.2	5.2	6.6	3.6
Brazil	18.5	19.8	14.0	16.6	20.6	23.0	24.1	N/A
South Africa	7.7	10.3	11.0	8.8	11.7	15.3	8.8	4.6
World Total	645.0	704.2	700.7	754.2	741.8	730.9	764.8	780.9
Imports:								
Japan	13.5	15.9	17.0	17.9	18.9	18.9	18.3	18.7
West Europe	24.8	35.7	23.4	22.9	23.2	20.8	22.4	16.6
East Europe	7.8	9.0	8.3	10.5	11.4	10.7	7.0	3.6
USSR	15.5	5.7	11.7	9.9	18.4	18.0	25.5	11.5
China	0.0	0.0	0.1	3.1	2.0	0.9	1.3	2.7
Other	14.8	16.2	23.6	25.8	27.0	36.2	30.9	35.4
World Total	76.4	82.5	84.0	90.1	100.9	105.5	105.4	88.5
Exports:								
United States	46.3	50.6	52.1	56.9	71.6	72.4	61.4	52.5
Canada	4.9	4.6	3.7	3.9	4.8	4.6	7.6	6.2
Argentina	5.4	9.5	11.0	11.5	6.6	9.9	13.6	10.8
Australia	3.2	3.3	2.0	2.6	4.1	2.2	3.4	1.3
South Africa	3.4	1.4	2.9	2.9	2.9	3.6	4.9	3.3
Thailand	2.6	2.3	1.3	2.3	2.3	2.4	3.5	2.4
West Europe	5.0	4.6	6.0	6.2	5.6	7.0	5.9	6.3
USSR	0.0	2.0	1.0	1.0	0.0	0.0	0.0	0.0
Other	5.6	4.2	4.0	2.8	3.0	3.4	5.1	5.7
World Total	76.4	82.5	84.0	90.1	100.9	105.5	105.4	88.5

Source: U.S. Department of Agriculture. Foreign Agriculture Circular: Grains. Various issues, Foreign Agriculture Service, Washington, D.C., July 1983.

Production of corn is concentrated in the U.S., China, Argentina and Brazil, with 69 percent of the world's production in 1982/83. Only the United States, South Africa, Thailand and Argentina export significant quantities of corn, shipping 91.6 percent of the world's corn exports in 1982/83.

Turning to the import side Japan is the world's largest, single country, importer of coarse grains and corn. In 1982/83, over 75 percent of Japan's coarse grain imports were corn. The U.S.S.R., Spain, East Europe and China are also significant importers of corn. The European Community was, at one time, a significant importer of corn but their imports have declined significantly in the past five years. In sections 5.3 and 5.4 more detailed information is provided on the major countries involved in the world corn market.

5.2 Cost of Production of Competitors

A detailed comparison of cost of production data for the United States and Canada was given in section 2.5 and is not repeated here.

The author was unable to find any detailed cost-of-production information for major exporters, other than the U.S., except for some very old estimates for Argentina (Hutchison, et. al.). Given that the estimates were for the late 1960's they are not repeated here. It should be noted, however, that the international competitiveness of the Argentine corn industry is extremely dependent on their macroeconomic and trade policies. With domestic inflation rates in the range of 50 to 100 percent the exchange rate must be constantly adjusted in order to keep export products competitive on the world market.

Corn yields in Argentina, South Africa and Thailand are far below those in the United States and Canada (table 5.4). A linear trend (Trend) fit to the yield data for Argentina (YLDCO.AR), South Africa (YLDCO.SF) and Thailand (YLDCO.TH) shows that there has been a significant upward trend in corn yields, equaling 1.57 bushels/acre/year in Argentina and 1.12 bushels/acre/year in South Africa, over the period 1970 to 1982, but no trend in Thailand's yields.

5.1 YLDCO.AR = -129.82 + 1.57 Trend
t-value (-2.20) (2.95)

R^2 = 0.44 D.W. = 2.38 Sample = 1970-1982

5.2 YLDCO.SF = -91.72 + 1.12 Trend
t-value (-1.40) (1.90)

R^2 = 0.25 D.W. = 2.67 Sample = 1970-1982

Table 5.4: Corn Yields, Argentina, South Africa and Thailand, 1970 to 1982, (bushels/acre)

Year	Argentina	South Africa	Thailand
1970	37.12	23.17	41.26
1971	38.87	31.12	44.45
1972	29.63	33.00	21.03
1973	40.15	18.35	35.85
1974	45.25	39.64	36.01
1975	39.99	32.45	36.33
1976	33.78	25.62	33.14
1977	52.26	34.80	22.15
1978	58.10	36.12	32.08
1979	49.46	30.61	34.48
1980	40.95	39.79	35.16
1981	60.55	53.77	39.60
1982	48.25	28.46	29.71
Average (1970-1982)	44.20	32.84	33.96
Average (1978-1982)	51.46	37.75	34.20

Source: U.S. Dept. of Agriculture. Foreign Agriculture Circular: Grains. Various issues, Foreign Agriculture Service, Washington, D.C., June 1984.

5.3 YLDCO.TH = 72.68 - 0.35 Trend
t-value (1.29) (-0.69)

R^2 = 0.04 D.W. = 2.18 Sample = 1970-1982

5.3 Recent and Expected Trends in Production and Exports of Competitors

5.3.1 United States

The United States is the world's largest producer and exporter of feed grains and corn (tables 5.5 and 5.6). Corn is the dominant feed grain produced in the United States representing, in 1982/83, 83.5 percent of U.S. feed grain production and 88.0 percent of U.S. feed grain exports. In 1982/83 the U.S. also produced 11.4 mmt of barley, 9.0 mmt of oats and 21.4 mmt of grain sorghum.

United States corn production has been heavily influenced, since the end of World War II, by government intervention in the form of acreage control programs, a nonrecourse loan program, a deficiency payment program, and more recently the farmer owned reserve (FOR) and payment in kind (PIK) programs.

The United States loan rate for corn tends to set a floor price for world corn prices because the United States government has agreed to purchase all of the corn offered to it, at the loan rate, from any U.S. corn producer participating in the U.S. corn program. The extent to which the U.S. loan rate has set a floor price (some producers would also argue that it has also often set a ceiling price) for corn is shown in table 5.7.

For the first three years of the 1960's the loan rate was above the average price received by farmers for corn, and U.S. government owned stocks of feed grains were huge, representing 51.6 mmt or 66.0 percent of total feed grain stocks in 1960/61. In the mid 1960's the U.S. lowered the loan rate in an attempt to lower government stocks, reduce supply, and to improve the competitiveness of U.S. corn on the international market (during much of this time export subsidies were also available). Nonetheless during the decade of the 1960's the price received by farmers for corn was significantly above the loan rate only in 1966/67. Beginning in 1972/73 corn prices, along with the prices of many other basic commodities, moved rapidly upward. Between 1972/73 and 1980/81 corn prices, with the exception of 1977/78, were well above the loan rate and most government supply control programs were disengaged.

The price increases of the 1970's brought forth a sizeable increase in the area planted and production of feed grains and corn. In 1972/73, the harvested area of corn was 57.5 million acres and total production was 141.7 mmt. By 1981/82 the harvested area was 74.7 million acres and total production was 208.3 mmt. In just ten years (1972 to 1981) the United States added 17.2 million acres to corn production and total output expanded by 66.6 mmt or 47.0 percent.

Table 5.5: United States Supply and Utilization of Feed Grains, October/September Crop Years, 1960/61 to 1982/83, mmt

Crop Year	Supply				Disappearance			
	Production	Imports	Beginning Inventory	Total Supply	Exports	Feed	Food	Seed	Ending Inventory
1960/61	141.1	0.4	69.0	210.5	11.6	108.1	10.1	2.1	78.5
1961/62	126.8	0.5	78.5	205.8	15.5	110.9	10.6	1.9	66.8
1962/63	128.6	0.2	66.8	195.6	15.4	107.8	10.9	1.8	59.7
1963/64	139.5	0.4	59.7	199.6	17.0	105.3	11.4	1.7	64.3
1964/65	121.7	0.3	64.3	186.3	19.5	102.3	11.7	1.6	51.1
1965/66	143.3	0.2	51.1	194.6	26.4	115.0	12.0	1.6	39.7
1966/67	144.2	0.2	39.7	184.1	20.0	115.3	12.2	1.5	35.0
1967/68	162.3	0.3	35.0	197.6	21.3	117.4	12.2	1.6	45.1
1968/69	154.7	0.3	45.1	200.1	16.7	122.8	12.2	1.6	46.7
1969/70	160.9	0.3	46.7	207.9	19.0	129.4	12.3	1.7	45.5
1970/71	145.2	0.3	45.5	191.0	18.9	126.1	12.7	1.7	31.5
1971/72	188.3	0.3	31.5	220.1	24.5	135.6	13.1	1.6	45.4
1972/73	181.3	0.4	45.4	227.1	39.1	141.7	14.0	1.6	30.8
1973/74	186.2	0.2	30.8	217.2	40.4	139.2	14.5	1.4	21.5
1974/75	150.5	0.5	21.5	172.5	35.7	105.4	14.6	1.5	15.3
1975/76	184.6	0.5	15.3	200.4	50.0	116.2	15.6	1.5	17.2
1976/77	194.0	0.3	17.2	211.5	50.6	113.1	16.3	1.6	29.9
1977/78	205.3	0.3	29.9	235.5	56.3	117.9	18.4	1.5	41.4
1978/79	221.5	0.3	41.4	263.2	60.2	135.9	19.5	1.4	46.2
1979/80	238.2	0.3	46.2	284.7	71.3	138.7	20.9	1.4	52.4
1980/81	198.0	0.3	52.4	250.7	69.3	123.0	22.5	1.3	34.6
1981/82	248.5	0.3	34.6	283.3	58.6	130.6	24.4	1.4	68.4
1982/83	254.1	0.3	68.4	326.4	54.0	142.8	26.5	1.4	98.1

Source: U.S. Dept. of Agriculture. Feed Situation. Various issues, Economics Research Service, Washington, D.C., 1984.

