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THE CANADIAN CANOLA INDUSTRY: IN THE CONTEXT OF THE WORLD OILSEEDS COMPLEX

by

Lyndon Harvey Peters

A thesis
presented to the University of Manitoba
in partial fulfillment of the
requirements of the degree of
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ABSTRACT

The Canadian canola industry is strongly oriented towards competing in the world oilseeds complex. World oilseed market conditions and distortions have a very direct and important effect on the prices, production of and demand for Canadian canola products.

One of the primary goals of this study was to clearly define the world oilseeds market, including the important players and market distortions facing the Canadian canola industry. A detailed summary of the important commodities, major producers and consumers and relevant policies affecting production, demand and trade are provided.

Based on the detailed description of the oilseeds market, and the information available from previous studies, a quadratic programming model was developed to simulate the prices and trade flows for a subset of the most important commodities and regions to the Canadian canola industry. Scenarios of change simulated the hypothetical elimination of the Canadian canola processing capacity constraint observed in 1993-94 and the elimination of the Japanese edible oils tariff. Results of the model suggest that Canadian canola processing was severely restricted by the capacity constraint observed in 1993-94. Also, the study suggests that the Japanese oilseed processing industry would be very vulnerable to imported oil and meal if the Japanese edible oils tariff was eliminated.

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CHAPTER I

INTRODUCTION

1.1 Background to Problem

Agriculture, and crop production in particular, make a significant contribution to the Gross Domestic Product of the Canadian prairie provinces (Table 1.1). Since the early 1970's canola[1] has become an increasingly important cash crop in western Canada, becoming the second largest crop (with respect to area in production). In terms of farm cash receipts, canola surpassed barley in 1993-94 to become the second most important crop.

Over 80 per cent of Canadian canola demand was from the export market in 1993-94. Historically, the largest share of the export flow has been in the form of raw seed product. However, the Canadian crushing industry is also structured in such a way that its viability is dependent on the export market.

Canola is Canada's second most important agricultural export in the grains and oilseeds sector. In 1987, Canada exported almost $700 million worth of canola seed, oil and meal (Statistics Canada, 65-004)[2]. This increased to just under $1.0 billion in 1989 and is

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[1] Canola is an improved form of rapeseed that contains less than 3 mg/g of glucosinolates in the meal and less than 5 percent erucic acid in the oil.

[2] Important export markets for Canadian canola seed, oil and meal include the Pacific Rim, the United States, Mexico and Western Europe. Appendix A provides detailed statistics concerning canola production and trade.

estimated at $1.6 billion for 1993-94.

TABLE 1.1 - Average Canadian Grains & Oilseeds Production, 1983-84 - 1992-93

Crop	Western Canada ('000 tonnes)	Eastern Canada	Canada	Value of Production ($000,000)	(% of tot.)
Wheat	21964	1164	23128	2604.4	39.9
Durum	3255	0	3255	364.7	5.6
Canola	3538	35	3573	965.8	14.8
Barley	10732	1224	11956	1042.4	16.0
Corn	155	6277	6432	782.5	12.0
Soybeans	0	1163	1163	285.7	4.4
Flax	641	0	641	157.2	2.4
Oats	2231	547	2778	274.3	4.2
All Rye	477	50	527	42.7	0.7
Mixed	163	711	874	n/a	n/a
Total	43156	11170	54326	6519.7	100.0

Source: Statistics Canada, 22-007

1.1.1 International Trade

Given the large role that exports play in the Canadian canola industry, the world oilseed and oilseed products market has a significant impact on the Canadian industry. In order to maintain or expand market share and/or trade levels, Canadian canola products must remain competitive with other major oil and meal products. Therefore, market and policy analysis of the Canadian canola industry must consider the relationships between the various substitute products, importers and exporters and the relevant policies affecting oilseed production within and trade between these regions.

The world oilseeds market includes a number of substitute products. The major products in the world oilseeds complex include palm oil, soybean, cottonseed, rapeseed and sunflowerseed products. The United States, Brazil, Argentina, European Union (EU[3]) and Malaysia represent the major competitors for Canadian canola and canola products.

Trade barriers are a significant factor affecting the world oilseeds complex. Distortions include tariffs, import quotas, export subsidies, production subsidies and production controls. These trade barriers affect the Canadian canola industry both directly and indirectly.

Given the importance of the export market to the Canadian canola industry, international trade distortions have a significant impact on Canadian oilseed commodity prices and trade flows. For example, economic theory suggests that the Japanese import tariff on vegetable oils[4] has an adverse effect on the Canadian canola crushing industry.

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[3] European Union of 12 countries. The countries included are Belgium, Luxembourg, Denmark, France, Greece, Ireland, Italy, Netherlands, Portugal, Spain, the U.K. and Germany.

[4] Japanese import tariffs on vegetable oils are 17,000 and 23,500 yen/tonne on crude and refined oils, respectively.

This tariff severely restricts imports of canola oil and allows Japanese crushers to import canola seed to capture the domestic edible oils market in Japan. In the past when inventories of canola seed have been low Japanese crushers have been able to outbid Canadian domestic crushers for Canadian canola seed by raising the Japanese domestic canola oil price above world prices. This raises the price of Canadian canola seed, thereby increasing the input cost for the Canadian crusher who must compete with the Japanese bids but in turn sell the canola oil and meal at world prices.

On the product side of the market, world edible oil prices are depressed by the tariff. Through the protection provided, Japanese crushers are able to capture the Japanese edible oils market despite forcing domestic prices above world market prices. This results in a reduced crushing margin for Canadian processors, thereby reducing the viability and quantity of Canadian value-added processing.

1.1.2 Agricultural Policies

The problem facing canola crushers in Canada is further compounded by the structure of the Japanese tariff. The Japanese nominal tariff is constant for most vegetable oils. One of the most important substitute product sources for canola oil is soybeans. Since canola seed has a higher oil content than soybeans, the constant nominal tariff causes a bias in protection against canola oil, in relation to soybean oil[5]. Carter (1985) developed and

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[5] Canola seed yields about 40 per cent oil and 60 per cent meal, whereas soybeans yield about 18 per cent oil and 80 per cent meal.

discussed the implications of this concept.

Another prominent example of trade distorting policies is found in the EU. In the past, Europe was a significant market for top grade Canadian canola exports. However, in recent years Canada has been, to a large extent, forced out of the European market. Through the implementation of the oilseeds regime, the EU altered its domestic oilseeds market to such an extent that it not only became largely self-sufficient in canola quality rapeseed, but has become, at times, a significant competitor of Canadian canola products in the export market. The EU was an important export market for Canadian canola in 1993-94, but a competitor of Canadian canola oil exports.

Under the EU oilseeds regime EU domestic crushers were paid a subsidy to purchase oilseeds originating in the EU. This subsidy was passed on to producers through higher oilseed prices. As a result, the EU greatly enhanced its domestic production of rapeseed, sunflowerseed and soybeans, along with the products derived from these oilseeds. In fact, the EU became a significant exporter of rapeseed oil.

Beginning in 1993-94, the EU subsidy scheme changed to a direct land based subsidy, including a set-aside requirement. Although recent developments suggest that future increases in EU oilseed production will be restricted, EU domestic and trade policies continue to distort oilseed production, processing and trade.

The United States (U.S.) is affected by, as well as a source of, important trade distortions. To maintain its world market share and supposedly counter the adverse effects of world trade distortions on its domestic oilseed production and crushing industry, the U.S. has introduced a number of domestic support and export subsidy initiatives.

Currently, the U.S. is maintaining and possibly enhancing its presence in the export market for oilseed products through export subsidies and credit/aid programs. This action not only depresses prices in the world markets but also results in the loss of potential sales for Canadian canola and canola products in markets such as Mexico. It should be noted, however, that Canadian revenues from sales to the U.S. are enhanced by the U.S. export subsidies.

Other factors influencing the world trade of oilseeds can be found. Malaysia has undergone an immense and rapid expansion of its palm oil industry through product research, production subsidies and export initiatives. Brazil, influenced by various government incentives, disincentives and controls, has become a major soybean producer and developed a large crushing industry that competes with Canadian canola products in the world oilseeds market. The U.S. attempts to regain/maintain its market share by encouraging exports and controlling imports through initiatives such as the Export Enhancement Program and import tariffs.

1.2 Problem Statement

The international oilseeds and oilseed products complex is very important to the Canadian canola industry. Trade distortions have a significant impact on the Canadian canola industry.

Trade distortions affect the supply, demand, trade and prices of world oilseed commodities. Therefore, the parameters to consider in policy and/or market analysis of the Canadian canola industry must include farmers, processors, the transportation sector, consumers and the governments that regulate the activities of the world oilseeds complex.

The world oilseeds complex is a dynamic market. In addition to understanding the influence of existing market parameters there are numerous changes currently being considered by various members of the world oilseeds complex facing the Canadian canola industry.

There has been increasing pressure to reduce and/or remove trade distortions and barriers in the trade of agricultural products. This is one of the major goals of the recently concluded Uruguay round of General Agreement on Tariffs and Trade (GATT) negotiations. Another example of the current drive towards reducing trade barriers in the world has been the implementation of the North American Free Trade Agreement (NAFTA). Also, the recent announcement of talks aimed at extending the agreement to include Chile suggests that this trend will continue.

The reduction or removal of various trade barriers on oilseeds and oilseed products could have a significant impact on not only the Canadian oilseeds industry but also canola's contribution to the Canadian agricultural economy as a whole. Therefore, it is important to monitor the direction and magnitude of changes to Canadian oilseed and oilseed product prices and trade flows from ongoing market and policy developments in the world oilseeds complex.

The question being addressed by this study, then, is what is the world market structure facing the Canadian canola industry and what are the implications of some of the various changes it faces? This study attempts to facilitate a better understanding of the relevant issues and their implications for the Canadian canola industry.

1.3 Objectives

The overall goal of this study is to provide an economic analysis of the world oilseeds market, and in particular the position of the Canadian canola industry within this world market. Attainment of this goal includes the development of a methodology capable of analyzing trade barriers and determining the potential benefits/losses caused by the introduction of changes to these barriers. The fulfillment of this overall goal will provide a tool capable of facilitating a better understanding of the relative significance of the economic and political factors involved in the oilseeds markets.

Within this broad overall goal, this study has several specific objectives. The first objective is to provide an overview of the world oilseeds market. This overview includes the identification of commodities, markets (both demand and supply), and trade distorting policies that are most relevant to an analysis of the Canadian canola industry.

The second objective is to specify and test an economic model that incorporates the subset of important inter-relationships within the world oilseeds market that are considered most important to the Canadian canola industry. This will involve endogenous inclusion of production, processing, trade and consumption of the relevant oilseeds in the major geographical regions of the world. Other relevant factors to be incorporated into the model include transportation costs and trade distorting policies.

The third objective is to assess the world oilseed market facing the Canadian oilseed industry, given the current economic and political environment. Using the economic model, a matrix which simulates regional oilseed processing, trade and consumption information for the important subset of the world oilseeds complex will be determined. This is done in order to validate the use of the model in this study, and to provide baseline results for comparison purposes.

The fourth and final objective is to assess the potential impacts of some potential changes within the world oilseeds market, again using the economic model developed in this study. In assessing these inputs, particular emphasis is placed on the Canadian canola industry. The impacts are measured in terms of changes from the baseline results provided by the economic model.

1.4 Organization of Thesis

The remainder of this study is organized into five chapters. Chapter 2 is composed of two major parts; 1) background on the oilseeds complex, including primary and secondary production and the relevant economic and political policies and 2) a literature review of related studies of the world oilseeds market.

Chapter 3 discusses the theoretical foundations for the empirical analysis. This entails a discussion of trade theory, including relevant topics such as incentives for trade and welfare maximization. A mathematical representation of the theoretical model is also provided in this chapter.

Chapter 4 develops the empirical economic model. It incorporates demand estimations for consumption and stocks. In addition, the other data requirements and sources (such as seed supplies, trade flows, transportation and crushing costs, available supplies and so on) are determined.

Chapter 5 presents the validation results of the trade model developed in Chapter 4. This is followed by an empirical analysis of alternative trade and policy scenarios and the presentation of the estimated impact of these scenarios of change.

Chapter 6 offers conclusions and an overall assessment of the impact of some of the potential changes facing the Canadian canola industry. The study concludes with an outline of the limitations of the study and suggestions for future research.

CHAPTER II

BACKGROUND AND LITERATURE REVIEW

2.1 World Oilseed Crops and Their Products

Oil crops and their products are the second-largest category of agricultural commodities, in terms of value, traded in world markets. World production, consumption and trade in these commodities have expanded significantly over the past thirty years. Refer to Appendix B for relevant data. Table 2.1 summarizes world production levels for the major oilseeds between 1990-91 and 1993-94.

TABLE 2.1 - World Production of the Major Oilseeds Between 1990-91 and 1993-94 (million tonnes)

Oilseed	1990-91	1991-92	1992-93	1993-94
Soybeans	104.14	107.38	117.11	116.60
Cottonseed	33.42	36.62	31.61	29.49
Groundnuts	22.12	22.24	23.05	23.97
Sunflowerseed	22.84	21.84	21.32	22.98
Rapeseed	25.11	28.27	25.33	26.79
Flaxseed	2.92	2.57	1.97	2.20
Copra	4.76	4.73	4.84	4.82
Palm Kernel	3.32	3.41	4.00	4.26
Total	218.63	227.06	229.23	229.12

Source: USDA, FAS. December, 1994.
Oil World Weekly. November 18, 1994.

Technological advances in the world oil crops and products market have resulted in improved productivity and better quality products. These advances have included new crops, improved yields, better disease resistance, improved processing techniques and advances in transportation and storage technology. The world oilseeds industry continues to benefit from improved productivity and quality, greater availability and increasing versatility of the products produced.

There are numerous oil crops that are produced at various locations throughout the world. In most cases the oil crop is processed, whereby an oil and a protein meal product are produced. The predominant use of the oil products are for human consumption. Edible oils are nutritionally important, as a carrier for fat soluble vitamins and as an energy source. The oils produced are also used, to a lesser extent, for industrial purposes[1].

The bulk of the demand for meal results from its usefulness in animal feed as a high content, good quality protein source. Other uses of the meal are somewhat limited to niche markets. For example, rapeseed meal is used in China and Japan as an organic fertilizer for vegetable, citrus and tobacco crops. Also, soybean-based products, in

[1] Industrial uses include feeds, soaps, paint or varnish, resins or plastics, adhesives, agrochemicals, fabric softeners, lubricants, fuel sources and for extraction of the component fatty acids.

addition to traditional soybean foods[2], have begun to penetrate the human food market in various forms in regions of the world other than China and the Pacific Rim.

The demand for oilseeds is primarily[3] derived from the utilization of processed oil and meal products. Since the various oilseeds have different oil and meal contents the relative importance of a given type of meal or oil can be different from that of the origin seed. Refer to Appendix B for information on the relative availability of the major oilseed products. Also, there are various alternate sources of protein meals and oils, such as palm oil, olive oil, fish oil and meal, bone and blood meal and animal fat. These substitutes are an indirect component of the world oilseeds and oilseed products market.

Within the world oilseeds and oilseed products market there is a subset of commodities of particular importance to the Canadian canola industry. The remainder of this section provides a discussion of the products and policies and trade barriers deemed to be most important to the Canadian canola industry.

Appendix C provides a discussion on how the demand for oilseeds is derived from the

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[2] Products include whole roasted soybeans for animal feed supplements and confectionery use, soymilk (a watery extract), tofu (a protein curd), soy sauce, miso (used as a soup base), tempeh (a solid product produced by fermentation with fungus), and also various flours and grits.

[3] Oilseed demand also includes seed requirements, some food and feed products and a demand for stocks within a given period.

primary demand for oils and protein meals. The appendix also discusses the inter-relationships of prices for oilseeds and their products.

2.1.1 Important Individual Crops[1]

2.1.1.1 Soybeans and Soybean Products

Soybeans are the most important of the oilseed crops. Between 1989-90 and 1993-94, soybeans have accounted for approximately 50 percent of total world oilseed crop production. Soybean oil and meal are consumed in larger volumes than any other vegetable oil or oilseed meal. The seed, which yields approximately 80 percent protein meal and 18 percent oil, currently provides 28 percent and 61 percent of the world's oil and oilseed meal supply, respectively.

Soybean meal is the dominant oilseed meal for livestock rations. In general, the other available meals are less palatable, not as readily available, not as consistent in their quality, or have a lower nutritional value than soybean meal.

Soybean oil is also a preferred product for human consumption. This preference is due to several factors, including the relatively consistent and large available supplies, low saturated fat content, and bland flavor.

Soybeans are commercially grown in at least 40 countries. Close to 90 per cent of world production, however, is currently concentrated in Argentina, Brazil, the People's Republic of China and the U.S. (see Table 2.2). Between 1989-90 and 1993-94 the U.S. averaged

[1] Based on Bickerton, 1990 and personal experience as an oilseeds analyst with Agriculture Canada.

about 49 per cent of world production, Brazil 18 per cent, Argentina 10 per cent, and the People's Republic of China 10 per cent. Of these producers Brazil and Argentina have undergone the most dramatic increases in production over the past 15 years.

TABLE 2.2 - World Soybean Production (million metric tonnes)

Country	1989-90 - 1992-93	1991-92	1992-93	1993-94
EU	1.68	1.50	1.18	0.69
Canada	1.34	1.46	1.39	1.85
United States	54.60	54.07	59.55	50.86
Argentina	11.10	11.15	11.35	11.70
Brazil	19.42	19.30	22.50	24.50
Paraguay	1.50	1.30	1.75	1.80
China, PR	10.31	9.71	10.30	15.31
Other	10.15	8.89	9.09	9.89
World	108.74	107.38	117.11	116.60

Source: USDA, FAS. December , 1994.

Soybeans and soybean meal dominate world trade in oilseeds and protein meals. In recent years soybeans and soybean meal have represented between 70 and 75 percent of world oilseed and protein meal trade flows. The market share of soybean oil traded in the world edible oils complex has diminished somewhat over the last two decades. Increases in palm oil production have captured an increasing portion of the world edible oils market. Soybeans remain the dominant oilseed however, both in overall production and trade.

MAJOR SOYBEAN EXPORT REGIONS

THE UNITED STATES

Over the past five years approximately 35 per cent of the U.S. soybean and 20 per cent of the soybean meal production has been exported. The most important destination, representing 35 per cent of U.S. soybean exports, has been the EU. This market share is being pressured, however, by policy changes in the EU and increasing South American competition. Exports to Japan, Taiwan and South Korea combined, account for another 30 to 35 per cent of U.S. soybean exports.

The largest share of U.S. soybean meal exports have, prior to 1993, gone to the former Soviet Union (FSU). Since then, FSU imports have become limited to credit/aid availability. Other important U.S. soybean meal export markets include the EU, Canada, Venezuela and the Pacific Rim. In general, about 95 per cent of total annual U.S. protein meal exports are soybean meal (not including mid-range protein exports of corn gluten feed).

Prior to 1991 the dominant export market for U.S. soybean oil was Pakistan. Since 1991, however, this market has been lost to South American soybean oil and Malaysian palm oil. Currently, important export markets for U.S. soybean oil include Algeria, the FSU, Morocco, Tunisia, Mexico, India and Turkey. Most of these oil exports are being made under export assistance and credit/aid initiatives.

BRAZIL AND ARGENTINA

Brazilian soybean production has continued to trend higher over the past five years, with a large portion being processed domestically before being exported. Brazilian soybean exports seem to have remained relatively constant however, at the level first achieved in the mid-1970's. In Argentina, soybean production has roughly doubled over the past six years, also with a large portion being processed domestically. About 75 per cent of South American soybean production is processed domestically, with approximately 73 per cent of the resulting products exported. In Brazil about 25 per cent of the soybean oil and 75 per cent of the meal is exported, while in Argentina about 95 per cent of the soybean products produced are exported. By 1994/95 Brazil and Argentina are expected to capture almost 35 per cent of world soybean production, up almost 10 per cent in five years.

The bulk of Argentinean and Brazilian soybeans and soybean meal exports go to the EU. Other important destinations for these two commodities are Japan, the FSU, and Eastern Europe. The major soybean oil export markets for Argentina and Brazil are India, Iran, China, Venezuela, Pakistan and Bangladesh.

CHINA

China produces approximately 10 per cent of world soybean output, with the bulk of the production being used for domestic consumption. Throughout the 1980's China experienced a significant surge in soybean production. Despite strong domestic demand, a large portion of this additional production has been exported as seed or meal in an attempt to increase foreign currency earnings. Domestic demand for soybean oil has been increasing, resulting in increased domestic crushing activities. Destinations for Chinese exports of soybeans and soybean meal include Japan, the Philippines, South Korea, Thailand, Malaysia, the EU, FSU and Eastern Europe, providing direct competition for North and South American soybean commodity exports.

OTHER EXPORTERS

Two other producers involved in the export market are Paraguay and the EU. Paraguay's exports of seed, meal and oil have been small relative to those of the U.S., Brazil and Argentina. Since the early 1980's EU soybean output has increased by more than tenfold. This increased production came in response to price supports that were well above world market prices. Despite this increase, the EU continues to only meet a very small portion of its demand for soybeans with domestic production. It should be noted, however, that the EU is heavily involved in the world trade of soybean oil, being the source of about 30 per cent of world exports and about 15 per cent of world imports. Also, the EU's locational advantage in relation to the frequently protein-deficient regions of Eastern Europe, the FSU and other Western European regions have allowed the EU to expand export sales of soybean meal using imported soybeans.

IMPORTANT REGIONS IMPORTING SOYBEAN COMMODITIES

THE EU

Throughout the mid and late 1980's the EU has accounted for almost 50 per cent of global soybean imports. This has been changing, however, due to the massive subsidization of domestic oilseed production, initiated in the early 1980's. The EU also was the second largest importer of soybean meal. The relative proportions of annual soybean and soybean meal imports are dependant on the EU domestic crushing margins and capacity constraints. The crushing margins are determined by the relative world prices of soybeans and soybean oil and meal. To a large extent, the quantities of soybean products demanded have been accentuated by high domestic grain prices in relation to soybean prices. This was the result of the implementation of the Common Agricultural Policy (CAP). These CAP price distortions resulted in significant increases in the oilseed meal content of EU feed rations. The excessive consumption of meal has resulted in excess soybean oil production, which must find a market outside the EU. Reforms introduced in 1993-94 to the CAP and the EU oilseed production support policies have begun to eliminate the distorted price incentives which encouraged the high levels of protein meal in EU feed rations.

JAPAN

In response to an expanding livestock sector over the past few decades, Japan has increased its imports of oilseeds, protein meals and feed grains. Due to severe crop area constraints Japan must rely heavily on imports to meet its domestic requirements. Also, future potential for expanded traditional livestock production will be limited by area and environmental constraints. Aquaculture may, however, represent a sector with significant potential for growth in the coming years. The limited domestic soybean production, which is heavily subsidized by the Japanese government, is used mainly to meet direct human consumption requirements. Future protein meal demand growth will be tied to any expansion in livestock production, which is expected to be relatively small.

Japanese soybean imports rank second to the EU. Imports of soybean meal are relatively small however, due to the Japanese edible oils import tariff, domestic vertical integration arrangements and a general attitude of support for domestic industries. Japanese demand for soybeans is approximately 25 per cent for direct human food consumption and the other 75 per cent for crushing purposes. This is in sharp contrast to the U.S. where over 90 per cent of soybean demand is for crushing purposes.

About 25 per cent of Japanese vegetable oil requirements are met by soybean oil. The market share of soybean oil was pressured by imports of relatively lower priced soybean meal from China in the late 1980's and early 1990's. These soybean meal imports have put downward pressure on domestic Japanese meal prices, consequently increasing crushers demand for alternative sources of seed which contain a higher vegetable oil content. This has encouraged the import of oilseeds such as Canadian canola.

OTHER IMPORTERS

The level of soybean and soybean meal imports by the FSU increased in the mid 1980's, peaking at levels similar to Japanese imports. At present, however, FSU imports are reduced significantly and heavily dependant on aid/credit. The bulk of FSU imports have been from the United States. Since the mid-1980's, about one-half of the FSU imports have been in meal form due to a limited crushing capacity. Currently the FSU is struggling to meet its needs while moving to a market economy.

Eastern Europe is also a large importer of soybean products. A large proportion of these imports are in the form of meal since edible oil requirements for the region are fulfilled with the domestic crush of rapeseed and sunflowerseed production. In most years oilseeds and oilseed products represent one of the largest item of trade between these regions and the U.S.

South Korea and Taiwan also represent an important importing region. Combined, these two countries represent the fourth largest importer of soybeans and soybean meal, with the bulk of the imports being soybeans. Other important soybean and soybean product importing regions include Canada (soybean meal), Venezuela and Mexico.

2.1.1.2 Rapeseed (Canola) and Rapeseed Products

Over the past decade rapeseed production has expanded faster than any other of the 10 major oilseeds, averaging an annual growth rate of over seven per cent as compared to a total world oilseeds production growth rate of about three per cent. This has led to the current situation where rapeseed production, average for 1991-92 to 1993-94 crop years, represents over 11 per cent of world total oilseeds production. This growth has resulted in rapeseed oil becoming the third most important edible oil in terms of quantity demanded, with only soybean oil and palm oil being more important. Also, rapeseed meal has become the second most important protein meal, behind soybean meal, with an average production and consumption market share of about 12 per cent for the major world protein meals over the 1991-92 to 1993-94 period.

Rapeseed has a normal extraction rate of about 40 per cent oil and 60 per cent meal with the meal containing between 38 and 44 per cent high quality protein. The regional average oil-content values and extraction rates depend on factors such as origin of production, variety of seed used, climatic conditions of the production season and the technological capabilities of the crusher.

One of the major reasons for the rising demand of rapeseed products has been the development of improved seed varieties. The development of canola seed with lower glucosinolate levels, a compound that limits rapeseed's use in livestock feeds, has led to improved digestibility and fewer restrictions on rapeseed meal use in animal feeds.

Part of the development of canola varieties has also involved a reduction in the level of erucic acid in the oil. This fatty acid has been linked to heart disease. Earlier varieties of rapeseed contained more than 40 per cent erucic acid but Canadian bred canola varieties have reduced it to well below the two per cent standard set for "canola".

Another important factor, from a nutritional perspective, for the increasing demand for canola oil is that it has a very low saturated fat content. Canola oil is the least saturated of all vegetable oils (six per cent), compared to 11 per cent for sunflowerseed oil, 13 per cent for corn oil, 14 per cent for olive oil, 15 per cent for soybean oil, 18 per cent for peanut oil, 27 per cent for cottonseed oil, 41 per cent for lard, 51 per cent for palm oil, 52 per cent for beef tallow, 66 per cent for butterfat and 92 per cent for coconut oil (Meyer, 1982).

Evidence of the impact of these improvements in canola oil can be found in the U.S. where in 1985 the Food and Drug Administration granted GRAS (Generally Regarded as Safe) status to low-erucic-acid rapeseed oil. Also, in 1987 the American Health Foundation of New York named one retail brand of canola oil as its product of the year.

Rapeseed is commercially grown in at least 35 countries. In recent years, however, over 90 per cent of recent world rapeseed production has been in the EU, Poland, Canada, the Peoples Republic of China and India (see Table 2.3). Between 1991-92 and 1993-94 China averaged 27 per cent of world production, the EU (including East Germany) 25 per cent, India 21 per cent, Canada 17 per cent and Poland three per cent.

TABLE 2.3 - World Rapeseed Production (thousand tonnes)

Country/Region	1989-90 - 1992-93	1991-92	1992-93	1993-94
EU	6340	7438	6057	5947
Sweden	309	252	247	300
Czechoslovakia	408	490	375	420
Poland	1148	1043	758	690
FSU	458	307	321	271
Canada	3597	4224	3875	5480
United States	69	94	85	118
Argentina	21	36	40	50
Brazil	10	10	10	15
China, PR	6871	7436	7653	6940
India	5130	5863	4872	5500
Japan	2	2	2	1
Other	920	1075	1035	1058
Total	25283	28270	25330	26790

Source: USDA, FAS. December 1994.
Oil World Annual, 1993.

As shown in Appendix B rapeseed and its products are a significant part of world trade in oilseeds and their products. Over the past five years (1989-90 to 1993-94) rapeseed has ranked a distant second in terms of the volume of oilseed traded in the global market. For this same time period rapeseed meal trade flows have ranked third, behind soybean meal and fish meal, and rapeseed oil trade flows have ranked fourth, behind palm oil, soybean oil and sunflowerseed oil.

MAJOR RAPESEED PRODUCERS IN THE EXPORT MARKET

CANADA

Canada is the most important exporter in the global rapeseed and rapeseed products market. Between 1988 and 1992 Canada accounted for 74 per cent of rapeseed exports, if trade flows within the EU are not considered. Over this same time period Canada was one of the most important exporters of rapeseed oil and meal with an 18 and 28 per cent market share, respectively (Oil World Annual, 1993).

Japan is the major buyer of Canadian rapeseed exports, representing over 90 per cent of Canadian rapeseed exports between 1988 and 1992. This structure has changed in 1993, however, with the introduction of the EU, Mexico and U.S. as significant export markets. A significant portion of Canadian rapeseed meal exports, approximately 19 per cent between 1988 and 1992, have also gone to Japan with only the U.S. being a more important destination. The U.S. purchased 62 per cent of total Canadian rapeseed meal exports over the same time period (Oil World Annual, 1993). Since 1991 Canadian canola meal exports to the U.S. have expanded significantly, with market promotion and increasing familiarity and availability of canola meal facilitating the increase.

CHINA

Since 1985 Chinese rapeseed meal exports have exceeded Canada's. China exports protein meal to earn foreign currency at the expense of leaving its domestic meal protein deficient. The rapeseed oil production of China, despite being the largest in the world, is required for domestic consumption. Subject to foreign currency requirements China is expected to be a net importer of oilseed commodities in the future.

THE EU

Despite being one of the worlds largest producers of rapeseed, the EU is a net importer of rapeseed and rapeseed meal. The EU is protein deficient and is a net importer of oilseeds and oilseed meals. This meal demand has been moderated starting in 1993-94 by CAP reforms.

The EU's domestic demand for rapeseed oil does not meet its high levels of production however. This has resulted in the EU becoming the most important exporter of rapeseed oil in the world market. This trend started to reverse in 1993, however, due to increasing EU industrial demand for rapeseed oil as an alternative fuel and oilseed production controls due to international trade agreements.

OTHER SUPPLIERS

There are various other large producers in the rapeseed market such as India, Poland and Eastern Europe. In all of these regions the bulk of the supply is destined for domestic use. Exceptions to this rule include India, which uses the oil it produces but exports a large portion of its rapeseed meal production. In recent years most of the rapeseed meal exports of India have gone to the EU and Pacific Rim, providing increased competition for Canadian canola meal. Also, Poland was a large exporter of rapeseed, approximately 10 per cent of world rapeseed exports, between 1985 and 1989. Export subsidies and a need for foreign exchange fueled the rapeseed exports from Poland to markets such as Mexico. Since 1992, however, rapeseed production in Poland has been well below previous levels, with limited amounts available for export. This has allowed Canadian canola exports to regain a presence in the Mexican oilseeds market.

IMPORTANT REGIONS IMPORTING RAPESEED COMMODITIES

Between 1988 and 1992 Japan has accounted for about 70 per cent of all world rapeseed imports. Outside of Japan, the market shares of rapeseed importers are quite small and include the EU, Bangladesh and the U.S. Due to rapidly expanding demand and the availability of crushing facilities the U.S. has evolved as a significant importer of Canadian canola.

Over the past five years the U.S., Japan, South Korea, the EU and to a lesser extent Indonesia, Taiwan and Thailand have been the major importers of rapeseed meal. On average these seven main importers of rapeseed meal have accounted for over 90 per cent of total world rapeseed meal imports (Oil World Annual, 1993). Major importers of rapeseed oil include the U.S., Mexico, China and Hong Kong. The most rapidly expanding of these markets has been U.S. imports of Canadian canola oil.

2.1.1.3 Sunflowerseed and Sunflowerseed Products

Since 1986 sunflowerseed has ranked third, behind soybeans and rapeseed, in terms production of oilseeds grown in the world for the production of edible oil. Sunflowerseed fell to third place due to the faster rate of growth world rapeseed production. The average world total oilseeds production share for sunflowerseed between 1987-88 and 1993-94 has been about 10 per cent.

Sunflowerseed is grown commercially in over 35 countries around the world. Over 60 per cent of this production is grown in the EU, the FSU and Argentina and over 85 per cent of world production takes place in the eight largest producing regions. Between 1990-91 and 1993-94 the FSU averaged 27 per cent of world sunflowerseed production, the EU 19 per cent, Argentina 17 per cent, the U.S. six per cent, China six per cent, India five per cent, Turkey four per cent, and Hungary three per cent (see Table 2.4).

Not all of the sunflowerseed produced is crushed since there are other uses for the seed[10]. Between 80 and 90 per cent of production is crushed, however, yielding an edible oil and protein meal product. The average extraction rates of oil and meal are 38 and 43 per cent, respectively. In terms of world importance of edible oils produced, sunflowerseed oil ranks fourth, behind soybean oil, palm oil and rapeseed oil. Between 1989-90 and 1993-94 sunflowerseed oil represented about 13 per cent of world consumption of the major

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[10] Between 10 and 20 per cent of world sunflowerseed production is used for direct human consumption, bird seed, seeding requirements and wastage.

vegetable and marine oils. At the same time sunflowerseed meal was the fourth most important protein meal produced and represented approximately seven per cent of the world's protein meal consumption.

TABLE 2.4 - World Sunflowerseed Production (thousand metric tonnes)

Country/Region	1989-90 - 1992-93	1991-92	1992-93	1993-94
EU	3974	3993	3982	3412
Bulgaria	470	434	600	378
Hungary	599	855	756	680
Romania	650	612	774	660
Yugoslavia	400	400	362	400
FSU	6193	5633	5682	5292
South Africa	503	589	364	400
Canada	108	135	120	80
United States	1162	1639	1181	1178
Argentina	3725	3800	3100	3800
China, PR	1171	1420	1472	1250
India	996	1194	1185	1500
Turkey	870	620	900	900
Other	1062	516	842	1050
Total	21883	21840	21320	20980

Source: USDA, FAS. December, 1994.
Oil World Annual, 1993.

Generally, 80 per cent of the value of crushed sunflowerseed in obtained from the oil extracted (Bickerton, 1990). This is in sharp contrast to other oilseeds such as soybeans and cottonseed. For example, cottonseed value is very reliant on the fibre industry with the oil obtained being considered a by-product. Sunflowerseed oil is low in saturated fats, which makes it very desirable as an edible oil. Sunflowerseed oil generally is considered a premium oil due to its light color, bland flavor, high smoke point, high level of linoleic acid, vitamin E content and absence of linolenic acid.

As shown in Appendix B, sunflowerseed and its products are a significant part of world trade in oilseeds and their products. Between 1989-90 and 1993-94 sunflowerseed ranked third in terms of volume of oilseed traded in the global market. During this same time period sunflowerseed meal trade ranked fourth, behind soybean meal, fish meal and rapeseed meal. Sunflowerseed oil has been of greater importance, however, ranking third, behind palm oil and soybean oil, in terms of edible oil trade flows.

MAJOR SUNFLOWERSEED PRODUCERS IN THE EXPORT MARKET

Despite the fact that sunflowerseed is one of the major oilseeds produced in the world very little of the seed is traded in the world markets.

THE UNITED STATES

Although total production of sunflowerseed in the United States has been declining in recent years, it has maintained its position as the largest exporter of this oilseed in the world. Very little of the sunflowerseed meal produced in the United States goes to the world market. Sunflowerseed oil exports are significant for the U.S. however, and destinations have frequently included the Middle East, North Africa, Latin America and Eastern Asia. Export subsidies have been an important part of the U.S. sunflowerseed oil exports.

ARGENTINA

Argentina is the largest exporter of sunflowerseed commodities in the world, with the bulk of its exports being in processed form. In general, sunflowerseed exports tend to go to the EU and Mexico; meal exports to the EU and to a lesser extent Cuba; and oil to Africa, the EU, Mexico, Venezuela, Turkey and the FSU (prior to 1992).

OTHER SUPPLIERS

Despite being relatively important producers, India and China have limited involvement in world trade. Basically all of their production is processed domestically. Over the past five years, however, India has been exporting larger amounts of sunflowerseed meal.

IMPORTANT REGIONS IMPORTING SUNFLOWERSEED COMMODITIES

The EU and Mexico are the major importers of sunflowerseed. The EU is by far the most important destination of sunflowerseed meal trade flows. Other sunflower meal destinations of some significance include Cuba, Thailand and Eastern Europe. Sunflowerseed oil importing regions of the world are more numerous than those important to the seed and meal trade flows. The most significant, in terms of volume, destinations of sunflower oil trade flows include Eastern Europe, the FSU, Algeria, Egypt, South Africa, Cuba, Mexico, Venezuela and Turkey.

2.1.1.4 Cottonseed and Cottonseed Products

In terms of world oilseeds produced, cottonseed is second only to soybeans. The average world total oilseeds production share for cottonseed between 1989-90 and 1993-94 was almost 15 per cent. Its importance in the meal and oil markets is relatively small, however, since these products are only the by-products of the production of the cotton fibers. Producers mainly grow the crop for the production of the seed fibers. However, in recent years there has been research on the improvement of the meal and oil by-products produced.

Cottonseed is commercially grown in over 40 countries, with almost 80 per cent of the production in just six countries, namely; the FSU, the U.S., Brazil, China, India and Pakistan. Between 1989-90 and 1993-94 China averaged 23 per cent of world cottonseed production, the U.S. 17 per cent, India 13 per cent, Pakistan 10 per cent, the FSU five per cent and Brazil three per cent (see Table 2.5).

The processing of cottonseed yields about 15 per cent oil, 47 per cent meal, nine per cent linters, 26 per cent hulls and three per cent waste. It is the linter production for the textiles industry which is and will continue to be the important factor. Cotton fibers are important since they are a renewable resource that can be processed into various products with very desirable textile characteristics.

The refined cottonseed oil produced is used in the food industry, and in some parts of the

TABLE 2.5 - World Cottonseed Production (thousand tonnes)

Country/Region	1989-90 - 1992-93	1991-92	1992-93	1993-94
EU	496	494	547	595
FSU	1717	1759	1310	1356
Egypt	507	491	535	485
United States	5398	6283	5652	5754
Argentina	409	430	250	404
Brazil	1064	1190	730	672
China, PR	7856	9660	7660	6370
India	4234	4000	4665	4097
Pakistan	3405	4355	3080	2736
Turkey	946	930	891	810
Australia	608	724	528	460
Other	6425	6304	5762	5751
Total	33065	36620	31610	29490

Source: USDA, FAS. December, 1994.
Oil World Annual, 1993.

world is the preferred edible oil. Currently cottonseed oil is the fifth most important oil, behind soybean oil, palm oil, rapeseed oil and sunflower oil. Over the past five years, 1989-90 through 1993-94, cottonseed oil has represented, on average, six per cent of the world's production of vegetable oils.