Table 5.6: United States Corn Supply and Utilization, October/September Crop Years, 1960/61 to 1982/83, mmt

Crop Year	Supply				Disappearance			
	Beginning Inventory	Production	Imports	Total Supply	Exports	Feed	Food and Seed	Ending Inventory
1960/61	45.39	99.24	0.03	144.66	7.42	78.54	7.47	51.23
1961/62	51.23	91.39	0.03	142.65	11.05	81.61	8.00	41.99
1962/63	41.99	91.60	0.03	133.61	10.57	80.17	8.20	34.67
1963/64	34.67	102.09	0.03	136.79	12.70	76.43	8.64	39.04
1964/65	39.04	88.50	0.03	127.56	14.48	75.09	8.87	29.14
1965/66	29.14	104.22	0.03	133.38	17.45	85.40	9.14	21.39
1966/67	21.39	105.87	0.03	127.29	12.37	84.69	9.25	20.98
1967/68	20.98	123.45	0.03	144.46	16.08	89.49	9.20	29.69
1968/69	29.69	113.04	0.03	142.75	13.62	91.62	9.12	28.40
1969/70	28.40	119.06	0.03	147.48	15.55	97.13	9.27	25.53
1970/71	25.53	105.47	0.10	131.10	13.13	91.24	9.78	16.94
1971/72	16.94	143.42	0.03	160.38	20.22	101.15	10.39	28.63
1972/73	28.63	141.74	0.03	170.39	31.95	109.02	11.43	17.98
1973/74	17.98	144.05	0.03	162.06	31.57	106.20	11.99	12.29
1974/75	12.29	119.41	0.05	131.76	29.19	80.78	12.62	9.17
1975/76	9.17	148.37	0.05	157.59	43.46	90.68	13.28	10.16
1976/77	10.16	159.75	0.05	169.96	42.78	90.71	13.97	22.51
1977/78	22.51	165.23	0.08	187.82	49.48	95.10	15.01	28.22
1978/79	28.22	184.62	0.03	212.86	54.18	109.81	15.75	33.12
1979/80	33.12	201.66	0.03	234.81	61.80	114.79	17.15	41.07
1980/81	41.07	168.79	0.03	209.89	59.82	105.14	18.67	26.26
1981/82	26.26	208.34	0.03	235.63	49.96	108.61	20.63	55.43
1982/83	55.43	212.32	0.03	267.78	47.50	117.71	22.81	79.76

Source: U.S. Dept. of Agriculture. Agricultural Statistics 1982. Washington, D.C.
U.S. Dept. of Agriculture. Agricultural Outlook. Economic Research Service, June 1984, Washington, D.C.

Table 5.7: United States Loan Rate and Average Price Received by Farmers for Corn, October/September Crop Years, 1960/61 to 1982/83, ($/mt)

Crop Year	Loan Rate (LRC04)	Price Received by Farmers (FPC04)	Price Difference FPC04-LRC04
1960/61	41.73	39.37	-2.36
1961/62	47.24	43.31	-3.94
1962/63	47.24	44.09	-3.15
1963/64	42.12	43.70	1.57
1964/65	43.31	46.06	2.76
1965/66	41.34	45.67	4.33
1966/67	39.37	48.82	9.45
1967/68	41.34	40.55	-0.79
1968/69	41.34	42.52	1.18
1969/70	41.34	45.67	4.33
1970/71	41.34	52.36	11.02
1971/72	41.34	42.52	1.18
1972/73	41.34	61.81	20.47
1973/74	41.34	100.39	59.05
1974/75	43.31	118.89	75.59
1975/76	43.31	100.00	56.69
1976/77	59.05	84.64	25.59
1977/78	78.74	79.52	0.79
1978/79	78.74	88.58	9.84
1979/80	82.67	99.21	16.53
1980/81	88.58	122.44	33.86
1981/82	94.48	98.42	3.94
1982/83	100.39	105.51	5.12

Source: U.S. Dept. of Agriculture. Feed Situation. Various issues, Economic Research Service, Washington, D.C., 1984.

Gallagher has estimated the elasticity of U.S. corn area, with respect to the deflated farm price of corn, to be 0.29 when market prices are high relative to weighted support prices, and 0.06 when weighted support prices are high relative to the market price. While these estimates are interesting it is important to note that U.S. corn production has generally been determined more by a political decision process rather than the summation of individual producers marginal cost curves.

Market prices in the early 1980's have again dropped back close to the loan rate through a combination of (1) record corn yields in 1981/82 and 1982/83; (2) ineffective and unattractive supply control measures in the U.S. in 1981/82 and 1982/83; (3) higher loan rates and attractive storage payments for grain entering the FOR; (4) the U.S. embargo on grain sales to the U.S.S.R.; (5) a world wide recession which has reduced both domestic and export demand; and, (6) large production incentives in traditional importing countries such as the European Community.

The largest end use of corn in the U.S. is for animal feed. Between 1960/61 and 1972/73 the domestic use of corn for animal feed increased by 30.5 mmt or 38.8 percent. Since 1972/73, domestic use of corn for feed has exceeded 109 mmt in only two years, 1979/80 and 1982/83, and in fact fell to 80-90 mmt during the high priced years 1974/75 to 1976/77. Womack estimated the direct price elasticity of U.S. corn feed demand to be -0.91 while Meilke (1975) estimated the direct price elasticity of total feed grain demand, for feed use, to be -0.41. Womack's study indicates that a one percent increase in livestock production will result in a 1.08 percent increase in corn feed demand.

During the 1970's U.S. corn demand was fueled by increasing exports. In 1970/71 U.S. corn exports totaled 13.1 mmt and represented 13.0 percent of total domestic demand. By 1980/81, exports totaled 59.8 mmt or 32.6 percent of total domestic demand. The switch from a situation where domestic demand was the dominant end use of a commodity to one where exports account for one of every three tonnes of use has important implications for the U.S. corn economy. Schuh has argued that in the current situation the total demand for U.S. corn and feed grains is almost certainly greater than unity; which implies that total revenue in the sector will increase with price declines. Consequently, the U.S. supply control and price support measures may be counterproductive and work against the best interests of producers.

The demand for corn used in industrial and food products expanded slowly and steadily from 1960 until the mid 1970's when the rate of use began to accelerate. Between 1976/77 and 1982/83 corn used in food and industrial products expanded by 63.6 percent. Most of the growth in the demand for corn in this category is for fuel alcohol and high fructose corn syrup (HFCS). In 1982/83, HFCS accounted for 23.9 percent and fuel alcohol 20.0 percent of total industrial and food use. In the future the rate of growth in the demand for corn for use in HFCS is likely to

slow while that for fuel alcohol will expand. The U.S. Department of Agriculture predicts that by 1984/85 the use of corn in making fuel alcohol will reach 6.4 mmt, with roughly the same quantity used for HFCS.

The United States came out of the 1982/83 crop year with an ending inventory of corn of 79.8 mmt and a stocks/use ratio of 0.42 percent, the largest since the early 1960's. Farm prices in the fall of 1982 fell below $2.00/bushel in Central Illinois; compared to a loan rate of $2.55/bushel, which was ineffective in supporting farm prices in light of limited participation in the 1982/83 farm program. The Reagan Administration, which was under pressure to do something to support farm prices, announced the PIK program early in 1983. Following the announcement of the PIK program, and particularly after the heavy participation in the program became clear, corn prices increased substantially. Poor weather during the summer of 1983, coupled with the PIK program, resulted in the smallest U.S. corn crop (106.8 mmt) since 1970/71, and modest corn stocks (13.2 mmt) coming out of the 1983/84 crop year. Nonetheless, Schuh has characterized the PIK program as providing "short term gains in exchange for long term pain." His comment is based on the fact that the PIK program, although incredibly expensive, does nothing to address the adjustment problems that appear to face U.S. agriculture. The adjustment problem can be put in perspective by remembering that the trend analysis in section 2.6 indicates average U.S. corn yields will reach 115.6 bushels per acre by 1990. Multiplying the estimated 1990 yield by the acreage of corn planted in 1981/82 results in a 250 mmt potential corn crop by 1990. With 1982/83 total demand estimated at 188.0 mmt demand would have to expand by 33.0 percent to reach the 1990 production forecast.

During 1982/83, the Reagan Administration considered lowering the loan rate for 1983/84 corn to $2.35/bushel and freezing the target price at $2.86/bushel to reduce supply and stimulate demand. The corn price increases during the summer of 1983 resulted, however, in no action being taken with respect to the loan rate, which increased to $2.65/bushel for the 1983/84 crop. The target price will rise from $2.86/bushel in 1983/84 to $3.03/bushel in 1984/85, 15 cents lower than dictated by the 1981 farm bill.

5.3.2 Argentina

Argentina is a traditional exporter of coarse grains and corn. In 1981/82, Argentina exported 13.6 mmt of coarse grains, 12.9 percent of the world total, and 8.2 mmt of corn or 11.2 percent of world exports (tables 5.2 and 5.3). In recent years between one-half and two-thirds of Argentina's coarse grain exports have been corn with the remainder consisting primarily of grain sorghum.

The area planted to coarse grains trended downward over the 1970's from approximately 7.5 million hectares to around 6.0-6.5 million hectares. The area planted to corn has varied between 2.5 and 3.5 million hectares between 1971 and 1981. Corn competes with wheat and

soybeans, which are often double cropped, for land area and the supply price elasticity would appear to be quite low.

There was no significant trend in either coarse grain or corn production between 1970 and 1981 with yield increases offsetting the downward trend in planted area. Similarly there has been no significant trend in the domestic consumption of either corn or coarse grains (tables 5.8 and 5.9).

Net exports of coarse grains (NEFG.AR) and corn (NECO.AR) vary directly with changes in domestic coarse grain (QFG.AR) and corn (QCO.AR) production as shown in equations (5.4) and (5.5).

5.4 NEFG.AR = -30388.5 + 0.70 QFG.AR + 254.7 Trend
t-value (-4.15) (15.11) (3.93)

R^2 = 0.96 D.W. = 1.82 Sample = 1970/71 to 1982/83

5.5 NECO.AR = -8456.9 + 0.85 QCO.AR + 55.5 Trend
t-value (-2.08) (11.40) (1.49)

R^2 = 0.94 D.W. = 1.89 Sample = 1970/71 to 1982/83

A one tonne increase in coarse grain production results in a 0.70 tonne increase in coarse grain exports, while a one tonne increase in corn production results in a 0.85 tonne increase in corn exports. Exports of coarse grain exhibit an upward trend, of 0.25 mmt/year while the trend in corn exports is not statistically significant.

During 1980 coarse grain exports from Argentina were able to command premium prices from the U.S.S.R. because of the U.S. embargo on grain exports to the Soviet Union. This premium on Argentine grain prices disappeared in 1981, in the face of a large Argentine crop, and since 1981 Argentine corn prices have again followed world market trends.

Production of coarse grains in Argentina will continue to increase primarily as a result of yield increases. The area planted to coarse grains is not expected to show much growth because of the greater profitability of growing soybeans and wheat. Argentina maintains bilateral trade agreements with China, Iraq and the Soviet Union (Jabara).

5.3.3 Thailand

Thailand is a small producer of corn with less than one percent of total world production. However, 60-95 percent of its corn production is exported equaling 2-3 mmt of corn, in most recent years, or 3-5 percent of total world exports (tables 5.2 and 5.10). Thailand has

Table 5.8: Argentina Coarse Grain Supply and Disposition, December/November
Crop Year, 1970/71 to 1982/83, ('000 mt)

Crop Year	Supply			Total Supply	Disappearance			Net Exports
	Production	Imports	Beginning Inventory		Exports	Domestic Demand	Ending Inventory	
1970/71	15498	2	78	15578	8849	5782	947	8847
1971/72	9504	2	947	10453	2738	6811	904	2736
1972/73	15736	0	904	16640	7923	7814	903	7923
1973/74	17935	0	903	18838	8737	9733	368	8737
1974/75	13793	0	368	14161	5981	7081	1099	5981
1975/76	12438	0	1099	13537	7052	5656	829	7052
1976/77	16860	0	829	17689	9798	7403	488	9798
1977/78	18323	0	488	18811	11152	6886	773	11152
1978/79	17250	0	773	18023	10021	7609	393	10021
1979/80	10611	0	393	11004	5133	5706	165	5133
1980/81	21043	0	165	21208	14354	6495	359	14354
1981/82	18374	0	359	18733	11493	6593	647	11493
1982/83	17689	0	647	18336	11121	6864	351	11121

Source: U.S. Dept. of Agriculture. Foreign Agriculture Circular: Grains. Various issues, Foreign Agriculture Service, Washington, D.C., June 1984.

Table 5.9: Argentina Corn Supply and Disposition, April/March Crop Year, 1970/71 to 1983/84, ('000 mt)

Crop Year	Supply				Disappearance			
	Production	Imports	Beginning Inventory	Total Supply	Exports	Domestic Demand	Ending Inventory	Net Exports
1970/71	9360	0	8	9368	5510	3840	18	5510
1971/72	9930	1	18	9949	6436	2817	696	6435
1972/73	5860	1	696	6557	2040	3981	536	2039
1973/74	9000	0	536	9536	5066	3892	578	5066
1974/75	9900	0	578	10478	5399	4901	178	5399
1975/76	7700	0	178	7878	3485	3632	761	3485
1976/77	5855	0	761	6616	3368	2733	515	3368
1977/78	8300	0	515	8815	5177	3455	183	5177
1978/79	9700	0	183	9883	5916	3533	434	5916
1979/80	9000	0	434	9434	5965	3296	173	5965
1980/81	6400	0	173	6573	3417	3048	108	3417
1981/82	12900	0	108	12908	9098	3365	210	9098
1982/83	9600	0	210	10210	5795	4205	545	5765
1983/84	9000	0	545	9545	5400	4000	145	6000

Source: U.S. Dept. of Agriculture. Foreign Agriculture Circular: Grains. Various issues, Foreign Agriculture Service, Washington, D.C., June 1984.

Table 5.10: Thailand Corn Supply and Disposition, July/June Crop Year, 1970/71 to 1982/83, ('000 mt)

Crop Year	Supply			Disappearance		
	Production	Beginning Inventory	Total Supply	Exports	Domestic Demand	Ending Inventory
1970/71	1938	190	2128	1663	220	245
1971/72	2300	245	2545	2111	280	154
1972/73	1320	154	1474	1039	300	135
1973/74	2350	135	2485	2131	341	13
1974/75	2450	13	2463	1979	450	34
1975/76	3050	34	3084	2386	556	142
1976/77	2675	142	2817	2116	653	48
1977/78	1677	48	1725	1217	477	31
1978/79	2791	31	2822	2078	691	53
1979/80	3300	53	3353	2150	1050	153
1980/81	3200	153	3353	2142	1108	103
1981/82	4350	103	4453	3260	1050	143
1982/83	3450	143	3593	2136	1160	297

Source: U.S. Dept. of Agriculture. Foreign Agriculture Circular: Grains. Various issues, Foreign Agriculture Service, Washington, D.C., June 1984.

traditionally exported much of its corn to Japan and Taiwan.

Production of corn in Thailand grew rapidly in the 1950's and 1960's as a result of (1) malaria control in the major growing areas; (2) rapid expansion of roads into jungle areas; and, (3) promotion of corn growing in Thailand by Japanese interests (Konjing). Two crops of corn can be grown per year, the first planted during April/May and harvested in September/October. The second crop, which is small compared to the first, is planted right after harvesting of the first crop and reaches maturity in January or February.

The harvested area of corn (ACO.TH) has trended sharply upward at 0.082 million hectares per year (equation 5.6) and production of corn (QCO.TH) has followed a similar pattern, trending upward at 0.159 mmt per year, because corn yields have shown little increase (equation 5.7).

5.6 ACO.TH = -7860.9 + 82.2 Trend
t-value (-10.7) (12.5)

R^2 = 0.93 D.W. = 1.96 Sample = 1970/71 to 1982/83

5.7 QCO.TH = -15006.6 + 159.3 Trend
t-value (-3.34) (3.94)

R^2 = 0.58 D.W. = 2.17 Sample = 1970/71 to 1982/83

Domestic demand for corn (DCO.TH) has increased rapidly, nearly doubling between 1976/77 and 1981/82, and trending upward at 0.067 mmt per year (equation 5.8).

5.8 DCO.TH = -7087.7 + 0.10 QCO.TH + 67.1 Trend
t-value (-6.22) (1.95) (5.98)

R^2 = 0.93 D.W. = 1.95 Sample = 1970/71 to 1982/83

Exports of corn (EXCO.TH) have followed production changes, with a one tonne production increase resulting in 0.87 additional tonnes being exported. However, after correcting for production variations exports have been declining as a result of increased domestic demand by 0.073 mmt per year (equation 5.9).

5.9 EXCO.TH = 7774.1 + 0.87 QCO.TH - 72.8 Trend
t-value (4.94) (11.74) (-4.70)

R^2 = 0.95 D.W. = 2.21 Sample = 1970/71 to 1982/83

Corn prices in Thailand have generally followed world market prices, but in 1983 domestic demand was sufficient to raise prices above U.S. export prices. Because of this Thailand had difficulty competing in export markets unless it had a pronounced transportation advantage. Thailand has had bilateral export agreements with Taiwan and Japan.

5.3.4 South Africa

South Africa is another country whose total corn production is small in world terms, normally 2-4 percent of world production, but whose exports of 2.5 to 3.5 mmt per year make it one of the world's top four corn exporting countries (tables 5.2 and 5.11).

South African corn exports are handled by a marketing board which sells most of its corn using export tenders. The marketing board also sets producer prices and minimum selling prices. The difference between the two prices is used to provide export subsidies if needed. In recent years South Africa has had an export agreement with Taiwan to supply 0.6 mmt of corn per year.