Cottonseed meal is the third most important protein meal available in the world. Between 1989-90 and 1993-94 cottonseed meal represented approximately 10 per cent of total world protein meal production. This protein meal is used as a feed supplement for ruminant animals in many areas of the world. Often the hulls are added to the meal component of the feed for roughage. Currently cottonseed meal use is restricted in non-ruminant diets, such as poultry and swine, since it includes pigment glands containing gossypol, which is toxic to non-ruminants (Robbelen, 1989). Gossypol can be bound through heat treatment but at the cost of binding some of the amino acid lysine. Researchers are attempting to deal with this limiting factor in the use of cottonseed meal.

As shown in Appendix B, cottonseed and its products play a relatively small role in the world trade of oilseeds and their products. Between 1989-90 and 1993-94 cottonseed, on average, ranked fifth among the top seven oilseeds traded in the world. During this same period cottonseed meal trade flows ranked fourth, with sunflowerseed meal being of approximately equal importance. Cottonseed oil is one of the least important vegetable oils traded among the ten major edible oils, with only peanut oil trade flows being smaller.

MAJOR COTTONSEED EXPORT REGIONS

Despite being one of the major oilseeds produced in the world, less than one per cent of world production of cottonseed and its products are traded in the world market. Of the trade flows that do take place Argentina, Australia, the U.S. and China are the origin of most of the products.

AUSTRALIA

Although Australia is one of the smaller producers of cottonseed, it has accounted for approximately 30 per cent of total cottonseed exports in recent years, with the bulk of the product going to Japan.

UNITED STATES

The U.S. is the second-largest producer of cottonseed in the world and almost all of its production is crushed and consumed domestically. The U. S. is however, the largest exporter of cottonseed oil, often capturing 50 per cent of the cottonseed oil export market. The most important destinations for the oil include Egypt, El Salvador, Japan and South Korea. The U.S. became the dominant exporter of cottonseed in 1991-92.

CHINA

China is the largest producer of cottonseed in the world and yet it typically consumes all of its cottonseed oil production and over 80 per cent of its meal and seed supply. China is, however, the largest participant in cottonseed meal trade, exporting much larger volumes than any of its competitors. The most important destinations for Chinese cottonseed meal are the EU and South Korea.

OTHER SUPPLIERS

The FSU, despite being one of the larger producers of cottonseed, consumes virtually all of its cottonseed oil and meal production. Argentina, Brazil and Paraguay account for approximately 24 per cent of cottonseed meal exports and 45 per cent of cottonseed oil exports.

IMPORTANT REGIONS IMPORTING COTTONSEED COMMODITIES

Egypt is by far the largest import market for cottonseed oil, accounting for about 40 per cent of the trade flows in recent years. Other significant cottonseed oil importing regions include El Salvador, Japan and South Korea. The EU accounts for approximately 50 per cent of all cottonseed meal imports, with South Korea being the second most important importing country. Other cottonseed meal importers include Mexico and South Africa. The EU, Japan and Mexico are the three major cottonseed importers in the world accounting for about 80 per cent of the world's cottonseed imports. Other destinations of some significance include Turkey, Lebanon and Saudi Arabia.

2.1.1.5 Palm Oil

The oil palm is capable of producing more oil per unit area than any other oil-bearing plant, with yields capable of exceeding four tonnes of oil per hectare. In 1980 palm oil became the world's second most important vegetable oil. The expansion of world production was rapid, with production more than doubling between 1970 and 1980. Between 1989-90 and 1993-94, production grew at an average annual rate of over six per cent, compared with an average growth rate of 2.4 per cent for the 10 major edible oils as a whole. No other major oil has expanded this rapidly over the past five years.

An oil palm bunch must be harvested once ripe or it will spoil and lead to disease problems. Once harvested the bunch must be processed within 24 hours if the product obtained is to be of good quality (Senteri, 1985). An oil palm bunch will yield 20 to 24 per cent palm oil, a pulp (which currently has no real value) and palm kernels. The palm kernel can also be processed to obtain an oil and a meal. The oil obtained from the palm kernels represents between two and three per cent of the weight of the oil palm bunch (Robbelen, 1989). Palm kernel oil is mainly used as a substitute for coconut oil. Both palm kernel oil and coconut oil are similar in composition and contain a very high saturated fat content. The primary use of the palm kernel meal is in cattle feed due to its high fibre and mid-level protein content.

Palm oil is produced commercially in approximately 20 countries. Between 1989-90 and 1992-93 over 80 per cent of world palm oil production took place in three countries.

Malaysia averaged 54 per cent of world palm oil production over this time period, Indonesia 23 per cent and Nigeria five per cent (see Table 2.6).

TABLE 2.6 - World Production of Palm Oil (thousand tonnes)

Country/Region	1989-90	1990-91	1991-92	1992-93	1993-94
Cameroon	107	106	112	110	114
Ghana	83	84	84	89	91
Ivory Coast	264	227	299	300	317
Nigeria	592	631	633	640	640
Zaire	100	104	105	107	110
Costa Rica	62	61	79	80	82
Honduras	74	79	79	84	85
Brazil	55	74	65	67	70
Columbia	230	251	276	303	339
Ecuador	119	127	148	162	163
Indonesia	2272	2574	2803	3355	3501
Malaysia	6418	6036	6224	7122	7103
Philippines	45	52	54	55	57
Thailand	221	231	261	297	318
Papua N. Guinea	35	184	195	232	249
Other	332	337	353	420	436
Total	11109	11208	11770	13423	13675

Source: Oil World Annual, 1993.
Oil World Weekly. November 18, 1994.

As shown in Appendix B, palm oil is the most important oil in terms of trade flows. Over the past five years about two-thirds of total world production of palm oil has been involved in trade.

There is some concern with palm oil consumption in the U.S., Canada and other developed ("health conscious countries"), due to its high saturated fat content. If these concerns with palm oil, and tropical oils in general, continue the demand for them may have limited potential to expand significantly on a per capita basis in developed countries despite relative price considerations. There may simply be a shift in the regional importance of demand, however, since the primary concern of most developing countries (which represent the bulk of both world population growth and total population) is nutritional energy. Also, the Malaysian Palm Oil Research Institute (PORIM) has been focusing attention on minimizing these negative concerns through product research and development and the promotion of palm oil use. The health concerns of consuming a saturated fat are mainly found in the developed, health conscious regions of the world. These concerns do, however, strengthen the position of lower saturated-fat oils such as canola oil.

MAJOR PALM OIL PRODUCERS IN THE EXPORT MARKET

Throughout the 1980's Malaysia and Indonesia alone have accounted for over 75 per cent of world palm oil production. Over the past few years Malaysia alone has accounted for about two-thirds of world palm oil exports, with Indonesia accounting for an additional 17 per cent. Palm oil production occurs year round and so it is able to compete in all markets on a continual basis.

The palm oil crop is very important to the Malaysian economy, generating an average of 5 per cent of its Gross National Product (GNP) in the late 1980's (Food and Agriculture Organization (FAO) Trade Yearbooks). Palm oil exports, since the mid 1970's, have represented about 10 per cent of total export earnings for Malaysia. The number of countries importing Malaysian palm oil are numerous and include consumers that are important to the Canadian canola industry.

IMPORTANT REGIONS IMPORTING PALM OIL

There are over 90 countries that import palm oil. These importing countries include developed countries such as the EU, the U.S. and Japan; centrally planned economies such as the FSU and China; and developing countries such as India, Pakistan and Bangladesh. Other than the EU, China and Pakistan, no single importing region represents more than 10 per cent of the world palm oil imports (Oil World Annual, 1993).

2.2 Important Regional Policies and Trade Barriers

2.2.1 Introduction

Agriculture tends to be a prime candidate for government intervention, both within regions of a country and across international borders. World agriculture, as a part of international trade, is facing some serious trade issues. Policies of the countries involved in agricultural trade are not trade neutral and cause significant distortions in the world market. In order for this situation to be rectified the countries involved will need to develop trade neutral agricultural policies which are consistent with the multilateral trade of agricultural products. The recent GATT agreement represents a step in this direction.

Rather than look at this topic as a whole, this study requires a discussion of only those policies initiated by the various countries deemed most important to the Canadian canola industry. The regions to be discussed, in relation to oilseeds and oilseeds products, can therefore be restricted to Canada, the U.S., the EU, Japan, Brazil, Argentina and Malaysia. Refer to Appendix D for a more comprehensive listing of regional barriers currently in place.

Before discussing the relevant domestic and trade policy issues for each of the regions mentioned it is important to review the economic theory underpinning international trade.

2.2.2 Economic Theory on International Trade

2.2.2.1 Rationale for Trade[1]

The rationale for trade goes beyond the importation of products that a country can not produce. There are few agricultural products that could not be produced anywhere in the world, though some would be at a considerable cost. Many countries import products that are also produced domestically.

There is a profit incentive for countries to specialize in the production of certain commodities, and then to trade with countries specializing in other products. The incentive for this action comes from the economies of producing commodities that are, in relative terms, best produced by a country's resource base[2]. The fundamental basis for the trade in food comes as a result of an uneven distribution of productive resources, a desire by consumers to have variation in their diet and the fact that different products require different resources for production.

The world market provides an arena wherein the buyer is able to select according to his/her choice. The opportunity for trade encourages the producers of the world to specialize in those activities to which they are best suited. Thus international trade comes about in response to the demand for optimal efficiency on a world wide basis rather than

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[1] Based on Kohls, 1985.

[2] This resource base includes such things as land, labor, energy sources, technology base, etc..

only within a country. Through this process an improved average standard of living is obtainable.

It is price differentials in the international market that signal what products to produce, to import and to export. Each country has an incentive to produce those commodities which make the most efficient use of their resource endowment. It is from this concept that the principle of comparative advantage was formally developed by David Ricardo in the 1800's.

> The "*principle holds that there are economic gains when, under free trade, nations produce and export those commodities that they can produce relatively most efficiently by virtue of their resource endowment and import those commodities that other nations can produce more efficiently.*" (Kohls, 1985, pg.128)

This principle goes against the general human instinct of trying to be self-sufficient and encourages dependency on others[3]. It is also important to note that a country's comparative advantages can shift over time as technologies, resource bases, products desired, and other factors change. This shift is often very painful and difficult to handle within a country, as revealed by the concerns raised by various interest groups over the Canada-U.S. bilateral free-trade agreement, the persistence of the edible oils tariff in Japan, and resistance to change the CAP policies of the EU.

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[3] This is one point that tends to cause problems in the international market.

The argument in favor of trade is that it improves the net welfare of society as a whole. This means that trade will include individuals or regions who gain and others that lose, with the net result being that the gainers receive more than enough to compensate the losers. For example, as a result of increased export trade due to higher foreign prices the domestic price of a product may increase, much to the chagrin of domestic consumers. Also, the foreign price may drop, to the delight of the foreign consumer. Under different conditions imports may under-cut the prices needed by domestic producers and thereby force the domestic producers out of the market. Also, in a dynamic world, comparative advantage is real but changes over time and can be influenced by regional policies and incentives.

Even though the gains of international trade are positive as a whole, the shifting of resource use and the reality of dependency on others can be a sensitive issue to those involved. Also, current economic theory does not identify, quantify or incorporate all of the different characteristics of humanity that are involved. For most individuals, the maximization of welfare involves more than profit maximization. Being self-sufficient, maintaining relationships with associates and imperfect information are additional important considerations.

2.2.2.2 Spatial Price Equilibrium[4]

Tomek and Robinson (1981) developed a spatial price equilibrium model that provides a simple theoretical basis for understanding the gains of international trade. It is important, however, to remember the rigid assumptions of i) a competitive market structure, ii) homogeneous commodities, iii) perfect market information and iv) no prohibiting barriers to trade upon which the model is based.

Although the theoretical assumptions of the model stray from economic reality, it maintains some functional use for the analysis of price relationships. In fact, the model can be extended to analyze the effects, on an importing and exporting region, of imposing or removing a tariff.

Tomek and Robinson (1981) hypothesize that the price differential for a product between two regions should not exceed the costs of transfer between the regions. The mechanism governing this relationship can be explained as follows:

> *Any time the price difference is greater than transfer costs, buyers will purchase commodities from lower priced markets and ship them to the higher priced market, thereby raising prices in the former and reducing them in the latter. This form of arbitrage will continue until it is no longer profitable to ship commodities between markets - that is until the price difference between them no longer exceeds transfer costs.* (Tomek, 1981)

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[4] Based on Futz, 1988.

This price relationship can be shown diagrammatically (Figure 2.1). The "potential volume of trade" is shown by the potential trade curve and is equal to the excess demand curve minus the excess supply curve. This curve portrays the relationship between transfer costs and the volume of trade. For example, if there is a transfer cost of t, the total volume traded will be q_1 and the differential in relevant prices between the two regions will be t.

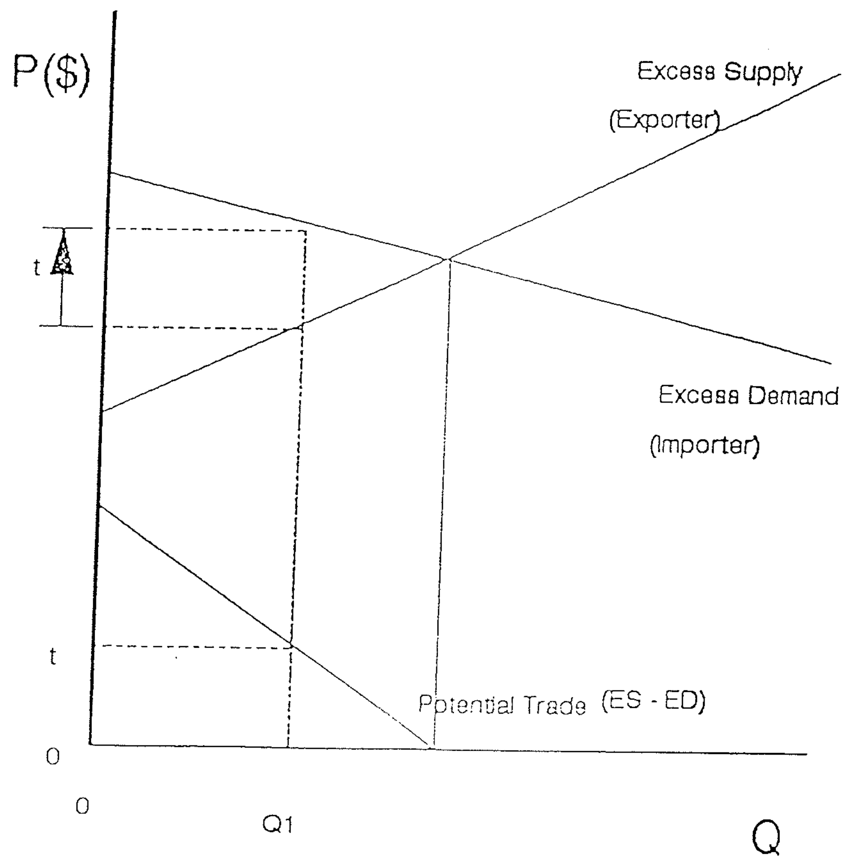

FIGURE 2.1 - Theoretical Trade Potential - Graphical Model

Although useful, this representation of trade has some short-comings that must be considered (Tomek and Robinson, 1981). The concept of a relationship between transfer costs and the price differential between the exporting and importing region is valid, but there are some important factors that influence the relationship:

i) The homogeneity of the product coming in from each market may not be there. For example, the quality, oil content and appearance of an oilseed may differ from one time period to the next or due to its place of origin. The preferences of the buyers will determine if and to what extent the consumer will be indifferent as to the source of supply. Also, products which appear to be homogeneous may not be fully substitutable. For example, before the introduction of canola a limited amount rapeseed meal could be used as a feed supplement since it contained toxic levels of glucosinolates. Another example is the different crushing characteristics and requirements between rapeseed and soybeans.

ii) Physical or institutional barriers may exist which prevent the neutral movement of goods between regions. Transportation networks, trade barriers, and established business relationships, for example, can distort this relationship, as is currently being observed in the oilseeds and oilseeds products market.

iii) Price differences may exceed the costs of transportation between regions for periods of time due to inaccurate and incomplete information between parties involved in the market. Also, consideration needs to be given to the available supply of transportation services. Businesses often are unwilling to switch between products unless a consistent supply on an ongoing basis can be assumed.

iv) Inefficiencies in the various components such as handling, processing, transportation and so on may exist, thereby hindering the potential gains of trade. New technology is not always adopted immediately and so various segments of the market often operate under inefficient conditions.

2.2.2.3 Rationale for Protection and Regulation[5]

Intervention, in its various forms, has played a significant role in industrial location and resource allocation. Tariffs, quotas, and subsidies as well as other policies have distorted the free movement of products. The potential gains of trade are based on comparative advantage, as discussed in Section 2.2.2.2, and any trade barriers will cause distortions in the market and reduce the potential gains. In many cases these barriers are imposed either to exploit market power or to encourage and protect the domestic industries. In those cases where significant market power does not exist, there are gains from trade that could be realized through the reduction of the trade barriers.

> *As exporting countries face greater competition in the world market, tariff structures become increasingly more important. Exporting countries compete for gains when trade restrictions are reduced. However, the desire for self-sufficiency and the political strength of domestic producer groups make trade liberalization important to both importing and exporting countries.* (Johnson, 1987, p. 16)

Over time there has been an evolution in the types of trade restrictions used. One of the earlier forms was that of licensing imports. This was a simple method of controlling the level of imports. Through the arbitrary assignment of import licenses a limited number of importers were able to obtain a monopoly type structure, whereby excess profits were attainable, even though exporters were aware of and willing to meet the demands for the scarce good. This meddling with the market, in turn, led to a reallocation of resources

[5] Based on Johnson, 1987.

within the importing country so as to enhance domestic production. Further developments then led to the use of import tariffs. The overall effect of this form of action was that industries in the importing country developed domestic substitutes. This type of policy can encourage the development of domestic industries, but in a country that is highly dependent on imports it is uneconomical.

In developing a possible response to these trade distortions caused by import control measures Carter, Gallini and Schmitz (1980), studied the effect of an introduction of export taxes in the international commodity market. The work concentrated on the effect of a grain cartel composed of the major wheat exporters restricting the trade of wheat. They concluded that substantial financial gains could be experienced by cartel members. Similarly, Swallow (1983) estimated the effect of imposing an export tax on rapeseed in Canada. This study was motivated by the large interdependence in Canadian/Japanese rapeseed trade and the hypothesis of exploitation by Japan of that relationship. Swallow (1983) concluded that significant gains could be realized by imposing an export tax on Canadian rapeseed.

> *Despite strong theoretical arguments about the broad benefits of freer trade, its application will impose hardship on some industries and people. This sometimes includes farmers, sometimes consumers. Those affected often argue successfully for specific protection against the full force of international competition. These deliberate actions include tariffs, import quota, domestic content regulations, packing and labelling requirements, sanitary restrictions, variable import levies, export controls, export subsidies, and so on.* (Houck, 1986, p. 20)

Public decisions for the development of regional policies affecting trade can be classified into a relatively small number of categories: (Houck, 1986)

i). **Protection of a New Industry.** In some instances an industry may not be able to compete in the short-term and thus protection is needed to establish the industry. This is known as the "infant industry" argument for protection. The problem is that in many instances if the industry was able to get enough political power to get the initial protection, it will also maintain its power so as to keep the protective measures in place. The result is the industry never "matures" and some long-run inefficiencies are built into the market. For example, this likely applies to a portion of the Japanese crushing industry.

ii). **Protection of National Security.** Because of the comparative advantage concept, nations tend to specialize. The result of this is that a given industry may decline and be threatened with a complete collapse unless protection is provided. This can be a serious problem in terms of strategic reasoning. A country must be cautious so as to not become overly exposed to the actions of the exporting nations. It also places a country in a very vulnerable and potentially catastrophic position during times of international dissention and upheaval. It is for this reason that many countries insist on maintaining certain essential industries, especially those dealing with the production and processing of staple food ingredients. Current economic theory on free trade does not agree with this. However, economic theory does not currently quantify all factors, such as the utility obtained from maintaining national security.

In many cases the inefficient industries will suppress the standard of living obtained by a country. This inefficiency is accepted however, in light of the alternative of being vulnerable and having to deal with the probability of having essential products withheld. It is for this reason that many countries insist on maintaining a minimum level of control over industries such as agriculture, energy, steel, aircraft and electronics. Many countries have come through severe problems with food shortages during times of war or other disasters. Thus they find security in maintaining the needed policies essential to the survival of certain levels of production for various industries. The determination of the optimal level of protection is uncertain, however, and has caused much debate in the international and national arena. For example, Japan has tried to use this as the reason for protecting its rice production or crushing industry in the past. The EU was determined to encourage massive increases in grains and oilseeds production for this reason.

iii). **Protection of National Health Standards.** In some cases there are serious health concerns with respect to products being imported by a country. Under these conditions there is a valid reason for the restriction of trade. This public safety argument is open to misuse, however, and at times is used to protect some domestic industries.

iv). **Protection against "Unfair" Foreign Trade Policy.** In some instances an exporter subsidizes sales of a product at below world market prices on the international markets and thereby distorts the market. In response to this, most importing nations who produce the product domestically or have competitive goods will attempt to restrict the entry of the low priced imports.

From the exporters perspective the dumping of surplus production is often used to capture markets lost to other exporters, to reduce storage costs on excess production or even to transfer unemployment problems to other nations. Means of accomplishing this include: export subsidies, multiple price schemes, tax advantages, favorable credit arrangements and so on. The consumers of the subsidized exports (importers) receive the benefit of goods at lower prices. Domestic producers are injured by this action, however, and respond by lobbying for the introduction of countervailing duties, quotas, and so on. In addition to this, a third country may find that it is unable to find a market or loses its available market for export products since it is being undercut by the actions of the other country. The Canadian grains and oilseeds industry, for example, has claimed that it is suffering the effects of these types of action being initiated by countries such as the U.S. and the EU.

v). **Protection of Domestic Programs.** In many cases a government will attempt to support a domestic price above that of the international market. For this to be effective it is necessary to control imports so as to not be swamped with goods from other countries looking for the best price.

There also are difficulties on the domestic side. Unless decoupled, an enhanced domestic price will lead to increased production and thus, unless the government has access to a large and ever-increasing treasury, some form of supply control will be necessary (or at a minimum, a control on imports). In many cases this leads to large domestic supply increases which can not all be sold in the domestic market at the target price and the surpluses are dumped on the international market through some form of export enhancement policy. These sorts of problems are currently very real to the EU and the U.S..

vi). **Protection of the Balance of Payments.** In some cases a country may find that its payments to foreign countries consistently exceed its earnings from them. Unless action is taken the currency of the country will come under strong downward pressures. To prevent this, a government will often restrict imports so as to reduce payments to foreigners. This is a sensitive issue, however, since in some instances the foreign country may in turn look to other countries for markets or may retaliate by raising trade barriers of their own against the products of the restricting nation. Japan, for example, went through this experience in the past. However, in more recent years the tables have turned so as to be heavily in their favor (in terms of total value of trade flows).

vii). **Attempt to improve International Terms of Trade.** An importing nation which dominates a trade flow (such as Japanese imports of Canadian canola) may be able to exert downward pressure on the world price of a desired product by imposing a tariff on it. The result of this being improved terms of trade for the country. The theoretical explanation of this phenomenon is that a large importer may be able to apply some degree of a monopoly influence on the international market. This "optimal" tariff implementation concept, as cited earlier in reference to the work done by Carter (1980) and Swallow (1983), indirectly supports the domestic industry.

viii). **Governments may be seeking a source of revenues.** In many countries the use of tariffs, levies, and taxes on trade provide a source of revenue. In most developed countries this revenue source is minimal. For many of the developing countries, however, where income and profit taxes are difficult to collect the government needs tariffs as a source of revenue. Countries such as Brazil and Argentina, for example, obtain significant revenues from export taxes on their oilseeds industry.

ix). **Protection against Painful Economic Adjustment.** As time passes, changes occur that suggest changing comparative and absolute advantages of production. Industries that have been strong may come under increasing world market pressure and new industries may become feasible. Economic adjustment to these shifts are not painless, however. When an industry comes under these pressures it often lobbies for government protection. In some instances the real reason for protectionist action is hidden under the disguise of more internationally acceptable explanations. Protectionist actions are a means of dealing with the harsh economic adjustment sometimes asked for by the market. For example this may be one of the major reasons behind the vegetable oils import tariff in Japan. Japan may simply not be willing to give up this domestic industry before it is forced to by the international market.

Exporting countries may also use this type of action so as to keep resources from going to higher priced international markets in an attempt to keep domestic consumer costs low.

The economic gains available from freer trade in the international markets are real and significant. These gains are not the only important issue, however. There are some very real concerns such as the protection of national security, the protection of new domestic industries, protection against "unfair" foreign trade and production policies, the protection of domestic polices, the protection of a countries balance of payments, attempts to improve international terms of trade, needs for government revenues, and protection against painful economic adjustment that must be balanced with the benefits of freer trade. However, as indicated by the recent GATT agreement, the countries of the world have indicated a willingness to move towards freer trade and reap the anticipated economic gains.

2.2.3 The Important Domestic and Trade Policies

Government intervention in world trade markets has played a significant role in influencing production and trade patterns. Intervention may take the form of tariffs, quotas, subsidies and taxes, as well as, non-tariff barriers such as quality standards and inspections. The goals of these interventions may be to suppress or stimulate trade and/or production.

This section provides a brief overview of important trade distorting policies for the world oilseeds market. Emphasis is placed on those policies that directly impact on the Canadian canola industry. More detailed information on the various policies implemented by oilseed exporting and importing countries is provided in Appendix D as well as other sources such as Au (1990), Bickerton and Glauber (1990), Glance (1989), Griffith and Meilke (1980), Landell Mills Commodities (1990), Santana (1985), Senteri (1985), Suryana (1986), USDA, FAS (1990), and Williams (1981).

2.2.3.1 In Canada

The Canadian oilseed industry receives assistance from a number of policies that influence production and trade. Among the issues of concern are the price and crop insurance components of the Gross Revenue Insurance Program (GRIP), the Western Grain Transportation Act (WGTA) rail freight subsidies and the Export Development Corporation export credits.

GRIP, introduced in 1991-92, is a producer level program designed to stabilize the revenues generated from crop production. However, canola returns have been above the level of support provided by the program since 1992-93.

The WGTA, which was introduced in 1984, expanded earlier rail subsidies to include the oils and meals of oilseeds (excluding soybeans) transported on the Canadian rail system. At the same time the WGTA expanded the number of ports eligible for the subsidy on certain commodities. Also, the U.S. was explicitly named as an eligible export destination for the first time. However, under the Free Trade Agreement Canada eliminated the WGTA subsidy on products shipped to the U.S. through West Coast ports (as of January 1989).

Due to the current payment method for the WGTA subsidy (approximately $560 million expected to be paid to the Canadian railways in 1994-95) farm gate prices are higher than they would be without the payment. If producers were responsible for payment of the full transportation costs, it is hypothesized that they would potentially produce less grains and oilseeds and sell more of their production to local processors. The amount that Canadian prices would drop is uncertain and would be dependent on issues such as transport and handling efficiencies and lower Prairie crop prices leading to a decline or a different mix of the crops produced in Western Canada. The price drop could stimulate sales to the U.S., which would limit the drop to less than the imposed higher transportation costs.

The EDC offers credit guarantees, mainly to developing countries, who purchase Canadian agricultural commodities. In 1988 the EDC offered approximately $335 million worth of guarantees. These guarantees are mainly for one year loans. The credit is made available only when the EDC feels Canadian competitors have or would provide similar credit to the particular market in question.

2.2.3.2 In the United States

A number of different policies are in place that influence the U.S. position in the production and trade of oilseeds and oilseeds products. Currently the U.S. maintains a price support program for soybeans and indirect support for cottonseed production through the upland cotton program. Other oilseeds such as sunflowerseed and rapeseed receive price floor support through a minor oilseeds program.

Exports of vegetable oils produced in the U.S. are eligible for subsidization through the Export Enhancement Program (EEP), as well as other specialized assistance programs. The U.S. imposes a system of significant tariffs on foreign vegetable oils entering the country and minimal tariffs on the seed and meal products. These import tariffs are highest on oilseed products produced in the U.S. As world trade subsidization escalated throughout the 1980's, the U.S. continued to implement measures such as tariffs and export subsidies in an attempt to protect their domestic industry. Under the current U.S. tariff structure imports of vegetable oils and meals are placed at a disadvantage to the import of the seed product.

These oilseed commodity trade barriers are being eliminated for Canada, Mexico and the U.S. under the North American Free Trade Agreement. Also, with the recent conclusion of the GATT negotiations the trend of escalating trade distortions will be reversed.

2.2.3.3 In the EU

Currently the EU allows oilseeds and oil meals to be imported free of duty. Domestic production is greatly encouraged however, by the EU oilseeds regime. This oilseeds regime was revised in 1993-94 to a direct land based payment for oilseeds production. Conditions of the program include a Maximum Guaranteed Area, including a set-aside requirement, with payment penalties for "over-planting". Eligible oilseeds include rapeseed, soybeans and sunflowerseed.

Within individual countries in the EU there are various provisions designed to encourage consumption of olive oil and butter relative to other edible oils. For example, in France it is illegal to advertise margarine (which is produced from oils) on television in an attempt to protect its domestic butter industry. Also, France has tax structures which discriminate against the use of soybean oil. Finally, both France and Belgium have a value added tax structure in place which is higher on edible oil products than on butter.

In Portugal there is a quota on domestic use of soybean oil to protect domestic producers of olive oil and other vegetable oils. Also, Portugal provides export subsidies to sunflowerseed producers in other EU countries so as to aid in the disposal of surplus production. Finally, vegetable oils have specific labelling and content requirements, with domestic suppliers receiving production and processing aids to help meet these requirements.

In Spain soybean oil consumption is controlled by a quota and its price is fixed at an artificially high level so as to discourage domestic consumption and protect producers of competing vegetable oils. Also, Spain provides producer protection through export subsidies on the export of soybean and sunflowerseed oil.

2.2.3.4 In Japan

Japan has a system of deficiency payments for soybean and rapeseed production. Production is very limited, however, and is insignificant in comparison to consumption requirements. Imports of oilseeds and meals are free of duties and restrictions, except for peanuts which currently are subject to an import quota. Soybean meal, however, is placed at a disadvantage in relation to fish meal through feed mixing regulations.

As has been mentioned already, vegetable oils are subject to an import tariff. This tariff applies to most edible oils, with the notable exception being palm oil. A higher tariff is imposed on refined oils so as to protect/support the domestic refiners.

2.2.3.5 In Brazil

The major instruments of agricultural policy in Brazil are minimum support prices for production and the availability of subsidized credit. A minimum support price mechanism is not in place, however, for soybeans (the primary oilseed grown) and the amount of credit made available to oilseed producers has declined significantly in recent years. Due to improvements in producers' financial positions, the ongoing problems with the Brazilian economy and the increasing use of forward price contracting against input purchases, the availability of subsidized operating credit has declined significantly in 1994-95.

In general, import policies have been such that oilseeds and oilseeds product imports are not allowed. At times, however, soybeans are imported for processing, but the products produced are simply resold into the export market. The purpose of these imports has been to aid processors in maintaining profitability through optimal capacity utilization.

One of the major factors increasing the competitiveness of Brazilian soybean commodities has been the rapid devaluation of Brazil's currency. Other factors include; subsidized credit, tax exemptions, and the use of export restrictions or taxes to assure low-cost domestic supplies. Currently the Brazilian government applies preferential financing and differential taxation on oilseed and oilseed product exports. Differential export taxation is applied at the state level, which distorts trade by being relatively less restrictive on processed products than oilseeds. This may, however, simply offset other domestic market taxes on the processing and handling sector. Also, the Brazilian government has made use of initiatives such as; preferential income tax treatment for earnings from soybean oil and cottonseed oil exports, federal government price support loans for processor inventories of soybeans and soybean meal, preferential financing from the Bank of Brazil for soybean commodity exports and deferred collection without monetary correction for taxes on soybean oil and meal exports.

In summary, Brazil uses a host of measures to maintain a number of domestic objectives. The objectives include self- sufficiency, maintenance of low domestic prices and increased export earnings through structures which encourage the export of processed rather than primary goods. Overall, however, the Brazilian government intervention has been a net cost or restriction on the Brazilian oilseeds industry.

2.2.3.6 In Argentina

Argentina is a major producer and exporter of agricultural products, with most of its export earnings coming from agricultural products. Export taxes are one of the major sources of revenue for the Argentine government. The taxation is not applied evenly, however, and creates relatively less of a dis-incentive on the export of the processed oil and meal products than on oilseeds. Other distortions which are relatively less restrictive on the export of processed goods include rebates of indirect taxes collected on the oil and meal products that are exported. Many of the available rebates and subsidies on exports were eliminated in July of 1989, however, by the Menem Administration.

In general, Argentina does not allow the importation of goods that are considered luxuries or are available from domestic suppliers. These measures have been put in place to protect domestic producers and to save foreign exchange earnings for essential goods.

Ongoing reforms to the structure of Argentine agriculture are expected to improve its competitiveness in the world market. Privatization of its port and transportation system are expected to make it more efficient, resulting in increased competitiveness in the world market and increased profitability for Argentine producers.

2.2.3.7 In Malaysia

Malaysia has been able to develop a massive palm oil and palm kernel products industry through research and other government assistance (including an export program for palm oil). For example, various land development and settlement schemes have been effective in expanding Malaysian palm oil production.

The Malaysian government has also sought to encourage increased exports of value-added, processed products instead of the primary commodities. For example, a differential tax scheme creates less of a dis-incentive for the export of refined palm oil products, rather than crude oil. Other efforts, designed to encourage the export of palm and palm kernel oil, include: export credit programs, market promotion done by trade associations such as the Palm Oil Research Institute of Malaysia and government sponsored overseas trade missions. In November of 1988 Malaysia also introduced a

Palm Oil Promotion fund designed to develop an information campaign and to enhance the image of palm oil in the international market. The Malaysian government has a policy of reducing taxes on value- added agricultural exports such as refined, deodorized and bleached palm oil.

In general, primary agricultural imports are admitted with a minimum of restriction, but high-value and processed foods are subject to import duties which generally range from 30 to 50 percent.

2.3 Literature Review

A number of previous studies have examined different aspects of the world oilseeds complex. These studies have taken various approaches and had different areas of focus. While none of these previous studies fully address the issues of concern for the present study, a number of them do provide useful insight into the task at hand. Various sources (e.g. Glance 1989, Griffith 1980 and Williams 1981) provide a lengthy discussion of previous studies that are relevant to the topic. The following discussion highlights previous research that relates most directly to the goals and objectives of this study.

2.3.1 Economic Impact of Trade Liberalization for Oilseeds - Roningen and Dixit (1989)

Roningen and Dixit (1989) assessed the impact of eliminating protectionist agricultural policies for industrial market economies. Using a multi-commodity multi-region static partial equilibrium trade model, Roningen and Dixit evaluated the effect of unilateral and multilateral liberalization of agricultural trade policies for several commodities. The model projected an increase in world prices for most commodities in response to the trade liberalization.

For oilseeds, the model projected an increase of 6.4 percent in the world price if all agricultural policy supports affecting the world market were removed. Domestic prices in many countries (e.g. U.S., Canada, the EU, and Japan) would decrease, however. Domestic production of oilseeds would increase in some regions (e.g. U.S. and Canada), while decreasing in other regions (e.g. the EU and Japan). Trade flows in oilseed products would expand for some regions and decline for others.

Overall, the results indicated that countries such as Canada and the U.S. would improve their agricultural balance of trade. Regions such as the EU and Japan would face larger agricultural trade deficits or reduced surpluses. However, all economies would generally experience income gains from trade policy liberalization, suggesting that current policies are inefficient.

Roningen and Dixit's results provide an assessment of the general impact of trade liberalization for specific regions. However, it does not suggest implications for the oilseed industry in specific regions, in terms of the effects of changes to individual policies, or the resulting effects in terms of changes to the various sectors of a country's oilseed industry.

2.3.2 Economic Studies Involving the Canadian Canola Market

There are numerous studies analyzing various economic issues affecting the Canadian canola industry[1]. Only a limited number, however, include an analysis of some of the trade issues directly relevant to this study. Among the more important studies dealing with trade issues are Furtan, Nagy and Storey (1979), the various publications by Griffith and Meilke between (1979 & 1983), Swallow (1983), Carter and Mooney (1987), Johnson (1987), Glance (1989), Landell Mills Commodities (1990) and Agriculture Canada (1990).

FURTAN, NAGY AND STOREY (1979)

Furtan, Nagy and Storey developed a quadratic programming model to estimate the effects of changes in transportation and tariff costs. A spatial equilibrium model was developed to analyze tariff and transportation policies affecting the Canadian rapeseed industry. The model solved for equilibrium prices, quantities and trade flows in each of

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[1] See studies done by Agriculture Canada (1977 and 1990), Canadian International Grains Institute (1977), Canola Council of Canada (1988), Carter and Mooney (1985 and 1987), Committee on Canola Marketing (1987), Craddock (1973), Experience Incorporated (1984), Furtan, Nagy and Storey (1978 and 1979), Glance (1990), Gordon (1989), Griffith (1979), Griffith and Meilke (1979, 1980, 1982a, 1982b, 1983a and 1983b), Johnson (1987), Kulshreshtha et al. (1979), Kwon and Uhm (1980), Landell Mills Commodities (1987 and 1990), Lowe and Petrie (1979), Martin and Storey (1975), Meilke and Griffith (1981 and 1983), Nagy and Furtan (1977), Natural Products Marketing Council (1981), Perkins (1976), Rigaux (1976), Spriggs (1981), Strain and Baudry (1987), Swallow (1983), Uhm (1975) and Umenoto (1973).

the regions and commodities endogenous to the model[2].

Five different scenarios of change to transportation costs and tariffs where then developed and compared to the initial equilibrium situation. The five scenarios were: (1) the removal of the Canadian statutory Crow rate, (2) the introduction of oil and meal transportation at the statutory Crow rate equivalent, (3) the removal of the Japanese rapeseed oil tariff, (4) the joint implementation of scenarios one and three, and (5) the joint implementation of scenarios two and three.

The model solved for the scenarios developed by maximizing a proxy of social welfare. The proxy was a maximization of the net average revenues (perfect competition solution) of those variables endogenous to the model. The estimated impact, given each of the scenarios considered, on Canadian consumers of meal and oil and Canadian producers and crushers are shown in Table 2.7.

Among the limitations of the Furton, Nagy and Storey study are the exogenous treatment of substitute goods and other regions. Another concern with the model developed is the fixed supply of the seed product. The model does not allow seed supply to adjust to the changes introduced under the various scenarios. The conclusion that significant overall

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[2] The endogenous regions included in the model were Canada, Japan and the EU with the fourth region being an exogenous Rest-of-World. The commodities endogenous to the model were rapeseed and its oil and meal products. It should be noted that the major substitute products (soybeans) were treated exogenously.

gains to the Canadian canola industry could result from the considered changes is, however, important and useful.

TABLE 2.7 - Welfare Effects from the Five Policy Simulations - Relative to the 1974 Base Period
(in thousand dollars)

Scenario Number[a)]	Can. Meal Consumers	Can. Oil Consumers	Canadian Producers	Canadian Crushers
(1)	960.3	-18.4	-5911.5	892.2
(2)	899.4	-1318.5	2938.9	907.7
(3)	3023.9	-3761.5	8411.2	2705.1
(4)	2459.0	-4062.8	2499.1	31185.6
(5)	2961.7	-2901.6	13917.4	31411.6

a) Scenario numbers as discussed earlier in text.
Source: FNS (1978) page 85.