Corn competes with sunflowers, peanuts and grain sorghum for land in South Africa. The production of corn (QCO.SF) has been trending upward by 0.329 mmt per year while there has been no significant trend in area (equations 5.10 and 5.11).

5.10 ACO.SF = 2218.1 + 19.4 Trend
t-value (1.02) (1.00)

R^2 = 0.08 D.W. = 2.49 Sample = 1970/71 to 1982/83

5.11 QCO.SF = -27472.7 + 329.2 Trend
t-value (-1.46) (1.94)

R^2 = 0.26 D.W. = 2.80 Sample = 1970/71 to 1982/83

The domestic demand for corn (DCO.SF) has been expanding rapidly, averaging 0.184 mmt/yr, as the result of a growing domestic poultry industry, and population growth equaling 2.5 percent per year (equation 5.12).

5.12 DCO.SF = -14176.5 + 0.008 QCO.SF + 183.9 Trend
t-value (-6.90) (0.26) (9.37)

R^2 = 0.92 D.W. = 1.27 Sample = 1970/71 to 1982/83

Net exports of corn (NECO.SF) have followed production changes, with a one tonne increase in production resulting in a 0.41 tonne

Table 5.11: South Africa Corn Supply and Disposition, May/April Crop Year, 1970/71 to 1983/84, ('000 mt)

Crop Year	Supply			Total Supply	Disappearance			Net Exports
	Production	Imports	Beginning Inventory		Exports	Domestic Demand	Ending Inventory	
1970/71	6132	9	873	7014	1104	5159	751	1095
1971/72	8600	2	751	9353	2555	5173	1625	2553
1972/73	9483	0	1625	11108	3562	5540	2006	3562
1973/74	4160	0	2006	6166	157	5544	465	157
1974/75	11105	0	465	11570	3227	6325	2018	3227
1975/76	9140	0	2018	11158	3206	6376	1576	3206
1976/77	7314	0	1576	8890	1465	6438	987	1465
1977/78	9727	0	987	10714	2525	6598	1591	2525
1978/79	10201	0	1591	11792	3012	6665	2115	3012
1979/80	8271	0	2115	10386	2325	6702	1359	2325
1980/81	10794	0	1359	12153	3444	6757	1952	3444
1981/82	14645	0	1952	16597	4955	7097	4545	4955
1982/83	8355	130	4545	13030	4034	7673	1323	3904
1983/84	3915	2500	1323	7738	285	7223	230	-2215

Source: U.S. Dept. of Agriculture. Foreign Agriculture Circular: Grains. Various issues, Foreign Agriculture Service, Washington, D.C., June 1984.

increase in exports (equation 5.13).

5.13 NECO.SF = -6751.3 + 0.41 QCO.SF + 52.27 Trend
t-value (-1.27) (5.19) (1.03)

R^2 = 0.82 D.W. = 1.73 Sample = 1970/71 to 1982/83

In 1983 a severe drought in South Africa lowered corn yields to an estimated 15 bushels per acre. Corn production was down 73 percent from its record production in 1981 and more than 50 percent from a small 1982 crop. For the first time in more than thirty years South Africa will import coarse grains. Their imports are currently forecast at 2.2 mmt for crop year 1983/84.

The long term impact of the current drought is difficult to forecast, but with growing domestic demand and high production costs it is difficult to see South African corn exports exceeding 4-5 mmt in the near future.

5.4 Recent and Expected Trends in Production and Trade for Major Corn Importers

5.4.1 European Community (10 Nations)

The European Community (EC) has been a traditional importer of feed grains and corn, in fact, in 1970 net imports equaled 22 percent of domestic demand. Table 5.12 shows that between 1970/71 and 1978/79 the EC imported (net) between 11.2 and 15.7 mmt of feed grains, with the exception of 1976/77, when net imports grew to 23.0 mmt in response to a crop shortfall. Since 1978/79 declines in EC domestic demand, and a high level of production have resulted in the EC's imports declining to 1.8 mmt, or only 2.5 percent of domestic consumption, in 1982/83. Consequently, as indicated in equation 5.14, a one tonne increase in production leads to a 0.68 tonne decrease in net coarse grain imports (NIFG.EC).

5.14 NIFG.EC = 80675.3 - 0.679 QFG.EC - 0.23 Trend
t-value (3.02) (-3.27) (-0.74)

R^2 = 0.73 D.W. = 0.71 Sample = 1970/71 to 1982/83

The EC is a relatively small corn producer with about 4.4 percent of world production, compared to about 8.0 percent of world coarse grain production. Imports of corn by the EC have declined following the pattern established by coarse grains. In 1979/80, 12.7 mmt of corn were imported, while net imports in 1982/83 are forecast to equal only 5.3 mmt (table 5.2).

Table 5.12: European Community Coarse Grain Supply and Disposition, August/July Crop Year, 1970/71 to 1982/83, ('000 mt)[a/]

Crop Year	Supply				Disappearance			
	Production	Imports	Beginning Inventory	Total Supply	Exports	Domestic Demand	Ending Inventory	Net Exports
1970/71	54697	24250	6488	85434	8524	70817	6094	-15726
1971/72	61843	22954	6094	90891	10843	74146	5902	-12111
1972/73	63416	23537	5902	92855	10928	75764	6163	-12609
1973/74	66032	27861	6163	100056	13780	79644	6632	-14081
1974/75	64444	25737	6632	96813	11130	77801	7882	-14607
1975/76	60801	26657	7882	95340	12413	77784	5143	-14244
1976/77	53208	32572	5143	90923	9503	76257	5163	-23069
1977/78	66460	24978	5163	96601	13311	77648	5642	-11667
1978/79	70078	24316	5642	100036	13152	79749	7135	-11164
1979/80	69124	22530	7135	98789	13255	79013	6521	-9275
1980/81	69788	20800	6521	97109	14300	76109	6700	-6500
1981/82	67800	19800	6700	94300	14400	73900	6000	-5400
1982/83	71600	16900	6000	94500	15100	72000	7400	-1800

a/ Trade figures include intra-EC trade.

Source: U.S. Dept. of Agriculture. Foreign Agriculture Circular: Grains. Various issues, Foreign Agriculture Service, Washington, D.C., June 1984.

There has been a steady upward trend in EC coarse grain production (QFG.EC) of 1.0 mmt per year, between 1970/71 and 1982/83, as shown in equation (5.15).

5.15 QFG.EC = -46983.9 + 1004.9 Trend
t-value (-1.31) (3.10)

R^2 = 0.47 D.W. = 1.53 Sample = 1970/71 to 1982/83

All of the increase in coarse grain production is the result of yield (YLDFG.EC) increases since the area of coarse grain harvested has declined by 1.2 million hectares between 1970 and 1981. The trends in EC area and yields of coarse grains are shown below.

5.16 AFG.EC = 26577.9 - 94.2 Trend
t-value (10.71) (-4.21)

R^2 = 0.62 D.W. = 1.49 Sample = 1970/71 to 1982/83

5.17 YLDFG.EC = -5.63 + 0.086 Trend
t-value (-2.77) (4.75)

R^2 = 0.67 D.W. = 1.37 Sample = 1970/71 to 1982/83

The area of coarse grain harvested is declining by 0.094 million hectares per year and yields are increasing by 0.086 mt/hectare per year.

Domestic demand for coarse grain (DFG.EC) in the EC shows no significant trend over the period 1970/71 to 1982/83 (equation 5.18). Coarse grain consumption peaked in 1978/79 at 79.7 mmt and has since fallen to 72.0 mmt in 1982/83.

5.18 DFG.EC = 72893.7 + 232.2 QFG.EC - 103.6 Trend
t-value (3.19) (1.30) (-0.4)

R^2 = 0.18 D.W. = 0.53 Sample = 1970/71 to 1982/83

The production, consumption and pricing of coarse grains in the EC is governed by the Common Agricultural Policy. The CAP has been the subject of considerable discussion and debate since its inception in 1968, and it is impossible to provide more than the flavor of these

studies in this short report.[15/] The salient features of the CAP for feed grains are nonetheless obvious: (1) domestic feed grain prices are determined through a political process which has normally resulted in feed grain prices well above world market prices, which are maintained using a variable import levy; (2) domestic feed grain consumption has been reduced and production increased as a result of domestic prices being above world market levels; (3) world market prices have been lower and less stable than they would have been in the absence of the CAP; and, (4) output increases have resulted in the use of export subsidies to move production in excess of domestic requirements (primarily barley in the case of coarse grains) onto the world market.

To give an idea of the size of the price distortions currently in place in the EC, the price of U.S. corn, CIF Rotterdam on July 19, 1983 was $148/mt and the variable levy was $124/mt. At the same time the EC's export subsidy on barley was $52.89 (Livestock Feed Board of Canada).

In the international wheat market Sarris has estimated that world wheat prices are 9 percent lower, and 17 percent more variable than they would be in the absence of the CAP.

Budgetary problems in the EC are currently putting considerable pressure on policy makers to hold future price increases to modest levels (Josling and Pearson). However, it seems unlikely, barring some major change in the CAP, that the EC will emerge as a major feed grain importer in the future. In fact, with the possible accession of Spain into the EC it seems certain that Spain will shift some of its demand for corn, bought on the international market, to EC barley.

5.4.2 Japan

Japan is the world's largest single country importer of feed grains and corn. In 1981/82, Japan's share of the world's coarse grains and corn trade were 17.4 and 17.7 percent, respectively. Japan's imports of coarse grains are dominated by corn, whose market share has varied from 55 to 77 percent since the mid 1970's (tables 5.13 and 5.14). Barley imports in Japan are under the control of the Japanese Food Agency and are subject to quotas while trade in corn is free of government interference and is handled by private traders.

Japan's production of coarse grain (table 5.13) and corn (table 5.14) is negligible and their livestock industry is almost totally dependent upon imported feedstuffs.

Imports of coarse grain (IMFG.JA) increased by 80.3 percent between 1970/71 and 1979/80. Since 1979/80, coarse grain imports have stagnated, although corn imports have continued to increase, expanding

15/ For more information on the CAP see Josling and Pearson and the references in their report.

Table 5.13: Japan Coarse Grain Supply and Disposition, July/June
Crop Year, 1970/71 to 1982/83 ('000 mt)

Crop Year	Supply			Disappearance	
	Beginning Inventory	Production	Imports	Domestic Demand	Ending Inventory
1970/71	1004	667	10476	11105	1042
1971/72	1042	596	10274	11296	616
1972/73	616	406	12048	11908	1162
1973/74	1162	286	14111	13780	1779
1974/75	1779	294	13116	13318	1871
1975/76	1871	264	13535	14137	1533
1976/77	1533	247	15894	15708	1966
1977/78	1966	232	16954	16867	2285
1978/79	2285	351	17871	18113	2394
1979/80	2394	425	18888	19183	2524
1980/81	2524	390	18863	19101	2676
1981/82	2546	398	18319	18601	2662
1982/83	2179	405	18676	18710	2550

N/A = not available

Source: U.S. Dept. of Agriculture. Foreign Agriculture Circular: Grains. Various issues, Foreign Agriculture Service, Washington, D.C., June 1984.

Table 5.14: Japan Corn Supply and Disposition, July/June
Crop Year, 1970/71 to 1982/83, ('000 mt)

Crop Year	Supply				Disappearance	
	Production	Imports	Beginning Inventory	Total Supply	Domestic Demand	Ending Inventory
1970/71	33	5173	415	5621	5282	339
1971/72	33	5416	339	5788	5460	328
1972/73	24	6881	328	7233	6795	438
1973/74	19	8210	438	8667	7825	842
1974/75	14	7388	842	8244	7415	829
1975/76	11	7879	829	8719	7925	794
1976/77	11	8874	794	9679	8764	915
1977/78	8	9717	915	10640	9674	966
1978/79	5	10936	966	11907	10730	1177
1979/80	5	11876	1177	13058	11795	1263
1980/81	3	13989	1263	15255	13678	1577
1981/82	3	12953	1577	14533	13357	1176
1982/83	3	14537	1176	15716	13850	1866

N/A = not available

Source: U.S. Dept. of Agriculture. Foreign Agriculture Circular: Grains. Various issues, Foreign Agriculture Service, Washington, D.C., 1984.

their share of total coarse grain imports from 62.9 percent in 1979/80 to a projected 77.8 percent in 1982/83. Linear trend lines fit to data on coarse grain (DFG.JA) and corn (DCO.JA) consumption from 1970/71 through 1982/83 show consumption of coarse grains increasing by 0.78 mmt per year and corn by 0.76 mmt per year (equations 5.19 and 5.20).

5.19 DFG.JA = -71270.5 + 782.4 Trend
t-value (-10.57) (12.89)

R^2 = 0.94 D.W. = 0.94 Sample = 1970/71 to 1982/83

5.20 DCO.JA = -75173.3 + 762.2 Trend
t-value (-15.38) (17.32)

R^2 = 0.96 D.W. = 1.26 Sample = 1970/71 to 1982/83

Clearly, however, from the information in table 5.13 there has been no upward trend in Japanese coarse grain consumption since 1979/80 and future increases in coarse grain sales to Japan will depend on expansion of their livestock sector. Meat products in Japan have fairly high price and income elasticities, and output expansion should follow expansion in the general economy. The Japanese announced in 1983 that 860,000 tonnes of surplus rice were earmarked for mixed feed production in JFY 1982 and another 800,000 tonnes in JFY 1983. The use of rice for feed likely will displace imported coarse grains on a nearly one-to-one basis.

5.4.3 U.S.S.R.

After many years as a net exporter of grain the U.S.S.R. entered the international market place and purchased 22.8 mmt of grain in 1972/73, of which 6.9 mmt were coarse grains. Imports of coarse grain since 1972/73 have been extremely variable ranging from 2.7 mmt in 1974/75 to 25.5 mmt in 1981/82 (table 5.15).

There was no discernible trend in either U.S.S.R. production or consumption of coarse grains between 1972/73 and 1981/82.

Imports of feed grains have been used to offset a portion of production (QFG.RU) shortfalls as shown in equations (5.21) and (5.22), where net imports of feed grains (NIFG.RU) are regressed against production and a linear time trend.

5.21 NIFG.RU = -161.4 - 0.27 QFG.RU + 1.76 Trend
t-value (-6.33) (-6.62) (7.97)

R^2 = 0.95 D.W. = 3.18 Sample = 1972/73 to 1981/82

Table 5.15: U.S.S.R. Coarse Grain Supply and Disposition, July/June Crop Year, 1972/73 to 1982/83, ('000 mt)

Crop Year	Supply			Disappearance			
	Production	Imports	Total Supply	Exports	Domestic Demand	Stock Change	Net Exports
1972/73	72.0	6.9	78.9	0.4	75.5	3.0	-6.5
1973/74	101.0	6.4	107.4	0.9	111.5	-5.0	-5.5
1974/75	100.0	2.7	102.7	1.0	99.7	2.0	-1.7
1975/76	65.8	15.6	81.4	0.0	84.4	-3.0	-15.6
1976/77	115.0	5.7	120.7	2.0	115.7	3.0	-3.7
1977/78	92.6	11.7	104.3	1.0	108.3	-5.0	-10.7
1978/79	105.3	9.9	115.2	1.0	113.2	1.0	-8.9
1979/80	81.1	18.4	99.5	0.0	99.5	0.0	-18.4
1980/81	80.5	18.0	98.5	0.0	99.5	-1.0	-18.0
1981/82	72.0	25.5	97.5	0.0	98.5	-1.0	-25.5
1982/83	86.0	11.3	97.3	0.0	98.3	-1.0	-11.3

Source: U.S. Dept. of Agriculture. Foreign Agriculture Circular: Grains. Various issues, Foreign Agriculture Service, Washington, D.C., June 1984.

5.22 NIFG.RU = -88.4 - 0.30 QFG.RU + 1.12 Trend
t-value (-2.60) (-4.29) (3.78)

R^2 = 0.78 D.W. = 2.08 Sample = 1972/73 to 1983/84

The only difference in equations (5.21) and (5.22) is the choice of sample period. Equation (5.22) includes data for 1982/83 and 1983/84 which at the time of writing are estimated values. Both equations indicate that 0.27 to 0.30 of each tonne of a production shortfall will be made up with imports. However, equation (5.21) shows a trend increase in net coarse grain imports of 1.76 mmt per year while equation (5.22) shows a trend increase of only 1.12 mmt per year. Clearly, the trend towards larger imports of coarse grains is greatly reduced with the inclusion of the latest two years of data.

Johnson (p. 852) in discussing Soviet agriculture states "The recent extensive review of agricultural matters in the Soviet Union was unable to come up with any; significant steps that would prevent further deterioration in the performance of Soviet agriculture". Desai has projected Soviet average annual grain imports to equal 30.0 to 34.0 mmt per year from 1981 to 1985, in years of below average harvests. Assuming coarse grains make up 50-60 percent of the total gives a coarse grain import requirement of 15.0 to 20.4 mmt per year. These estimates seem optimistic compared with annual imports in 1982/83 and 1983/84 of 11.3 and 12.1 mmt, respectively.

With regard to the Soviet Union perhaps all that can be said, with certainty, is that they will continue to be a destabilizing factor in the market as their imports fluctuate to accommodate production changes.

5.4.4 Eastern Europe

Eastern Europe was a growing market for coarse grain exports, with net imports increasing from 1.0 to 4.0 mmt in the early 1970's to an average of 9.6 mmt for the period 1978/79 to 1981/82 (table 5.16). East European coarse grain imports in 1980/81 equaled 10.1 percent of total world imports. Corn accounts for the major share of Eastern Europe's coarse grain imports, with a 81.4 percent market share in 1981/82, up from 75.7 percent in 1980/81. Imports of coarse grains and corn have declined sharply in 1981/82 and 1982/83, after peaking in 1979/80. Corn imports in 1982/83 are forecast, by the U.S.D.A., to equal only 2.0 mmt compared with 8.4 mmt in 1979/80; similarly, coarse grain imports are down to 5.0 mmt from their peak of 11.5 mmt. This is partly due to a good crop in 1982/83, and balance of payments problems.

Johnson argues that the policy of subsidizing food prices in Eastern European countries encouraged the consumption of food, particularly meat products, as real prices declined and this necessitated keeping investment in agriculture at a high percentage of national investment. Increases in prices paid to farmers were paid for, in whole or in part, by the public treasury, rather than by consumers.