GRIFFITH AND MEILKE (1979 to 1983)

Over the 1979 to 1983 time period Griffith and Meilke wrote a number of articles relating to the Canadian rapeseed industry. The 1980 article provides a wealth of information relating to the production and policies of some of the most important oilseed regions, including an outline of the market structure and agricultural policies of five regional oilseed and oilseed product markets. A useful discussion of the industry and policies in each of the five individual regions in the early 1980's is provided. The regions covered included Canada, the U.S., Brazil, Japan and the EU. Despite being quite useful, the information provided has become somewhat dated.

In 1982b Griffith and Meilke made use of an econometric model of the world markets for rapeseed, soybeans and their products to analyze the impact of removing edible oil tariffs in Japan and the EU. The model featured 141 behavioral equations, market-clearing conditions and technical identities, representing the six commodity markets in six regions (Canada, the U.S., Brazil, Japan, the EU and an aggregate Rest-of-the-World).

The specific scenarios analyzed included the impact of eliminating the Japanese oil tariff on rapeseed oil, eliminating the Japanese oil tariff on soybean oil, the joint elimination of the Japanese oil tariff on rapeseed and soybean oil, eliminating the EU oil tariff on rapeseed oil, eliminating the EU oil tariff on soybean oil, and the joint elimination of the EU oil tariff on rapeseed and soybean oil.

The general conclusions made were that Canada would gain from rapeseed oil tariff elimination and lose from soybean oil tariff cuts. It was also concluded that Canada would gain if the oil tariff was removed on both commodities in Japan but lose if both oil tariffs were removed in the EU. In contrast to the results found by Furton, Nagy and Storey (1978 and 1979), Griffith and Meilke suggested that the overall impacts on the Canadian industry from abolishing Japanese oil tariffs would be minimal. The effects from the elimination of the EU oil tariffs would be somewhat more pronounced. In general, however, Griffith and Meilke concluded that Canada should not be very concerned with tariff reduction, but rather focus on market development and the solving of domestic infrastructure problems such as freight rates.

SWALLOW (1983)

The primary objective of the study done by Swallow was to enhance Canadian awareness of the factors influencing the Canadian/Japanese trade of rapeseed and rapeseed products. Structural aspects of the Canadian and Japanese market, as well as alternative trade and transportation policies, were discussed and analyzed. A spatial equilibrium model, capable of handling the relationships between rapeseed and its products while allowing alternative solution techniques to be incorporated, was used.

A short run variant[3] of the model was developed to evaluate the impact of alternative transportation and tariff policies. The results suggested that neither the removal of the Japanese oil tariff nor the application of the Crow Rate to edible oil transport in Canada would have any effects on trade if applied independently. The simultaneous implementation of the two policies would have had a minimal positive effect on trade for Canada and the EU and a negative effect on Japan.

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[3] For the short run variant of the model the supply of raw seed product was fixed. The solution for the model was estimated by maximizing the sum of the consumer surplus plus economic rent less transportation and processing costs. (On a standard demand/supply diagram this is shown as the area under the downward sloping demand curve and to the left of the vertical supply curve.)

A long run variant[4] of the model was developed to facilitate an estimation of "optimal" trade restrictions. This process yielded an estimation of the optimal export taxes and optimal tariffs for Canada and Japan respectively. It was concluded that the current oil tariff imposed by Japan encouraged the domestic crushing industry, thereby increasing Japan's domestic welfare. To counter the market power of the Japanese an export tax on rapeseed exports from Canada was suggested. The study concluded that the resulting Canadian government revenues would more than offset Canadian producer losses.

The conclusions made by Swallow must, however, be tempered by the various limitations of the work done. Restrictive assumptions of the study include; the limited number of regions endogenous to the model, the absence of endogenous substitute products and regions, and the assumption that Japan would not retaliate or find alternative products in response to the implementation of a Canadian rapeseed export tax.

JOHNSON (1987)

The primary objective of the study done by Johnson was to empirically estimate the impact of changes to the Japanese import tariffs on vegetable oils. A single period (1984) spatial equilibrium trade model of the rapeseed and soybean commodities market was developed. The regions endogenous to the model were Canada, the U.S., the EU and

[4] The competitive equilibrium of the long run variant of the model was estimated by maximizing the sum of consumer surplus and economic rent in each of the primary demand markets less the cost of rapeseed production, transportation and processing for each region.

Japan. Consumption and stock demand functions were estimated for each region using ordinary least squares regression on data for the 1974 to 1984 period. These demand equations were then incorporated into a quadratic programming model in combination with a fixed supply, as well as transportation, processing and tariff costs. The matrix solution was obtained by maximizing a proxy of social welfare under perfect competition, total net average revenue.

Four alternative tariff scenarios were then compared to the bench-mark solution in order to evaluate their impact on prices, crushing activities and trade. The results obtained suggest that the Canadian canola crushing industry suffers economic hardship as a result of the current Japanese edible oils tariff structure. The current tariff not only inhibits Japanese canola oil imports, but places it at a disadvantage in relation to soybean oil imports. A reduction in the tariff rate on canola oil relative to soybean oil, so as to equalized the relative rate of protection provided (Carter and Mooney, 1987), would be beneficial to the Canadian processing industry. It was estimated that the equalization and removal of the tariff would result in a 3.2 and 3.7 percent increase, respectively, in annual revenue for Canadian canola crushers.

Limitations of the study include the limited number of regions and substitute products included in the study. The model estimated the short run effects of changes to the Japanese edible oils tariff.

GLANCE (1989)

In the study done by Glance a synthetic model of the world oilseeds and oilseeds products market was developed to evaluate the impacts of policy issues facing market participants. The model consisted of a large synthetic econometric model which specified production, consumption and net trade of fourteen major fats and oils, eight major protein meals and seven major oilseeds in ten regions/countries[5].

The three policy issues considered were; the removal of tariffs for vegetable oil and protein meals in major importing regions, the effects of technological change in the palm oil producing countries of Malaysia and Indonesia, and the impacts of an oilseeds tax proposed by the EU. The impacts of these individual changes were estimated through deterministic simulation experiments. The results obtained were then compared to the base period results, a simple average of 1984 to 1986 data, to determine the changes expected in world prices, consumption, production and net trade.

The first policy simulation estimated the effect of removing import tariffs for vegetable oils and protein meals entering Canada, the EU, and Japan. The conclusion made was that the removal of the tariffs would have a small positive effect in terms of export revenues to all endogenous exporting countries studied, with the exception of the

[5] The eleven regions/countries included are the United States, the EU, Japan, Canada, Brazil, Argentina, Indonesia, Malaysia, Philippines, Africa and a residual trading block to represent the Rest of the World.

Philippines. Also, resulting higher world prices would cause increased import expenditures for countries such as Japan and the EU. The suggested reason for a decline in Philippine export revenues was EU substitution effects.

Technological change occurring in Malaysian and Indonesian edible oil production has come as a result of various factors. Two of the most important considerations are the major replanting of oil palm with high yielding varieties and the introduction of the pollinating weevil. These technological advances are having a significant impact of the world oilseeds complex. However, these changes are putting negative pressure on the edible oils complex as a whole. The positive effects on the joint meal products were estimated to be more than enough to compensate for the negative impact on edible oil exports.

The third policy simulation evaluated the impact of an oilseeds tax on seeds entering the EU. The results obtained suggest that all market participants would be adversely affected, with the exception of Japan, which would experience a small gain as a result of lower world prices. Significant losses were projected for the Canadian rapeseed industry.

The primary shortcoming of the study was the lack of information provided. Other limitations of the study include; the assumption of homogeneous products despite place of origin or variety of seed, the assumption of a crushing and transportation industry that do not adjust in response to market and technological changes, the inability of the model to account for regions of demand that are expanding rapidly, and the difficulty of dealing with the model due to its size.

LANDELL MILLS COMMODITIES (1990)

The Landell Mills Commodities study addressed the impact of the reduction or elimination of the Japanese oil tariff on the western Canadian canola industry. Since the study consisted of a consultant's report, details on the approach taken to the problem are difficult to obtain. Despite being void of information of the modelling techniques used to estimate various scenarios, the study does contain a wealth of information on topics such as; the Japanese crushing industry, other Asian crushing capacity, Japan's internal marketing structure, Japan's oil industry income distribution, western Canadian canola's competitiveness in Japan, western Canadian canola's competitiveness in the U.S., Third World imports into Japan, Japanese owned crushing capacity in the U.S., the estimated impact of Japanese tariffs on western Canadian canola, issues dealing with GATT developments and U.S. attitudes towards Japan's oil tariff.

In dealing with the Japanese tariff a number of scenarios were studied. One scenario considered was the impact of increasing Japanese oil consumption, without changes to the tariff. The results obtained suggested that Japanese crushing activity would increase, meeting some of the increased demand, as would world rapeseed prices. Also, Canadian crushing volumes would decline but net crushing margins would increase due to stronger demand for oil exports, with Canadian canola oil exports to Japan increasing at the expense of sales to the U.S.

Two scenarios of change to the Japanese oil tariff were considered, that being a 50 percent reduction and a complete elimination. Under a full elimination of the tariff the study projected that Japanese crushing activity would decline, the world price for rapeseed would decline and margins and volumes for Canadian canola crushers would improve. The short term impact would be greater than the long term impact since increased exports of oil to Japan at higher prices would lead to a recovery of the Japanese crushing industry. This recovery would not, however , reach the levels obtained prior to the tariff elimination. The projected impact under a 50 percent reduction in the tariff were similar, simply of a smaller magnitude.

These improvements in conditions for the Canadian crusher were achieved, in large part, as a result of a transfer of income from producers, both in the short term and long term. Therefore, the estimations suggest that the overall impact of the tariff elimination for the Canadian canola industry as a whole would be negative. At the same time, however, the study concluded that without an improvement in conditions for the Canadian crushing industry it would not obtain financial viability (as structured prior to 1990). Recent restructuring of ownership and the development of the export market to the U.S. have improved the financial viability of the Canadian crushing industry.

Some of the limitations of the model developed include; the assumption of a fixed supply of rapeseed, the linkage of canola seed crushing activity in Canada to the expected net crushing margin from processing canola seed, the assumption that the Japanese tariff elimination will only apply to rapeseed oil, and the assumption that activities dealing with rapeseed will have absolutely no effect on soybean and soybean product prices. In general, the study provides a useful description of the Japanese industry but details on the modelling done are limited.

AGRICULTURE CANADA (1990)

The study done by Agriculture Canada investigated the potential for exports of Canadian canola and canola products to the U.S.. The primary objectives of the study were to; determine the U.S. demand for imported canola oil and meal, assess the profitability of marketing Canadian products into the U.S. market, and to determine the impact of the U.S. oil and meal tariffs and the Canadian Western Grain Transportation Act (WGTA) subsidies on industry profits.

The study developed a number of conclusions about the future of canola in the U.S.. The projection was for U.S. canola production to expand quite rapidly over the next 15 years. The rate of this expansion will, however, be very dependent on developments in U.S. farm policy relating to changes in the current wheat programs for example. Demand for canola oil and meal is expected to continue to grow and current crushing facilities available in the U.S. should be able to fulfill the bulk of this need as seed supplies become available. Also, the study concluded that the amount of canola and canola product trade flows are quite dependent on the origin of the products within Canada and their destination within the U.S.

Results of the study suggest that the elimination of border tariffs on canola and its products will increase the Canadian processing sector's average weighted returns significantly.

The impact of the removal of WGTA freight subsidies on oil and meal, combined with the assumption that the cost of seed will decline by an equal amount, resulted in an increase in crushing margins for Canadian canola processors. The actual amount of the increase will again be dependent on the location of the processor and the final U.S. market for the oil and the meal. If, however, the resulting reduction in seed costs for crushers is less than the value of the freight subsidies, the net effect will depend on whether or not the decrease in seed price is larger than the total additional freight cost on the end products.

2.3.3 Summary

In all, the various studies cited above provide a useful store of information, direction and empirical estimation of results that will be beneficial in the development of the model designed to meet the objectives of this study.

CHAPTER III

THEORETICAL DEVELOPMENT OF MODEL

3.1 Introduction

An analysis of the world oilseeds market requires an interactive system allowing for numerous trade flows of various competing products. In order for a study of this problem to be timely and understandable, however, it must develop a simplification of reality that incorporates only those factors most relevant to the concerns at hand. This chapter provides a discussion of the theoretical model required for the desired analysis.

3.2 Theoretical Model

The most simple theoretical model involving trade is autarky, or an isolation model. Under conditions of autarky, there are no trade flows. Market equilibrium levels for prices, production and consumption are determined within each country or region. Economic analysis of this scenario is relatively simple, as it requires estimation and examination of demand and supply within each country. Autarky is not realistic, however, as important trade flows exist in the world oilseeds and oilseeds products market facing the Canadian oilseeds industry.

Comparative advantage refers to the ability of a country or region to produce a good at a lower opportunity cost, measured in terms of other foregone goods, than its trading partners. This concept was first formally defined by David Ricardo early in the nineteenth century.

The introduction of trade between regions allows the regions involved to experience an improvement in general "well-being" or net social welfare. There are several alternative definitions of social welfare. One method by which net social welfare may be approximated is the summation of consumer surplus (CS) and producer surplus (PS). Consumer surplus is the value that consumers gain by being able to purchase as much as they desire at the equilibrium market price rather than having to pay the highest price they would be willing to pay for each additional unit (Houck, 1986). Producer surplus is a corresponding measure for producers, reflecting the value gained by owners of productive assets (eg., land, labor, management).

As shown in Figure 3.1, CS may be measured by area A under the demand curve (D), and to the left and above the equilibrium price (P_E). Producer surplus is equal to area B, above the supply curve (S) and to the left and below P_E. The sum of CS and PS may be calculated by subtracting the area between the supply curve and demand curve and to the left of the equilibrium point (Samuelson, 1952). Maximization of this area can be used as a proxy for the maximization of a regions net social welfare and provides a mechanism for determining an optimal solution for a trade scenario.

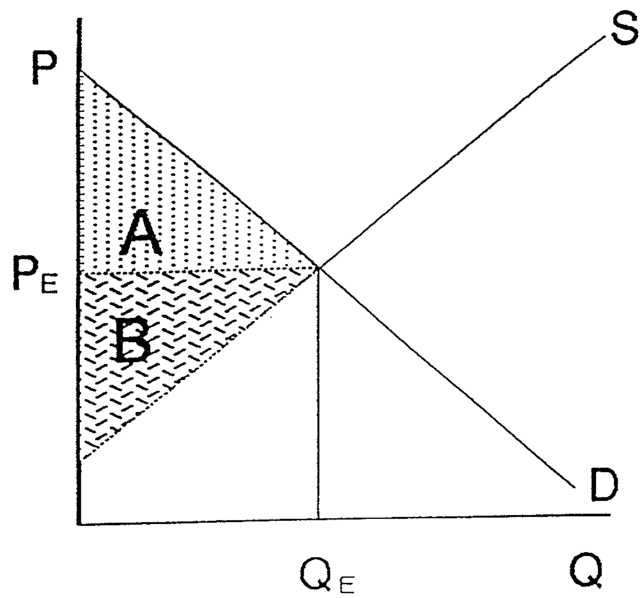

FIGURE 3.1 - Producer and Consumer Surplus

Enke (1951) provides a description of the general spatial equilibrium problem, and its equilibrium solution. The problem can have two or more regions with known supply and demand functions that produce and consume a homogeneous product. The regions in question are physically separated but the product can move between the regions at a cost (ie., transfer cost). Given this information the problem becomes one of determining the equilibrium levels of production, consumption and prices in each region with consideration being given to the equilibrium trade flows between regions. These trade flows are justified through the concept of maximization of net social welfare, and the effects on this objective of comparative advantage and the introduction of products otherwise unavailable to a region.

Samuelson (1952) provides a graphical solution for this problem with a geometric expression for the two region, one good scenario. The solution was developed with a three panel trade diagram. An example of this diagram is provided in Figure 3.2. The first panel represents demand (D_1) and supply (S_1) for an importing country (ie., country 1). The third panel represents demand (D_2) and supply (S_2) for an exporting country (ie.,country 2). In an autarkic scenario, the equilibrium quantities and prices are Q_1^A and P_1^A in country 1 and Q_2^A and P_2^A in country 2, respectively. Given the demand and supply relationships in the two countries, producers in country 2 have a comparative advantage in production. Thus, there is an incentive for trade in the good to flow from country 2 to country 1.

The middle panel of Figure 3.2 represents the excess demand (ED_1) and excess supply (ES_2) for the product in countries 1 and 2, respectively. The excess demand function is derived from the difference in quantity supplied and demanded for prices below the autarkic equilibrium solution for country 1. The excess supply function is derived from the difference in quantity supplied and demanded for prices above the autarkic equilibrium solution for country 2.

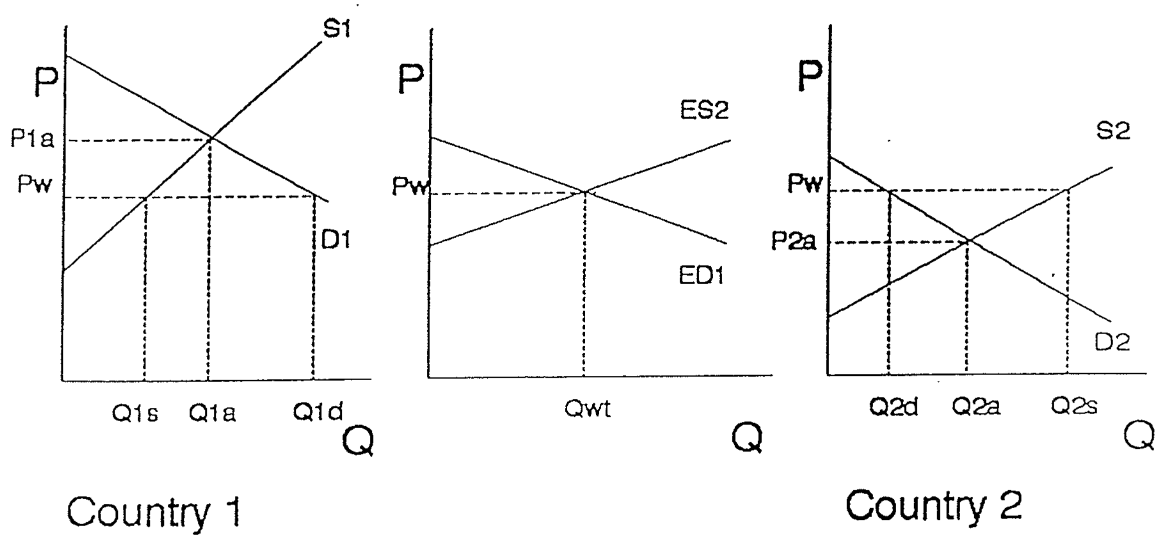

FIGURE 3.2 - Three Panel Trade Diagram

If trade is allowed between the two countries (assuming transportation costs are zero), the middle panel determines the "world" equilibrium price, and the quantity traded between the two countries. In particular, the intersection of ED_1 and ES_2 represents the equilibrium solution. The resulting price in both countries is P_w. Production and consumption in country 1 is Q_1^S and Q_1^D, respectively. Production and consumption in country 2 is Q_2^S and Q_2^D, respectively. Volume of trade between the two countries is Q_W^T, which is also equal to the difference between demand and supply in each country.

and a lower price in the importing region (country 1).

With reference to the free-trade scenario developed in Figure 3.2, the optimal trade level is reached when the area of consumer surplus plus producer surplus (as defined in Figure 3.1) is maximized for the middle panel. The area above the world price line (Pw) and below the excess demand curve (ED1) in the middle panel is the geometric equivalent to the changes in producer and consumer surplus caused by the introduction of trade to country 1 (left panel). Similarly, the area below the world price line and above the excess supply curve (ES2) in the middle panel is the geometric equivalent to the changes in producer and consumer surplus caused by the introduction of trade to country 2 (right panel). The trade market is in equilibrium when the total of the sums of changes in producer and consumer surplus in each region (Figure 3.2) is maximized.

When transportation costs, import tariffs, export subsidies, quotas, etc. are introduced the size of the area maximized is altered. For example, the introduction of a transportation cost or tariff would place a "wedge" between the price in the importing and exporting region. The result being a higher price in the importing region, a lower price in the exporting region and a reduced level of trade, as shown in Figure 3.3. The solution remains, however, in that the market (with the various restrictions and parameters) is in equilibrium when the area of consumer and producer surplus is maximized for each region, subject to the imposed conditions.

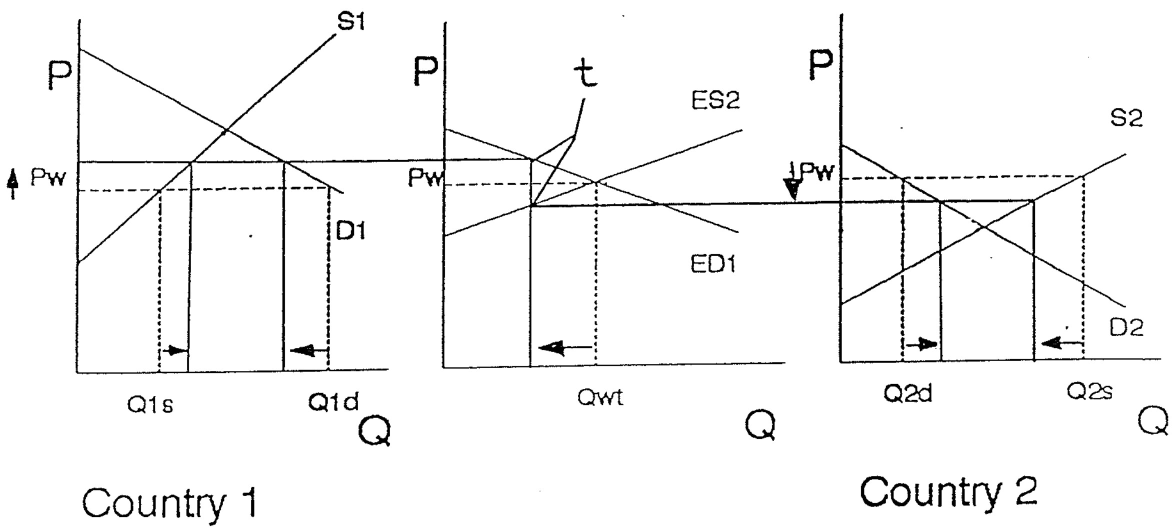

FIGURE 3.3 - Impact of a Transportation Cost or Tariff

Although widely used, the concepts of consumer and producer surplus, as depicted, have some weaknesses. Just, Hueth and Schmitz (1982) provide a useful discussion of these issues.

The capabilities of the theoretical model make this formulation well suited to the problem at hand. Johnson (1987) used this approach to model the Canadian canola industry within the world oilseeds complex. The same approach is used in this study to analyze an updated and expanded view of the world oilseeds complex, and the impacts of international trade policies on the Canadian canola industry. However, since cross-price effects in demand and supply relationships are included, maximization of consumer surplus and producer surplus are not appropriate (Martin, 1981). The actual formulation required for this study is a variation of this model; in particular, the maximization of a net average revenue function, subject to appropriate demand and supply parameters.

3.2 Mathematical Form of Model[1]

To estimate the consumer and producer surplus for each region, it is necessary to estimate each region's demand and supply functions. As a simplification of the problem, it can be assumed that the functions are linear in form (as shown in Figures 3.1 and 3.2). Based on this assumption the functions take on the following form when expressed in price domain:

$$Y_1 = a_1 + b_1 P_1 \quad (3.2.1)$$

$$Y_2 = a_2 + b_2 P_2 \quad (3.2.2)$$

$$X_1 = c_1 + d_1 P^1 \quad (3.2.3)$$

$$X_2 = c_2 + d_2 P^2 \quad (3.2.4)$$

where:

Y_i, X_i = consumption and production respectively;

a_i, c_i = intercepts of the demand and supply functions respectively; ($a_i>0$, $c_i<0$)

b_i, d_i = slope coefficients for the demand and supply functions respectively; ($b_i<0$, $d_i>0$)

P_i, P^i = demand and supply prices, respectively;

i = country 1 and country 2.

Note that a quantity formulation could be used to develop the same model.

In matrix form the demand functions may be written as:

[1] Based on Johnson (1987) - founded on the theoretical work of Martin (1981) and Takayama and Judge (1964).

$$\begin{bmatrix} Y_1 \\ Y_2 \end{bmatrix} - \begin{bmatrix} a_1 \\ a_2 \end{bmatrix} + \begin{bmatrix} b_1 & 0 \\ 0 & b_2 \end{bmatrix} \begin{bmatrix} P_1 \\ P_2 \end{bmatrix}$$

The supply functions may be written as:

$$\begin{bmatrix} X_1 \\ X_2 \end{bmatrix} - \begin{bmatrix} c_1 \\ c_2 \end{bmatrix} + \begin{bmatrix} d_1 & 0 \\ 0 & d_2 \end{bmatrix} \begin{bmatrix} P^1 \\ P^2 \end{bmatrix}$$

An estimate of the change in consumer and producer surplus (using the measure discussed earlier) in moving from a scenario of autarky to one of trade (as done graphically in Figure 3.2) can be obtained when each function is integrated over the range between autarky and post-trade. This results is a determination of the total area between the excess supply curve (ES2) and the excess demand curve (ED1) to the left of the equilibrium point in the middle panel of Figure 3.2. This quasi-welfare function for the two region model can be expressed as:

$$W(P_1, P^1, P_2, P^2) = \qquad (3.2.5)$$

$$\int_{Pw}^{P_1} (a_1 - b_1 P_1)\,\delta P_1 - \int_{Pw}^{P^1} (c_1 + d_1 P^1)\,\delta P^1 + \int_{Pw}^{P_2} (a_2 - b_2 P_2)\,\delta P_2 - \int_{Pw}^{P^2} (c_2 + d_2 P^2)\,\delta P^2$$

When these supply and demand functions are evaluated throughout their respective quantity ranges, the following indirect welfare function can be found:

$$IW(P_1, P^1, P_2, P^2) = \qquad (3.2.6)$$

$$K_1+a_1P_1-\frac{1}{2}b_1(P_1)^2-c_1P^1-\frac{1}{2}d_1(P^1)^2+K_2+a_2P_2-\frac{1}{2}b_2(P_2)^2-c_2P^2-\frac{1}{2}d_2(P^2)^2$$

where K_1 and K_2 are the constants of integration. After these constants are dropped, equation (3.2.6) can be used as the objective function to be maximized.

Since equation (3.2.6) is integrated throughout the range of prices, it is not equal to equation (3.2.5). Therefore, a constraint (price equilibrium condition) must be introduced which will ensure that an equilibrium is obtained. As discussed and shown (Figure 3.2) earlier, equilibrium is reached when the prices in the different markets are equal or differ by not more than the value of the price "wedge" between the markets. This "wedge" represents considerations such as transportation and tariff costs. If equilibrium occurs where prices differ by less than the value of the price "wedge", no trade will occur between the regions. The price equilibrium condition must have the following form:

$$-P_1 + P^2 + t_{21} \geq 0; \tag{3.2.7}$$

where t_{21} represents the price "wedge".

Given this, the problem can be expressed by the maximization of (3.2.6) subject to (3.2.7) and the condition that P_1, P^1, P_2, $P^2 > 0$.

In order to make this problem operational, the Lagrangian of the objective fuction must

be formed:

$$L(P_1, P^1, P_2, P^2, t_{21}) = \tag{3.2.8}$$

$$a_1P_1 - b_1P_1P_1 - c_1P^1 - d_1P^1P^1 + a_2P_2 - b_2P_2P_2 - c_2P^2 - d_2P^2P^2 + e'_{21}(t_{21} - P_1 + P^2);$$

where the Langrangian multiplier (e'_{21}) represents the trade flow from Country 2 to Country 1 that is associated with the price constraint (t_{21}). The Kuhn-Tucker necessary conditions that must be met, are:[2]

$$a)\quad \frac{\delta \bar{L}}{\delta P_1} = a_1 - b_1\overline{P_1} \le 0; \quad and \quad \left(\frac{\delta \bar{L}}{\delta P_1}\right)\overline{P_1} = 0$$

$$b)\quad \frac{\delta \bar{L}}{\delta P^1} = -c_1 - d_1\overline{P^1} - e_{21} \le 0 \quad and \quad \left(\frac{\delta \bar{L}}{\delta P^1}\right)\overline{P^1} = 0$$

$$c)\quad \frac{\delta \bar{L}}{\delta P_2} = a_2 - b_2\overline{P_2} + e_{21} \le 0 \quad and \quad \left(\frac{\delta \bar{L}}{\delta P_2}\right)\overline{P_2} = 0$$

$$d)\quad \frac{\delta \bar{L}}{\delta P^2} = -c_2 - d_2\overline{P^2} \le 0 \quad and \quad \left(\frac{\delta \bar{L}}{\delta P^2}\right)\overline{P^2} = 0$$

$$e)\quad \frac{\delta \bar{L}}{\delta e_{21}} = t_{21} - P_1 + P^2 \ge 0 \quad and \quad \left(\frac{\delta \bar{L}}{\delta e_{21}}\right)\overline{e_{21}} = 0.$$

As can be seen, conditions a) and c) represent optimum consumption with no excess demand since:

---

[2] Note that a bar (-) over a symbol indicates an evaluation at its optimal value.

$$c_1 - d_1\overline{P_1} = \overline{Y_1} \quad and \quad c_2 - d_2\overline{P_2} = \overline{Y_2}.$$

Conditions b) and d) represent optimum production and the possibility for excess supply conditions since:

$$a_1 + b_1\overline{P^1} = \overline{X_1} \quad and \quad a_2 + b_2\overline{P^2} = \overline{X_2}$$

Condition e) is the original spatial equilibrium condition. Thus a model has been developed for the two-region, one good scenario which satisfies trade, spatial price and optimum production and consumption conditions.

The model is:

Maximize IW(P_1, P^1, P_2, P^2, e_{21}) = (3.2.9)

$$a_1P_1 - \frac{1}{2}b_1P_1P_1 + a_2P_2 - \frac{1}{2}b_2P_2P_2 - c_1P^1 - \frac{1}{2}d_1P^1P^1 - c_2P^2 - \frac{1}{2}d_2P^2P^2$$

subject to:

$$t_{21} - P_1 + P^2 \geq 0 \qquad (3.2.10)$$

$$and \quad P_1,\ P_2,\ P^1,\ P^2,\ e_{21} \geq 0$$

3.3 Generalized Mathematical Form[1]

The model developed can now be extended to the multi-commodity, multi-region scenario required for the problem being considered in this study. Once again, the formulation developed will be in the price domain.

$$Y_i^k = a_i^k + \sum b_i^{kh} P_i^k \quad \textit{for } i = (1,2,\ldots,n) \textit{ regions} \quad k,h = (1,2,\ldots,m) \textit{ commodities} \tag{3.3.1}$$

$$X_i^k = c_i^k + \sum d_i^{kh} P^{ik} \quad \textit{for all } i \textit{ and } k. \tag{3.3.2}$$

where:

Y_i^k, X_i^k are quantities demanded and supplied, respectively of commodity k in region i.

P_i^k, P^{ik} are demand and supply prices, respectively for commodity k in region i.

a_i^k, c_{ik} are intercepts of demand and supply functions, respectively for commodity k in region i. (a > 0, c <=> 0)

b_i^{kh}, d_i^{kh} are the slope coefficients relating the quantity demanded or supplied, respectively, of commodity k to the price of commodity k in region i; b, d > 0 for h=k and b,d <=> 0 for h not equal to k.

For region i, the demand functions for all m commodities can

be written as:

---

[1] Based on Johnson (1987). Refer to Martin (1981) and Takayama and Judge (1964) for a full developemnt of the theoretical model.

$$Y_i = \begin{bmatrix} Y_i^1 \\ Y_i^2 \\ \cdot \\ \cdot \\ Y_i^m \end{bmatrix} = \begin{bmatrix} a_i^1 \\ a_i^2 \\ \cdot \\ \cdot \\ a_i^m \end{bmatrix} - \begin{bmatrix} b_i^{11} & b_i^{12} & \cdots & b_i^{1m} \\ b_i^{21} & b_i^{22} & \cdots & b_i^{2m} \\ \cdot & \cdot & \cdots & \cdot \\ \cdot & \cdot & \cdots & \cdot \\ b_i^{m1} & \cdot & \cdots & b_i^{mm} \end{bmatrix} \begin{bmatrix} P_i^1 \\ P_i^2 \\ \cdot \\ \cdot \\ P_i^m \end{bmatrix}$$

The supply functions can be written as:

$$X_i = \begin{bmatrix} X_i^1 \\ X_i^2 \\ \cdot \\ \cdot \\ X_i^m \end{bmatrix} = \begin{bmatrix} c_i^1 \\ c_i^2 \\ \cdot \\ \cdot \\ c_i^m \end{bmatrix} - \begin{bmatrix} d_i^{11} & d_i^{12} & \cdots & d_i^{1m} \\ d_i^{21} & d_i^{22} & \cdots & d_i^{2m} \\ \cdot & \cdot & \cdots & \cdot \\ \cdot & \cdot & \cdots & \cdot \\ d_i^{m1} & \cdot & \cdots & d_i^{mm} \end{bmatrix} \begin{bmatrix} P^{i1} \\ P^{i2} \\ \cdot \\ \cdot \\ P^{im} \end{bmatrix}$$

This set of demand and supply functions can then be summed up for the n regions to give:

$$Y = A + B\,P_y \qquad (3.3.3)$$

$$X = C + D\,P_x \qquad (3.3.4)$$

Note that the matrices Y, X, A, C, P_y, and P_x have dimensions of (nm * 1) and matrices B and D have dimensions (nm *nm), which contain non-zero, off-diagonal elements.

The vector for inter- regional tariff costs and trade flows that is associated with the price constraints can be defined as:

$$T'E_x = \sum\sum t_{ij}^k e_{ij}^k \qquad (3.3.5)$$

where:

t_{ij}^{k} is the tariff cost associated with transferring commodity k between the producing region i and the consuming region j.

e_{ij}^{k} is the trade flow between i and j.

Just as was done in the one commodity, two region scenario, a constraint must be imposed to ensure equilibrium. Prices must be constrained so that the price difference between the demand and supply region is not greater than the tariff and transportation costs of movement between the two regions. The condition can be expressed as:

$$t_{ij}^{k} - P_{j}^{k} + P^{ik} \geq 0 \qquad (3.3.6)$$

where:

t_{ij}^{k} is the tariff and movement cost.

P_{j}^{k} is the demand price of commodity k in region j.

P_{i}^{k} is the supply price of k in region i.

Thus the price equilibrium condition can be expressed as:

$$T - G'_{y}P_{y} - G'_{x}P_{x} => 0 \qquad (3.3.6)$$

where:

T is a ($nn^2 * 1$) vector of transfer costs.

G_y is an ($mn * nn^2$) matrix of the form:

$$\begin{bmatrix} 1 & 0 & 0 & . & . & . & 1 & 0 & 0 & . & . & . & 1 & 0 & 0 & . & . & . & 0 \\ 0 & 1 & 0 & 0 & . & . & 0 & 1 & 0 & 0 & . & . & 0 & 1 & 0 & 0 & . & . & 0 \\ . & . & 1 & . & . & . & . & . & 1 & . & . & . & . & . & 1 & . & . & . & . \\ . & . & . & . & . & . & . & . & . & . & . & . & . & . & . & . & . & . & 0 \\ 0 & . & . & . & 0 & 1 & 0 & . & . & . & 0 & 1 & 0 & . & . & . & . & 0 & 1 \end{bmatrix}$$

G_x is an ($mn * nn^2$) matrix of the form:

$$\begin{bmatrix} -1 & -1 & -1 & -1 & -1 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & . & . & . \\ 0 & 0 & 0 & 0 & 0 & 0 & -1 & -1 & -1 & -1 & -1 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & . & . & . \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & -1 & -1 & -1 & -1 & -1 & 0 & 0 & . \\ . & . & . & . & . & . & . & . & . & . & . & . & 0 & 0 & 0 & 0 & 0 & 0 & -1 & -1 & . \end{bmatrix}.$$

Thus, the quadratic programming model can be expressed as:

Maximize $NR(P_y, P_x, E_x) =$ (3.3.7)

$$(A - B\,P_y)P_y - (C - D\,P_x)P_x - T'E_x$$

subject to:

$$T - G'_yP_y - G'_xP_x => 0 \qquad (3.3.8)$$

In order to show that the model's solution will meet the trade, production and consumption optimal conditions the Lagrangian function must be specified:

$L(P_y, P_x, E_x) =$

$$AP_y - \frac{1}{2}P_yBP_y - CP_x - \frac{1}{2}P_xBP_x + E_x(T - G_yP_y - G_xP_x)$$

Note that E_x is a ($mn * 1$) vector of Lagrangian multipliers which represents the interregional trade flows associated with the price constraints:

$E_x = (e_{11}, e_{12},\ldots, e_{1n}, e_{21},\ldots, e_{2n},\ldots, e_{m1},\ldots, e_{mn}).$

The (generalized) necessary Kuhn-Tucker conditions can now be expressed as:

A)

$$\frac{\delta \overline{L}}{\delta P_y} = A - B\overline{P_y} - G_y\overline{E_x} \leq 0 \quad \text{and} \quad \left(\frac{\delta \overline{L}}{\delta P_y}\right)' \overline{P_y} = 0$$

where P_y are the optimal regional demand prices and the second portion of the condition fulfills the complimentary slackness condition.

$$1.\ \text{If}\ \overline{P_y} > 0,\ \frac{\delta \overline{L}}{\delta P_y} = 0.$$

$$\text{Therfore,}\ G_y\overline{E_x} => A\text{-}B\overline{P_y}\ \ \text{since}\ \ A\text{-}B\overline{P_y} = \overline{Y},\ G_y\overline{E_x} = \overline{Y};$$

ie., when optimum demand prices are positive there is no excess demand or excess supply.

$$2.\ \text{If}\ \overline{P_y} = 0,\ \frac{\delta \overline{L}}{\delta P_y} \leq 0.\quad \text{Therefore,}\ G_y\overline{E_x} => A\text{-}B\overline{P_y};$$

ie., when optimum demand prices equal zero there is no possibility of excess demand, however, the possibility of excess supply exists.

B)

$$\frac{\delta \overline{L}}{\delta P_x} = -(C+D\overline{P_x}) - G_x\overline{E_x} \leq 0 \quad \text{and} \quad \left(\frac{\delta \overline{L}}{\delta P_x}\right)' \overline{P_x} = 0.$$

where P_x are the optimal regional supply prices and the second portion of the condition fulfills the complementary slackness condition.

$$1.\ \textit{If}\ \overline{P}_x > 0,\ \frac{\delta \overline{L}}{\delta P_x} = 0.$$
$$\textit{Therefore}\ G_x\overline{E}_x = -(C{+}D\overline{P}_x),\ \textit{since}\ C{+}D\overline{P}_x = \overline{X},\ G_x\overline{E}_x = -\overline{X};$$

ie., when optimum supply prices are positive there is no excess supply.

$$2.\ \textit{If}\ \overline{P}_x = 0,\ \frac{\delta \overline{L}}{\delta P_x} \leq 0.$$
$$\textit{Therefore}\ G_x\overline{E}_x \leq -(C{+}D\overline{P}_x);$$

ie., when supply prices are zero there still exists the possibility of excess supply.