Table 5.16: Eastern Europe Coarse Grain Supply and Disposition, July/June Crop Year, 1972/73 to 1982/83, mmt

Crop Year	Supply			Disappearance			
	Production	Imports	Total Supply	Exports	Domestic Demand	Stock Change	Net Exports
1972/73	56.7	5.1	61.8	1.5	59.0	1.3	-3.6
1973/74	55.7	3.8	59.5	2.7	58.2	-1.4	-1.1
1974/75	57.2	6.5	63.7	1.3	63.1	-0.7	-5.2
1975/76	59.4	7.8	67.2	2.9	65.0	-0.7	-4.9
1976/77	59.5	8.8	68.3	1.3	65.9	1.1	-7.5
1977/78	59.3	8.3	67.6	1.8	65.9	-0.1	-6.5
1978/79	60.5	10.6	71.1	1.2	68.9	0.1	-9.4
1979/80	63.4	11.5	74.9	1.8	73.2	-0.1	-9.7
1980/81	61.4	10.2	71.6	2.1	70.0	-0.5	-8.1
1981/82	64.5	6.1	70.6	2.1	68.7	-0.2	-4.0
1982/83	71.8	5.0	76.8	3.3	72.5	1.0	-1.7

Source: U.S. Department of Agriculture. Foreign Agriculture Circular: Grains. Various issues, Foreign Agriculture Service, Washington, D.C., June 1984.

The burden of the food price subsidies became so great that by the end of the 1980's, with the country's external debt problems rising, drastic steps were taken to increase food prices, in some cases by enormous amounts. Quoting Johnson (p. 851) with regard to Poland; "The price increases required were enormous, with retail food prices in early 1982 being double to quadruple the average prices for 1980."

Yields of coarse grains (YLD.EE) have been increasing at a fairly rapid rate of 0.06 mt/ha over the period 1972 to 1982 (equation 5.23). Coarse grain production (QFG.EE) has been increasing in line with yield changes, at 1.20 mmt per year, because the harvested area has been very stable ranging between 18.8 and 19.8 million hectares (equation 5.24).

5.23 YLD.EE = -3.43 + 0.059 Trend
t-value (-2.82) (5.40)

R^2 = 0.76 D.W. = 1.52 Sample = 1972/73 to 1982/83

5.24 QFG.EE = -73.85 + 1.20 Trend
t-value (-3.11) (5.68)

R^2 = 0.78 D.W. = 1.42 Sample = 1972/73 to 1982/83

Domestic demand (DFG.EE) in Eastern Europe has been expanding more rapidly than production, averaging 1.35 mmt per year (equation 5.25).

5.25 DFG.EE = -85.47 + 0.02 QFG.EE + 1.35 Trend
t-value (-2.40) (0.05) (2.86)

R^2 = 0.83 D.W. = 1.47 Sample = 1972/73 to 1982/83

Production changes appear to have had little impact on coarse grain consumption, but they have been very important in determining imports. Equation (5.26 shows that a one tonne increase in coarse grain production results in a 0.78 tonne decrease in coarse grain net imports (NIFG.EE).

5.26 NIFG.EE = -75.07 - 0.78 QFG.EE + 1.15 Trend
t-value (-1.90) (-2.04) (2.19)

R^2 = 0.38 D.W. = 1.62 Sample = 1972/73 to 1982/83

Equation (5.26) shows that after correcting for the influence of production changes net imports have been advancing by 1.15 mmt per year.

Coarse grain imports by Eastern Europe will continue to fluctuate with changes in domestic production, but with many Eastern Block countries facing severe debt payment problems, and with sharply higher consumer prices for meat products, the outlook for sharply higher imports seems unlikely.

5.5 Trade Competition and Potential Policy Changes in the Coarse Grain Economy

5.5.1 Long-Term Forecasting: The Record

Long-term forecasting is a hazardous task at best and impossible at worst. Several attempts to forecast the long-run demand for grain products have been made in the past, and invariably the studies have projected a continuation of economic conditions as they existed at the time the reports were written. Studies conducted in the late 1960's and early 1970's foresaw a continuation of commodity surpluses and lower real prices for grain (Rojko, et. al). Conversely, studies undertaken during the "commodity boom" years of the mid to late 1970's, perhaps best exemplified by the Global 2000 report, the conclusions of which were incorporated into Agriculture Canada's report Challenge for Growth an Agri-Food Strategy for Canada, projected shortages of foodstuffs and a doubling of real food prices between 1970 and 2000. In response to these studies Paarlberg has discussed what he calls "the scarcity syndrome". In general Paarlberg rejects the idea that the world has entered a new era of farm product scarcity; arguing instead that if market prices are allowed to reflect scarcity or shortage, to individual economic decision makers, market forces will result in a correction of either situation.

In mid 1984 the agricultural projections in Global 2000 seem precarious. Several national and international organizations, including Agriculture Canada, the U.S. Dept. of Agriculture, Resources for the Future and the O.E.C.D. have begun projects to analyze what went wrong in the studies which predicted a growing scarcity of agricultural products. These reports may provide some guidance as to what were the key assumptions responsible for the long-term scarcity projections.

In considering the possible path of corn prices over the next decade it is perhaps useful to examine the historical evidence. Figure 5.1 shows the time path of real corn prices (price received by U.S. farmers for corn deflated by the wholesale price index) from 1866 to 1981. The figure shows an upward trend in real corn prices from 1866 to the beginning of World War I when prices rose rapidly to over $2.00/bushel. Following the end of World War I corn prices declined reaching a low of $0.85/bushel in 1931, only to increase again with the outbreak of World War II to reach their all time high of $2.82 per bushel in 1947. Following the end of World War II corn prices began a long down trend that has been interrupted only by the commodity boom years of 1972/73 to 1975/76. In fact a trend regression on real corn prices from 1950 to 1981 shows an annual decline of 1.5 cents per bushel

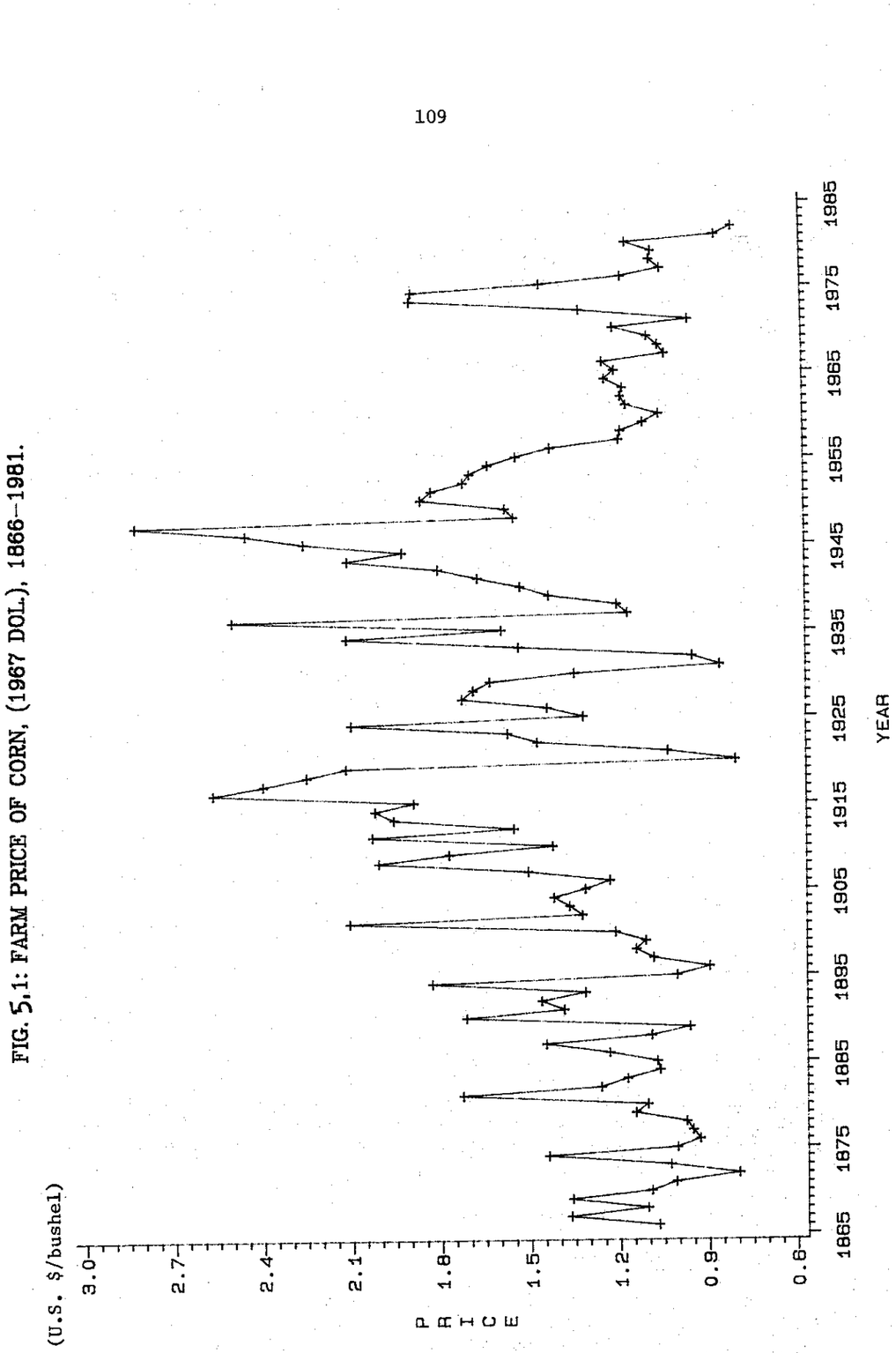

FIG. 5.1: FARM PRICE OF CORN, (1967 DOL), 1866–1981.

per year. Those arguing for a large, continuous, sustained, peace time increase in the real price of corn are arguing for a major change in a 30 year trend and, in fact, for something that hasn't happened in the 115 years for which price data are available. This is not to say that it couldn't happen, just that it would mark a major reversal of long standing trends.

5.5.2 Price Discovery in the Corn Market

Part of the difficulty in making short and long-run projections of corn prices is the result of the fine line between "scarcity" and "surplus" in the world's grain markets. Corn prices, at least since the early 1960's, have been influenced by two major factors (1) supply and demand conditions, and (2) the U.S. loan rate. This fact is illustrated by equation (5.27) where, the logarithm of the difference between the annual price of corn in St. Louis (PC04), and the loan rate (LRC04), is regressed on the ratio of the world's ending inventory of feed grains (IFG.WLD) and the world demand for feed grains (DFG.WLD), also converted to logarithms.

5.27 $\text{Ln}(PC04 - LRC04) = -6.53 - 4.54\ \text{Ln}(IFG.WLD/DFG.WLD)$
t-value $(-6.24)\quad(-9.01)$

$R^2 = 0.84$ D.W. = 2.18 Sample = 1965/66 to 1981/82

Equation (5.27) shows that a one percent change in the stock/utilization ratio causes the difference between the market price and the loan rate to change by 4.5 percent in the opposite direction. The functional form of equation (5.27) was chosen purposefully to capture the fact that the U.S. loan rate tends to set a floor for corn market prices. Figure 5.2 illustrates the relationship between market prices and the stock/utilization ratio using the 1982 loan rate of $104.32/mt in constructing the graph. For stock/utilization ratios above 17 percent market prices are very close to the loan rate, and production and demand changes have little impact on price. For example, a change in the stock/utilization ratio from 0.20 to 0.17 would raise the annual average price by only $2.37/mt or 2.2 percent. In contrast, changes in the stock/utilization ratio below 0.17 have a much greater impact on price; for example, a decline in the stock/utilization ration from 0.14 to 0.11 raises prices by $21.55/mt or 18.7 percent. Consequently, changes in the stock/utilization ratio, as small as three or four percentage points, can result in vastly different prices, and price changes. The line between scarcity and surplus in the coarse grain market is a thin one indeed.

5.5.3 The Decade Ahead

The U.S.D.A. (1982) has recently made projections of world coarse grain trade to 1991/92 (table 5.17). The U.S.D.A. projects world coarse grain imports to increase by 42.7 percent, from 1979-81 to 1991-92. The

FIG. 5.2: RELATIONSHIP BETWEEN THE STOCKS/USE RATIO AND CORN PRICE.

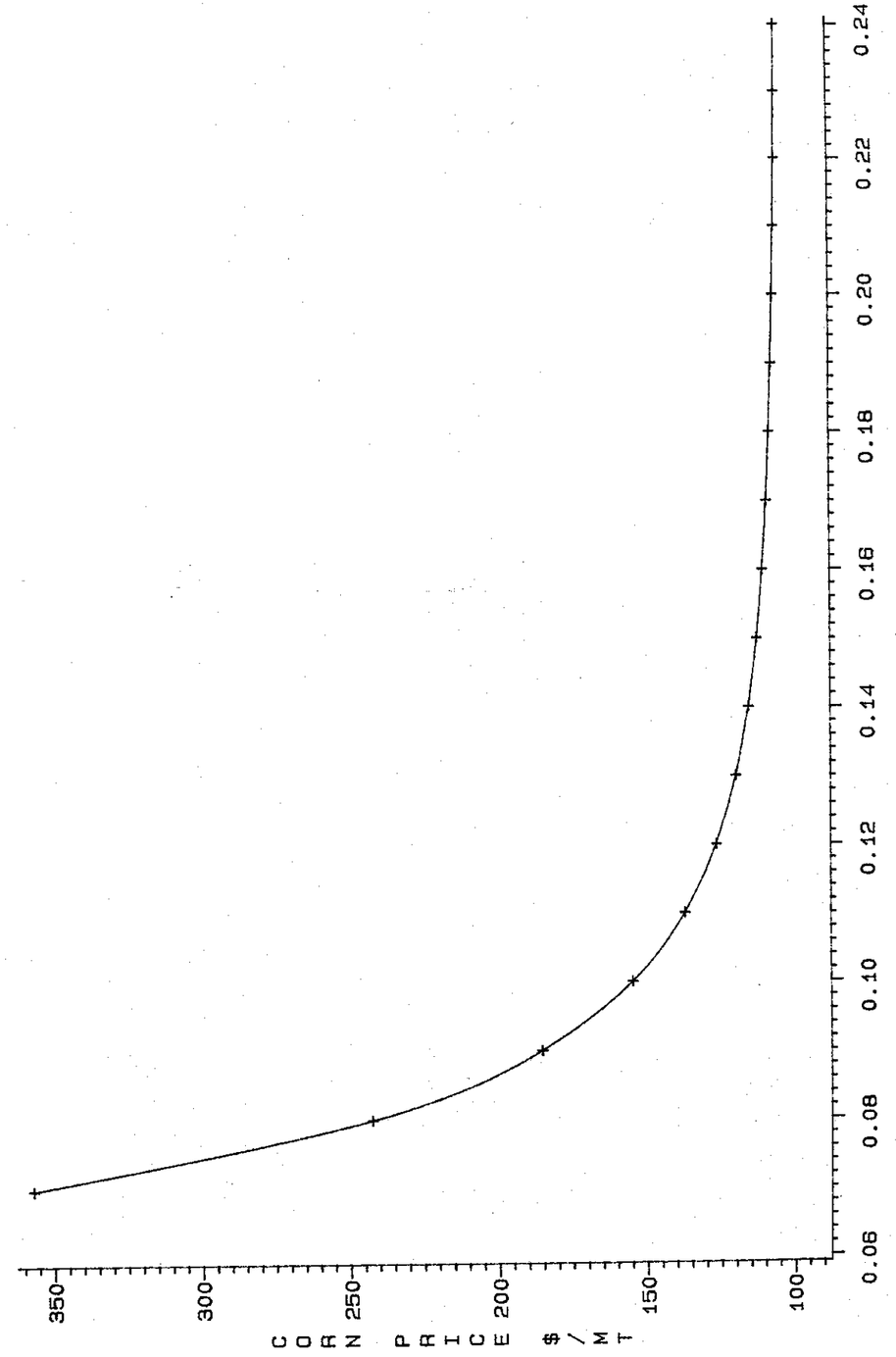

Table 5.17: Projections of World Coarse Grain Production, Use and Trade, 1979-81 and 1991/92, mmt

Countries	Production			Use			Imports		
	1979-81	1991-92	% Change	1979-81	1991-92	% Change	1979-81	1991-92	% Change
Developed	133	158	18.8	158	198	25.3	52.0	71.5	37.5
Developing	160	197	23.1	171	232	35.7	26.3	54.5	107.2
Centrally Planned	226	302	33.6	257	331	28.8	31.8	31.1	-2.2
Total	519	657	26.6	586	761	29.9	110.1	157.1	42.7

Source: U.S. Dept. of Agriculture. World Agriculture: Outlook and Situation. WAS-30, Economic Research Service, December 1982, Washington, D.C.

distribution of imports is extremely interesting in that the U.S.D.A. predicts a decline in coarse grain imports by the centrally planned economies, a more than doubling of imports by developing countries, and growth in imports by developed countries of 2.9 percent per year. The U.S.D.A. did not report the price at which the projected trade volumes would occur. Recall, however, in section 5.3.1 where it was determined that U.S. coarse grain production could expand by 65 mmt by 1990 because of yield increases alone. Consequently, a 47.1 mmt increase in total imports would appear to be easily accommodated with no major price increases.

Steadman has projected world coarse grain trade to equal 140 mmt in 1991/92 which is slightly less optimistic than the U.S.D.A. Steadman concurs with the U.S.D.A. that the major growth in import demand will occur in the less developed countries. Steadman summarizes his assessment of the 1980's as follows "... the decade of the 1980's is expected to be a period when demand growth is modest and supply control problems (in the U.S.) are more the "rule" than the exception. Certainly with fluctuations in crop yields in the United States, as well as other countries, programs will be removed during some years."

Based on the analysis in this report, and an admittedly brief review of other work, several conjectures with respect to the world's coarse grain economy until the end of the decade seem justified.

First, world coarse grain trade will expand over the next ten years at a slower rate than in the 1970's, perhaps into the range of 140 to 160 mmt per year.

Second, growth in world trade is most dependent on increased imports by developing countries. At present, many of these countries, including some OPEC countries, are facing heavy debt burdens and foreign reserve and balance of payments problems. Under these conditions there is considerable "potential" demand but limited "effective demand" for coarse grain imports. Many developing countries (LDC's) are dependent on the export of primary commodities for their foreign exchange earnings and improvement in the prices received for their export products, probably caused by general economic recovery in the developed countries (DC's), is a precondition for the rapid expansion in their imports.