C)

$$\frac{\delta \overline{L}}{\delta E_x} = T - G'_y\overline{P}_y - G'_x\overline{P}_x \geq 0 \quad \textit{and} \quad \left(\frac{\delta \overline{L}}{\delta E_x}\right)' E_x = 0.$$

where E_x, at its optimal points, are the optimal trade flows and the second portion of the condition fulfills the complementary slackness condition.

$$1.\ \textit{If}\ \overline{E}_x > 0,\ \frac{\delta \overline{L}}{\delta E_x} = 0.$$
$$\textit{Therefore,}\ G'_y\overline{P}_y - G'_x\overline{P}_x = T;$$

ie., if there are positive trade flows, then the demand prices minus the supply prices equal the tariff and transportation costs between regions (this is the price condition).

$$2.\ \text{If } \overline{E_x} = 0, \frac{\delta \overline{L}}{\delta E_x} > 0.$$
$$\text{Therefore } T - G'_x\overline{P_x} > G'_y\overline{P_y};$$

ie., if the tariff and transportation costs plus the supply price is greater than the demand price, no trade flows will exist.

These are the optimal conditions for trade, prices, production and consumption.

Based on this the following net average revenue quadratic programming model can be formed:

Maximize $NR(P_y, P_x, E_x) =$ (3.3.9)

$$(A - BP_y)'P_y - (C - DP_x)'P_x - T'E_x$$

subject to:

$A - BP_y - G_yE_x \leq 0$ (3.3.10)

$C + DP_x + G_xP_x \leq 0$ (3.3.11)

$T - G_yP_y - G_xP_x \geq 0$ (3.3.12)

and $P_y, P_x, E_x \geq 0$.

CHAPTER IV

EMPIRICAL MODEL

4.1 Introduction

This study uses quadratic programming to model the subset of the world oilseeds complex that is most important to the Canadian canola industry. The model provides economically optimal prices, consumption and production levels, as well as trade flows, given the quasi-welfare function being maximized. The optimal solution is constrained by the demand and supply conditions of the endogenous regions. Other important factors, including transportation costs, crushing costs and capacities, and trade policies are also incorporated into the model.

The model focuses on the six commodities and five regions most important to the Canadian canola industry. The commodities are: rapeseed, rapeseed meal, rapeseed oil, soybeans, soybean meal and soybean oil. The five regions are: Canada, the U.S., the EU, Japan, and the Rest-of-the-World.

There are two possible forms that the quadratic programming model may take. The first is a quantity formulation, where demand and supply relationships have price as the dependent variable (ie., P=a+bQ). The second version is the price formulation, where demand and supply have quantity as the dependent variable (ie., Q=c+dP). The two formulations are entirely consistent in that , for a given problem, they provide the same optimal solution. The price formulation is utilized in this study. Given this form of the model , the activities solved for are prices (demand and supply), regional crush levels and trade flows of seed, meal and oil.

4.2 Empirical Mathematical Model

The structure of the empirical model defines the relationship between the regional demands for the oil and meal products (which determines the derived demand for oilseed) and the available regional supplies of oilseed. These demands are constrained by the various transportation, tariff, and crushing cost and capacity considerations.

The objective of the model is to maximize the net average revenue associated with the demand for oilseeds products in the world. The Langrange form of the net average revenue function incorporates the demand for: the joint products of oil and meal; the supply of inputs (ie., oilseed); the prices for inputs and products; the crushing, transportation and tariff costs; the quantities crushed; and the quantities of inputs and products consumed in each region and traded between regions. The impact of any relevant tariffs and/or subsidies are also incorporated into the objective function, where appropriate.

There are two sets of constraints for the empirical oilseed trade model. The first set of constraints are defined in terms of price relationships. These price relationships are required so that the arbitrage relationships between regional markets are maintained. For example, the demand price for any oilseed products in a particular region are constrained to be no greater than the oilseed supply price plus processing, transport and trade barrier costs. In addition, the revenue associated with oilseed crushing in any region is constrained to be no greater than the cost of crushing. Any relevant subsidies and/or tariffs are also incorporated into these constraints, as they add to the difference between equilibrium prices in different countries.

The second set of constraints are related to quantity relationships. Again, they are required to assume that the markets equate quantities supplied and demanded. For example, the quantity demanded of a product in a particular region is constrained to be no greater than the domestic production and imports less ending stocks demand. Similar constraints are modelled for supply. Also, crushing activities in any region are constrained to be no greater than crushing capacity. Finally, constraints may be added to reflect any import or export quotas that may be relevant.

The general mathematical structure of the empirical model can be presented as follows:

Maximize Net Average Revenue (NR) =

Quantity of oil sold * Price of oil

+ Quantity of meal sold * Price of meal

- Available seed supply * Price of seed

- Cost of crushing seed * Quantity of seed crushed

- Cost of transferring oil * Quantity of oil transferred

- Cost of transferring meal * Quantity of meal transferred

- Cost of transferring seed * Quantity of seed transferred or

mathematically as:

$$\text{Max NR}(P_i^k, P_i^h, P_i^l, P_i^n, Q_i^g, X_{ji}^k, X_{ji}^l, X_{ji}^g) =$$

$$(a_i^k + b_i^{kk}P_i^k + \sum b_i^{kh}P_i^h)P_i^k + (a_i^l + b_i^{ll}P_i^l + \sum b_i^{ln}P_i^n)P_{ii}^{ll})P_i^l - S_i^gP_i^g - C_i^gQ_i^g -$$

$$T_{ji}^kX_{ji}^k - T_{ji}^lX_{ji}^l - T_{ji}^gX_{ji}^g$$

Subject to:

<u>SET ONE</u>

<u>Condition 1</u>

$$P_j^k - P_i^k \leq T_{ij}^k$$

$$P_j^l - P_i^l \leq T_{ij}^l$$

$$P_j^g - P_i^g \leq T_{ij}^g$$

The price of each oilseed commodity in region j is less than or equal to the price of the commodity in region i plus cost of shipping the commodity from region i to region j (including the costs of any trade barriers).

<u>Condition 2</u>

$$r_i^kP_i^k + r_i^lP_i^l - P_i^g \leq C_i^g + T_{ji}^g$$

The marginal revenue of crushing one unit of oilseed g in region i is less than or equal to the marginal cost (which is fixed in this model) of crushing one unit on oilseed g in region i plus cost of transferring oilseed from region j to region i.

SET TWO

Condition 3

$$(a^{ik} + b_i^{kk}P_i^k + \sum b_i^{kh}P_i^h) + (g_i^k + h_i^kP_i^k) \leq \sum_i X_{ji}^k$$

The shipment of oil, from itself and other regions to region i, must satisfy the demand for an oil, including any oil stocks demand.

Condition 4

$$(a_i^l + b_i^{ll}P_i^l + \sum b_i^{ln}P_i^n) + (c_i^l + d_i^lP_i^l) \leq \sum_i X_{ji}^l$$

The shipment of meal, from itself and other regions to region i, must satisfy the demand for a protein meal, including any meal stocks demand.

Condition 5

$$Q_i^g + (e_i^g + f_i^gP_i^g) \leq \sum_i X_{ji}^g$$

The quantity of oilseed g crushed in region i plus demand for oilseed g stocks is less than or equal to quantity of inputs transferred to region i, from itself and other regions.

Condition 6

$$S_i^g \geq \sum_i X_{ji}^g + (e_i^g + f_i^gP_i^g)$$

The supply of oilseed g in region i minus demand for oilseed g stocks in region i is less than or equal to the quantity transferred to region i, from itself and other regions.

Condition 7

$$r_i^k Q_i^g \geq \sum_i X_{ij}^k + (g_i^k + h_i^k P_i^k)$$

The quantity of oil shipped from region i, to itself and to other regions, cannot exceed the product equivalent from the quantity of the oilseed crushed in region i.

Condition 8

$$r_i^l Q_i^g \geq \sum_i X_{ij}^l + (c_i^l + d_i^l P_i^l)$$

Meal shipments from region i, to itself and other regions, plus demand for meal stocks in region i cannot exceed the product equivalent from the quantity of the oilseed crushed in region i.

Condition 9

$$Q_i^g \leq K_i^g$$

Quantity of oilseed crushed in region i cannot exceed crush capacity.

Condition 10

$$P_i^k, P_i^h, P_i^l, P_i^n, P_i^g, Q_i^g, X_{ji}^l, X_{ji}^g, X_{ji}^k \geq 0$$

Where:

a_i^k, a_i^l = intercepts of the demand equation for oil and meal, respectively in region i (values are ≥ 0).

b_i^{kk}, b_i^{ll} = direct price coefficients relating the quantity of oil and meal demanded to prices of oil and meal respectively in region i (values are be ≤ 0).

b_i^{kh}, b_i^{ln} = cross price coefficients relating quantity of each oil and meal demanded to substitute oil and meal prices, respectively in region i (values can be $<=> 0$).

P_i^k, P_i^l = own prices for oil and meal, respectively in region i.

P_i^h, P_i^n = substitute oil and meal prices, respectively in region i.

c_i^l, e_i^g, g_i^k = intercepts of the demand equations for meal, seed and oil stocks, respectively in region i (values are ≥ 0).

d_i^l, f_i^g, h_i^k = direct price coefficients relating quantity of meal, seed and oil stocks demanded to prices of meal, seed and oil, respectively in region i (values are ≤ 0).

P_i^g = price of oilseed in region i.

S_i^g = available supply of oilseed in region i.

C_i^g = cost of crushing oilseed in region i.

Q_i^g = quantity of oilseed crushed in region i.

T_{ji}^k, T_{ji}^l, T_{ji}^g = cost of transferring oil, meal and oilseeds, respectively from region j to region i.

X_{ji}^k, X_{ji}^l, X_{ji}^g = quantities of oil, meal and oilseeds, respectively transferred from region j to region i.

r_i^k, r_i^l = oil and meal yields, respectively from crushing one unit of oilseed in region i.

K_i^g = crushing capacity in region i.

i, j = endogenous regions for transfers of products.

g, h, k, l, n, = the relevant oil, meal and oilseed commodities.

4.3 Estimation of Demand Functions

The model being developed for forecasting and policy analysis is adaptable to both short-run and long-run scenarios. The analysis of either a short-run and long-run scenario is dependant on the specific input data and elasticities used and constraints placed on the model. The base run scenario used for validating the model is a short-run scenario designed to simulate the 1993-94 crop year.

4.3.1 Theoretical Development of Demand Functions

In general, a demand function for any product can be expressed as a function of: its own price; the price of substitute goods; the price of complimentary goods; and other factors such as disposable income, population, trends in preferences, technology, and so on. The quadratic program developed for this study requires , however, that the demand functions for the oil and meal products be expressed as a function of only endogenous prices and a constant. The impact of any factors other than relevant endogenous prices must be predetermined and introduced through the constant term. Thus, the required demand functions for the model are of a collapsed form where:

$$\text{Demand} = \alpha_i^k + \beta_i^{kk} P_i^k + \Sigma \beta_i^{kh} P_i^h \qquad (4.3.1)$$

and i refers to the region, k refers to the commodity and h refers to complimentary and/or substitute commodities.

In order to maintain consistency in the model, all of the functions must be introduced to the programming matrix with common units of measure. For the purposes of this study the units of measure will be millions of metric tonnes and millions of Canadian dollars.

The process of developing meaningful estimations of demand functions is a difficult and time consuming task. Numerous studies, as cited earlier in the literature review in section 2.3.2, have been done to determine the elasticities of demand for rapeseed and soybean oil and meal in the various regions of the world. The information provided in previous research, listed in the literature review, form the basis for determining acceptable elasticities to be used in the model. Upon selection of an acceptable estimate of the various price and cross-price elasticities, a linear demand equation was built around the data point of price and quantity for each meal and oil in each region. These estimated functions are then incorporated into the programming matrix. It should be noted that there is a large degree of variability in the empirical estimates presented in previous studies of the world oilseeds complex.

Given an elasticity estimate and the relevant price and quantity demanded for a product, a linear estimate of the demand function can be constructed.

An own-price elasticity can be defined as:

$$E_{own} = \frac{\delta Q_{own}}{\delta P_{own}} * \frac{P_{own}}{Q_{own}}.$$

A cross-price elasticity can be defined as:

$$E_{cross} = \frac{\delta Q_{own}}{\delta P_{cross}} * \frac{P_{cross}}{Q_{own}}.$$

Given the required information, the unknown coefficients can be determined by solving for the unknown partial derivative (slope coefficient). Once the values of the coefficients have been calculated, the value of the constant term can be determined and the required function can been formulated. For example, suppose a product has an estimated own-price elasticity of -0.54 and a cross-price elasticity for a complementary good of -0.35. Given a current own-price of $350/unit, a complimentary good price of $360/unit and a demand for 300 units, the estimated linear demand function[1] can be calculated in the following way.

$$E = \delta Q/\delta P * P/Q \qquad (4.3.2)$$

$$-0.54 = ß_{own} * 350/300 \qquad (4.3.3)$$

$$-0.35 = ß_{cross} * 360/300 \qquad (4.3.4)$$

$$ß_{own} = -0.54 \div (350/300) = -0.463 \qquad (4.3.5)$$

$$ß_{cross} = -0.35 \div (360/300) = -0.292 \qquad (4.3.6)$$

$$300 = \alpha + (-0.463)*350 + (-0.292)*360 \qquad (4.3.7)$$

$$\alpha = 567.17 \qquad (4.3.8)$$

and thus, the estimated linear demand function can be expressed as:

$$Q = 567.17 - 0.463*P_{own} - 0.292*P_{comp}. \qquad (4.3.9)$$

---

[1] A demand function of the form
$Q = \alpha + ß_{own}P_{own} + ß_{cross}P_{cross}$

Given the required information for the base period (1993-94) used in this study, linear demand functions can be estimated for all of the relevant regional demands for the various oils and meals included in the quadratic programming matrix.

4.3.2 Determination of Base Period (1993-94) Demand Functions

The following acronyms are used to define the various regional commodities: Canada (C), United States (U), European Union (E), Japan (J), Rest of World (R), rapeseed oil (RO), rapeseed meal (RM), rapeseed (RS), soybean oil (SO), soybean meal (SM), soybeans (SB) and stocks (S). For example, the acronym used for Canadian rapeseed stocks is CRSS and the acronym for Japanese soybean oil is JSO.

Table 4.1 provides the data used to estimate the oil and meal demand functions endogenous to the model. The resulting constant terms and price coefficients are presented in Table 4.2. Appendix E contains the complete programming matrix used to model the 1993-94 base solution, including additional information on the definition of and sources for the data used.

Table 4.1 1993-94 Prices, Quantities Demanded and Elasticities				
Country/ Commodity	Price ($/tonne)[a]	Demand (mln tonnes)[a]	Own Elasticity[b]	Cross Elasticity[b]
CRO	810	0.51	-0.700	0.150
URO	820	0.57	-0.620	0.200
ERO	800	1.75	-0.800	0.250
JRO	950	0.77	-0.500	0.520
RRO	855	5.58	-0.850	0.200
CSO	810	0.15	-0.600	0.250
USO	815	5.88	-0.520	0.050
ESO	795	1.71	-0.750	0.250
JSO	945	0.68	-1.000	0.150
RSO	850	9.72	-0.950	0.200
CRM	190	0.43	-0.600	0.860
URM	200	1.02	-0.750	0.300
ERM	215	4.33	-0.850	0.190
JRM	230	1.33	-0.750	0.130
RRM	195	8.41	-0.750	0.400
CSM	295	1.35	-0.740	0.460
USM	290	22.73	-0.400	0.005
ESM	305	20.28	-0.350	0.220
JSM	310	3.73	-0.650	0.200
RSM	285	30.44	-0.400	0.250

[a] See Appendix E for data sources and pricing points.
[b] Own estimates based on estimated values in previous studies.

Table 4.2 Estimated Demand Function Coefficients for 1993-94

Region / Commodity	Constant Term (α)	Own Price Coeff. (β own)	Cross Price Coeff. (β cross)
CRO	0.79050	-0.000440741	0.000094444
URO	0.80940	-0.000430976	0.000139877
ERO	2.71250	-0.001750000	0.000550314
JRO	0.78400	-0.000421053	0.000440212
RRO	10.18050	-0.006133918	0.001451765
CSO	0.21600	-0.000118519	0.000049383
USO	8.70240	-0.003777178	0.000360976
ESO	2.55000	-0.001603774	0.000531250
JSO	1.23950	-0.000708995	0.000105789
RSO	17.76250	-0.011344118	0.002374269
CRM	0.31080	-0.001326316	0.001224407
URM	1.34850	-0.003487500	0.000962069
ERM	7.18780	-0.017118605	0.002697377
JRM	2.05740	-0.004141304	0.000532581
RRM	10.50300	-0.029923077	0.010919298
CSM	1.72800	-0.003386441	0.003268421
USM	31.84785	-0.031489655	0.000570750
ESM	23.19890	-0.023559016	0.021007442
JSM	5.36500	-0.007758065	0.003217391
RSM	35.98350	-0.043915789	0.040115385

Table 4.3 provides the required data to estimate the stock demand functions that are endogenous to the model. Note that stocks are estimated solely as a function of own price. Table 4.4 provides the estimated constant term and the own price coefficients for the stocks functions that are endogenous to the model. Endogenous stocks functions include: world rapeseed oil and meal stocks; U.S. and Rest-of-World soybean oil and meal stocks; Canadian, EU and Rest-of-World rapeseed stocks; and U.S. and Rest-of-World soybean stocks.

Table 4.3 1993-94 Ending Stocks, Prices and Estimated Elasticities of Stock Demand

Region / Commodity	Price ($/tonne)[a]	Ending Stocks (mln tonnes)[a]	Own Price Elasticity[b]
RROS	855	0.39	-0.75
USOS	815	0.49	-2.65
RSOS	850	0.83	-0.16
RRMS	195	0.48	-0.70
USMS	290	0.20	-0.75
RSMS	285	3.47	-0.35
CRSS	395	0.31	-3.00
ERSS	410	0.17	-0.75
RRSS	400	0.39	-0.45
USBS	320	5.69	-3.00
RSBS	325	12.15	-0.50

[a] See Appendix E for data sources and pricing points.
[b] Own estimates based on estimates available in previous studies.

Table 4.4 Coefficients for 1993-94 Estimated Stocks Demand Functions		
Region / Commodity	Constant (α)	Own Price Coefficient (β)
RROS	0.68250	-0.000342105
USOS	1.78850	-0.001593252
RSOS	0.96280	-0.000156235
RRMS	0.81600	-0.001723077
USMS	0.24500	-0.000362069
RSMS	4.76550	-0.004335088
CRSS	1.24000	-0.002354430
ERSS	0.29750	-0.000318750
RRSS	0.56550	-0.000438750
USBS	22.76000	-0.053343750
RSBS	18.2250	-0.018692308

4.4 Supply of Oilseeds for 1993-94

In the short run, the supply of oilseeds is fixed by annual production levels. Also, given that the model is not designed to incorporate the cross effects of cropping alternatives, there is little value in incorporating endogenous oilseed production functions, even for long run scenarios. Other models, which endogenously solve for the substitution between cropping alternatives are better suited for the estimation of regional oilseed production.

The available supply of an oilseed in a region is determined by production minus the regional usage of seed, food, feed, waste and dockage. In regions where significant fluctuations in stock levels occur, ending stocks demand as a function of price was estimated (as presented in Table 4.4), with beginning stock levels added to the available regional supply. Rest-of-world stock levels include total world stocks less those stock levels explicitly included in other endogenous regions.

For rapeseed, the system losses for seed, feed, waste and dockage are relatively easy to determine from the available data. However, soybeans are used not only for crushing purposes but also for whole seed production of foods for human consumption. These food-use soybeans are not available to the crushing industry and are not included in the supplies made available to the model scenarios. Given that the food-use of soybeans is relatively independent of price, with a general upward trend related to population and income, the estimation of non-crush use for soybeans is exogenous from the model.

Oilseed supplies for 1993-94, with adjustments for stocks and system losses are provided in Table 4.5.

Table 4.5 Available supplies of oilseeds for 1993-94

Country / Commodity	Available Supply (mln tonnes)	Includes Beginning Stocks
CRS	5.85	Yes
URS	0.10	No
ERS	6.00	Yes
JRS	0.00	No
RRS	13.85	Yes
CSB	1.50	No
USB	55.00	Yes
ESB	0.00	No
JSB	0.00	No
RSB	63.40	Yes

In addition to the seed supplies, stocks of the oils and meals are held in some regions of the world. Rest-of-world stocks of oil and meal are calculated as total world stocks less any regional stocks made endogenous to the model. Beginning regional stocks of oil and meal for 1993-94 are presented in Table 4.6.

Table 4.6 Beginning regional stocks of oil and meal for 1993-94	
Region / Commodity	Beginning Stocks (mln tonnes)
RROS	0.41
USOS	0.71
RSOS	1.06
RRMS	0.48
USMS	0.19
RSMS	3.49

4.5 Crushing, Transportation and Tariff Costs for 1993-94

For purposes of the model, fixed average crush, transportation and tariff cost estimates are used. These costs are a key component in the determination of the crushing levels and transportation flows of the various commodities and the determination of regional prices for each of the commodities.

4.5.1 Crushing Costs and Capacity Constraints

Specific data on regional crushing costs are very difficult to obtain. However, the studies by Landell Mills Commodities (1991) and Johnson (1987) provide useful estimates. The information contained in these studies, combined with estimations based on commodity price data and information from industry sources (including the Canadian Oilseed Processors Association, the Canola Council of Canada, the American Soybean Association and the U.S. National Oilseed Processors Association) have been used to develop the crushing cost estimates provided in Table 4.7.

In the long run, regional oilseed crushing capacities will adjust to the profitability of oilseed processing. In the short run, however, a capacity constraint can limit regional oilseed crushing activities. For example, in 1993-94 Canadian canola processors were limited by capacity constraints and likely would have processed additional quantities if facilities had been available. These short run constraints on processing activity are provided in Table 4.7.

Table 4.7 Estimated Regional Crushing Capacities and Costs for 1993-94		
Region / Commodity	Crush Capacity (mln tonnes)	Crushing Costs ($/tonne)
CRS	2.200	43.00
URS	0.500	47.00
ERS	8.000	43.00
JRS	2.200	50.00
RRS	20.000	47.00
CSB	1.100	41.00
USB	40.000	39.00
ESB	18.000	39.00
JSB	7.000	45.00
RSB	54.000	40.00

4.5.2 Estimated Seed, Oil and Meal Transportation Costs for 1993-94

Actual transportation costs fluctuate within a crop year. Since the factors involved in determining transportation costs are not endogenous to the model, however, estimated transportation rates are set by route for the period being modelled (1993-94 for the validation of the model). Truck, rail and ocean freight rates are used as required to move the various products between the pricing points specified for each region within the model.

The prices used in the model represent port locations in most cases, thereby requiring transportation costs to largely reflect ocean freight rates. An exception would be, for example, the movement by truck of rapeseed from Canada to the U.S.. In those cases where the domestic processors are expected to be able to sell the oil and meal or purchase the seed at less than the pricing point price a negative transportation charge is applied. The complete listing of all the estimated trade flow costs is provided in the model input file in Appendix E. Transportation costs associated with the various potential trade flows are based on information obtained from the International Wheat Council, Sparks Companies Incorporated, and Oils and Fats International publications. Transportation rates for routes not found in these publications are estimated.

4.5.3 Tariff Costs

As found in Appendix D, there are a number of ad valorem and fixed tariffs associated with the various oilseed commodities and regions included in the model. The mechanism for incorporating a specific tariff into the model depends on its type. Fixed tariffs can be incorporated into the model by adding them to the transportation costs (as observed in Appendix E). Ad valorem tariffs are incorporated into the price equilibrium conditions as developed by Takayama and Judge (1971) and applied by Johnson (1987) and Furtan, Nagy and Storey (1978). Tariff levels for 1993-94 are presented in Table 4.8. Note that trade barriers with the Rest-of-World region are estimated with adjustments to the transportation costs and the price conditions, as required to reflect the major regional shipments to the Rest-of-World region.

Table 4.8 Import Tariff Barriers to Trade				
Commodity	Canada	United States	European Union	Japan
RO	10% except for U.S. 0%	7.5% except for Canada 0%	10%	17 Yen/kg
SO	7.5% except for U.S. 0%	22.5% except for Canada 0%	10%	17 Yen/kg
RM	None	US$2.60/t except for Canada 0	10%	None
SM	None	US$7.00/t except for Canada 0	10%	None
RS	None	None	None	None
SB	None	None	None	None

In some cases the transportation costs were also adjusted to account for export subsidies or the timing of sales. For example, U.S. soybean oil exports were heavily subsidized by the Export Enhancement program for sales to the Rest-of-the-World. These sales, as well as some EU exports required a negative transportation cost to reflect the subsidies. In Canada the aid supported sales, as well as sales early in the crop year when edible oil prices were significantly lower, were reflected by lowering the estimated transportation costs.

4.6 The Mathematical (Quadratic) Programming Matrix

The quadratic programming matrix developed delineates a single-period spatial equilibrium scenario designed to determine the optimal prices and trade flows between all oilseed commodities endogenous to the model. The equilibrium solution for the regional demand, prices and trade flows of the individual oilseed commodities was constrained by the relevant oilseed supply, crushing costs and capacities, transportation costs and trade barriers.

The MINOS (Modular In-core Nonlinear Optimization System) solver within the GAMS (General Algebraic Modeling System) program was used to solve the linearly constrained optimization problem in this study. The quadratic programming matrix, as presented in Appendix E, is in the format required for GAMS. The GAMS/MINOS solver uses a reduced-gradient algorithm combined with a quasi-Newton algorithm.[1]

Appendix E includes the entire input file required by GAMS to solve the base scenario for 1993-94, including an explanation of the component parts of a GAMS input file, symbol definitions and a complete reference of data sources used.

The quadratic portion of the programming matrix is confined to the objective function.

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[1] See Brooke, 1988 for complete details on the GAMS program.

Note that the cross commodity elasticities of the substitute goods are averaged in the objective funtion. This is required to eliminate the problems of assymetry (Martin 1981). The individual values of the cross commodity elasticities are maintained in the linear demand function contraints.

The quadratic objective function follows the form of the indirect welfare function developed in Chapter III and as defined in equation 3.2.6, less the crushing and transportation (including tariffs) costs associated with achieving the equilibrium condition. Therefore, the price coefficients used in the objective function must be divided by two (as shown in the GAMS input file in appendix E) as defined by the integration of linear demand functions between no trade and the constrained equilibrium solution.

The maximization of the defined objective function is subject to the two sets of contraints, the equilibrium price and quantity conditions. The first 136 contraints (C1R001 to C1R136) fulfill the price equilibrium conditions as defined by condition 1 in Chapter IV section 4.2. The first 44 constraints, C1R001 to C1R044, defined the oil price conditions. The next 43 price conditions, C1R045 to C1R089, define the protein meal price conditions. The remaining constraints, C1R090 to C1R136, define the seed price conditions.

The price equilibrium conditions ensure that the commodities are traded until the commodity price differences between any two regions are less than or equal to the costs of transferring the commodity between the two regions. For example, the second price equilibrium contraint (C1R002) ensures that the EU rapeseed oil price , OIL("PDERO"), must be equal to or less than the price of Canadian rapeseed oil, OIL("PDCRO"), plus the transportation costs of about $65/tonne, TRANOIL("TCERO"), and the EU rapeseed oil tariff of 10%. After rearranging the terms, the price constraint can be expressed as the Canadian rapeseed oil price, OIL("PDCRO"), minus 90% of the EU rapeseed oil price, OIL("PDERO") is greater than or equal to the negative value of the transportation costs of moving rapeseed oil from Canada to the EU, TRANOIL("TCERO"). This constraint is presented in the GAMS input file as:

```
C1R002.. OIL("PDCRO") - 0.90*OIL("PDERO") =G= - TRANOIL("TCERO")
```

If a price equilibrium condition requires the inclusion of a fixed tariff, rather than the ad valorem tariff shown in C1R002, the cost of the tariff is simply added to the transportation cost between the two regions. For example, the equilibrium Canadian rapeseed oil price, OIL("PDCRO"), minus the Japanese rapeseed oil price, OIL("PDJRO"), must be greater than or equal to the negative value of the transportation costs of about $40/tonne plus the Japanese edible oils tariff of about $255/tonne. The GAMS input file contains this condition in the third price equilibrium condition, C1R003, as:

C1R003.. OIL("PDCRO") - OIL("PDJRO") =G= - TRANOIL("TCJRO")

The price equilibrium conditions also include a price equality condition for each region that has an endogenous stocks demand function in the model. This equality condition simply forces stocks to be valued at the same price as the commodity is priced in a region. For example, row C1R031 forces the price of soybean oil stocks in the U.S., OIL("PDUSOS"), to be equal to the price of soybean oil in the U.S., OIL("PDUSO"). This price condition is expressed in the GAMS input file as:

C1R031.. - OIL("PDUSO") + OIL("PDUSOS") =E= 0

The second price equilibrium condition ensures that the marginal revenue from crushing an oilseed in a region minus the cost of the seed is less than or equal to the cost of crushing the oilseed plus the cost of transporting the oilseed. This condition must be ensured for all potential sources of seed, both domestic and imported. These price conditons are expressed as condition two in the GAMS input file and are contained in rows C2R139 to C2R188. The revenue from crushing an oilseed is equal to the extraction rate of oil multiplied by the oil price plus the yield of protein meal multiplied by the protein meal price. Rapeseed crushing yields about 40 per cent oil, YLDOIL("PD-RO"), and 60 per cent meal, YLD("PD-RM"), while soybeans yield about 18 per cent oil, YLDOIL("PD-SO"), and 80 per cent meal, YLDMEAL("PD-SM") (with two per cent loss).

Condition C2R139 ensures that the revenues from the rapeseed oil and meal obtained from rapeseed in Canada are less than or equal to the costs of crushing the rapeseed in Canada plus the cost of sourcing rapeseed in Canada. This constraint is expressed in the GAMS input file as:

```
C2R139.. YLDOIL("PDCRO")*OIL("PDCRO") +
YLDMEAL("PDCRM")*MEAL("PDCRM") - SEED("PDCRS") =L=
(CC("QCRS") + TRANSEED("TCCRS"))
```

This equilibrium condition must also hold for the potential imports of an oilseed from a different region. For example, Canadian rapeseed crushing revenues minus the price of rapeseed in the EU must be less than or equal to the cost of crushing rapeseed in Canada plus the cost of transporting rapeseed from the EU to Canada. This condition is expressed in the GAMS input file as:

```
C2R159.. YLDOIL("PDCRO")*OIL("PDCRO") +
YLDMEAL("PDCRM")*MEAL("PDCRM") - SEED("PDERS") =L=
(CC("QCRS") + TRANSEED("TECRS"))
```

The second set of constraints on the objective function being maximized ensure that the quantity conditions are met. The third condition, as expressed in the GAMS input file in rows C3R190 to C3R202, ensure that the oil supplied to a region is greater than or equal to the demand for the oil in the region. Stocks demand conditions are also included. The condition that the demand for rapeseed oil in Canada is less than or equal to the rapeseed oil supplied to Canada, FLOWOIL("T-CRO"), is expressed, after some algebraic manipulation, in the GAMS input file as:

C3R190.. SUM(A, DCRO(A)*OIL(A)) - FLOWOIL("TCCRO") - FLOWOIL("TUCRO") - FLOWOIL("TECRO") - FLOWOIL("TJCRO") - FLOWOIL("TRCRO") =L= - OILCONS("PDCRO")

Note that the notation SUM(A, DCRO(A)*OIL(A)) in C3R190 is a simplified notation for DCRO("PDCRO")*OIL("PDCRO") + DCRO("PDCSO")*OIL("PDCSO"). Algebraic manipulation was used to move the constant term of the linear demand function to the right-hand-side of the equation, with the oil supplied component of the equation moved to the left-hand-side of the equation.

The fourth condition ensures that the the demand for a protein meal in a region is less than or equal to the amount of the particular protein meal supplied to the region. These constaints, as expressed in the GAMS input file in rows C4R204 to C4R216, follow the same format and have the same interpretation as used in condition 3 for the oils. Again, constraints are also included for the relevant protein meal stocks equations.

The fifth condition ensures that the quantity of an oilseed crushed in a region does not exceed the quantity of that oilseed supplied to the region. These constraints are incorporated into the GAMS input file in rows C5R218 to C5R227A. For example, the quantity of rapeseed crushed in Canada, CRUSH("QCRS"), is less than or equal to the domestic and imported rapeseed supplied to Canada. This constraint is expressed in the GAMS input file as:

```
C5R218.. CRUSH("QCRS") - FLOWSEED("TCCRS") - FLOWSEED("TUCRS") -
    FLOWSEED("TECRS") - FLOWSEED("TJCRS") - FLOWSEED("TRCRS")
    =L= 0
```

The oilseed stocks demand constraints are also included in condition five, using the same format used for stocks demand constraints in conditions three and four.

The sixth condition ensures that the demand (ie, outflows) for an oilseed from a region, including any demand for stocks, is less than or equal to the available supply (production plus beginning stocks) of the oilseed in that region. These supply constraints are expressed in the GAMS input file in rows C6R229 to C6R238. For example, the outflow of rapeseed from Canada is less than or equal to the available supply of rapeseed in Canda, SUPPLY("PDCRS"). This constraint is expressed in the GAMS input file as:

```
C6R229.. FLOWSEED("TCCRS") + FLOWSEED("TCCRSS") +
    FLOWSEED("TCURS") + FLOWSEED("TCERS") + FLOWSEED("TCCJS") +
    FLOWSEED("TCRRS") =L= SUPPLY("PDCRS")
```

Note that Canada rapeseed demand includes a demand for stocks of rapeseed.

The seventh condition specifies that the outflows of an oil from a region must be less than or equal to the quantity of that oil produced, oil yield multiplied by quantity crushed of the oilseed, in a region. Where relevant, beginning and ending stocks considerations for the oil are also included in the constraint. These constraints are expressed in rows C7R240 to C7R249 of the GAMS input file. For example, the constraint that the production of rapeseed oil in Canada minus the outflow of rapeseed oil from Canada is greater or equal to zero is expressed in the GAMS input file as:

```
C7R240.. YLDOIL("PDCRO")*CRUSH("QCRS") - FLOWOIL("TCCRO") -
        FLOWOIL("TCURO") - FLOWOIL("TCERO") - FLOWOIL("TCJRO") -
        FLOWOIL("TCRRO") =G= 0
```

Condition eight, as expressed in the GAMS input file in rows C8R251 to C8R260, ensures that the outflow of a protein meal from a region is less than or equal to the production of a protein meal in a region. The same format as in condition seven is used.

The nineth condition is relevant to the short-run scenario, for 1993-94, developed for the validation of the model. This condition constrains the regional quantities processed for an oilseed to be less than or equal to the maximum capacity of crush for the region. These constraints are expressed in rows C9R262 to C9R271. For example, constraining Canadian rapeseed crush activity to be less than or equal to Canadian rapeseed crush capacity is expressed in the GAMS input file as:

```
C9R262.. CRUSH("QCRS") =L= CAPACITY("QCRS")
```

The tenth, and final, condition placed on the maximization of the objective function simply ensures that all variables being solved for (ie, all prices and quantities) and positive numbers. This constraint is expressed in the GAMS input file as a declaration that the endogenous OIL, MEAL, SEED, CRUSH, FLOWOIL, FLOWMEAL and FLOWSEED variables to be solved for must be positive.

In summary, the above presentation (as fully expressed in Appendix E) of a net average revenue function subject to the necessary and sufficient equilibrium conditions provides the needed structure for GAMS to determine an equilibrium solution similar to that observed in the world oilseeds complex for rapeseed and soybeans in 1993-94. The results of the simulation for 1993-94, as well as the results of a number of alternative scenarios, are detailed in the next chapter.

CHAPTER V

EMPIRICAL RESULTS

5.1 Introduction

The quadratic programming matrix was designed to facilitate forecasting and policy analysis of the world oilseeds complex. The model was validated using data from 1993-94 crop year. Prices, quantities supplied and demanded, transportation and crushing costs and the relevant trade barriers were incorporated into the programming matrix (as presented in Appendix E). The performance of the model was validated by comparing the estimated results produced by the model against the available data for the 1993-94 crop year. Sources for available data are provided in Appendix E. Differences between the historical observations for 1993-94 and the model results are due to factors such as the problems associated with using annual data, inaccurate cost data, the potential inaccuracy of the demand elasticity estimates used and the fact that the objective function is only a simple proxy of the utility function facing the world oilseeds market. Note that the objective function is desinged to maximize the utility of the world oilseeds complex, not the Canadian canola industry.

Following the validation of the model, three scenarios of change were imposed on the base scenario to gain insight into the implications of some of the constraints facing the Canadian canola industry. The three scenarios of change imposed on the base solution were:

1) an elimination of the Canadian canola crush capacity constraint,
2) an elimination of the Japanese edible oils tariffs, and
3) the combination of scenario 1) and 2).

5.2 Base Results and Model Validation

The actual data, empirical estimates from the model and the differences between the two are presented in Tables 5.1 to 5.9. Although no rigorous statistical methods are used (or available) to test the performance of the model, a comparison of the model results and actual data suggests that the model is capable of simulating the 1993-94 crop year relatively well. In general the price, crushing and regional demand estimates are close to the actual results. In some cases, the simulated regional trade flows were not indicative of 1993-94 results.

World edible oil prices were extremely volatile in 1993-94. Prices increased over $200 per tonne (/t) between the beginning and end of the crop year. This rapid price movement was the result of a sharp decline in available world edible oil supplies and strong growth in world demand as the global economy began to recover in 1993-94. Contributing to the decline in world edible oil supplies were below average yields for Malaysian palm oil production (a factor that is exogenous to the model) and below average oil content for U.S. soybeans. The surge in world oil demand was led by a sharp increase in Chinese edible oil demand.

Table 5.1 shows that eight out of the 10 regional oil price estimates were within five per cent of the actual values observed in 1993-94, with the remaining two estimates within 10 per cent. The most significant differences between the model results and actual data were low edible oil price estimates for Japan rapeseed oil and EU soybean oil (PDJRO and PDESO). Price estimates for the edible oils in Canada were very close to the actual values.

Table 5.1 Edible Oil Prices for 1993-94: Base Results

Region / Commodity	Estimated Value ($/t)	Actual Value ($/t)	Difference ($/t)	Per Cent Difference
PDCRO	815.16	810.00	5.16	0.6%
PDURO	826.16	820.00	6.16	0.8%
PDERO	771.67	800.00	-28.33	-3.5%
PDJRO	890.63	950.00	-59.37	-6.2%
PDRRO	861.00	855.00	6.00	0.7%
PDCSO	812.05	810.00	2.05	0.3%
PDUSO	837.05	815.00	22.05	2.7%
PDESO	729.85	795.00	-65.15	-8.2%
PDJSO	917.65	945.00	-27.35	-2.9%
PDRSO	829.04	850.00	-20.96	-2.5%

The model estimates for protein meal prices were quite close to the actual values for 1993-94, as presented in Table 5.2. Overall, price estimates were within six per cent of actual values. The model did tend to over-estimate protein meal prices in the EU.

Table 5.2 Protein Meal Prices for 1993-94: Base Results				
Region / Commodity	Estimated Value ($/t)	Actual Value ($/t)	Difference ($/t)	Per Cent Difference
PDCRM	183.22	190.00	-6.78	-3.6%
PDURM	198.22	200.00	-1.78	-0.9%
PDERM	226.52	215.00	11.52	5.4%
PDJRM	218.22	230.00	-11.78	-5.1%
PDRRM	194.01	195.00	-0.99	-0.5%
PDCSM	301.19	295.00	6.19	2.1%
PDUSM	292.94	290.00	2.94	1.0%
PDESM	318.25	305.00	13.29	4.4%
PDJSM	307.28	310.00	-2.72	-0.9%
PDRSM	282.28	285.00	-2.72	-1.0%

In general, the oilseed prices generated by the model were above those observed in 1993-94. This is consistent with market information which suggests that oilseed processing was very profitable in 1993-94. The model prices imply that processors paid less for oilseeds than what was required to cover the assumed processing costs. The EU rapeseed price (PDERS) estimate was slightly below the actual price due to the lower than expected rapeseed oil price (PDERO), as shown earlier in Table 5.1.

Table 5.3 Oilseed Prices for 1993-94: Base Results				
Region / Commodity	Estimated Value ($/t)	Actual Value ($/t)	Difference ($/t)	Per Cent Difference
PDCRS	410.22	395.00	15.22	3.9%
PDURS	414.79	410.00	4.79	1.2%
PDERS	408.89	410.00	-1.11	-0.2%
PDJRS	445.54	430.00	15.54	3.6%
PDRRS	408.89	400.00	8.89	2.2%
PDCSB	351.74	315.00	36.74	11.7%
PDUSB	341.82	320.00	21.82	6.8%
PDESB	352.08	345.00	7.08	2.1%
PDJSB	357.68	350.00	7.68	2.2%
PDRSB	334.03	325.00	9.03	2.8%

The regional oilseed demand (regional crush levels) estimates were within four per cent of actual 1993-94 crush levels for both rapeseed and soybean processing in each of the five endogenous regions. Canadian and U.S. rapeseed crushing (QCRS and QURS) was constrained by the limited processing capacity available in 1993-94.

Table 5.4 Regional Oilseed Crushing for 1993-94: Base Results				
Region / Commodity	Estimated Value (mln tonne)	Actual Value (mln tonne)	Difference (mln tonne)	Per Cent Difference
QCRS	2.20	2.20	0.00	0.0%
QURS	0.35	0.35	0.00	0.0%
QERS	5.91	5.81	0.10	1.7%
QJRS	1.96	1.91	0.05	2.6%
QRRS	14.14	14.36	-0.22	-1.5%
QCSB	1.05	1.05	0.00	0.0%
QUSB	34.03	34.62	-0.59	-1.7%
QESB	12.43	12.12	0.31	2.6%
QJSB	3.73	3.67	0.06	1.6%
QRSB	49.86	48.26	1.60	3.3%

In general, regional oil trade flows (as presented in Table 5.5) were simulated relatively well, with some discrepancies observed for minor trade flows of oil, especially in dealing with the Rest-of-the-World region of the model. The problem with the endogenous variables for this region were that they included numerous countries with significant differences in market conditions and prices. Some of the countries were net exporters of edible oil with low domestic edible oil prices while as a whole the defined Rest-of -World region was a net importer of rapeseed and soybean oil. For alternative edible oils exogenous to the model, such as palm oil, the Rest-of-the-World was a net exporter in 1993-94.

The oil prices used to generate the demand functions for the model represent those regions of the world (within the Rest-of-the-World) that are net exporters of vegetable oils. Therefore, in order to allow oil shipments from the four regions to the Rest-of-the-World, the transportation costs (including factors such as the export subsidies available for U.S. soybean oil exports) were heavily discounted to counter the price premium available in the oil deficient regions of the Rest-of-the-World. U.S. soybean oil shipments to the Rest-of-the-World were constrained by the quantity limits on the Export Enhancement Program subsidy. The actual transportation costs used, including adjustments, are provided in the input file of the base scenario, as presented in Appendix E.

Table 5.5 Regional Oil Trade Flows for 1993-94: Base Results				
Region / Commodity	Estimated Value (mln tonne)	Actual Value (mln tonne)	Difference (mln tonne)	Per Cent Difference
TCCRO	0.51	0.51	0.00	0.0%
TCURO	0.41	0.35	0.06	17.1%
TCRRO	0.00	0.06	-0.06	-100.0%
TUURO	0.15	0.15	0.00	0.0%
TEURO	0.02	0.07	-0.05	-71.4%
TEERO	1.76	1.75	0.01	0.6%
TERRO	0.64	0.56	0.08	14.3%
TJJRO	0.81	0.80	0.01	1.3%
TRRRO	5.47	5.55	-0.08	1.4%
TRRROS	0.39	0.39	0.00	0.0%
TCCSO	0.16	0.16	0.00	0.0%
TCUSO	0.03	0.03	0.00	0.0%
TUUSO	5.81	5.89	-0.08	1.4%
TUUSOS	0.46	0.49	-0.03	-6.1%
TURSO	0.64	0.64	0.00	0.0%
TEESO	1.79	1.70	0.09	5.3%
TERSO	0.56	0.59	-0.03	5.1%
TJJSO	0.68	0.67	0.01	1.5%
TRRSO	9.20	8.92	0.28	3.1%
TRRSOS	0.83	0.83	0.00	0.0%

As observed in the results for oil trade flows, meal trade flow estimates were relatively good, with trade flows to the Rest-of-the-World causing the most significant discrepancies (Table 5.6). The largest error in the estimated results was that U.S. soybean meal shipments were shown to go directly to the EU (TUESM) rather than U.S. shipments to the Rest-of-the-World, with the Rest-of-the-World exporting to the EU. This problem was, again, the result of the difficulty of modelling the diversity contained within the Rest-of-the-World region.

Table 5.6 Regional Protein Meal Trade Flows for 1993-94: Base Results

Region / Commodity	Estimated Value (mln tonne)	Actual Value (mln tonne)	Difference (mln tonne)	Per Cent Difference
TCCRM	0.44	0.42	0.02	4.8%
TCURM	0.73	0.72	0.01	1.4%
TCJRM	0.14	0.12	0.02	14.3%
TCRRM	0.01	0.09	-0.08	-88.9%
TUURM	0.21	0.21	0.00	0.0%
TEERM	3.46	3.40	0.06	1.8%
TJJRM	1.18	1.15	0.03	2.6%
TRERM	0.71	0.93	-0.22	-23.7%
TRRRM	7.77	7.69	0.08	1.0%
TRRRMS	0.48	0.48	0.00	0.0%
TCCSM	0.84	0.84	0.00	0.0%
TUCSM	0.47	0.51	-0.04	-7.8%
TUUSM	22.74	22.83	-0.09	-0.4%
TUUSMS	0.14	0.14	0.00	0.0%
TUESM	3.97	0.80	3.17	396.3%
TURSM	0.00	3.51	-3.51	-100.0%
TEESM	9.98	9.74	0.24	2.5%
TJJSM	2.95	2.90	0.05	1.7%
TRESM	6.51	9.99	-3.48	-34.8%
TRJSM	0.73	0.80	-0.07	8.8%
TRRSM	31.37	27.78	3.59	12.9%
TRRSMS	4.77	3.51	1.26	35.9%

Despite the discrepancies in some of the regional oil trade flows, the overall regional consumption levels were all within five per cent of actual 1993-94 levels. The estimated EU soybean oil consumption had the largest error (five per cent). The lower estimated prices result in consumption being above the observed EU consumption in 1993-94.

Table 5.7 Regional Oil Consumption for 1993-94: Base Results

Region / Commodity	Estimated Value (mln tonne)	Actual Value (mln tonne)	Difference (mln tonne)	Per Cent Difference
CRO	0.51	0.51	0.00	0.0%
URO	0.58	0.57	0.01	1.8%
ERO	1.76	1.75	0.01	0.6%
JRO	0.81	0.80	0.01	1.3%
RRO	6.11	6.17	-0.06	-1.0%
CSO	0.16	0.16	0.00	0.0%
USO	5.84	5.92	-0.08	-1.4%
ESO	1.79	1.70	0.09	5.0%
JSO	0.68	0.67	0.01	0.1%
RSO	10.40	10.15	0.25	2.5%

The estimated regional protein meal consumption levels also were all within five per cent of the observed levels for 1993-94.

Table 5.8 Regional Protein Meal Consumption in 1993-94: Base Results				
Region / Commodity	Estimated Value (mln tonne)	Actual Value (mln tonne)	Difference (mln tonne)	Per Cent Difference
CRM	0.44	0.42	0.02	4.8%
URM	0.94	0.93	0.01	1.1%
ERM	4.17	4.33	-0.16	-3.7%
JRM	1.32	1.27	0.05	3.9%
RRM	7.78	7.78	0.00	0.0%
CSM	1.31	1.35	-0.04	3.0%
USM	22.74	22.83	-0.09	-0.4%
ESM	20.46	20.53	-0.07	-0.3%
JSM	3.68	3.70	-0.02	-0.5%
RSM	31.37	31.29	0.08	0.3%

Despite being relatively accurate on estimating regional crush levels, the model had some difficulty in simulating some of the regional trade flows for oilseeds, as shown in Table 5.9. For example, in early 1993-94 the EU exported a significant quantity of rapeseed to Japan (TEJRS), since Canadian canola was not available due to very tight available supplies. Then later in the crop year, Canada resumed its position as the dominant supplier of rapeseed to Japan (TCJRS) and actually exported rapeseed to the EU (TCERS) to back-fill for the early season shipments to Japan. The net effect, however, simply was a timing issue of Japan sourcing EU rapeseed and then Canada back-filling into the EU later in the season. The errors in the trade flows for soybeans were the result of the U.S. shipping more soybeans to the Rest-of-the-World, and the Rest-of-the-World correspondingly shipping more soybeans to the EU, rather than the U.S. shipping directly to the EU. Again the regional trade flows involving the Rest-of-the-World were manipulated by adjusting the endogenous transportation costs (as presented in the model's input file in Appendix E) to reflect the diversity of prices and market conditions within the Rest-of-the-World region.

5.2.1 Summary of Baseline Results

Canadian canola crushers were unable to take advantage of strong world demand and attractive crushing returns due to a limited processing capacity in 1993-94. Limited oilseed supplies, and in turn edible oil supplies, in the U.S. contributed to strong edible oil prices around the world. Limited domestic oilseed supplies, strong domestic protein meal demand and attractive crushing margins (largely due to the very strong world edible oil prices) allowed the EU to be a large importer of oilseeds, including Canadian canola in 1993-94. Protected by the Japanese edible oils tariff, Japan maintained its position as a major importer of Canadian canola. Rest-of-world demand for oilseeds and oilseed products outpaced supply despite the strength in edible oil prices.

Table 5.9 Regional Oilseed Trade Flows for 1993-94: Base Results

Region / Commodity	Estimated Value (mln tonne)	Actual Value (mln tonne)	Difference (mln tonne)	Per Cent Difference
TCCRS	2.20	2.20	0.00	0.0%
TCCRSS	0.27	0.31	-0.04	12.9%
TCURS	0.25	0.25	0.00	0.0%
TCERS	0.20	0.94	-0.74	-78.7%
TCJRS	1.96	1.60	0.36	22.5%
TCRRS	0.41	0.56	-0.15	-26.8%
TUURS	0.10	0.10	0.00	0.0%
TEERS	5.70	5.25	0.45	8.6%
TEERSS	0.17	0.17	0.00	0.0%
TEJRS	0.00	0.31	-0.31	-100.0%
TERRS	0.00	0.07	-0.07	-100.0%
TRRRS	13.73	13.73	0.00	0.0%
TRRRSS	0.39	0.39	0.00	0.0%
TCCSB	1.05	1.05	0.00	0.0%
TCUSB	0.45	0.45	0.00	0.0%
TUUSB	33.58	34.22	-0.64	-1.9%
TUUSBS	4.53	5.69	-1.16	-20.4%
TUESB	0.00	6.00	-6.00	-100.0%
TUJSB	3.73	3.10	0.63	-20.3%
TURSB	14.45	7.27	7.18	98.8%
TRESB	12.43	6.12	6.31	103.1%
TRJSB	0.00	0.57	-0.57	-100.0%
TRRSB	35.42	40.99	-5.57	-13.6%
TRRSBS	11.98	12.12	-0.14	-1.2

5.3 Scenario One: Elimination of Canadian Canola Crush Capacity Constraint

During 1993-94 Canadian canola processors operated at full capacity. Crushing margins were profitable and processors were unable to keep up with the demand for canola products. Canadian processors have expanded plant capacities in 1994-95, with plans for additional crush facilities to be built and in operation by 1995-96.

As a means of helping to determine the optimal crush capacity for Canada, a scenario was run with the restriction on Canadian canola crush capacity relaxed. Under this scenario, the model suggests that Canadian processors would have been able to process and sell 4.27 million tonnes of canola products in 1993-94, almost double the actual Canadian canola crush observed. Net Canadian canola oil, meal and seed export revenues (using regional prices less the costs of moving the commodity to the market) generated by the Canadian canola industry would have been $1.785 billion, up $193 million from the base scenario due to increased value-added processing.

In order for Canadian processors to reach this level of domestic processing, exports of Canadian canola seed were reduced significantly, with shipments to the EU and Rest-of-World disappearing and shipments to Japan sharply reduced. Japan's requirements for rapeseed were maintained due to the protection provided by the Japanese edible oils tariff, with the limited availability of Canadian canola being replaced with EU rapeseed. EU rapeseed processing was reduced as a result of the increase in rapeseed exports to Japan.

The regional oil and meal consumption levels were relatively unchanged despite the large shift in rapeseed crush activity. The increased availability of canola oil in Canada allowed Canada to move a significant quantity of oil into the Rest-of-the-World, displacing the reduced availability of rapeseed oil from the EU. The additional availability of canola meal in Canada also facilitated a sharp increase in exports to the Rest-of-the-World, with the decline in EU rapeseed meal supplies being fulfilled with imported rapeseed meal (and a limited increase in soybean meal imports) from the Rest-of-the-World.

The overall impact on regional oilseed commodity prices from the elimination of the crush capacity constraint on Canada was estimated to be slightly negative. With the improved efficiencies rapeseed commodity prices were marginally lower (less than one per cent change from the base results), with virtually no impact on the much larger world soybean complex.

For complete details on the estimated implications of the elimination of the Canadian canola crush capacity constraint refer to Tables F.1.1 to F.1.9 in Appendix F.

5.3.1 Summary of Scenario One Results

Given the elimination of the capacity constraint on Canadian canola processors, Canada would have processes roughly double the 2.2 million tonnes crushed in 1993-94, at the expense of canola exports to the EU and the Rest-of-the-world. The additional products produced in Canada would have mostly been exported. This change would have had little impact on the U.S. oilseeds industry. Japan would have continued to process similar amounts of oilseeds, with Canadian canola imports replaced with EU rapeseed. As a result, EU rapeseed processing would have been reduced. Overall, regional demand was not significantly impacted by the relaxation of the Canadian canola processing capacity constraint, with prices marginally lower.

5.4 Scenario Two: Elimination of Japanese Edible Oils Tariff

Canadian and world oilseed processors have long been lobbying for the elimination of the Japanese edible oils tariff. Under the current GATT agreement the tariff is scheduled to be reduced by 36 per cent over the six years ending in 2000-01. However, for purposes of this study a scenario of complete elimination of the tariff under the conditions observed in 1993-94 was considered, as is currently being lobbied for by processors outside of Japan.

The restrictions of the Japanese edible oils tariff are included in the base model as an addition to the transportation costs of moving edible oils into Japan. To simulate the elimination of this tariff, transportation costs to Japan from other regions of the world were reduced by $255 per tonne (roughly equivalent to the 17,000 yen per tonne tariff on crude soybean and rapeseed oil). Japanese crushing costs were also reduced to reflect the anticipated elimination of the inefficient facilities, with any potential remaining crush facilities in Japan operating at crushing costs similar to those used for other regions of the world. Japanese rapeseed processing costs were reduced to $45 per tonne and soybean processing costs were reduced to $42 per tonne. Refer to the GAMS input file in Appendix E for the base scenario regional processing costs.

As expected, the elimination of the tariff resulted in a sharp reduction in Japanese edible oil prices. Without the tariff, imported edible oils into Japan would be available at prices below the estimated Japanese edible oils prices presented in the base scenario.

Under the simulated change, the model suggests that Japan would stop processing oilseeds, with the increased processing activity largely concentrated in the EU. Canadian canola processing capacity was unable to take advantage of the imposed change due to the limited crush capacity.

Canadian canola oil shipments to the Rest-of-the-World increased at the expense of exports to the U.S., with EU rapeseed oil exports to Japan replacing the loss of domestic supplies. Japanese soybean oil supplies were replaced with imports of soybean oil from the Rest-of-the-World, with EU soybean oil exports back-filling into the Rest-of-the-World.

Japan's rapeseed meal requirements were largely replaced with imported rapeseed meal from the Rest-of-the-World, with the EU becoming a net exporter of (was a net importer in the base scenario) rapeseed meal to the Rest-of-the-World. Japan's domestic soybean meal supplies were replaced with imported soybean meal from the Rest-of-the-World. The EU soybean meal import requirements were reduced as a result of the sharp increase in EU soybean crushing.

In terms of oilseed trade flows, as a result of the elimination of oilseed demand in Japan, Canadian canola exports to the EU and Rest-of-the-World were sharply higher. U.S. soybean exports to Japan were shifted into the Rest-of-the-World, with the increase in EU soybean crushing facilitated by increased soybean imports from the Rest-of-the-World.

Complete results of the estimated impact of the elimination of the Japanese edible oils tariff under 1993-94 conditions are presented in Tables F.2.1 to F.2.9 of Appendix F.

5.4.1 Summary of Scenario Two Results

Given the elimination of the Japanese edible oils tariff, Japanese oilseed processors were projected to have been forced out of business by imported oilseed products under 1993-94 conditions. Despite the removal of the Japanese trade barrier Canadian canola products did not enter the Japanese market since other products were more competitive. Canadian canola exports to the EU and Rest-of-world replaced the lost exports to Japan. The EU, given its excess capacity in 1993-94, was estimated to have been able to take advantage of the market opportunity to produce more protein meals domestically, with exports of edible oil displacing Japanese domestic edible oil production. Increased oilseed processing in the Rest-of-world region produced additional protein meal supplies, which were able to displace Japanese domestic protein meal production. Overall, regional demand was relatively unchanged, with regional oilseed commodity prices slightly lower (significantly lower for Japanese edible oils) as a result of increased efficiencies.

5.5 Scenario Three: Combination of Scenario One and Two

Scenario three explored the potential implications of eliminating the Japanese edible oils tariff and the Canadian canola processing capacity constraint so as to allow Canadian processors to potentially expand sales of oil and meal to the Japanese market. This scenario probed the potential importance for the Canadian canola industry of the combined implications of added crush capacity in Canada and the elimination of the Japanese edible oils tariff. Complete details of the implications on prices, processing activities and trade flows from these hypothetical changes to the 1993-94 conditions are provided in Tables F.3.1 to F.3.9 of Appendix F.

Given this scenario of change to the 1993-94 conditions, supplies from Canadian canola processors and European soybean processors would have largely displaced Japanese oilseed processing. This suggests that under the economic conditions observed in 1993-94 there were economic incentives for Japan to import oil and meal rather than process oilseeds domestically. Although it is not likely that Japan would completely stop processing oilseeds, the model does support the hypothesis that a large portion of the Japanese processing industry's viability is questionable without the protection provided by the Japanese edible oils tariff. Certainly the portion of the Japanese processing industry that is most efficient would likely be maintained despite the elimination of the protective barriers it currently operates under. However, the model does suggest that Canadian processors would be a significant benefactor from the elimination of the Canadian capacity constraint and the Japanese edible oils tariff.

Conventional wisdom and industry beliefs suggest that the Vancouver price for canola is supported by the Japanese purchases (which are supported by the Japanese edible oils tariff). However, with the imposed changes the Vancouver price of canola dropped by less than $6 per tonne. Canadian producer prices would not necessarily drop by the full $6 per tonne since the costs of moving product to the domestic processors is less than the cost of moving canola to port locations and some efficiencies would be gained from increased canola product movement. Through competition, the basis between port and farm prices would be expected to narrow, thereby minimizing the potential for a negative impact on producer returns from canola production in Canada.

Given that the price decline in Japanese rapeseed oil prices was limited by the constraint on Canadian canola processing capacity in scenario two, the elimination of this constraint is shown to allow additional efficiencies in scenario three. The Japanese rapeseed oil price was able to decline an additional one per cent in scenario three due to the increase in Canadian canola processing, which was relatively more attractive to the maximization of world net average revenues compared to scenario two where the EU and Rest-of-World rapeseed processing replaced the less attractive Japanese processing.

Canadian agriculture (as a coalition of the major players in the industry and Agriculture and Agri-food Canada) has set the goal of doubling the value of agricultural exports by the year 2000. Given the changes presented in scenario three, the estimated export revenues generated by the Canadian canola industry in 1993-94 would have increased

$180 million to $1.772 billion. This increase implies an 11.1 per cent increase in export revenues generated by the Canadian canola industry through increased value added processing. Additional revenues could be generated by producing further processed products such as refined and bottled salad oil, margarine, and other value-added products.

The model results suggest that in terms of Japanese consumption, rapeseed oil would decline slightly, with soybean oil (or possibly other less expensive oils such as palm oil) being used instead. This suggests that rapeseed oil demand from regions of the world other than Japan would be more attractive to the sellers. Overall, the levels of oil and meal demanded did not change significantly in response to the simulated changes on the 1993-94 conditions. Rather than observing significant differences in consumption patterns, regional trade flows adjusted to minimize the costs of processing and transporting the fixed supply of commodities between the regions.

Overall, the model suggests that the potential for the Canadian canola processing industry was severely restricted by limited capacity in 1993-94. Also, given the elimination of the Japanese edible oils tariff, the competitive position of oilseed processing in Japan is questionable.

5.5.1 Summary of Scenario Three Results

Given the elimination of the capacity constraint on canola processing in Canada and the Japanese edible oils tariff, Canadian canola processing would have roughly doubled.

Japanese edible oil production would have been displaced with EU rapeseed oil, Canadian canola meal and Rest-of-world soybean oil and meal. This suggests that the elimination of the Japanese edible oils tariff would have only indirect benefits for the Canadian edible oils processors and exporters. Overall, regional oilseed demand would not change significantly, with a modest decline in oilseed commodity prices likely as a result of increased economic efficiencies.

5.6 Summary

The model developed was able to produce acceptable estimates of the actual base results observed in 1993-94 for the world rapeseed and soybean market. Some of the difficulty in determining reasonable regional transfer costs were associated with the significant price movement observed within 1993-94. Throughout the crop year world oilseeds prices were volatile, with sharp gains observed by the end of the crop year. Some of the trade activity observed early in the crop year, under relatively low prices became uneconomical later in the year when regional prices, especially in North America, were significantly higher. Also, not all of the commodity is of equal quality (oilseed commodities are not homogenious). For example, a significant portion of the Canadian canola exports to the EU were of low quality canola that traded at a significant discount and was either blended with better quality EU rapeseed or was used for biofuel production (where chlorophyll content and oil quality is less important).

The potential of the Canadian processing industry was severely restricted by capacity constraints in 1993-94. Rather than exporting value added / processed products, a large portion of the record Canadian canola crop was exported as raw seed. Scenario one suggested that a significant economic opportunity was lost due to the limited Canadian canola processing capacity available in 1993-94. Due to the protective nature of the Japanese edible oils tariff, however, an expanded crush capacity would not be expected to result in a significant penetration of Canadian canola oil and meal into the Japanese market.

Scenario two determined that without the protection of the Japanese edible oils tariff, the viability of oilseed processing in Japan is questionable. However, without an expanded processing capacity the Canadian canola industry would be unable to directly benefit from the elimination of the Japanese tariff.

Scenario three determined that given an expanded Canadian canola processing capacity and the elimination of the Japanese edible oils tariff, the Canadian economy could experience a significant economic gain. A sharp increase in value-added canola product exports to Japan and the Rest-of-the-World (likely to the Pacific Rim markets within the Rest-of-the-World) could be attained given adequate Canadian canola supplies and the elimination of international protectionist policies.

CHAPTER VI

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary and Conclusions

Over the past few years the Canadian canola industry has undergone a significant expansion. In 1994-95 canola is expected to become a close second to wheat, in terms of economic contributions from grains and oilseeds to the Canadian economy.

The economic viability of the Canadian canola industry is a function of not only conditions within Canada but also the larger world oilseeds complex. Alternative oils and meals from around the world play an important role in determining the value and demand for Canadian canola products. Factors influencing the trade flows and profitability of the Canadian canola industry are numerous. Canadian capital investment and policy decisions regarding transportation, handling and domestic processing, various trade barriers around the world, production subsidies, and so on, are all important factors affecting the Canadian canola industry.

6.1.1 Important Commodities in the Oilseeds Complex

Soybeans are the dominant oilseed produced in the world, with the U.S. being the largest producer. In recent years soybeans and soybean meal have accounted for between 70 and

75 per cent of world oilseed and protein meal trade flows. The U.S. is the largest exporter of soybeans and soybean products, with South American production and exports becoming increasingly important. China's historical role as a soybean and soybean meal exporter has been diminishing in recent years. The EU is the dominant importer of soybeans, due to its large deficiency in domestic protein meal. Japan is the second largest importer of soybeans and soybean meal, with the importance of other markets such as the FSU and Eastern Europe relatively unstable in recent years.

The production gains in world rapeseed production have outpaced all other oilseeds over the past decade, with rapeseed currently the second largest source of edible oils from oilseeds. Given the much higher oil-content of rapeseed (over 40 per cent compared to less than 20 per cent for soybeans) and lower protein content, the rapeseed market is much more sensitive to developments in the world edible oils market than the soybean market. Canada, China, the EU and India are the dominant producers of rapeseed in the world. Japan is the largest importer of rapeseed in the world, with Canada being the dominant source. Other than in Canada, most of the world's rapeseed production tends to be consumed domestically.

Sunflowerseed production is the third most important source of edible oils from oilseeds, with the FSU, the EU and Argentina being the dominant producers. As with rapeseed, most of the production tends to be processed and consumed domestically, with Argentina being the exception. The EU and Mexico are the two major importers of sunflowerseed commodities.

World cottonseed production is second only to soybeans. However, its importance in the oil and meal markets is relatively small, since these products are only the by-products of the cotton fibers. It is the production of the cotton fibre which drives cottonseed production. The FSU, U.S., Brazil, China, India and Pakistan are the dominant producers with limited international trade in cottonseed oil and meal.

Palm oil production is the second most important source of edible oil in the world, and is expected to surpass soybean oil as the most important edible oil within the next decade. Despite being considered an inferior edible oil source for the major edible oil applications in developed nations (due to its very high saturated fat content), a large portion of the world's edible oil requirements are fulfilled with palm oil. Palm oil tends to be the cheapest source of edible oil with world production concentrated in Malaysia and Indonesia. Small quantities of palm oil are imported by most countries of the world due to the functional properties required for certain applications. However, the dominant importers of palm oil are the EU, China and Pakistan.

6.1.2 Regional Policies Affecting Oilseed Production and Trade

As with many other food related commodities, the oilseeds sector (edible oils portion in particular) is heavily influenced by regional production and trade policies. All of the various distortions, such as production subsidies, export subsidies or taxes, and import barriers, distort the world trade solution suggested by the economic rational for trade and spatial price equilibrium. Reasons given for the introduction of these types of regional policies often include: protection of a new industry, national security, health standards, protection against unfair foreign trade policies, protection of domestic programs, protection of the balance of payments, a means of improving international terms of trade, a source of revenue for a government and/or a desire to protect a regions industry from painful economic adjustment.

Some of the more important trade distorting policies affecting the Canadian canola industry include: the Western Grain Transportation Act, the Gross Revenue Insurance Program, and foreign aid programs in Canada; the direct export subsidies for edible oils and credit availability for importers of U.S. oilseed commodities; direct production subsidies for oilseed production, tax break incentives for industrial uses of vegetable oils and export credit subsidies in the EU; a prohibitive import tariff on edible oils in Japan; production subsidies and differential export taxes in South America; and differential taxes and export credit programs in Malaysia.

6.1.3 The Economic Model

An in-depth analysis of the potential implications of change to the world oilseeds market affecting the Canadian canola industry requires a complex, interactive system which allows for numerous trade flows of various competing products between the many players involved, subject to the various conditions and restrictions. The general spatial equilibrium problem, as developed by Enke (1951) and graphically solved for by Samuelson (1952), is well suited for an analysis of the world oilseeds complex. The capabilities of this theoretical model, based on maximizing consumer and producer surplus, are useful for an analysis of some of the issues affecting the Canadian canola industry. However, since cross-price effects of demand and supply relationships are important, maximization of consumer surplus and producer surplus is not appropriate (Martin, 1981). The actual formulation required for this study is a variation of the model; in particular, the maximization of a net average revenue function (simulating a perfect competition solution), subject to the appropriate regional demand and supply parameters observed in the world oilseeds complex.

The quadratic programming model developed facilitated a study of the implications of the limited Canadian canola crushing capacity and the Japanese edible oils tariff. The endogenous variables in the model included the six commodities and five regions considered most important to the Canadian canola industry. The commodities included were: rapeseed, rapeseed meal, rapeseed oil, soybeans, soybean meal and soybean oil. The five regions were: Canada, the U.S. the EU, Japan and the Rest-of-the-World.

6.1.4 The Empirical Model

The mathematical structure of the empirical model was designed to maximize the net average revenue from world rapeseed and soybean commodity demand (oil and meal revenue less seed, processing and transportation costs) subject to the various regional price equilibrium and quantity constraints observed in 1993-94. Theoretical demand functions for the regional oils and meals were derived based on available estimates of own-price and cross-price elasticities and the available price and demand data for 1993-94. Demand equations for regional stocks were also estimated and incorporated where relevant. The MINOS solver within the GAMS program was used to solve the model.

6.1.5 1993-94 Base Results From the Model

The model developed provided an acceptable simulation of the actual regional prices, demand, processing levels and trade flows observed in 1993-94. The model structure developed is likely to be a useful tool in forecasting the price and trade flow implications of projected regional rapeseed and soybean production in the future.

Given the acceptable simulation of the base scenario for 1993-94, three scenarios of change where imposed on the model. Note that reasonable results for the base scenario do not ensure good results from shocking the model. The scenarios provide some valuable insight into the implications of some of the constraints that faced the Canadian canola industry in 1993-94. The three scenarios of change investigated the extent of the restriction on value-added processing in Canada due to a limited crush capacity and the impact of the Japanese edible oils tariff, and the combined effect of these two constraints.

6.1.6 Implications From Removing Canadian Canola Crush Capacity Constraint

Model results from eliminating the constraint on Canadian canola crushing capacity suggested that Canada would have processed about 4.27 million tonnes of canola, virtually double the actual crush observed in 1993-94. This additional value-added processing would have contributed an additional $193 million to the export earnings generated by the Canadian canola industry in 1993-94, estimated at $1.592 billion in the base scenario (including oil, meal and seed exports).

The sharp increase in domestic demand for canola, as suggested by eliminating the Canadian canola crush constraint, would severely restrict Canadian canola exports, including a reduction in the ability to service the traditional Japanese demand for canola. However, access to the Japanese market for canola oil and meal would remain limited due to the protection provided to Japanese processors by the Japanese edible oils tariff. Increased Canadian canola processing would simply have displaced rapeseed processing in the EU and the Rest-of-the-World (likely in markets such as Mexico, and Pacific Rim markets other than Japan).

6.1.7 Implications From Eliminating Japanese Edible Oils Tariff

A second scenario determined that given an elimination of the Japanese edible oils tariff, the viability of oilseed processing in Japan is questionable. The model suggested that Japanese domestic oilseed products would be replaced with imports. Despite reducing Japanese crushing costs to world levels, the processing sector was estimated to be uncompetitive. In reality, however, some additional efficiencies through more competitive transportation rates, alternative oilseed sources, and so on, would likely also occur. Therefore, it is unlikely that Japanese oilseed processing would be completely eliminated. However, the scenario certainly confirms the vulnerability of the Japanese processing sector to competition. Further study on the model parameters leading to these conclusions is needed.

6.1.8 Implications From Elimination of the Tariff and Capacity Constraint

The third scenario explored with the model determined that given an elimination of the Japanese edible oils tariff and no constraint on Canadian canola crushing capacity, Canadian canola meal would be very competitive in the Japanese market, with most of the surplus canola oil produced in Canada continuing to go to the Rest-of-the-World. However, given the strong preference for the Canadian quality canola oil, Japan would likely be willing to pay the premium required to obtain Canadian canola oil. Overall, this scenario suggested that the Canadian canola industry would have been able to contribute a minimum of an additional $180 million to Canadian export earnings in 1993-94. Further study of the parameters used in the model would be useful.

6.2 Model Limitations and Suggestions for Further Research

The available literature related to the Canadian and world oilseeds complex contained a wide range of elasticity estimates for the variables included in the model. Within these ranges, an estimate was selected for purposes of validating the model and obtaining an indication of the direction and magnitude of change that could be expected given an elimination of a limiting factor, such as the canola crush capacity in Canada. Rather than provide a definitive solution, the goal of developing the model was to provide a framework that was easily adaptable to alternative assumptions.

Certainly the assumption of oilseed products being homogeneous is not completely accurate. The quality characteristics of the commodities will differ between regions and over time. These types of considerations would tend to result in actual changes to world trade flows being more inelastic than suggested by the model, especially in the short term. For example, the Japanese are not likely to consider the lower quality rapeseed oil and meal produced in a large portion of the world as an acceptable alternative to the products produced from Canadian canola. However, these types of considerations can be made when evaluating and interpreting the results produced by the model.

Alternative commodities such as sunflowerseed products and palm oil have a significant impact on the Canadian canola industry. Future research is likely to benefit from the inclusion of additional commodities. However, with the addition of additional commodities the data requirements and size of the model would expand significantly. Model size and data availability were key considerations in limiting the commodities included in this study. Note that the objective function maximizes the net average revenue of the world oilseeds complex, not the Canadian oilseeds industry.

One of the difficulties facing the model developed was the diversity of conditions contained in the endogenous Rest-of-World region. Future research would certainly benefit from breaking out several key regions such as South America, which is a large net exporter of soybean commodities. Also, the economic conditions in the rapeseed market are very different in the various regions included in the Rest-of-the-World. For example, the economic conditions in Mexico are very different from those in the Pacific Rim, China or India. However, as was stated with respect to the commodities included, the introduction of additional regions adds significantly to the data requirements and model size.

The results obtained when analyzing scenarios of change were very sensitive to the transportation and processing costs used in the model. In addition to finding accurate estimates of the values, it is difficult to anticipated the changes that would occur as a result of the imposed changes. For example, what transportation efficiencies would be gained or lost due to a doubling of Canadian domestic processing of canola at the expense of exports? Also, how valid are the parameter estimates for the large shocks imposed on the model?

The oilseed markets can be extremely volatile within a crop year, with crop year average data hiding the true economic incentives behind the market prices and trade flows observed. Also, factors such as general economic conditions, weather conditions, exchange rates, and so on have important impacts on the world oilseeds complex and are subject to significant changes within a crop year.

Despite the various limitations of the model, some of which have been pointed out, the model does provide a useful tool for studying some of the important issues facing the Canadian canola industry. Results from the model, when combined with a good understanding of the overall world oilseeds market and the limitations of the model, can provide valuable insight into the implications and economic importance of the various issues facing the Canadian canola industry.

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Appendix A

Production and Export Statistics for Canadian Canola Products

TABLE A.1 - Supplies and Consumption of Canadian Canola
'000 tonnes, August/July crop years

	1990-91	1991-92	1992-93	1993-94	1994-95f
Opening Stocks	749	399	734	692	309
Production	3266	4224	3872	5480	7228
Imports	19	42	112	23	20
TOTAL SUPPLY	4034	4664	4719	6195	7557
Exports	1888	1894	1876	3348	4200
Crushings	1441	1829	1913	2196	2425
Other Uses[a]	705	208	238	342	450
Closing Stocks	399	734	692	309	482
TOTAL USAGE	4034	4664	4719	6195	7557
Export (%supply)	47	41	40	54	54
Domestic Crush (%supply)	36	39	41	35	31

[a] Uses include seed, feed, and wastage.
Source: Statistics Canada
f: Author, December, 1994

TABLE A.2 - Canadian Canola Seed Exports, by Country of Final Destination ('000 tonnes)

Country/Area	1987-88 - 1991-92	1992-93	1993-94	1994-95f
Japan	1771	1485	1662	1600
Mexico	98	104	434	550
W. Europe	4	272	867	1200
Other	16	15	385	850
Total Exports	1889	1876	3348	4200

Source: Statistics Canada, 22-007
f: Author, December 1994

TABLE A.3 - Canadian Canola Oil Exports, by Country of Final Destination ('000 tonnes)

Country Area	1987-88 -1991-92	1992-93	1993-94	1994-95f
India	27	11	19	20
Pakistan	3	0	0	5
Japan	7	3	5	5
Hong Kong	1	10	4	10
Africa	5	5	2	5
Middle East	4	2	3	4
Central/South America	25	1	12	15
United States	151	305	347	315
Other	15	30	22	90
Total	236	367	414	469

Source: Statistics Canada, 22-007
f: Author, December 1994

TABLE A.4 - Canadian Canola Meal Exports, by Country of Final Destination ('000 tonnes)

Country/Area	1987-88 - 1991-92	1992-93	1993-94	1994-95f
Western Europe	35	31	39	50
Indonesia	24	39	20	25
Japan	108	129	124	130
South Korea	23	59	15	20
Taiwan	4	0	12	15
United States	302	505	722	700
Other	9	0	1	10
Total	505	763	933	950

Source: Statistics Canada, 22-007
f: Author, December 1994

TABLE A.5 - Value of Canadian Exports of Canola, Canola Oil and Canola Meal (million dollars)

Commodity	1991-92	1992-93	1993-94f
Canola	504	563	1115
Canola Oil	166	235	285
Canola Meal	122	135	185
Total	792	933	1585

Source: Statistics Canada, 65-004
f: Author, January 1994

Appendix B

World Production and Trade for Oilseed Commodities

TABLE B.1 - Historical Development of World Oilseed Production

Oilseed Crop	1935-36 - 1939-40	1957-58 - 1961-62	1972-73 - 1976-77	1984-85 - 1985-86	%change 1935: 1986	%ann. growth 1957-61 - 1984-86
	------ million tonnes -----					
Soybean	12.62	25.67	58.26	94.98	653	5.2
Cottonseed	13.87	18.03	23.59	32.34	133	2.3
Groundnuts[1]	6.08	9.04	11.24	13.70	125	1.6
Sunflowerseed	2.53	5.86	10.52	18.74	640	4.6
Rapeseed	3.82	3.72	7.18	17.83	367	6.2
Sesame	1.62	1.39	1.78	2.07	24	1.5
Copra/Palm Kernel	3.83	4.05	5.44	6.82	78	2.0
Linseed	3.42	3.26	2.46	2.48	- 27	-1.0
Castor & Tung	1.28	1.26	1.56	1.21	- 6	-
World Production	49.07	72.28	122.03	190.17	288	3.8

[1] In some of the literature groundnuts are called peanuts.