Third, the U.S.D.A. projects modest growth in the demand for coarse grains by the DC's, but their projection of a 2.9 percent growth rate may prove to be too optimistic. Canada is planning to increase its exports of barley and will enter the export market for corn in a small way. There is no reason to expect coarse grain exports from Australia and Argentina to decline, and the EC has nearly reached self-sufficiency in coarse grain production. While exports from Thailand and possibly South Africa may decline, import expansion in Japan and the other developed nations may slow as the income elasticity for meat declines with income increases.

Fourth, the U.S.D.A. forecasts no growth in coarse grain imports by

the Centrally Planned (CP) economies. While this may be somewhat pessimistic, the CP economies are faced with many of the same financial problems as the LDC's. What is more certain is that the import demand by the CP's will fluctuate with changes in their domestic production and their entries and exits from the world market will be a destabilizing influence.

Fifth, corn prices over the decade should remain generally modest, although short periods of higher prices will occur as a result of production shortfalls and ill timed policy actions. Supply control programs may well be necessary in the United States over part of the period to keep stocks at acceptable levels. Nonetheless, all out trade warfare, including the use of explicit export subsidies by the U.S. seems remote.[16]

5.5.4 Expected Policy Changes Affecting Ontario

One of the major policy changes affecting Ontario corn producers is, strangely enough, changes in the U.S. loan rate since in many years this price establishes the floor price for corn. Schuh has argued that increases in the U.S. loan rate, and the escalating value of the U.S. dollar have provided considerable stimulas for the foreign production of coarse grains. Schuh's point is well illustrated by the Canadian situation. Table 5.18 shows that between 1975/76 and 1982/83 the U.S. loan rate in United States dollars has increased by 131.2 percent, while the loan rate in Canadian dollars has increased by 183.7 percent. To the extent that the input costs of Canadian corn producers have not increased by the full extent of the Canadian dollar devaluation, the exchange rate variations have served to stimulate domestic production.

Canadian feed grain policy has been the subject of long and nearly continuous debates. The Federal government announced a review of national feed grain policy early in 1981, and a series of meetings between Agriculture Canada personnel and industry participants were held during the Spring and Summer of 1982. These meetings were prompted, in part, by the fact that the domestic price of barley, calculated using the corn competitive pricing formula, was below the export price. As a consequence of this the federal government paid the Wheat Board eight million dollars to compensate it for the revenue lost in selling barley on the domestic market at prices below the export price, between March and December 1982. Although an additional eight million dollars were allocated to compensate the Wheat Board for losses on domestic sales between January and July 1983, little of this money was needed because of declining export prices for barley.

It was widely expected that the federal government would announce changes in feed grain policy in August 1983. However as of this writing (July 1984) no policy changes have been announced.

16/ Less obvious forms of subsidization such as blended credit and food aid shipments will probably continue to be used.

Table 5.18: Comparison of U.S. Corn Loan Rate in U.S. and Canadian Dollars, 1970/71 to 1982/83

Crop Year	Loan Rate (US$/mt)	% Change	Loan Rate (C$/mt)	% Change
1970/71	41.34	0.0	41.99	-5.3
1971/72	41.34	0.0	41.43	-1.3
1972/73	41.34	0.0	41.01	-1.0
1973/74	41.34	0.0	40.81	-0.5
1974/75	43.31	4.8	43.17	5.8
1975/76	43.31	0.0	43.55	0.9
1976/77	59.05	36.4	59.82	37.4
1977/78	78.74	33.3	86.85	45.2
1978/79	78.74	0.0	91.85	5.8
1979/80	82.67	5.0	96.64	5.2
1980/81	88.58	7.1	104.85	8.5
1981/82	94.48	6.7	114.73	9.4
1982/83	100.39	6.3	123.54	7.7
Percentage Change				
1970/71 to 1982/83		142.8		194.2
1975/76 to 1982/83		131.2		183.7

The corn competitive pricing provisions of the feed grain policy have a limited impact on Ontario, in that the policy puts a ceiling price on Western feed grains in Quebec. This provision results in larger consumption of Western feed grains in Eastern Canada, and less consumption of Ontario corn when barley prices are above the formula price, but the demand contraction is probably minimal.

Ontario corn producers are eligible for deficiency payments on corn from the federal government under the Agricultural Stabilization Act. Corn prices under this program are supported at 90 percent of the five year average price of corn, adjusted for cash costs. Ontario through its price stabilization program raises the level of support to 95 percent of the support price established by the federal government. The Ontario stabilization plan made a payment of $2.01/mt to 3,106 eligible producers for corn marketed between September 1, 1981 and August 31, 1982.

CHAPTER 6

OPPORTUNITIES FOR EXPANSION OF PRODUCTION, PROCESSING AND MARKETING OF GRAIN CORN

Production of corn in Ontario is expected to increase in the future as a result of both area and yield increases. Average Ontario corn yields are expected to increase to 106.4 bushels per acre by 1990, as a result of plant breeding research, and the harvested area is expected to reach 2.5 million acres.

In the next decade the rapid growth in the area planted to corn will moderate, and most of the area expansion that does occur will take place outside Southern Ontario. Corn production will be increasingly influenced by price relationships, particularly the corn/soybean price ratio. Corn production in Ontario could reach 6.777 mmt by 1990, a 29.4 percent increase from the 1981 level.

The industrial use of corn, in Ontario, is projected to increase sharply from its early 1980's level of approximately 0.87 mmt to 1.2 to 1.5 mmt by 1990. Growth in the industrial use of corn will be confined primarily to the corn wet milling industry. Milling capacity to reach the lower end of the use estimate is already in place. In order to reach the upper end, of the estimate on corn use, high fructose corn syrup will have to capture a 25 percent market share of the total sweetener market. The rate of adaption of high fructose corn syrup will be highly dependent on the level of world sugar prices. Use of corn in the distilling industry is likely to show little or no growth because of the declining consumption of whiskey.

The demand for corn for animal feed in Eastern Canada is expected to grow very slowly over the next ten years. This coupled with the expansion of grain production in Quebec will result in Ontario having an exportable surplus of close to 1.5 mmt per year, after allowing for shipments to Quebec and the Maritimes. While this represents a forward step in the evolution of the Ontario corn industry it also presents a number of challenges, as the focus of the market turns increasingly away from domestic marketing problems to international marketing problems.

If current projections of the world demand, supply and trade in coarse grains by 1990 are correct corn prices are likely to remain at modest levels. In order to maximize their returns from the marketplace Ontario corn producers will not only have to be technically efficient but adopt more sophisticated marketing practises.

CHAPTER 7

CONSTRAINTS TO EXPANSION OF ONTARIO GRAIN CORN PRODUCTION, PROCESSING AND MARKETING

There are two major sets of constraints to increased grain corn production. The first set of constraints are physical constraints and involve the development of higher yielding, earlier maturing, more disease resistant varieties of corn, and related production requisites, suited for Ontario conditions. This constraint can be overcome through continued and expanded research and development activity in both the public and private sectors.

The second set of constraints are economic constraints. Basically, producers will not grow corn unless they perceive this as the most profitable use of their resources. Clearly, as a small producing nation there is little Canada can do to affect the price of corn. Corn producers are provided with some price protection under the Provincial and Federal Agricultural Stabilization Acts, and a review of the adequacy of these price guarantees would be prudent. However, for individual producers better and more sophisticated marketing strategies may be a way to improve the returns they can obtain from the marketplace. Again a research and educational program is necessary.

Increases in corn production over the next decade coupled with slow growth in the domestic livestock economy will result in a corn industry increasingly dependent on offshore sales of corn. Long-term projections of the future course of the world coarse grains economy provide little evidence to support the "scarcity syndrome"; represented by rapidly rising real corn prices and large upward shifts in demand.

As offshore exports of Ontario corn expand producers will lose the benefit of the Canadian tariff on corn. In order to compete in the international marketplace Ontario corn producers, and the grain handling system must be not only technically efficient, but economically sophisticated.

The 1980's are likely to be characterized as a "buyers market" where sales can be made only if the price, quality and terms of sale are competitive. Canada as a small corn exporting nation will be forced to find, and cultivate, export markets. To date Ontario's export sales have been largely to buyers in rather special circumstances, e.g., Cuba, which cannot buy from the U.S., and the U.S.S.R. during the U.S. export embargo. Heimbecker in discussing Ontario's corn trade has characterized a number of potential corn buyers in the following, admittedly abbreviated, way.

1. Russia - at times a large buyer but after meeting their commitments under long term agreements will buy from the cheapest source.

2. Spain - a consistent buyer of corn, but only on "Spanish terms" which are difficult, but not impossible for Canada to meet.

3. Cuba - a sporadic buyer of Canadian corn whose other source of supply is Argentina.

4. Iran - a potential buyer of Canadian corn given political feelings towards the United States.

5. Portugal - a regular importer of corn but only with special long-term, low interest loans.

6. Japan, China, Taiwan, Korea - all large buyers of corn but geographically St. Lawrence seaway corn cannot compete with corn from the U.S. Gulf coast.

7. Poland - a fair buyer but a high credit risk.

8. Italy - a large buyer who prefers Argentine corn even at a slight price premium.

The use of corn by Ontario's processing industry should increase by at least 50 percent by the end of the decade and they will require a steady supply of properly dried, No. 2 corn.

The above discussion, and the analysis in this report, highlight the forthcoming need for increased market development activities, quality control, efficient production and grain handling sectors, and the further development of merchandising expertise related to the corn industry. As stated by Heimbecker "coping successfully in the 1980's will require thoughtful contingency planning, timely analysis, responsive management strategies and a dash of good luck."

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