Source: Robbelen, 1989

TABLE B.2 - World Production of Protein Meals[2]
(million metric tonnes)

Protein Meal:	1990-91	1991-92	1992-93	1993-94
Soybean	69.50	73.08	75.78	78.88
Cottonseed	12.23	13.32	11.46	10.63
Rapeseed	14.40	15.62	14.05	15.14
Sunflowerseed	8.88	8.63	8.28	8.01
Fish	5.98	6.28	5.91	6.24
Peanut	4.81	4.79	5.10	5.17
Copra	1.66	1.57	1.61	1.62
Palm Kernel	1.72	1.79	2.04	2.25
Total	119.16	125.03	124.24	127.94

[2] The protein content and amino acid make up is different for each of the meals shown.

Source: USDA, FAS. December, 1994.

TABLE B.3 - World Production of Fats and Oils (million metric tonnes)

Fats & Oils	1990-91	1991-92	1992-93	1993-94
Soybean	15.93	16.89	17.10	17.94
Palm	11.09	11.50	13.01	13.41
Sunflowerseed	7.89	7.69	7.37	7.16
Rapeseed	8.65	9.32	8.41	9.17
Cottonseed	3.79	4.18	3.59	3.35
Peanut	3.38	3.38	3.60	3.60
Coconut	2.99	2.92	3.04	3.02
Olive	1.50	2.14	1.78	1.61
Fish	1.39	1.11	1.19	1.22
Palm Kernel	1.47	1.49	1.74	1.89
Total	58.06	60.60	60.82	62.38

Source: USDA, FAS. December, 1994.

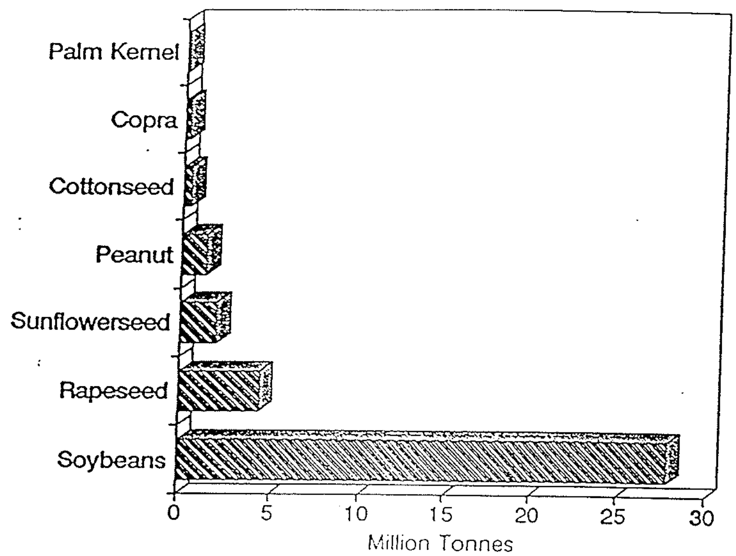

FIGURE B.1 - MAJOR WORLD OILSEEDS - 1989-90 to 1993-94
Average Exports
Source: USDA, FAS. December 1993.

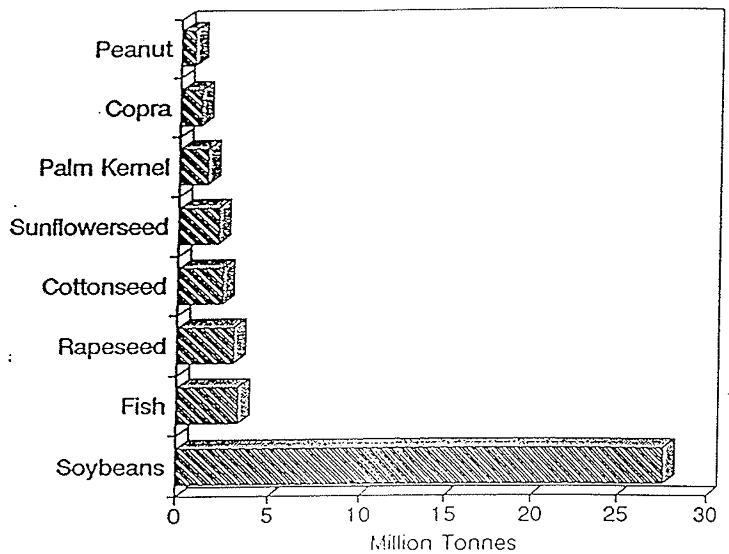

FIGURE B.2 - MAJOR WORLD PROTEIN MEALS -
Average Exports for 1988-89 to 1993-94
Source: USDA.FAS. December 1993.

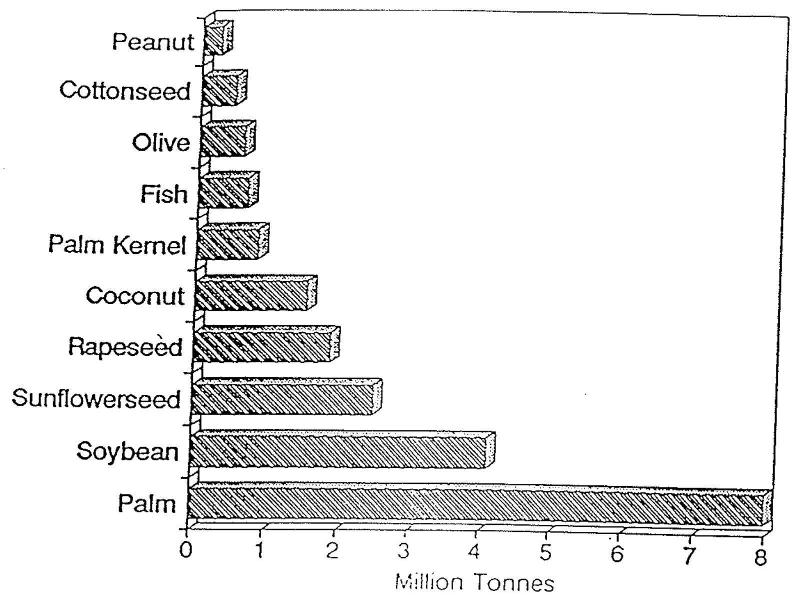

FIGURE B.3 - MAJOR WORLD VEGETABLE AND MARINE OILS - Average Exports for 1988-89 to 1993-94

Source: USDA, FAS. December 1993.

Appendix C

World Oilseeds and Products Price Relationships[1]

[1] Based on Bickerton, 1990.

C.1 Oilseeds Demand Determinants

The demand for an oilseed is derived from the value of the products produced from it. Thus, an oilseed price is linked to the value of the meal and oil products produced from it. The following relationship expresses how the value of a given oilseed can be determined.

$$P_{seed} = [A*P_{meal}] + [B * P_{oil}] - C_{crush}$$

where P_{seed} denotes the price per unit of oilseed; A, the meal yield of the oilseed; B, the oil yield of the oilseed; P_{meal}, the price per unit of the meal; P_{oil}, the price per unit of the oil and C_{crush} the cost per unit for crushing and processing the oilseed. This price relationship can then be further modified by the introduction of transportation costs. Also, the introduction of tariffs and non-tariff trade barriers between trading regions for inter-regional flows will further modify this price relationship.

There are some other important exceptions and modifications to this derived price relationship since not all oilseeds are crushed. For example, a significant proportion of world groundnut (peanut) production and some soybean, sunflowerseed and flaxseed production is not crushed but rather sold directly to the food and livestock feed markets. In the U.S. there also is a portion of its cottonseed production that is used directly in livestock feeds.

It is equally important to recognize that price levels in various regions of the world for oilseeds and oilseeds products depend on the complementary and substitutional relationships among the various oilseeds, oilseed products and feed grains. Therefore an economic analysis of a given oilseed commodity is quite complex since no one oil, meal or oilseed can be analyzed in isolation.

C.2 Oilseed Meals Demand Determinants

There is a complex set of interrelationships of demand and supply that work together to determine oilseed meal prices. The demand for protein meals is driven by the requirements for balanced feed rations around the world. These requirements differ both by region of the world and also by the type of livestock in question. For example, non-ruminant livestock, such as hogs and chickens, require high protein feeds without the larger amounts of fibre that the ruminant animal can handle.

As the demand for meat products continues to rise and also shift towards poultry (which are a higher protein-consuming animal) there is an increasing demand for high protein feed rations. In general this has resulted in there being a complimentary relationship between the base grains of feeds such as wheat, barley and corn and the various high protein meal supplements.

The actual level of substitutability between the available protein meals is limited by a number of factors. The actual protein content of the meals are dependant on the seed type. Soybean meal, for example, contains around 48 per cent protein whereas canola meal contains approximately 36 per cent. This difference in protein content means that the rapeseed meal must trade at a discount in relation to soybean meal on a per tonne of meal basis. The actual amino acid content of the protein sources is also different and is an important consideration in the formulation of feeds. Certain meals also have other limiting factors such as availability and reliability of supply, variability in quality, and other limiting factors[2]. All these considerations are important in the determination of the price of a given oilseed meal.

C.3 Oils Demand Determinants

Most of the demand for vegetable oils is for human food. The relative amount of vegetable oils used in industrial applications declined significantly as synthetic materials were being developed. This trend is, however, being counteracted by the growing interest in using renewable, environmentally friendly organic products. Factors supporting the growing demand for vegetable oils include substitution away from animal fats[3], growth in world population, income growth, changing personal preferences and the alternative oils made available.

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[2] For example, rapeseed meal content in a feed ration is limited due to the adverse effects of the glucosinolates present in the meal. The development of the current canola varieties, produced in Canada and the EU, has reduced this restriction. The Canola Council of Canada is currently working on overcoming the resistance against its use in some parts of the world due to bad experiences of the past with rapeseed meal through research and promotion.

[3] "Increased awareness about nutrition affects consumer preferences. In particular, concern about the need to reduce the level of saturated fats in diets is raising the demand for liquid oils at the expense of tropical oils and animal fats."(Bickerton, 1990, pg.9.)

As with protein meals, an edible oils' demand is based on issues such as availability, reliability and consistency of supply and variability in quality. Some of the other important considerations include the concentration and characteristics of the various fatty acids contained in the oil; the proportional levels of saturated, mono-unsaturated and poly-unsaturated fatty acids; the flavor of the oil and the functional properties of a given oil. The actual degree of substitution and the price differential between oils of different origin are tempered by these properties[4]. The degree of substitutability between oils has been increasing with technological advances such as hydrogenation and randomization. Also, over a longer time period a food product manufacturer will respond to price differentials and supply availability but in the short run little substitution can take place without altering the food product.

C.4 Price Relationships

There are both complimentary and substitutionary elements to the price relationships between oilseed meals and non oilseeds in feed rations. Feed rations are composed of a proportional balance of protein meals and feed grains such as corn, barley and wheat. Since there is a limited range of variation, the relative prices of protein meals and grains affect the demand of one another. However, since farmers want to maximize animal production at the minimum feed cost, a wide spread in prices will cause the feed rations

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[4] For example, lauric oils (such as coconut oil and palm kernel oil) have a distinctive use where foaming is desired. Olive oil has good demand despite higher prices due to its highly palatable flavor.

to be altered. Prior to 1993-94 an example of this was found in the EU where, due to high relative grain prices, the feed rations contain higher levels of protein meal.

The processing of an oilseed generally results in the production of the joint products of a meal and an oil. The yield of each of these two components is fixed for a given oilseed. This joint product characteristic ties the meal and oil markets together, thereby causing a disturbance in the one market to be transmitted to the other.

For example, increased demand for canola oil will change not only the equilibrium conditions of the canola oil market but also influence the canola meal market equilibrium (see Figure C.1). An increase in canola oil demand results in more canola seed being crushed to accommodate the increased demand and a new canola oil market equilibrium being reached. The canola oil demand function has shifted outward and the new equilibrium results in a higher price and larger quantity demanded and supplied. The increase in crush demand shifts out the seed demand function thereby increasing the price in the canola seed market and increasing the quantity demanded (seed market not shown in Figure C.1). Also, the resulting additional quantity of the joint meal product causes the supply curve of the meal market to shift outward. The effect of this outward supply curve shift in the canola meal market is that the price must decline so as to increase the quantity demanded for the given demand curve.

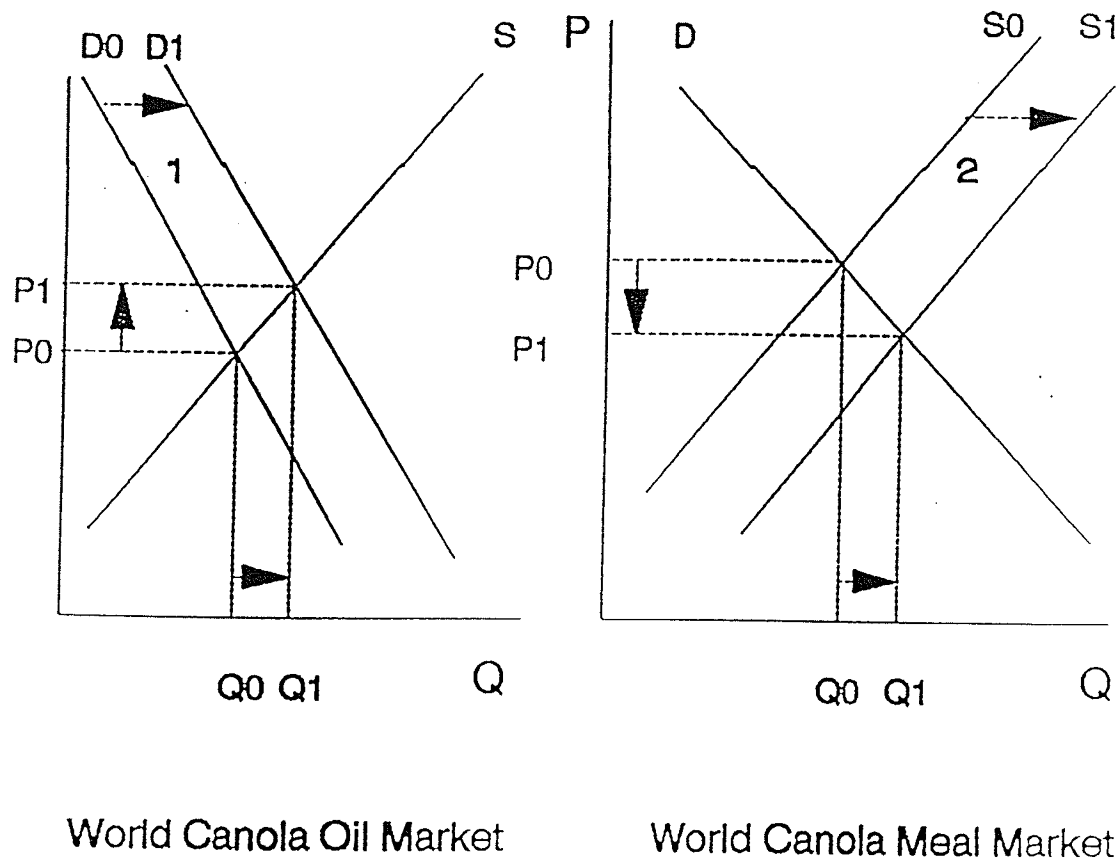

FIGURE C.1 - The Complementary Price Relationship Between Oil and Meal

In should be noted that the joint product considerations do not apply to a product such as palm oil. Palm oil is produced from the fruit of the palm tree and currently the only valuable product produced is the oil. The palm kernel, however, which is obtained from the mesocarp of the palm fruit, does yield the joint oil and meal products. Research is ongoing to develop an economic value for the remaining pulp product.

Another important consideration is that the relative substitutability between the various oilseeds and oilseed products affects demand. The two major factors affecting the degree of substitution are; 1) the respective oil and meal content of a given oilseed and 2) their degree of digestibility and usability.

Soybean meal sets the standard in the world protein meal market. In general, the other available meals are less palatable, or not as readily available, or do not have a consistent quality or have a lower nutritional value than soybean meal. The proportional relationships between these meals is not static however. Two of the more important factors affecting the change in quantity used for a given protein meal are the relative prices of the meals and the changing qualities of a given meal. For example, canola meal is an improved formulation of rapeseed meal which has reduced the restrictions on the absolute amount of it that can be used in a given feed ration.

The degree of substitutability between vegetable oils is quite high for oils with similar fatty acid profiles over the longer run. This means that any significant price differentials between oils will result in manufacturers and consumers switching to the less expensive oil source. This factor is, however, tempered by considerations such as the industrial demand for a given oil[5], local tastes and preferences and nutritional concerns.

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[5] For example, the lauric oils such as palm oil, palm kernel oil and coconut oil are more widely used in industrial applications.

Appendix D

Important Barriers to Trade in Oilseeds Products

The following tables were prepared by Agriculture and Agri-food Canada in November 1993 as part of the negotiations aimed at eliminating all trade barriers in the world oilseeds complex. Although not included in the recent agreement of the General Agreement on Tariffs and Trade (GATT), efforts to eliminate all trade distortions in the oilseeds sector may be re-started in 1995, largely at the request of the major oilseed processors and processor organizations around the world. The negotiations aimed at the elimination of trade barriers in the oilseeds sector during the Uruguay round of negotiations were referred to as the "zero-for-zero proposal in the oilseeds sector".

QR's refer to specific regional quantitity restictions.

ZERO-FOR-ZERO PROPOSAL IN THE OILSEEDS SECTOR

	COUNTRY	HS CODE	DESCRIPTION	TARIFF	OTHER MEASURES
I	Argentina		Oilseeds and products	2.5%	
I	Argentina		Oilseed products		Differential Export Taxes, 2.5% Export Subsidy.
	Argentina	1205.10	Canola seed	2.5% applied; Base Rate blank; Offer 35%	SPS certificates (3).
	Argentina	1514.10	Canola (Rapeseed) oil, crude (5)		No interest, large soybean producer; 2.5%.
	Argentina	1514.90	Canola (Rapeseed) oil, other (5)		No interest, large soybean producer, 2.5%
	Argentina	1515.11	Linseed oil, crude		
	Argentina	1515.19	Linseed oil, other		
	Argentina	2303.10	Gluten meal		No interest, 2.5%.
	Argentina	2306.40	Canola (Rapeseed) oil-cake		No interest, 2.5%.
I	Algeria				State Trading, crude oil imports only, no refined.
I	Austria		Refined vegetable oils	15%	
I	Bangladesh		Oilseeds	20%	
I	Bangladesh		Oilseed meals		Import ban.
I	Bangladesh		Soybean oil, crude	30% Duty (Fixed value of $440/MT for tariff purposes)	
I	Bangladesh		Palm oil, crude	45% Duty (Fixed value of $355/MT for tariff purposes)	

I = Important Barriers To Trade In Oilseed Products (as of June 2/93) Provided by NOPA

ZERO-FOR-ZERO PROPOSAL IN THE OILSEED SECTOR

I	Bangladesh		Palm oil, refined	45% Duty (Fixed value of $540/MT for tariff purposes)	
I	Bangladesh		Vegetable oils, crude	30% Duty (Import ceiling, 325,000 MT in 92/93)	
I	Bangladesh		Vegetable oils, refined	75% Duty (Fixed import value for tariffs of $700/MT)	
I	Bangladesh		All products	15% VAT, 8% surchargeand 7.5% miscell. fees)	
I	Bolivia		Vegetable oils	10%	
I	Brazil		Soybeans	10%	
I	Brazil		Vegetable oils	10%	
I	Brazil		Soybean meal	10.9%	
I	Brazil		Oilseed products		Differential export tax (ICM) subsidies.
I	Burma		Oilseed meals		Import licenses.
I	Canada[1]		Soybean oil, food use	7.5%	
I	Canada[1]		Peanut oil, refined	10.0%	
I	Canada[1]		Palm oil, refined	8.7%	
I	Canada[1]		Sunseed oil	7.5%	
I	Canada[1]		Safflowerseed oil	17.5%	
I	Canada[1]		Palm kernel oil, refined	8.7%	
I	Canada[1]		Rapeseed oil, crude	10%	

I - Important Barriers To Trade In Oilseed Products (as of June 2/93) Provided by NOPA

ZERO-FOR-ZERO PROPOSAL IN THE OILSEED SECTOR

I	Canada[1]		Rapeseed oil, refined	17.5%	
I	Canada[1]		Cottonseed oil, refined	10%	
I	Canada[1]		Linseed oil, crude	7.5%	
I	Canada[1]		Linseed oil, refined	6.2%	
I	Canada[1]		Corn oil, all	7.5%	
I	Canada[1]		Soy flour	10%	
?	Chile	1206 (or 1205)	Rapeseed (or sunflower)		- Specific Limitations: Other
I	Chile		Oilseeds	11%	
I	Chile		Oilseed meals	11% Duty + 9% surcharge + 65,000 MT duty-free quota for Bolivia	
I	Chile		Vegetable oils	11% duty + price band + Bolivian duty free access	
I	Chile		Oilseeds and meals	30% Duty for imports from ALADI (AR,BR) countries	
I	Chile		All oilseeds and products	18$ VAT	
	China	1200	Oilseeds.		- Specific Limitations: QR's & Import Licensing. - Government Participation in Trade: State Trading.
?	China	1507.9 (or 1514)	Rape (canola) or colza seed oil (soybean oil other)	70%	
I	China		Soybeans	3%	
I	China		Rapeseed	45%	
I	China		Sunflowerseed	45%	
I	China		Cottonseed	45%	
I	China		Soybean meal (2304)	20%	

I = Important Barriers To Trade In Oilseed Products (as of June 2/93) Provided by NOPA

ZERO-FOR-ZERO PROPOSAL IN THE OILSEED SECTOR

I	China		Soybean flour (1208)	9%	
I	China		Other oilseed meals (2306)	20%	
I	China		Fish meal	20%	
I	China		Soybean oil, crude and refined	20%	
I	China		Palm oil, crude and refined	28%	
I	China		Peanut oil, crude and refined	20%	
I	China		Sunflowerseed oil, crude and refined	45%	
I	China		Cottonsed oil, crude and refined	45%	
I	China		Coconut oil, crude and refined	28%	
I	China		Palm Kernel oil, crude and refined	28%	
I	China		Rapeseed oil, crude and refined	25%	
I	China		Corn oil, crude and refined oil	20%	
I	China		Sesamesed oil, crude and refined	15%	
I	Columbia		Oilseeds	Price band + 15% Duty + import licenses	
I	Columbia		Soybean meal	15%	
I	Columbia		Vegetable oils	20%	
I	Columbia		All oilseed products		Duty free status for Andean pact countries.
I	Costa Rica		Oilseeds	5% Duty + 11% Sales Tax	
I	Costa Rica		Soybean meal	5%	

I - Important Barriers To Trade In Oilseed Products (as of June 2/93) Provided by NOPA

ZERO-FOR-ZERO PROPOSAL IN THE OILSEED SECTOR

I	Costa Rica		Oilseed meals	9%	
I	Costa Rica		Vegetable oils	19%	
I	Czechoslovakia		Rapeseed and sunseed		Variable levy.
I	Czechoslovakia		Oilseed meals		Import licenses.
I	Czechoslovakia		Soybean oil	6.6%	
I	Czechoslovakia		Sunseed oil	10%	
I	Czechoslovakia		Rapeseed oil	40%	
I	Czech Republic		Oilseeds		Duty Free.
I	Czech Republic		Oilseed meals		Duty Free.
I	Czech Republic		Rapeseed Oil	20%	
I	Czech Republic		Other vegetable Oils	5%	
I	Dominican Republic		Oilseeds, meals, and crude vegetable oils	10% of C & F basic tariff	
I	Dominican Republic		Refined oils	30% of C & F basic tariff	
I	Dominican Republic		All oilseeds and products	10% surcharge + 10% basic tax + 8% VAT (C&F value)	
I	Ecuador		Vegetable oil, crude	12% Duty + price band	
I	Ecuador		Vegetable oil, refined	17% Duty + price band	
I	Ecuador		Protein meals	12% Duty, and licenses	

I = Important Barriers To Trade In Oilseed Products (as of June 2/93) Provided by NOPA

ZERO-FOR-ZERO PROPOSAL IN THE OILSEED SECTOR.

*	EEC	1005.10	Maize (corn) seed	Duty Free	- Certification and labelling requirements; - national listing requirements; - variety certification equivalence testing - In addition to customs duty, the application of a countervailing tax is provided for under certain conditions
*	EEC	1005.13	Maize, 3-cross hybrids for sowing	Duty Free	- Certification and labelling requirements; - national listing requirements; - variety certification equivalence testing - In addition to customs duty, the application of a countervailing tax is provided for under certain conditions
*	EEC	1005.13	Maize, 3-cross hybrids for sowing	Duty Free	- Certification and labelling requirements; - national listing requirements; - variety certification equivalence testing - In addition to customs duty, the application of a countervailing tax is provided for under certain conditions
*	EEC	1005.15	Maize, simple hybrid for sowing	Duty Free	- Certification and labelling requirements; - national listing requirements; - variety certification equivalence testing - In addition to customs duty, the application of a countervailing tax is provided for under certain conditions

I = Important Barriers To Trade In Oilseed Products (as of June 2/93) Provided by NOPA

ZERO-FOR-ZERO PROPOSAL IN THE OILSEED SECTOR

*	EEC	1005.90	Maize (corn) nes	Duty Free	- Certification and labelling requirements; - national listing requirements; - variety certification equivalence testing - In addition to customs duty, the application of a countervailing tax is provided for under certain conditions
*	EEC	1005.92	Maize, other	9% (L)	
*	EEC	1005.99	Maize for sowing, other	2% (L)	- Certification and labelling requirements; - national listing requirements; - variety certification equivalence testing - In addition to the customs duty, the application of a countervailing tax is provided for under certain conditions
*	EEC	1103.13	Maize (corn) groats and meal	23% (L)	
*	EEC	1104.23	Maize (corn), hulled, pearled, sliced or kibbled	23% (L)	- Discretionary import licensing - Sur charges
*	EEC	1108.12	Maize (corn) starch	27% (L)	
*	EEC	1201.00	Soybeans, whether or not broken	Duty Free	- Certification and labelling requirements - national listing requirements - variety certification equivalence testing Government Participation in Trade: Government Aid - Technical barriers: Health/sanitary requirements
*	EEC	1202.10	Ground-nuts in shell not roasted or other wise cooked	?	
*	EEC	1202.20	Ground-nuts shelled whether or not broken not roasted or other wise cooked	?	

I = Important Barriers To Trade In Oilseed Products (as of June 2/93) Provided by NOPA

ZERO-FOR-ZERO PROPOSAL IN THE OILSEED SECTOR

*	EEC	1204.00	Linseed, whether or not broken	?	- Certification and labelling requirements; national listing requirements; variety certification equivalence testing
*	EEC	1205.00	Rape (canola) or colza seeds, whether or not broken	Duty Free	- Certification and labelling requirements - national listing requirements - variety certification equivalence testing - Discretionary import licensing - Import deposit - Government Participation in Trade: Government Aid
*	EEC	1206.00	Sunflower seeds, whether or not broken	?	- Certification and labelling requirements - national listing requirements - variety certification equivalence testing - Government Participation in Trade: Government Aid
*	EEC	1207.40	Sesamum seeds, whether or not broken	?	
*	EEC	1207.50	Mustard seeds, whether or not broken	4%	- Definition (non-tariff)
*	EEC	1207.60	Safflower seeds, whether of not broken	?	
*	EEC	1207.99	Oilseeds and oleaginous fruits, nes, whether or not broken	Duty Free	
*	EEC	1208.10	Soybean flour and meals	10%	- In certain conditions the collection of a compensatory amount is provided for in addition to customs duty
*	EEC	1208.90	Flours and meals of oilseeds or oleaginous fruits, except soybeans and mustard, nes	Duty Free	

I - Important Barriers To Trade In Oilseed Products (as of June 2/93) Provided by NOPA

ZERO-FOR-ZERO PROPOSAL IN THE OILSEED SECTOR

*	EEC	1514.10	Rape (canola), colza or mustard oil, crude	?	- Oil crushing subsidy is primary trade impediment
?	EEC	1514.10.90	Crude Canola Oil (?)	10%	
?	EEC	1514.90.90	Rape (canola), colza or mustard oil, other than crude (refined), (canola Oil ?)	15% plus levy	
*	EEC	1515.19	Linseed oil and its fractions, other than crude (refined), but not chemically modified	?	
*	EEC	1515.21	Maize (corn) oil and its fractions, crude	?	
*	EEC	1515.29	Maize (corn) oil and its fractions, other than crude (refined), but not chemically modified	?	
*	EEC	1515.50	Sesame oil and its fractions whether or not refined, but not chemically modified	?	
*	EEC	1515.90	Veg fats and oils nes and their fractions, refined or not but not chemically modified	?	
*	EEC	1517.10	Margarine, excluding liquid margarine	?	
*	EEC	2103.15	Mustard flour in containers more than 1kg	5%	
*	EEC	2103.30	Mustard flour and meal	10%	
*	EEC		Prepared mustard	17%	
*	EEC	2302.10	Maize (corn) bran, sharps and other residues, pelleted or not.	21%	
*	EEC	2306.40	Rape or colza seed oil-cake and other solid residues, whether or not ground or pelleted	?	

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ZERO-FOR-ZERO PROPOSAL IN THE OILSEED SECTOR

*	EEC	2306.90	Veg oil-cake and other solid residues nes, whether or not ground or pelleted, other	?	
I	Egypt		Soybeans and sunseed	5% Duty + 10% sales tax	
I	Egypt		Cottonseed and peanuts		Imports prohibited except to port areas.
I	Egypt		Vegetable oils	1% Duty	
I	Egypt		Protein meals	5% Duty	
I	Egypt		Rapeseed oil, sunoil, unseed, and soyoil		Private sector imports prohibited.
I	El Salvador		Oilseed meals	5%	
I	El Salvador		Vegetable oils	30%	
I	European Community		Crude vegetable oils	10%	
I	European Community		Palm oil	1%	
I	European Community		Refined palm oil	12%	
I	European Community		Refined vegetable oils	20%	
	Finland	1204	Oilseeds		Specific Limitations: QR's & Import Licensing.
	Finland	1204.00.00	Linseed, whether or not broken	19%	
*	Finland	1204.00.90	Linseed, whether or not broken	?	
	Finland	1205.00.00	Rape (canola) or colza seed, whether or not broken	19%	Specific Limitations: QR's & Import Licensing
	Finland	1206.00.00	Sunflower seeds, whether or not broken	19%	Specific Limitations: QR's & Import Licensing
*	Finland	1207.50.00	Mustard seeds, whether or not broken	?	

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ZERO-FOR-ZERO PROPOSAL IN THE OILSEED SECTOR

	Finland	1514	Rape (canola), colza or mustard oil and fractions thereof, whether or not refined, but not chemically modified		Specific Limitations: QR's & Import Licensing.
	Finland	1514.10.00	Rape (canola), colza or mustard oil and fractions thereof, whether or not refined, but not chemically modified, crude	10%	
	Finland	1514.90.00	Rape (canola), colza or mustard oil and fractions thereof, whether or not refined, but not chemically modified, other than crude	16%	
?	Finland	1515	Vegetable oils including Rapeseed Oil (rape is 15.14 - linseed and maize is 15.15)		Specific Limitations: QR's & Import Licensing.
*	Finland	2103.30.00	Mustard flour and meal and prepared mustard	?	
I	Guatemala		Protein meals	5%	
I	Guatemala		Vegetable oils, crude	5%	
I	Guatemala		Vegetable oils, refined	20%	
I	Guatemala		Soybeans		Variable levy.
I	Hungary		Vegetable oils	8% Duty plus import licenses	
I	Hungary		Oilseeds	Duty Free	
I	Hungary		Oilseed meals	Duty Free	
	India	12	Oilseeds.	105%	Government Participation in Trade: State Trading.
I	India		Oilseeds	110% Duty, imports restricted (Palm kernel 250% Duty)	

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ZERO-FOR-ZERO PROPOSAL IN THE OILSEED SECTOR

	India	1205.00.00	Rape (canola) or colza seeds, whether or not broken		Specific Limitations: QR's & Import Licensing.
	India	1208.90	Flours and meals of oilseeds or oleaginous fruits, other than of soybean and mustard	10% + 10% VAT (unbound)	
?	India	1208.90.00	Flours and meals of oilseeds or oleaginous fruits, other than of soybean and mustard (flaxseed meal) (?)		Specific Limitations: QR's & Import Licensing.
	India	1507 1518	Soybean oil and its fractions, whether or not refined, but not chemically modified Animal or vegetable fats and oils and their fractions, boiled, oxidized, dehydrated, sulphurized, blown ...	45%/60%/170%	
I	India		All vegetable oils		State trading.
	India	1514	Rape (canola), colza or mustard oil and fractions thereof , whether or not refined, but not chemically modified		Government Participation in Trade: State Trading.
	India	1514.10	Rape (canola), colza or mustard oil and fractions thereof , whether or not refined, but not chemically modified, crude	45%/170%	
	India	1514.10.200	Crude Rape, Colza, (Canola) or Mustard Oil.	5% + 10% VAT + 40%	
I	India		Protein meals	105% Duty	
I	Indonesia		Oilseeds		BULOG is sole importer
I	Indonesia		Soybean oil, crude and refined	20% Duty + 10% VAT	
I	Indonesia		Soybean oil, neutralized, blanched	5% Duty + 10% VAT	

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ZERO-FOR-ZERO PROPOSAL IN THE OILSEED SECTOR

I	Indonesia		Soybean oil, chemically modified	5% Duty + 10% VAT	
I	Indonesia		Soybean meal	35% surcharge + 5% Duty	
I	Israel		Soybean Oil	18%	
I	Israel		Sunseed oil	14%	
I	Israel		Soybean meal	10%	
I	Ivory Coast		Oilseed meals	25% VAT	
I	Ivory Coast		Refined oils	35% Tax	
I	Ivory Coast		Crude oils	25% Tax	
I	Jamaica		Oilseeds meals and vegoils	40% import Duty	
*	Japan	1005.09.00	Maize, other than for use as materials for fodder and feeds	Duty Free	
*	Japan	1005.10	Maize (corn) seed	?	
*	Japan	1005.90	Maize (corn) nes	?	
*	Japan	1103.13	Maize (corn) groats and meal	?	
	Japan	12	Animal Feed.		Technical Barriers to Trade: Regulations & Standards.
*	Japan	1201.00	Soybeans, whether or not broken	Duty Free	
*	Japan	1204.00	Linseed, whether or not broken	Duty Free	
*	Japan	1205.00	Rape (canola) or colza seed, whether or not broken	Duty Free	
*	Japan	1206.00	Sunflower seeds, whether or not broken	Duty Free	
*	Japan	1207.50	Mustard seeds, whether or not broken	Duty Free	
*	Japan	1207.60	Safflower seeds, whether or not broken	?	

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ZERO-FOR-ZERO PROPOSAL IN THE OILSEED SECTOR

*	Japan	1208.10	Soybean flour and meals	?	
*	Japan	1208.90	Flours and meals of oil seeds or oleaginous fruits, except soybeans and mustard, nes	?	
*	Japan	1507.31.00	Rape seed oil and mustard seed oil of an acid value exceeding 0.6	17 ¥/kg	
*	Japan	1507.41.00	Sunflower seed oils of an acid value exceeding 0.6	17 ¥/kg	
*	Japan	1512.11	Sunflower, safflower or cotton seed oil and fractions thereof, crude	?	
*	Japan	1514.10	Rape (canola), colza or mustard oil and fractions thereof, whether or not refined, but not chemically modified, crude	17 ¥/kg	
?	Japan	1514.10.10	Rape (canola), colza or mustard oil and fractions thereof, whether or not refined, but not chemically modified, crude (?)	17 ¥/kg (Bound)	
	Japan	1514.10.20	Rape (canola), colza or mustard oil and fractions thereof, whether or not refined, but not chemically modified, other	20 ¥/kg (Bound)	
*	Japan	1514.90	Rape (canola), colza or mustard oil and their fractions, whether or not refined, but not chemically modified, other (refined)	20 ¥/kg (bound)	
*	Japan	1516.20	Veg fats and oils and their fractions hydrogenated, inter or re-esterified or elaidinized, whether or not refined, but not further prepared	?	

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ZERO-FOR-ZERO PROPOSAL IN THE OILSEED SECTOR

*	Japan	2103.30	Mustard flour and meal and prepared mustard	17.5%	
*	Japan	2304.27.0	Residues (except dregs) resulting from the extraction of rape seed oil	?	
*	Japan	2306.40	Rape (canola) or colza seed oil-cake and other solid residues, whether or not ground or pelleted	Duty Free	
I	Japan		Crude vegetable oils	17 ¥/kg Duty	
I	Japan		Refined vegetable oils	27.7 ¥/kg Duty	
I	Jordan		Vegetable oil		State trading.
I	Korea		Soybeans	Import quota + 3% Duty	
I	Korea		Sunseed	30%	
I	Korea		Cottonseed	4%	
I	Korea		Soybean oil (above 15,000 MT)	25%	
I	Korea		Sunseed oil	25%	
I	Korea		Cottonseed oil	9%	
I	Korea		Rapeseed oil	30%	
I	Korea		Coconut oil	7%	
I	Korea		Palm oil	4%	
I	Korea		Palm kernel oil	9%	
I	Korea		Peanut oil	40%	
*	Malaysia	1201.00.00.10	Soybeans, whether or not broken, for sowing	?	
*	Malaysia	1201.00.20	Soybeans, whether or not broken, for oil extraction	?	

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ZERO-FOR-ZERO PROPOSAL IN THE OILSEED SECTOR

*	Malaysia	1514.10.10	Rape (canola), colza or mustard oils and fractions thereof, whether or not refined, but not chemically modified, crude	?	
I	Malaysia		Soybean meal	10%	
I	Malaysia		Palm oil		Differential export taxes.
*	Mexico	1005.90.99	Maize (corn) nes	Duty Free	
	Mexico	12	Oilseeds.		Specific Limitations: QR's & Import Licensing.
*	Mexico	1204.00.00	Linseed, whether or not broken	Duty Free	- Import permits required - Government limits imports or bans them entirely when local product available
	Mexico	1204.00.01	Linseed	Unbound, applied at free.	Specific Limitations: QR's & Import Licensing.
*	Mexico	1205.00	Rape (canola) or colza seeds, whether or not broken	Duty Free	- Import permits required - Government limits imports or bans them entirely when local product available
	Mexico	1205.00.02	Rape (canola) seed, whether or not broken	Bound at 50% - Applied free (?)	Specific Limitations: QR's & Import Licensing.
*	Mexico	1206.00	Sunflower seeds, whether or not broken	Duty Free	- Import permits required - Government limits imports or bans them entirely when local product available
	Mexico	1208.90	Flours & meals of oil seeds or oleaginous fruits, other than soybeans and mustard	10% (not bound)	
	Mexico	1514	Rape (canola), colza or mustard oil and fractions thereof, whether or not refined, but not chemically modified	10% (competing and crude oils free), not bound	

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ZERO-FOR-ZERO PROPOSAL IN THE OILSEED SECTOR

	Mexico	1514.10.01	Rape (canola), colza or mustard oil and fractions thereof, whether or not refined, but not chemically modified, crude (canola oil)		Specific Limitations: QR's & Import Licensing.
?	Mexico	1514.90.90	Rape (canola), colza or mustard oil and fractions thereof, whether or not refined, but not chemically modified, other than crude (refined) (canola oil) (?)		Specific Limitations: QR's & Import Licensing.
I	Mexico[2]		Soybean meal	15% seasonal dry	
I	Mexico[2]		Soybean meal	10%	
I	Mexico[2]		Vegetable oils, crude	10%	
I	Mexico[2]		Vegetable oils, refined	20%	
I	Morocco		Oilseeds	7.5% Duty + 12.5% import tax	
I	Morocco		Vegetable oils	12.5% Duty + 12.5% import tax	
I	Morocco		Protein meals	12.5% Duty + 12.5% import tax + 19+% VAT	
I	Morocco		All oilseeds and products		Central buying group.
	Nicaragua	12	Oilseeds		Specific Limitations: Embargoes & Similar Restrictions.
I	Nigeria		Vegetable oil		Import ban.
I	Nigeria		Protein meals	20%	
*	Norway	1005.00.00	Maize	Duty Free	- Subject to import control.
*	Norway	1201.35.00 (?)	Linseed (?)	Duty Free	- Subject to import control.
*	Norway	1201.50.00 (?)	Rape (canola) and colza seeds (?)	Duty Free	- Subject to import control.

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ZERO-FOR-ZERO PROPOSAL IN THE OILSEED SECTOR

*	Norway	1201.60.00	Mustard seeds	Duty Free	- Subject to import control.
*	Norway	2107.99.40	Prepared Maize	?	
*	Norway	2306.40.40	Oil-cake and other residues resulting from extraction of colza, rape and turnip seed	Duty Free	
I	Norway		Oilseeds and products		Monopoly.
	OAN (Oman)?	1204.00	Linseed seeds, whether or not broken	5%	
	OAN (Oman)?	1205.00	Rape (canola) or colza seed, whether or not broken	20%	
	OAN (Oman)?	1208.90	Flours and meals of oil seeds and oleaginous fruits, other than those of soybean and mustard (rape meal ?)	10%	
	OAN (Oman)?	1514.90	Rape (canola), colza or mustard seed oils and fractions thereof, whether or not refined, but not chemically modified, other than crude (refined)	20%	
	Pakistan	1514.90	Rape (canola), colza or mustard seed oils and fractions thereof, whether or not refined, but not chemically modified, other than crude (refined)	Cdn $223 per M.T.	
I	Pakistan		Cottonseed	50% tariff + 5% lgra + 12.5 5 sales tax	
I	Pakistan		Soybeans	10% tariffs, 5% lgra	
I	Pakistan		Cottonseed oil	3,600 Rs/MT plus 10% Duty	
I	Pakistan		Sunseed oil	3,000 Rs/MT plus 15% Duty	
I	Pakistan		Soybean oil	2,000 Rs/MT plus 15% Duty	

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ZERO-FOR-ZERO PROPOSAL IN THE OILSEED SECTOR

I	Pakistan		Soybean meal	15%	
I	Pakistan		Cottonseed meal	30% tariff + 5% lgra + 12.5% sales tax	
I	Pakistan		Sunseed meal	30% tariffs + 5% lgra	
I	Panama		Oilseeds and Products		Import licensing.
I	Paraguay		Oilseeds and Products		Export tax on soybeans, export subsidy for meal.
	Peru	1205	Rape (canola) or colza seed, whether or not broken		Specific Limitations: Embargoes & Similar Restrictions.
	Peru	1514.10	Rape (canola), colza or mustard seed oils and fractions thereof, whether or not refined, but not chemically modified, crude	34%	
I	Peru		Vegetable oils	15%	
	Philippines	1205.00	Rape (canola) or colza seed, whether or not broken	50% (bound) 20% (applied)	
*	Philippines	1205.00.90	Rape (canola) or colza seed, whether or not broken, other than for sowing and oil extraction	?	
	Philippines	1208.90	Flours and meals of oilseeds or oleaginous fruits, other than those of soybean and mustard (rape ?)	10% (bound)	
	Philippines	1208.90	Flours and meals of oilseeds or oleaginous fruits, other than those of soybean and mustard (linseed)	50% (unbound)	
*	Philippines	1515.11	Linseed oil and its fractions, crude	20% (unbound) + 10% VAT	

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ZERO-FOR-ZERO PROPOSAL IN THE OILSEED SECTOR

*	Philippines	1515.19	Linseed oil and its fractions, other than crude (refined)	10% (Unbound) + 10% VAT	
*	Philippines	2306.40.00	Rape (canola) or colza oil-cake and other solid residues	?	
I	Philippines		Soybeans	3%	
I	Philippines		Soybean meal and sunseed meal	10%	
I	Philippines		Soybean oil, hydrogenated	40%	
I	Philippines		Soybean oil, crude and refined	20%	
I	Philippines		Palm oil, coconut oil, PK oil	50%	
I	Philippines		Corn oil and sunseed oil	50%	
I	Poland		Soybean meal	10% Duty on non-EC meal, EC-origin meal Duty free	
?	Slovenia	1202.00.00	Flours or Meals of Oilseeds or Oleaginous Fruit.	10%	
?	Slovenia	1507	Fixed Vegetable Oils - Fluid/Solid, Crude, Refined/Purified.	35%	
I	South Africa		Soybeans	R650/MT	
I	South Africa		Other oilseeds	10%	
I	South Africa		Soymeal	R200/MT	
I	South Africa		Cottonseed meal	R250/MT	
I	South Africa		Sunseed meal	R285/MT	
I	South Africa		Soybean oil	R750/MT	
I	South Africa		Sunseed oil	R750/MT	
I	South Africa		Fishmeal	Duty Free	
*	South Korea	1005.90.90	Maize	5%	

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ZERO-FOR-ZERO PROPOSAL IN THE OILSEED SECTOR

*	South Korea	1201.00	Soybeans, whether or not broken	5%	
*	South Korea	1204.00	Linseed, whether or not broken	?	
*	Korea	1205.00	Rape (canola) or colza seed, whether or not broken	35% 10% (temporary 30% before (?)	- Specific Limitations: QR's & Import Licensing - Charges on Imports: Discriminatory Taxes
*	South Korea	1207.50	Mustard seeds, whether or not broken	?	
* ?	Korea	1208.90	Flours and meals of oil seeds or oleaginous fruits, other than soybeans and mustard (rape, colza meals ?)	20% or 30% (bound); 5% applied.	
*	South Korea	1507.00	Soybean oil and its fractions, whether or not refined, but not chemically modified	15%	
*	Korea	1514	Rape (canola), colza or mustard oil and fractions thereof, whether or not refined, but not chemically modified	35% (unbound) 1990-35% 1-30% 2-30% 3-30% (?)	Canola - Specific Limitations: Embargoes & Similar Restrictions
	Korea	2008.11.90.00	Other Preparations of Ground Nuts.	50%	
	Korea	2008.19.90.00	Nuts, Ground Nuts & Seeds, Other (including mixtures).	50%	
*	South Korea	2304.00	Oil-cake and other solid residues, whether or not ground or in the form of pellets, resulting from the extraction of soybean oil	5%	
*	South Korea	2306.40	Rape (canola) or colza seed oil-cake and other solid residues, whether or not ground or pelleted	?	
I	Sri Lanka		Protein meals	10%	

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ZERO-FOR-ZERO PROPOSAL IN THE OILSEED SECTOR

I	Sri Lanka		Vegetable oils	50%	
*	Sweden	1005.00.10	Frozen maize, scalded, boiled or simply processed before freezing	Duty Free	- Import levy system - Export subsidies
*	Sweden	1005.00.90	Maize, other than frozen	Duty Free	- Import levy system - Export subsidies
* ?	Sweden	1201.30.00 (?)	Soybeans (?)	Duty Free	- Import levy system - Export subsidies
* ?	Sweden	1201.35.00 (?)	Linseed (?)	Duty Free	- Import levy system - Export subsidies
* ?	Sweden	1201.50.00 (?)	Colza seeds (?)	Duty Free	- Import levy system - Export subsidies
* ?	Sweden	1201.60.00 (?)	Mustard seeds (?)	Duty Free	- Import levy system - Export subsidies
* ?	Sweden	1201.07.00 (?)	Sunflower seeds (?)	Duty Free	- Import levy system - Export subsidies
* ?	Sweden	1201.90.90 (?)	Oilseeds and oleaginous fruit, whnes, whole or broken (?)	Duty Free	- Import levy system - Export subsidies
	Sweden	1205	Rape (canola) or colza seed, whether or not broken		Government Participation in Trade: Government Aid
*	Sweden	1507.10.10	Soybean oil and its fractions, whether or not refined, but not chemically modified, crude	Duty Free	- Import levy system - Export subsidies
*	Sweden	2103.10.00	Mustard flour	15% u	
I	Sweden		Vegetable oils		Variable levy.
I	Switzerland		Oilseeds and products		Variable levy.
I	Taiwan		Soybeans	1%	
I	Taiwan		Soybean meal	Duty Free	
I	Taiwan		Soybean oil	6%	
I	Taiwan		Sunseed oil	30%	
I	Taiwan		Cottonseed oil	15%	

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ZERO-FOR-ZERO PROPOSAL IN THE OILSEED SECTOR

I	Taiwan		Rapeseed oil	15%	
I	Taiwan		Palm oil	2.5%	
	Thailand	1201.00	Soybeans, whether or not broken		Specific Limitations: QR's & Import Licensing.
	Thailand	1205	Rape (canola) or colza seed, whether or not broken		Specific Limitations: QR's & Import Licensing.
	Thailand	1208.10	Soybean flours and meals		Government Participation in Trade: Government Procurement.
	Thailand	1208.90	Flours and meals of oilseeds or oleaginous fruits, other than soybean and mustard (canola meal)		Specific Limitations: QR's & Import Licensing.
	Thailand	1514	Canola oil and its fractions, whether or not refined, but not chemically modified		Specific Limitations: QR's & Import Licensing.
I	Thailand		Soybeans		Import licenses.
I	Thailand		Soybean oil, palm oil, and PK oil		Import licenses.
I	Thailand		Soybean meal	Surcharge of 1,150 baht/MT	
I	Thailand		Sunseed oil		No import licenses.
I	Turkey		Soybeans	3% + $4/MT	
I	Turkey		Sunseed	3% + $80/MT	
I	Turkey		Other oilseeds	2% + $4/MT	
I	Turkey		Soybean oil, crude	3% + $60/MT	
I	Turkey		Soybean oil, refined	5% + 30% CIF value	
I	Turkey		Sunseed oil, crude	3% + $200/MT	
I	Turkey		Sunseed oil, refined	5% + $500/MT	
I	Turkey		Palm oil and coconut oil, crude	3% + $60/MT	
I	Turkey		Palm oil, refined	3% + $4/MT	

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ZERO-FOR-ZERO PROPOSAL IN THE OILSEED SECTOR

I	Turkey		Protein meals	3% + $1/MT	
I	Turkey		Rapeseed	10% Duty + 15% CIF value	
	United States	12	Oilseeds		Specific Limitations: Quotas. Government Participation in Trade: Government Aid.
	United States	1507	Soybean oil and its fractions, whether or not refined, but not chemically modified		Government participation in Trade: Government Aid.
	United States	1512	Sunflower, safflower or cotton seed oil and fractions thereof, whether or not refined, but not chemically modified (sunflower)		Government participation in Trade: Government Aid.
I	United States[3]		Soybean oil	22.5%	
I	United States[3]		Soybean and sunseed meal	$7.00/MT	
I	United States[3]		Sunseed oil	$20/MT + 4%	
I	United States[3]		Cottonseed oil	$66/MT	
I	United States[3]		Rapeseed oil	7.5%	
I	United States[3]		Rapeseed meal	$2.60/MT	
I	Uruguay		Oilseeds and Products	25%	
I	Venezuela		Oilseeds		Price bands.
I	Venezuela		Oilseed meals	15% Duty plus price bands	
I	Venezuela		Soybean oil	20% tariff + S.A. Preference (Argentina 8%, Brazil 10%, Paraguay 0.1%)	

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ZERO-FOR-ZERO PROPOSAL IN THE OILSEED SECTOR

I	Venezuela		Other vegetable oils	20% Duty + price bands	
I	Zambia		Vegetable oils	30% Duty plus import levy	Government participation in Trade: Government Aid.

(L) Tariff rate followed by (L), e.g. 20% (L), indicates an ad valorem tariff made obsolete by a variable levy.

* = Canada Export Interest - Priority List (August 21, 1989)

I = Important Barriers To Trade In Oilseed Products (as of June 2/93) Provided by NOPA

Appendix E

The Quadratic Programming Matrix

Presented in the Format Required by the General Algebraic Modeling System (GAMS)

Following a brief description of the format required by GAMS, the complete input file used to solve for the base 1993-94 solution is presented. This is followed by a comprehensive description of the acronyms and data sources used.

E.1 Structure of the GAMS Input File

The basic structure required by GAMS for a given problem includes 5 major components.[1] The major components are SETS, DATA, VARIABLES, EQUATIONS and the MODEL AND SOLVE statements.

The first component of the GAMS input file contains the SETS. The SETS portion of the file basically introduces the building blocks to be used in constructing the model. For this study 7 groups of building blocks (sets) are introduced. These include a vegetable oil price set, a protein meal price set, an oilseed price set, a regional oilseed crush set, and three sets reflecting the potential trade flows for oils, meals and oilseeds between regions.

The second component of the GAMS input file contains the specific DATA or PARAMETERS required to analyze and solve the problem. Within this section the assigned values for each of the estimated linear demand functions, the crushing costs, the transportation costs, the oil and meal extraction rates, the available supplies of oilseeds, the beginning stocks of oil and meals, and the regional crush capacities are provided.

---

[1] Refer to Brooke, 1988 for complete details on the GAMS program.

The third section of the GAMS input file contains the listing of the variables to be solved for in the model. The variables to be solved for include oil prices (OIL (A)), meal prices (MEAL(B)), oilseed prices (SEED(E)), regional crush levels (CRUSH(F)), and transportation flows of oil, meal and oilseed (FLOWOIL(G), FLOWMEAL(H) and FLOWSEED(I)). Following the declaration of the variables to be solved for, the condition that all variables solved for must be positive is made. This statements ensures that condition ten of the equilibrium constraints, as developed in Chapter IV section 4.2 and defined in section 4.6, is met.

The fourth section of the GAMS input file contains the declaration of all the equations (the objective function and equilibrium condition constraints) followed by the specification of each equation. This section provides the structure of the problem being solved using the data provided in the PARAMETERS section. This section contains the quadratic objective function followed by all of the linear constraints to be imposed on the maximization of the net average revenue function.

The final component of the GAMS input file simply consists of a single statement instructing the GAMS program to maximize the net average revenue function subject to the given parameters and conditions using non-linear programming. Initial values for some of the key variables have then been provided, with an upper limit placed on U.S. soybean oil exports to simulate a bound on the quantitity of soybean oil exported from the U.S. using the Export Enhancement Program.

E.2 The GAMS Input File for the 1993-94 Base Scenario

```
SETS
 A oil demands prices
   / PDCRO , PDURO , PDERO , PDJRO , PDRRO , PDRROS ,
    PDCSO , PDUSO , PDUSOS , PDESO , PDJSO , PDRSO , PDRSOS /

 B meal demands prices
   / PDCRM , PDURM , PDERM , PDJRM , PDRRM , PDRRMS ,
    PDCSM , PDUSM , PDUSMS , PDESM , PDJSM , PDRSM , PDRSMS /

 E seed supply prices
   / PDCRS , PDCRSS , PDURS , PDERS , PDERSS , PDJRS , PDRRS ,
    PDRRSS , PDCSB , PDUSB , PDUSBS , PDESB , PDJSB , PDRSB ,
    PDRSBS /

 F crushing levels
   / QCRS , QURS , QERS , QJRS , QRRS ,
    QCSB , QUSB , QESB , QJSB , QRSB /

 G oil trade flow quantities
   / TCCRO , TCURO , TCERO , TCJRO , TCRRO , TUCRO , TUURO ,
    TUERO , TUJRO , TURRO , TECRO , TEURO , TEERO , TEJRO ,
    TERRO , TJCRO , TJURO , TJERO , TJJRO , TJRRO , TRCRO ,
    TRURO , TRERO , TRJRO , TRRRO , TRRROS , TCCSO , TCUSO ,
    TCESO , TCJSO , TCRSO , TUCSO , TUUSO , TUUSOS , TUESO ,
    TUJSO , TURSO , TECSO , TEUSO , TEESO , TEJSO , TERSO ,
    TJCSO , TJUSO , TJESO , TJJSO , TJRSO , TRCSO , TRUSO ,
    TRESO , TRJSO , TRRSO , TRRSOS /

 H meal trade flow quantities
   / TCCRM , TCURM , TCERM , TCJRM , TCRRM , TUCRM , TUURM ,
    TUERM , TUJRM , TURRM , TECRM , TEURM , TEERM , TEJRM ,
    TERRM , TJCRM , TJURM , TJERM , TJJRM , TJRRM , TRCRM ,
    TRURM , TRERM , TRJRM , TRRRM , TRRRMS , TCCSM , TCUSM ,
    TCESM , TCJSM , TCRSM , TUCSM , TUUSM , TUUSMS , TUESM ,
    TUJSM , TURSM , TECSM , TEUSM , TEESM , TEJSM , TERSM ,
    TJCSM , TJUSM , TJESM , TJJSM , TJRSM , TRCSM , TRUSM ,
    TRESM , TRJSM , TRRSM , TRRSMS /

 I seed trade flow quantities
   / TCCRS , TCCRSS , TCURS , TCERS , TCJRS , TCRRS , TUCRS ,
    TUURS , TUERS , TUJRS , TURRS , TECRS , TEURS , TEERS ,
```

```
    TEERSS , TEJRS , TERRS , TJCRS , TJURS , TJERS , TJJRS ,
    TJRRS , TRCRS , TRURS , TRERS , TRJRS , TRRRS , TRRRSS ,
    TCCSB , TCUSB , TCESB , TCJSB , TCRSB , TUCSB , TUUSB ,
    TUUSBS , TUESB , TUJSB , TURSB , TECSB , TEUSB , TEESB ,
    TEJSB , TERSB , TJCSB , TJUSB , TJESB , TJJSB , TJRSB ,
    TRCSB , TRUSB , TRESB , TRJSB , TRRSB , TRRSBS / ;


PARAMETERS
  OILCONS(A)  constant terms of the oil demand equations
        / PDCRO     0.7905 ,
          PDURO     0.8094 ,
          PDERO     2.7125 ,
          PDJRO     0.784 ,
          PDRRO     10.1805 ,
          PDRROS    0.6825 ,
          PDCSO     0.216 ,
          PDUSO     8.7024 ,
          PDUSOS    1.7885 ,
          PDESO     2.55 ,
          PDJSO     1.2395 ,
          PDRSO     17.7625 ,
          PDRSOS    0.962800 /

  MEALCONS(B)  constant terms of the meal demand equations
        / PDCRM     0.3108 ,
          PDURM     1.3485 ,
          PDERM     7.1878 ,
          PDJRM     2.0574 ,
          PDRRM     10.503 ,
          PDRRMS    0.816 ,
          PDCSM     1.728 ,
          PDUSM     31.84785 ,
          PDUSMS    0.245 ,
          PDESM     23.1989 ,
          PDJSM     5.365 ,
          PDRSM     35.9835 ,
          PDRSMS    4.7655 /

  SEEDCONS(E)  constant terms of the seed stock demand equations
        / PDCRSS    1.24 ,
          PDERSS    0.2975 ,
          PDRRSS    0.5655 ,
```

```
          PDUSBS     22.76 ,
          PDRSBS     18.225 /

DCRO(A)  coefficients of canadian rapeseed oil demand equation
        / PDCRO     -0.000440741 ,
          PDCSO      0.000094444 /

DURO(A)  coefficients of us rapeseed oil demand equation
        / PDURO     -0.000430976 ,
          PDUSO      0.000139877 /

DERO(A)  coefficients of eu rapeseed oil demand equation
        / PDERO     -0.00175 ,
          PDESO      0.000550314 /

DJRO(A)  coefficients of japan rapeseed oil demand equation
        / PDJRO     -0.000421053 ,
          PDJSO      0.000440212 /

DRRO(A)  coefficients of row rapeseed oil demand equation
        / PDRRO     -0.006133918 ,
          PDRSO      0.001451765 /

DRROS(A)  coeff of row rapeseed oil stock demand equation
        / PDRROS    -0.000342105 /

DCSO(A)  coefficients of canadian soybean oil demand equation
        / PDCRO      0.000049383 ,
          PDCSO     -0.000118519 /

DUSO(A)  coefficients of us soybean oil demand equation
        / PDURO      0.000360976 ,
          PDUSO     -0.003777178 /

DUSOS(A)  coeff of us soybean oil stock demand equation
        / PDUSOS    -0.001593252 /

DESO(A)  coefficients of eu soybean oil demand equation
        / PDERO      0.00053125 ,
          PDESO     -0.001603774 /

DJSO(A)  coefficients of japanese soybean oil demand equation
        / PDJRO      0.000105789 ,
```

PDJSO -0.000708995 /

DRSO(A) coefficients of row soybean oil demand equation
/ PDRRO 0.002374269 ,
PDRSO -0.011344118 /

DRSOS(A) coeff of row soybean oil stock demand equation
/ PDRSOS -0.000156235 /

DCRM(B) coefficients of canadian rape meal demand equation
/ PDCRM -0.001326316 ,
PDCSM 0.001224407 /

DURM(B) coefficients of us rape meal demand equation
/ PDURM -0.0034875 ,
PDUSM 0.000962069 /

DERM(B) coefficients of eu rape meal demand equation
/ PDERM -0.017118605 ,
PDESM 0.002697377 /

DJRM(B) coefficients of japan rape meal demand equation
/ PDJRM -0.004141304 ,
PDJSM 0.000532581 /

DRRM(B) coefficients of row rape meal demand equation
/ PDRRM -0.029923077 ,
PDRSM 0.010919298 /

DRRMS(B) coeff of row rape meal stock demand equation
/ PDRRMS -0.001723077 /

DCSM(B) coefficients of canadian soybean meal demand equation
/ PDCRM 0.003268421 ,
PDCSM -0.003386441 /

DUSM(B) coefficients of us soybean meal demand equation
/ PDURM 0.00057075 ,
PDUSM -0.031489655 /

DUSMS(B) coeff of us soybean meal stock demand equation
/ PDUSMS -0.000362069 /

```
DESM(B)  coefficients of eu soybean meal demand equation
         / PDERM     0.021007442 ,
           PDESM    -0.023559016 /

DJSM(B)  coefficients of japanese soybean meal demand equation
         / PDJRM     0.003217391 ,
           PDJSM    -0.007758065 /

DRSM(B)  coefficients of row soybean meal demand equation
         / PDRRM     0.040115385 ,
           PDRSM    -0.043915789 /

DRSMS(B)  coeff of row soybean meal stock demand equation
         / PDRSM     -0.004335088 /

DCRSS(E)  coeff of canada rapeseed stock demand equation
         / PDCRSS     -0.00235443  /

DERSS(E)  coeff of eu rapeseed stock demand equation
         / PDERSS      -0.00031875 /

DRRSS(E)  coeff of row rapeseed stock demand equation
         / PDRRSS      -0.00043875 /

DUSBS(E)  coeff of us soybean stock demand equation
         / PDUSBS    -0.05334375 /

DRSBS(E)  coeff of row soybean stock demand equation
         / PDRSBS    -0.018692308 /

CC(F)  crushing costs in mln dls per mln tonne
        / QCRS     43 ,
          QURS     47 ,
          QERS     43 ,
          QJRS     55 ,
          QRRS     44 ,
          QCSB     42 ,
          QUSB     41 ,
          QESB     41.45 ,
          QJSB     53 ,
          QRSB     40.02 /

TRANOIL(G)  transpt plus tax costs for oil flow in mln dls per mln tonne
```

```
   TJUSO     80 ,
   TJESO     90 ,
   TJJSO      0.2 ,
   TJRSO     95 ,
   TRCSO     65 ,
   TRUSO     75 ,
   TRESO     75 ,
   TRJSO    300 ,
   TRRSO     -5.1 ,
   TRRSOS    -5 /

TRANMEAL(H)  transpt plus tax costs for meal flow in mln dls per mln tonne
 / TCCRM     -4.9 ,
   TCURM     15 ,
   TCERM     45 ,
   TCJRM     35 ,
   TCRRM     22.4 ,
   TUCRM     15 ,
   TUURM     -5 ,
   TUERM     50 ,
   TUJRM     45 ,
   TURRM     50 ,
   TECRM     50 ,
   TEURM     55 ,
   TEERM     -0.25 ,
   TEJRM     65 ,
   TERRM     60 ,
   TJCRM     45 ,
   TJURM     50 ,
   TJERM     70 ,
   TJJRM      7.5 ,
   TJRRM     65 ,
   TRCRM     50 ,
   TRURM     55 ,
   TRERM      9.85 ,
   TRJRM     25 ,
   TRRRM      0 ,
   TRRRMS     0 ,
   TCCSM     -5 ,
   TCUSM     20 ,
   TCESM     40 ,
   TCJSM     60 ,
   TCRSM     55 ,
```

```
        TUCSM     8.25 ,
        TUUSM    -3.5 ,
        TUUSMS   -3.5 ,
        TUESM    21.87 ,
        TUJSM    31 ,
        TURSM     5.02 ,
        TECSM    45 ,
        TEUSM    55 ,
        TEESM    -0.1 ,
        TEJSM    65 ,
        TERSM    50 ,
        TJCSM    65 ,
        TJUSM    45 ,
        TJESM    65 ,
        TJJSM     7.5 ,
        TJRSM    50 ,
        TRCSM    30 ,
        TRUSM    35 ,
        TRESM    16.95 ,
        TRJSM    25 ,
        TRRSM     0.1 ,
        TRRSMS    0.1 /

TRANSEED(I)  transpt plus tax costs for seed  flow in mln dls per tonne
      / TCCRS    -5 ,
        TCCRSS   -5 ,
        TCURS    10 ,
        TCERS    -1.33 ,
        TCJRS    38.3 ,
        TCRRS     1.6 ,
        TUCRS    20 ,
        TUURS     0 ,
        TUERS    40 ,
        TUJRS    35 ,
        TURRS    40 ,
        TECRS    35 ,
        TEURS    40 ,
        TEERS    -3 ,
        TEERSS   -3 ,
        TEJRS    36.65 ,
        TERRS     0 ,
        TJCRS    30 ,
        TJURS    40 ,
```

TJERS 55 ,
TJJRS 0 ,
TJRRS 55 ,
TRCRS 60 ,
TRURS 65 ,
TRERS 39.95 ,
TRJRS 40 ,
TRRRS -5 ,
TRRRSS -5 ,
TCCSB -5 ,
TCUSB 10 ,
TCESB 35 ,
TCJSB 55 ,
TCRSB 45 ,
TUCSB 15 ,
TUUSB 3 ,
TUUSBS 3 ,
TUESB 16.1 ,
TUJSB 21.65 ,
TURSB -0.95 ,
TECSB 40 ,
TEUSB 30 ,
TEESB 0 ,
TEJSB 65 ,
TERSB 45 ,
TJCSB 50 ,
TJUSB 50 ,
TJESB 55 ,
TJJSB 0 ,
TJRSB 55 ,
TRCSB 40 ,
TRUSB 35 ,
TRESB 18.05 ,
TRJSB 23.65 ,
TRRSB 1 ,
TRRSBS 1 /

YLDOIL(A) yield of oil obtained from given seed
/ PDCRO 0.415 ,
PDURO 0.415 ,
PDERO 0.41 ,
PDJRO 0.415 ,
PDRRO 0.385 ,

```
        PDCSO   0.182 ,
        PDUSO   0.182 ,
        PDESO   0.189 ,
        PDJSO   0.183 ,
        PDRSO   0.180 /

YLDMEAL(B)  yield of meal obtained from given seed
       / PDCRM   0.60 ,
        PDURM   0.60 ,
        PDERM   0.585 ,
        PDJRM   0.60 ,
        PDRRM   0.60 ,
        PDCSM   0.80 ,
        PDUSM   0.797 ,
        PDESM   0.803 ,
        PDJSM   0.79 ,
        PDRSM   0.80 /

SUPPLY(E)  commodity supplies available in mln tonnes
       / PDCRS    5.86 ,
        PDCRSS  0.0 ,
        PDURS    0.1 ,
        PDERS    5.87 ,
        PDERSS  0.0 ,
        PDJRS     0.0 ,
        PDRRS  14.12 ,
        PDRRSS  0.0 ,
        PDCSB    1.5 ,
        PDUSB  56.28 ,
        PDUSBS  0.0 ,
        PDESB    0.0 ,
        PDJSB    0.0 ,
        PDRSB   59.83 ,
        PDRSBS   0.0 /

SUPPLYO(A)  beginning oil stocks in mln tonnes
       / PDRROS   0.41 ,
        PDUSOS   0.71 ,
        PDRSOS    1.06 /

SUPPLYM(B)  beginning meal stocks inmln tonnes
       / PDRRMS   0.48 ,
        PDUSMS    0.19 ,
```

```
        PDRSMS    3.49 /

  CAPACITY(F)  the crush capacities of each seed for each region
         / QCRS    2.200000 ,
           QURS    0.350000 ,
           QERS    8.000000 ,
           QJRS    2.200000 ,
           QRRS   20.000000 ,
           QCSB    1.050000 ,
           QUSB   40.000000 ,
           QESB   18.000000 ,
           QJSB    7.000000 ,
           QRSB   54.000000 / ;

VARIABLES
  NR  net revenue for oilseeds complex included
  OIL(A)
  MEAL(B)
  SEED(E)
  CRUSH(F)

  FLOWOIL(G)
  FLOWMEAL(H)
  FLOWSEED(I) ;

POSITIVE VARIABLES
  OIL , MEAL , SEED , CRUSH , FLOWOIL , FLOWMEAL , FLOWSEED ;

EQUATIONS
  OBJFUN  objective function of net revenues
  C1R001  rape oil price differences less than transport costs
  C1R002
  C1R003
  C1R004
  C1R005
  C1R006
  C1R007
  C1R008
  C1R009
  C1R010
  C1R011
  C1R012
  C1R013
```

C1R014
C1R015
C1R016
C1R017
C1R018
C1R019
C1R020
C1R021
C1R023 soybean oil price differences less than transport costs
C1R024
C1R025
C1R026
C1R027
C1R028
C1R029
C1R030
C1R031
C1R032
C1R033
C1R034
C1R035
C1R036
C1R037
C1R038
C1R039
C1R040
C1R041
C1R042
C1R043
C1R044
C1R046 rape meal price differences less than transport costs
C1R047
C1R048
C1R049
C1R050
C1R051
C1R052
C1R053
C1R054
C1R055
C1R056
C1R057
C1R058

C1R059
C1R060
C1R061
C1R062
C1R063
C1R064
C1R065
C1R066
C1R068 soy meal price differences less than transport costs
C1R069
C1R070
C1R071
C1R072
C1R073
C1R074
C1R075
C1R076
C1R077
C1R078
C1R079
C1R080
C1R081
C1R082
C1R083
C1R084
C1R085
C1R086
C1R087
C1R088
C1R089
C1R091 rapeseed price differences less than transport costs
C1R092
C1R093
C1R094
C1R095
C1R096
C1R097
C1R098
C1R099
C1R100
C1R101
C1R102
C1R103

C1R104
C1R105
C1R106
C1R107
C1R108
C1R109
C1R110
C1R111
C1R112
C1R113
C1R115 soybean price differences less than transport costs
C1R116
C1R117
C1R118
C1R119
C1R120
C1R121
C1R122
C1R123
C1R124
C1R125
C1R126
C1R127
C1R128
C1R129
C1R130
C1R131
C1R132
C1R133
C1R134
C1R135
C1R136

C2R139 marginal crushing revenue equilibrium conditions
C2R140
C2R141
C2R142
C2R143
C2R144
C2R145
C2R146
C2R147
C2R148

C2R149
C2R150
C2R151
C2R152
C2R153
C2R154
C2R155
C2R156
C2R157
C2R158
C2R159
C2R160
C2R161
C2R162
C2R163
C2R164
C2R165
C2R166
C2R167
C2R168
C2R169
C2R170
C2R171
C2R172
C2R173
C2R174
C2R175
C2R176
C2R177
C2R178
C2R179
C2R180
C2R181
C2R182
C2R183
C2R184
C2R185
C2R186
C2R187
C2R188

C3R190 supply of oils constraints
C3R191

C3R192
C3R193
C3R194
C3R195
C3R196
C3R197
C3R198
C3R199
C3R200
C3R201
C3R202

C4R204 supply of meals constraints
C4R205
C4R206
C4R207
C4R208
C4R209
C4R210
C4R211
C4R212
C4R213
C4R214
C4R215
C4R216

C5R218 crush activity is not more than seed stocks available
C5R218A
C5R219
C5R220
C5R220A
C5R221
C5R222
C5R222A
C5R223
C5R224
C5R224A
C5R225
C5R226
C5R227
C5R227A

C6R229 regional seed supplies meet or exceed demand

C6R230
C6R231
C6R232
C6R233
C6R234
C6R235
C6R236
C6R237
C6R238

C7R240 regional oil yields meet or exceed outflow
C7R241
C7R242
C7R243
C7R244
C7R245
C7R246
C7R247
C7R248
C7R249

C8R251 regional meal yields meet or exceed outflow
C8R252
C8R253
C8R254
C8R255
C8R256
C8R257
C8R258
C8R259
C8R260

C9R262 maximum crush capacities constraints
C9R263
C9R264
C9R265
C9R266
C9R267
C9R268
C9R269
C9R270
C9R271 ;

```
OBJFUN.. NR =E= (OILCONS("PDCRO") +DCRO("PDCRO")/2*OIL("PDCRO")
         + ((DCRO("PDCSO")+DCSO("PDCRO"))/2)/2*OIL("PDCSO"))
                        * OIL("PDCRO")

        + (OILCONS("PDURO") + DURO("PDURO")/2*OIL("PDURO")
         + ((DURO("PDUSO")+DUSO("PDURO"))/2)/2*OIL("PDUSO"))
                        * OIL("PDURO")

        + (OILCONS("PDERO") + DERO("PDERO")/2*OIL("PDERO")
         + ((DERO("PDESO")+DESO("PDERO"))/2)/2*OIL("PDESO"))
                        * OIL("PDERO")

        + (OILCONS("PDJRO") + DJRO("PDJRO")/2*OIL("PDJRO")
         + ((DJRO("PDJSO")+DJSO("PDJRO"))/2)/2*OIL("PDJSO"))
                        * OIL("PDJRO")

        + (OILCONS("PDRRO") + DRRO("PDRRO")/2*OIL("PDRRO")
         + ((DRRO("PDRSO")+DRSO("PDRRO"))/2)/2*OIL("PDRSO"))
                        * OIL("PDRRO")

        + (OILCONS("PDCSO") + DCSO("PDCSO")/2*OIL("PDCSO")
         + ((DCRO("PDCSO")+DCSO("PDCRO"))/2)/2*OIL("PDCRO"))
                        * OIL("PDCSO")

        + (OILCONS("PDUSO") + DUSO("PDUSO")/2*OIL("PDUSO")
         + ((DURO("PDUSO")+DUSO("PDURO"))/2)/2*OIL("PDURO"))
                        * OIL("PDUSO")

        + (OILCONS("PDESO") + DESO("PDESO")/2*OIL("PDESO")
         + ((DERO("PDESO")+DESO("PDERO"))/2)/2*OIL("PDERO"))
                        * OIL("PDESO")

        + (OILCONS("PDJSO") + DJSO("PDJSO")/2*OIL("PDJSO")
         + ((DJRO("PDJSO")+DJSO("PDJRO"))/2)/2*OIL("PDJRO"))
                        * OIL("PDJSO")

        + (OILCONS("PDRSO") + DRSO("PDRSO")/2*OIL("PDRSO")
         + ((DRRO("PDRSO")+DRSO("PDRRO"))/2)/2*OIL("PDRRO"))
                        * OIL("PDRSO")

       + (MEALCONS("PDCRM") + DCRM("PDCRM")/2*MEAL("PDCRM")
        + ((DCRM("PDCSM")+DCSM("PDCRM"))/2)/2*MEAL("PDCSM"))
                        * MEAL("PDCRM")
```

```
+ (MEALCONS("PDURM") + DURM("PDURM")/2*MEAL("PDURM")
  + ((DURM("PDUSM")+DUSM("PDURM"))/2)/2*MEAL("PDUSM"))
                  * MEAL("PDURM")

+ (MEALCONS("PDERM") + DERM("PDERM")/2*MEAL("PDERM")
  + ((DERM("PDESM")+DESM("PDERM"))/2)/2*MEAL("PDESM"))
                  * MEAL("PDERM")

+ (MEALCONS("PDJRM") + DJRM("PDJRM")/2*MEAL("PDJRM")
  + ((DJRM("PDJSM")+DJSM("PDJRM"))/2)/2*MEAL("PDJSM"))
                  * MEAL("PDJRM")

+ (MEALCONS("PDRRM") + DRRM("PDRRM")/2*MEAL("PDRRM")
  + ((DRRM("PDRSM")+DRSM("PDRRM"))/2)/2*MEAL("PDRSM"))
                  * MEAL("PDRRM")

+ (MEALCONS("PDCSM") + DCSM("PDCSM")/2*MEAL("PDCSM")
  + ((DCRM("PDCSM")+DCSM("PDCRM"))/2)/2*MEAL("PDCRM"))
                  * MEAL("PDCSM")

+ (MEALCONS("PDUSM") + DUSM("PDUSM")/2*MEAL("PDUSM")
  + ((DURM("PDUSM")+DUSM("PDURM"))/2)/2*MEAL("PDURM"))
                  * MEAL("PDUSM")

+ (MEALCONS("PDESM") + DESM("PDESM")/2*MEAL("PDESM")
  + ((DERM("PDESM")+DESM("PDERM"))/2)/2*MEAL("PDERM"))
                  * MEAL("PDESM")

+ (MEALCONS("PDJSM") + DJSM("PDJSM")/2*MEAL("PDJSM")
  + ((DJRM("PDJSM")+DJSM("PDJRM"))/2)/2*MEAL("PDJRM"))
                  * MEAL("PDJSM")

+ (MEALCONS("PDRSM") + DRSM("PDRSM")/2*MEAL("PDRSM")
  + ((DRRM("PDRSM")+DRSM("PDRRM"))/2)/2*MEAL("PDRRM"))
                  * MEAL("PDRSM")

- SUM(E , SUPPLY(E) * SEED(E))
- SUM(F , CC(F) * CRUSH(F))
- SUM(G , TRANOIL(G) * FLOWOIL(G))
- SUM(H , TRANMEAL(H) * FLOWMEAL(H))
- SUM(I , TRANSEED(I) * FLOWSEED(I)) ;
```

```
C1R001.. OIL("PDCRO") - OIL("PDURO") =G=
                     - TRANOIL("TCURO") ;
C1R002.. OIL("PDCRO") - 0.90*OIL("PDERO") =G=
                     - TRANOIL("TCERO") ;
C1R003.. OIL("PDCRO") - OIL("PDJRO") =G=
                     - TRANOIL("TCJRO") ;
C1R004.. OIL("PDCRO") - 0.85*OIL("PDRRO") =G=
                     - TRANOIL("TCRRO") ;
C1R005.. OIL("PDURO") - OIL("PDCRO") =G=
                     - TRANOIL("TUCRO") ;
C1R006.. OIL("PDURO") - 0.90*OIL("PDERO") =G=
                     - TRANOIL("TUERO") ;
C1R007.. OIL("PDURO") - OIL("PDJRO") =G=
                     - TRANOIL("TUJRO") ;
C1R008.. OIL("PDURO") - 0.85*OIL("PDRRO") =G=
                     - TRANOIL("TURRO") ;
C1R009.. OIL("PDERO") - 0.90*OIL("PDCRO") =G=
                     - TRANOIL("TECRO") ;
C1R010.. OIL("PDERO") - 0.925*OIL("PDURO") =G=
                     - TRANOIL("TEURO") ;
C1R011.. OIL("PDERO") - OIL("PDJRO") =G=
                     - TRANOIL("TEJRO") ;
C1R012.. OIL("PDERO") - 0.85*OIL("PDRRO") =G=
                     - TRANOIL("TERRO") ;
C1R013.. OIL("PDJRO") - 0.90*OIL("PDCRO") =G=
                     - TRANOIL("TJCRO") ;
C1R014.. OIL("PDJRO") - 0.925*OIL("PDURO") =G=
                     - TRANOIL("TJURO") ;
C1R015.. OIL("PDJRO") - 0.90*OIL("PDERO") =G=
                     - TRANOIL("TJERO") ;
C1R016.. OIL("PDJRO") - 0.85*OIL("PDRRO") =G=
                     - TRANOIL("TJRRO") ;
C1R017.. OIL("PDRRO") - 0.90*OIL("PDCRO") =G=
                     - TRANOIL("TRCRO") ;
C1R018.. OIL("PDRRO") - 0.925*OIL("PDURO") =G=
                     - TRANOIL("TRURO") ;
C1R019.. OIL("PDRRO") - 0.90*OIL("PDERO") =G=
                     - TRANOIL("TRERO") ;
C1R020.. OIL("PDRRO") - OIL("PDJRO") =G=
                     - TRANOIL("TRJRO") ;
C1R021.. - OIL("PDRRO") + OIL("PDRROS") =E=          0 ;
C1R023.. OIL("PDCSO") - OIL("PDUSO") =G=
                     - TRANOIL("TCUSO") ;
```

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C1R024.. OIL("PDCSO") - 0.90*OIL("PDESO") =G=
                         - TRANOIL("TCESO") ;
C1R025.. OIL("PDCSO") - OIL("PDJRO") =G=
                         - TRANOIL("TCJSO") ;
C1R026.. OIL("PDCSO") - 0.85*OIL("PDRRO") =G=
                         - TRANOIL("TCRSO") ;
C1R027.. OIL("PDUSO") - OIL("PDCSO") =G=
                         - TRANOIL("TUCSO") ;
C1R028.. OIL("PDUSO") - 0.90*OIL("PDESO") =G=
                         - TRANOIL("TUESO") ;
C1R029.. OIL("PDUSO") - OIL("PDJSO") =G=
                         - TRANOIL("TUJSO") ;
C1R030.. 0.98*OIL("PDUSO") - 0.85*OIL("PDRSO") =G=
                         - TRANOIL("TURSO") ;
C1R031.. - OIL("PDUSO") + OIL("PDUSOS") =E=          0 ;
C1R032.. OIL("PDESO") - 0.925*OIL("PDCSO") =G=
                         - TRANOIL("TECSO") ;
C1R033.. OIL("PDESO") - 0.775*OIL("PDUSO") =G=
                         - TRANOIL("TEUSO") ;
C1R034.. OIL("PDESO") - OIL("PDJSO") =G=
                         - TRANOIL("TEJSO") ;
C1R035.. OIL("PDESO") - 0.85*OIL("PDRSO") =G=
                         - TRANOIL("TERSO") ;
C1R036.. OIL("PDJSO") - 0.925*OIL("PDCSO") =G=
                         - TRANOIL("TJCSO") ;
C1R037.. OIL("PDJSO") - 0.775*OIL("PDUSO") =G=
                         - TRANOIL("TJUSO") ;
C1R038.. OIL("PDJSO") - 0.90*OIL("PDESO") =G=
                         - TRANOIL("TJESO") ;
C1R039.. OIL("PDJSO") - 0.85*OIL("PDRSO") =G=
                         - TRANOIL("TJRSO") ;
C1R040.. OIL("PDRSO") - 0.925*OIL("PDCSO") =G=
                         - TRANOIL("TRCSO") ;
C1R041.. OIL("PDRSO") - 0.775*OIL("PDUSO") =G=
                         - TRANOIL("TRUSO") ;
C1R042.. OIL("PDRSO") - 0.90*OIL("PDESO") =G=
                         - TRANOIL("TRESO") ;
C1R043.. OIL("PDRSO") - OIL("PDJSO") =G=
                         - TRANOIL("TRJSO") ;
C1R044.. - OIL("PDRSO") + OIL("PDRSOS") =E=          0 ;
C1R046.. MEAL("PDCRM") - MEAL("PDURM") =G=
                         - TRANMEAL("TCURM") ;
C1R047.. MEAL("PDCRM") - 0.90*MEAL("PDERM") =G=
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                              - TRANMEAL("TCERM") ;
C1R048.. MEAL("PDCRM") - MEAL("PDJRM") =G=
                              - TRANMEAL("TCJRM") ;
C1R049.. MEAL("PDCRM") - MEAL("PDRRM") =G=
                              - TRANMEAL("TCRRM") ;
C1R050.. MEAL("PDURM") - MEAL("PDCRM") =G=
                              - TRANMEAL("TUCRM") ;
C1R051.. MEAL("PDURM") - 0.90*MEAL("PDERM") =G=
                              - TRANMEAL("TUERM") ;
C1R052.. MEAL("PDURM") - MEAL("PDJRM") =G=
                              - TRANMEAL("TUJRM") ;
C1R053.. MEAL("PDURM") - MEAL("PDRRM") =G=
                              - TRANMEAL("TURRM") ;
C1R054.. MEAL("PDERM") - MEAL("PDCRM") =G=
                              - TRANMEAL("TECRM") ;
C1R055.. MEAL("PDERM") - MEAL("PDURM") =G=
                              - TRANMEAL("TEURM") ;
C1R056.. MEAL("PDERM") - MEAL("PDJRM") =G=
                              - TRANMEAL("TEJRM") ;
C1R057.. MEAL("PDERM") - MEAL("PDRRM") =G=
                              - TRANMEAL("TERRM") ;
C1R058.. MEAL("PDJRM") - MEAL("PDCRM") =G=
                              - TRANMEAL("TJCRM") ;
C1R059.. MEAL("PDJRM") - MEAL("PDURM") =G=
                              - TRANMEAL("TJURM") ;
C1R060.. MEAL("PDJRM") - 0.90*MEAL("PDERM") =G=
                              - TRANMEAL("TJERM") ;
C1R061.. MEAL("PDJRM") - MEAL("PDRRM") =G=
                              - TRANMEAL("TJRRM") ;
C1R062.. MEAL("PDRRM") - MEAL("PDCRM") =G=
                              - TRANMEAL("TRCRM") ;
C1R063.. MEAL("PDRRM") - MEAL("PDURM") =G=
                              - TRANMEAL("TRURM") ;
C1R064.. MEAL("PDRRM") - 0.90*MEAL("PDERM") =G=
                              - TRANMEAL("TRERM") ;
C1R065.. MEAL("PDRRM") - MEAL("PDJRM") =G=
                              - TRANMEAL("TRJRM") ;
C1R066.. - MEAL("PDRRM") + MEAL("PDRRMS") =E=          0 ;
C1R068.. MEAL("PDCSM") - MEAL("PDUSM") =G=
                              - TRANMEAL("TCUSM") ;
C1R069.. MEAL("PDCSM") - 0.90*MEAL("PDESM") =G=
                              - TRANMEAL("TCESM") ;
C1R070.. MEAL("PDCSM") - MEAL("PDJRM") =G=
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                    - TRANMEAL("TCJSM") ;
C1R071.. MEAL("PDCSM") - MEAL("PDRRM") =G=
                    - TRANMEAL("TCRSM") ;
C1R072.. MEAL("PDUSM") - MEAL("PDCSM") =G=
                    - TRANMEAL("TUCSM") ;
C1R073.. MEAL("PDUSM") - 0.90*MEAL("PDESM") =G=
                    - TRANMEAL("TUESM") ;
C1R074.. MEAL("PDUSM") - MEAL("PDJSM") =G=
                    - TRANMEAL("TUJSM") ;
C1R075.. 0.98*MEAL("PDUSM") - MEAL("PDRSM") =G=
                    - TRANMEAL("TURSM") ;
C1R076..  - MEAL("PDUSM") + MEAL("PDUSMS") =E=          0 ;
C1R077.. MEAL("PDESM") - MEAL("PDCSM") =G=
                    - TRANMEAL("TECSM") ;
C1R078.. MEAL("PDESM") - MEAL("PDUSM") =G=
                    - TRANMEAL("TEUSM") ;
C1R079.. MEAL("PDESM") - MEAL("PDJSM") =G=
                    - TRANMEAL("TEJSM") ;
C1R080.. MEAL("PDESM") - MEAL("PDRSM") =G=
                    - TRANMEAL("TERSM") ;
C1R081.. MEAL("PDJSM") - MEAL("PDCSM") =G=
                    - TRANMEAL("TJCSM") ;
C1R082.. MEAL("PDJSM") - MEAL("PDUSM") =G=
                    - TRANMEAL("TJUSM") ;
C1R083.. MEAL("PDJSM") - 0.90*MEAL("PDESM") =G=
                    - TRANMEAL("TJESM") ;
C1R084.. MEAL("PDJSM") - MEAL("PDRSM") =G=
                    - TRANMEAL("TJRSM") ;
C1R085.. MEAL("PDRSM") - MEAL("PDCSM") =G=
                    - TRANMEAL("TRCSM") ;
C1R086.. MEAL("PDRSM") - MEAL("PDUSM") =G=
                    - TRANMEAL("TRUSM") ;
C1R087.. MEAL("PDRSM") - 0.90*MEAL("PDESM") =G=
                    - TRANMEAL("TRESM") ;
C1R088.. MEAL("PDRSM") - MEAL("PDJSM") =G=
                    - TRANMEAL("TRJSM") ;
C1R089.. - MEAL("PDRSM") + MEAL("PDRSMS") =E=          0 ;
C1R091.. SEED("PDCRS") - SEED("PDURS") =G=
                    - TRANSEED("TCURS") ;
C1R092.. SEED("PDCRS") - SEED("PDERS") =G=
                    - TRANSEED("TCERS") ;
C1R093.. SEED("PDCRS") - SEED("PDJRS") =G=
                    - TRANSEED("TCJRS") ;
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C1R094.. SEED("PDCRS") - SEED("PDRRS") =G=
                           - TRANSEED("TCRRS") ;
C1R095.. - SEED("PDCRS") + SEED("PDCRSS") =E=          0 ;
C1R096.. SEED("PDURS") - SEED("PDCRS") =G=
                           - TRANSEED("TUCRS") ;
C1R097.. SEED("PDURS") - SEED("PDERS") =G=
                           - TRANSEED("TUERS") ;
C1R098.. SEED("PDURS") - SEED("PDJRS") =G=
                           - TRANSEED("TUJRS") ;
C1R099.. SEED("PDURS") - SEED("PDRRS") =G=
                           - TRANSEED("TURRS") ;
C1R100.. SEED("PDERS") - SEED("PDCRS") =G=
                           - TRANSEED("TECRS") ;
C1R101.. SEED("PDERS") - SEED("PDURS") =G=
                           - TRANSEED("TEURS") ;
C1R102.. SEED("PDERS") - SEED("PDJRS") =G=
                           - TRANSEED("TEJRS") ;
C1R103.. SEED("PDERS") - SEED("PDRRS") =G=
                           - TRANSEED("TERRS") ;
C1R104.. - SEED("PDERS") + SEED("PDERSS") =E=          0 ;
C1R105.. SEED("PDJRS") - SEED("PDCRS") =G=
                           - TRANSEED("TJCRS") ;
C1R106.. SEED("PDJRS") - SEED("PDURS") =G=
                           - TRANSEED("TJURS") ;
C1R107.. SEED("PDJRS") - SEED("PDERS") =G=
                           - TRANSEED("TJERS") ;
C1R108.. SEED("PDJRS") - SEED("PDRRS") =G=
                           - TRANSEED("TJRRS") ;
C1R109.. SEED("PDRRS") - SEED("PDCRS") =G=
                           - TRANSEED("TRCRS") ;
C1R110.. SEED("PDRRS") - SEED("PDURS") =G=
                           - TRANSEED("TRURS") ;
C1R111.. SEED("PDRRS") - SEED("PDERS") =G=
                           - TRANSEED("TRERS") ;
C1R112.. SEED("PDRRS") - SEED("PDJRS") =G=
                           - TRANSEED("TRJRS") ;
C1R113.. - SEED("PDRRS") + SEED("PDRRSS") =E=          0 ;
C1R115.. SEED("PDCSB") - SEED("PDUSB") =G=
                           - TRANSEED("TCUSB") ;
C1R116.. SEED("PDCSB") - SEED("PDESB") =G=
                           - TRANSEED("TCESB") ;
C1R117.. SEED("PDCSB") - SEED("PDJSB") =G=
                           - TRANSEED("TCJSB") ;
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C1R118.. SEED("PDCSB") - SEED("PDRSB") =G=
                    - TRANSEED("TCRSB") ;
C1R119.. SEED("PDUSB") - SEED("PDCSB") =G=
                    - TRANSEED("TUCSB") ;
C1R120.. SEED("PDUSB") - SEED("PDESB") =G=
                    - TRANSEED("TUESB") ;
C1R121.. SEED("PDUSB") - SEED("PDJSB") =G=
                    - TRANSEED("TUJSB") ;
C1R122.. 0.98*SEED("PDUSB") - SEED("PDRSB") =G=
                    - TRANSEED("TURSB") ;


C1R123.. - SEED("PDUSB") + SEED("PDUSBS") =E=        0 ;
C1R124.. SEED("PDESB") - SEED("PDCSB") =G=
                    - TRANSEED("TECSB") ;
C1R125.. SEED("PDESB") - SEED("PDUSB") =G=
                    - TRANSEED("TEUSB") ;
C1R126.. SEED("PDESB") - SEED("PDJSB") =G=
                    - TRANSEED("TEJSB") ;
C1R127.. SEED("PDESB") - SEED("PDRSB") =G=
                    - TRANSEED("TERSB") ;
C1R128.. SEED("PDJSB") - SEED("PDCSB") =G=
                    - TRANSEED("TJCSB") ;
C1R129.. SEED("PDJSB") - SEED("PDUSB") =G=
                    - TRANSEED("TJUSB") ;
C1R130.. SEED("PDJSB") - SEED("PDESB") =G=
                    - TRANSEED("TJESB") ;
C1R131.. SEED("PDJSB") - SEED("PDRSB") =G=
                    - TRANSEED("TJRSB") ;
C1R132.. SEED("PDRSB") - SEED("PDCSB") =G=
                    - TRANSEED("TRCSB") ;
C1R133.. SEED("PDRSB") - SEED("PDUSB") =G=
                    - TRANSEED("TRUSB") ;
C1R134.. SEED("PDRSB") - SEED("PDESB") =G=
                    - TRANSEED("TRESB") ;
C1R135.. SEED("PDRSB") - SEED("PDJSB") =G=
                    - TRANSEED("TRJSB") ;
C1R136.. - SEED("PDRSB") + SEED("PDRSBS") =E=        0 ;

C2R139.. YLDOIL("PDCRO")*OIL("PDCRO") + YLDMEAL("PDCRM")*
     MEAL("PDCRM") - SEED("PDCRS") =L=
              (CC("QCRS") + TRANSEED("TCCRS")) ;
C2R140.. YLDOIL("PDURO")*OIL("PDURO") + YLDMEAL("PDURM")*
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      MEAL("PDURM") - SEED("PDCRS") =L=
                    (CC("QURS") + TRANSEED("TCURS")) ;
C2R141.. YLDOIL("PDERO")*OIL("PDERO") + YLDMEAL("PDERM")*
      MEAL("PDERM") - SEED("PDCRS") =L=
                    (CC("QERS") + TRANSEED("TCERS")) ;
C2R142.. YLDOIL("PDJRO")*OIL("PDJRO") + YLDMEAL("PDJRM")*
      MEAL("PDJRM") - SEED("PDCRS") =L=
                    (CC("QJRS") + TRANSEED("TCJRS")) ;
C2R143.. YLDOIL("PDRRO")*OIL("PDRRO") + YLDMEAL("PDRRM")*
      MEAL("PDRRM") - SEED("PDCRS") =L=
                    (CC("QRRS") + TRANSEED("TCRRS")) ;
C2R144.. YLDOIL("PDCSO")*OIL("PDCSO") + YLDMEAL("PDCSM")*
      MEAL("PDCSM") - SEED("PDCSB") =L=
                    (CC("QCSB") + TRANSEED("TCCSB")) ;
C2R145.. YLDOIL("PDUSO")*OIL("PDUSO") + YLDMEAL("PDUSM")*
      MEAL("PDUSM") - SEED("PDCSB") =L=
                    (CC("QUSB") + TRANSEED("TCUSB")) ;
C2R146.. YLDOIL("PDESO")*OIL("PDESO") + YLDMEAL("PDESM")*
      MEAL("PDESM") - SEED("PDCSB") =L=
                    (CC("QESB") + TRANSEED("TCESB")) ;
C2R147.. YLDOIL("PDJSO")*OIL("PDJSO") + YLDMEAL("PDJSM")*
      MEAL("PDJSM") - SEED("PDCSB") =L=
                    (CC("QJSB") + TRANSEED("TCJSB")) ;
C2R148.. YLDOIL("PDRSO")*OIL("PDRSO") + YLDMEAL("PDRSM")*
      MEAL("PDRSM") - SEED("PDCSB") =L=
                    (CC("QRSB") + TRANSEED("TCRSB")) ;
C2R149.. YLDOIL("PDCRO")*OIL("PDCRO") + YLDMEAL("PDCRM")*
      MEAL("PDCRM") - SEED("PDURS") =L=
                    (CC("QCRS") + TRANSEED("TUCRS")) ;
C2R150.. YLDOIL("PDURO")*OIL("PDURO") + YLDMEAL("PDURM")*
      MEAL("PDURM") - SEED("PDURS") =L=
                    (CC("QURS") + TRANSEED("TUURS")) ;
C2R151.. YLDOIL("PDERO")*OIL("PDERO") + YLDMEAL("PDERM")*
      MEAL("PDERM") - SEED("PDURS") =L=
                    (CC("QERS") + TRANSEED("TUERS")) ;
C2R152.. YLDOIL("PDJRO")*OIL("PDJRO") + YLDMEAL("PDJRM")*
      MEAL("PDJRM") - SEED("PDURS") =L=
                    (CC("QJRS") + TRANSEED("TUJRS")) ;
C2R153.. YLDOIL("PDRRO")*OIL("PDRRO") + YLDMEAL("PDRRM")*
      MEAL("PDRRM") - SEED("PDURS") =L=
                    (CC("QRRS") + TRANSEED("TURRS")) ;
C2R154.. YLDOIL("PDCSO")*OIL("PDCSO") + YLDMEAL("PDCSM")*
      MEAL("PDCSM") - SEED("PDUSB") =L=
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            (CC("QCSB") + TRANSEED("TUCSB")) ;
C2R155.. YLDOIL("PDUSO")*OIL("PDUSO") + YLDMEAL("PDUSM")*
     MEAL("PDUSM") - SEED("PDUSB") =L=
            (CC("QUSB") + TRANSEED("TUUSB")) ;
C2R156.. YLDOIL("PDESO")*OIL("PDESO") + YLDMEAL("PDESM")*
     MEAL("PDESM") - SEED("PDUSB") =L=
            (CC("QESB") + TRANSEED("TUESB")) ;
C2R157.. YLDOIL("PDJSO")*OIL("PDJSO") + YLDMEAL("PDJSM")*
     MEAL("PDJSM") - SEED("PDUSB") =L=
            (CC("QJSB") + TRANSEED("TUJSB")) ;
C2R158.. YLDOIL("PDRSO")*OIL("PDRSO") + YLDMEAL("PDRSM")*
     MEAL("PDRSM") - SEED("PDUSB") =L=
            (CC("QRSB") + TRANSEED("TURSB")) ;
C2R159.. YLDOIL("PDCRO")*OIL("PDCRO") + YLDMEAL("PDCRM")*
     MEAL("PDCRM") - SEED("PDERS") =L=
            (CC("QCRS") + TRANSEED("TECRS")) ;
C2R160.. YLDOIL("PDURO")*OIL("PDURO") + YLDMEAL("PDURM")*
     MEAL("PDURM") - SEED("PDERS") =L=
            (CC("QURS") + TRANSEED("TEURS")) ;
C2R161.. YLDOIL("PDERO")*OIL("PDERO") + YLDMEAL("PDERM")*
     MEAL("PDERM") - SEED("PDERS") =L=
            (CC("QERS") + TRANSEED("TEERS")) ;
C2R162.. YLDOIL("PDJRO")*OIL("PDJRO") + YLDMEAL("PDJRM")*
     MEAL("PDJRM") - SEED("PDERS") =L=
            (CC("QJRS") + TRANSEED("TEJRS")) ;
C2R163.. YLDOIL("PDRRO")*OIL("PDRRO") + YLDMEAL("PDRRM")*
     MEAL("PDRRM") - SEED("PDERS") =L=
            (CC("QRRS") + TRANSEED("TERRS")) ;
C2R164.. YLDOIL("PDCSO")*OIL("PDCSO") + YLDMEAL("PDCSM")*
     MEAL("PDCSM") - SEED("PDESB") =L=
            (CC("QCSB") + TRANSEED("TECSB")) ;
C2R165.. YLDOIL("PDUSO")*OIL("PDUSO") + YLDMEAL("PDUSM")*
     MEAL("PDUSM") - SEED("PDESB") =L=
            (CC("QUSB") + TRANSEED("TEUSB")) ;
C2R166.. YLDOIL("PDESO")*OIL("PDESO") + YLDMEAL("PDESM")*
     MEAL("PDESM") - SEED("PDESB") =L=
            (CC("QESB") + TRANSEED("TEESB")) ;
C2R167.. YLDOIL("PDJSO")*OIL("PDJSO") + YLDMEAL("PDJSM")*
     MEAL("PDJSM") - SEED("PDESB") =L=
            (CC("QJSB") + TRANSEED("TEJSB")) ;
C2R168.. YLDOIL("PDRSO")*OIL("PDRSO") + YLDMEAL("PDRSM")*
     MEAL("PDRSM") - SEED("PDESB") =L=
            (CC("QRSB") + TRANSEED("TERSB")) ;
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C2R169.. YLDOIL("PDCRO")*OIL("PDCRO") + YLDMEAL("PDCRM")*
      MEAL("PDCRM") - SEED("PDJRS") =L=
                  (CC("QCRS") + TRANSEED("TJCRS")) ;
C2R170.. YLDOIL("PDURO")*OIL("PDURO") + YLDMEAL("PDURM")*
      MEAL("PDURM") - SEED("PDJRS") =L=
                  (CC("QURS") + TRANSEED("TJURS")) ;
C2R171.. YLDOIL("PDERO")*OIL("PDERO") + YLDMEAL("PDERM")*
      MEAL("PDERM") - SEED("PDJRS") =L=
                  (CC("QERS") + TRANSEED("TJERS")) ;
C2R172.. YLDOIL("PDJRO")*OIL("PDJRO") + YLDMEAL("PDJRM")*
      MEAL("PDJRM") - SEED("PDJRS") =L=
                  (CC("QJRS") + TRANSEED("TJJRS")) ;
C2R173.. YLDOIL("PDRRO")*OIL("PDRRO") + YLDMEAL("PDRRM")*
      MEAL("PDRRM") - SEED("PDJRS") =L=
                  (CC("QRRS") + TRANSEED("TJRRS")) ;
C2R174.. YLDOIL("PDCSO")*OIL("PDCSO") + YLDMEAL("PDCSM")*
      MEAL("PDCSM") - SEED("PDJSB") =L=
                  (CC("QCSB") + TRANSEED("TJCSB")) ;
C2R175.. YLDOIL("PDUSO")*OIL("PDUSO") + YLDMEAL("PDUSM")*
      MEAL("PDUSM") - SEED("PDJSB") =L=
                  (CC("QUSB") + TRANSEED("TJUSB")) ;
C2R176.. YLDOIL("PDESO")*OIL("PDESO") + YLDMEAL("PDESM")*
      MEAL("PDESM") - SEED("PDJSB") =L=
                  (CC("QESB") + TRANSEED("TJESB")) ;
C2R177.. YLDOIL("PDJSO")*OIL("PDJSO") + YLDMEAL("PDJSM")*
      MEAL("PDJSM") - SEED("PDJSB") =L=
                  (CC("QJSB") + TRANSEED("TJJSB")) ;
C2R178.. YLDOIL("PDRSO")*OIL("PDRSO") + YLDMEAL("PDRSM")*
      MEAL("PDRSM") - SEED("PDJSB") =L=
                  (CC("QRSB") + TRANSEED("TJRSB")) ;
C2R179.. YLDOIL("PDCRO")*OIL("PDCRO") + YLDMEAL("PDCRM")*
      MEAL("PDCRM") - SEED("PDRRS") =L=
                  (CC("QCRS") + TRANSEED("TRCRS")) ;
C2R180.. YLDOIL("PDURO")*OIL("PDURO") + YLDMEAL("PDURM")*
      MEAL("PDURM") - SEED("PDRRS") =L=
                  (CC("QURS") + TRANSEED("TRURS")) ;
C2R181.. YLDOIL("PDERO")*OIL("PDERO") + YLDMEAL("PDERM")*
      MEAL("PDERM") - SEED("PDRRS") =L=
                  (CC("QERS") + TRANSEED("TRERS")) ;
C2R182.. YLDOIL("PDJRO")*OIL("PDJRO") + YLDMEAL("PDJRM")*
      MEAL("PDJRM") - SEED("PDRRS") =L=
                  (CC("QJRS") + TRANSEED("TRJRS")) ;
C2R183.. YLDOIL("PDRRO")*OIL("PDRRO") + YLDMEAL("PDRRM")*
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     MEAL("PDRRM") - SEED("PDRRS") =L=
               (CC("QRRS") + TRANSEED("TRRRS")) ;
C2R184.. YLDOIL("PDCSO")*OIL("PDCSO") + YLDMEAL("PDCSM")*
     MEAL("PDCSM") - SEED("PDRSB") =L=
               (CC("QCSB") + TRANSEED("TRCSB")) ;
C2R185.. YLDOIL("PDUSO")*OIL("PDUSO") + YLDMEAL("PDUSM")*
     MEAL("PDUSM") - SEED("PDRSB") =L=
               (CC("QUSB") + TRANSEED("TRUSB")) ;
C2R186.. YLDOIL("PDESO")*OIL("PDESO") + YLDMEAL("PDESM")*
     MEAL("PDESM") - SEED("PDRSB") =L=
               (CC("QESB") + TRANSEED("TRESB")) ;
C2R187.. YLDOIL("PDJSO")*OIL("PDJSO") + YLDMEAL("PDJSM")*
     MEAL("PDJSM") - SEED("PDRSB") =L=
               (CC("QJSB") + TRANSEED("TRJSB")) ;
C2R188.. YLDOIL("PDRSO")*OIL("PDRSO") + YLDMEAL("PDRSM")*
     MEAL("PDRSM") - SEED("PDRSB") =L=
               (CC("QRSB") + TRANSEED("TRRSB")) ;

C3R190.. SUM(A , DCRO(A)*OIL(A)) - FLOWOIL("TCCRO") -
     FLOWOIL("TUCRO") - FLOWOIL("TECRO") - FLOWOIL("TJCRO")
     - FLOWOIL("TRCRO")
                    =L= - OILCONS("PDCRO") ;
C3R191.. SUM(A , DURO(A)*OIL(A)) - FLOWOIL("TCURO") -
     FLOWOIL("TUURO") - FLOWOIL("TEURO") - FLOWOIL("TJURO")
     - FLOWOIL("TRURO")
                    =L= - OILCONS("PDURO") ;
C3R192.. SUM(A , DERO(A)*OIL(A)) - FLOWOIL("TCERO") -
     FLOWOIL("TUERO") - FLOWOIL("TEERO") - FLOWOIL("TJERO")
     - FLOWOIL("TRERO")
                    =L= - OILCONS("PDERO") ;
C3R193.. SUM(A , DJRO(A)*OIL(A)) - FLOWOIL("TCJRO") -
     FLOWOIL("TUJRO") - FLOWOIL("TEJRO") - FLOWOIL("TJJRO")
     - FLOWOIL("TRJRO")
                    =L= - OILCONS("PDJRO") ;
C3R194.. SUM(A , DRRO(A)*OIL(A)) - FLOWOIL("TCRRO") -
     FLOWOIL("TURRO") - FLOWOIL("TERRO") - FLOWOIL("TJRRO")
     - FLOWOIL("TRRRO")
                    =L= - OILCONS("PDRRO") ;
C3R195.. DRROS("PDRROS")*OIL("PDRROS") - FLOWOIL("TRRROS")
                    =L= - OILCONS("PDRROS") ;
C3R196.. SUM(A , DCSO(A)*OIL(A)) - FLOWOIL("TCCSO") -
     FLOWOIL("TUCSO") - FLOWOIL("TECSO") - FLOWOIL("TJCSO")
     - FLOWOIL("TRCSO")
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                    =L= - OILCONS("PDCSO") ;
C3R197.. SUM(A , DUSO(A)*OIL(A)) - FLOWOIL("TCUSO") -
     FLOWOIL("TUUSO") - FLOWOIL("TEUSO") - FLOWOIL("TJUSO")
     - FLOWOIL("TRUSO")
                    =L= - OILCONS("PDUSO") ;
C3R198.. SUM(A , DESO(A)*OIL(A)) - FLOWOIL("TCESO") -
     FLOWOIL("TUESO") - FLOWOIL("TEESO") - FLOWOIL("TJESO")
     - FLOWOIL("TRESO")
                    =L= - OILCONS("PDESO") ;
C3R199.. SUM(A , DJSO(A)*OIL(A)) - FLOWOIL("TCJSO") -
     FLOWOIL("TUJSO") - FLOWOIL("TEJSO") - FLOWOIL("TJJSO")
     - FLOWOIL("TRJSO")
                    =L= - OILCONS("PDJSO") ;
C3R200.. SUM(A , DRSO(A)*OIL(A)) - FLOWOIL("TCRSO") -
     FLOWOIL("TURSO") - FLOWOIL("TERSO") - FLOWOIL("TJRSO")
     - FLOWOIL("TRRSO")
                    =L= - OILCONS("PDRSO") ;
C3R201.. DUSOS("PDUSOS")*OIL("PDUSOS") - FLOWOIL("TUUSOS")
                    =L= - OILCONS("PDUSOS") ;
C3R202.. DRSOS("PDRSOS")*OIL("PDRSOS") - FLOWOIL("TRRSOS")
                    =L= - OILCONS("PDRSOS") ;

C4R204.. SUM(B , DCRM(B)*MEAL(B)) - FLOWMEAL("TCCRM") -
     FLOWMEAL("TUCRM") - FLOWMEAL("TECRM") -
     FLOWMEAL("TJCRM") - FLOWMEAL("TRCRM")
                    =L= - MEALCONS("PDCRM") ;
C4R205.. SUM(B , DURM(B)*MEAL(B)) - FLOWMEAL("TCURM") -
     FLOWMEAL("TUURM") - FLOWMEAL("TEURM") -
     FLOWMEAL("TJURM") - FLOWMEAL("TRURM")
                    =L= - MEALCONS("PDURM") ;
C4R206.. SUM(B , DERM(B)*MEAL(B)) - FLOWMEAL("TCERM") -
     FLOWMEAL("TUERM") - FLOWMEAL("TEERM") -
     FLOWMEAL("TJERM") - FLOWMEAL("TRERM")
                    =L= - MEALCONS("PDERM") ;
C4R207.. SUM(B , DJRM(B)*MEAL(B)) - FLOWMEAL("TCJRM") -
     FLOWMEAL("TUJRM") - FLOWMEAL("TEJRM") -
     FLOWMEAL("TJJRM") - FLOWMEAL("TRJRM")
                    =L= - MEALCONS("PDJRM") ;
C4R208.. SUM(B , DRRM(B)*MEAL(B)) - FLOWMEAL("TCRRM") -
     FLOWMEAL("TURRM") - FLOWMEAL("TERRM") -
     FLOWMEAL("TJRRM") - FLOWMEAL("TRRRM")
                    =L= - MEALCONS("PDRRM") ;
C4R209.. SUM(B , DCSM(B)*MEAL(B)) - FLOWMEAL("TCCSM") -
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      FLOWMEAL("TUCSM") - FLOWMEAL("TECSM") -
      FLOWMEAL("TJCSM") - FLOWMEAL("TRCSM")
                  =L= - MEALCONS("PDCSM") ;
C4R210.. SUM(B , DUSM(B)*MEAL(B)) - FLOWMEAL("TCUSM") -
      FLOWMEAL("TUUSM") - FLOWMEAL("TEUSM") -
      FLOWMEAL("TJUSM") - FLOWMEAL("TRUSM")
                  =L= - MEALCONS("PDUSM") ;
C4R211.. SUM(B , DESM(B)*MEAL(B)) - FLOWMEAL("TCESM") -
      FLOWMEAL("TUESM") - FLOWMEAL("TEESM") -
      FLOWMEAL("TJESM") - FLOWMEAL("TRESM")
                  =L= - MEALCONS("PDESM") ;
C4R212.. SUM(B , DJSM(B)*MEAL(B)) - FLOWMEAL("TCJSM") -
      FLOWMEAL("TUJSM") - FLOWMEAL("TEJSM") -
      FLOWMEAL("TJJSM") - FLOWMEAL("TRJSM")
                  =L= - MEALCONS("PDJSM") ;
C4R213.. SUM(B , DRSM(B)*MEAL(B)) - FLOWMEAL("TCRSM") -
      FLOWMEAL("TURSM") - FLOWMEAL("TERSM") -
      FLOWMEAL("TJRSM") - FLOWMEAL("TRRSM")
                  =L= - MEALCONS("PDRSM") ;
C4R214.. DRRMS("PDRRMS")*MEAL("PDRRMS") - FLOWMEAL("TRRRMS")
                  =L= - MEALCONS("PDRRMS") ;
C4R215.. DUSMS("PDUSMS")*MEAL("PDUSMS") - FLOWMEAL("TUUSMS")
                  =L= - MEALCONS("PDUSMS") ;
C4R216.. DRSMS("PDRSMS")*MEAL("PDRSMS") - FLOWMEAL("TRRSMS")
                  =L= - MEALCONS("PDRSMS") ;

C5R218.. CRUSH("QCRS") - FLOWSEED("TCCRS")  -
      FLOWSEED("TUCRS") - FLOWSEED("TECRS") -
      FLOWSEED("TJCRS") - FLOWSEED("TRCRS")
                  =L= 0 ;
C5R218A.. DCRSS("PDCRSS")*SEED("PDCRSS") - FLOWSEED("TCCRSS")
                  =L=     - SEEDCONS("PDCRSS") ;
C5R219.. CRUSH("QURS") - FLOWSEED("TCURS") -
      FLOWSEED("TUURS") - FLOWSEED("TEURS") -
      FLOWSEED("TJURS") - FLOWSEED("TRURS")
                  =L= 0 ;
C5R220.. CRUSH("QERS") - FLOWSEED("TCERS") -
      FLOWSEED("TUERS") -  FLOWSEED("TEERS") -
      FLOWSEED("TJERS") - FLOWSEED("TRERS")
                  =L= 0 ;
C5R220A.. DERSS("PDERSS")*SEED("PDERSS") - FLOWSEED("TEERSS")
                  =L=  - SEEDCONS("PDERSS") ;
C5R221.. CRUSH("QJRS") - FLOWSEED("TCJRS") - FLOWSEED("TUJRS")
```

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  - FLOWSEED("TEJRS") - FLOWSEED("TJJRS") -
  FLOWSEED("TRJRS")                    =L= 0 ;
C5R222.. CRUSH("QRRS") - FLOWSEED("TCRRS") -
  FLOWSEED("TURRS") - FLOWSEED("TERRS") -
  FLOWSEED("TJRRS") - FLOWSEED("TRRRS")
                 =L= 0 ;
C5R222A.. DRRSS("PDRRSS")*SEED("PDRRSS")  - FLOWSEED("TRRRSS")
                 =L= - SEEDCONS("PDRRSS") ;
C5R223.. CRUSH("QCSB") - FLOWSEED("TCCSB") - FLOWSEED("TUCSB")
  - FLOWSEED("TECSB") - FLOWSEED("TJCSB") -
  FLOWSEED("TRCSB")                    =L= 0 ;
C5R224.. CRUSH("QUSB") - FLOWSEED("TCUSB") -
  FLOWSEED("TUUSB") - FLOWSEED("TEUSB") -
  FLOWSEED("TJUSB") - FLOWSEED("TRUSB")
                 =L= 0 ;
C5R224A..DUSBS("PDUSBS")*SEED("PDUSBS")  - FLOWSEED("TUUSBS")
                 =L=  - SEEDCONS("PDUSBS") ;
C5R225.. CRUSH("QESB") - FLOWSEED("TCESB") -
  FLOWSEED("TUESB") - FLOWSEED("TEESB") -
  FLOWSEED("TJESB") - FLOWSEED("TRESB")
                 =L= 0 ;
C5R226.. CRUSH("QJSB") - FLOWSEED("TCJSB") -
  FLOWSEED("TUJSB") - FLOWSEED("TEJSB") -
  FLOWSEED("TJJSB") - FLOWSEED("TRJSB")
                 =L= 0 ;
C5R227.. CRUSH("QRSB") - FLOWSEED("TCRSB") -
  FLOWSEED("TURSB") - FLOWSEED("TERSB") -
  FLOWSEED("TJRSB") - FLOWSEED("TRRSB")
                 =L= 0 ;
C5R227A.. DRSBS("PDRSBS")*SEED("PDRSBS") - FLOWSEED("TRRSBS")
                 =L=  - SEEDCONS("PDRSBS") ;

C6R229.. FLOWSEED("TCCRS") + FLOWSEED("TCCRSS") +
  FLOWSEED("TCURS") + FLOWSEED("TCERS") +
  FLOWSEED("TCJRS") + FLOWSEED("TCRRS")
                 =L=   SUPPLY("PDCRS") ;
C6R230.. FLOWSEED("TUCRS") + FLOWSEED("TUURS") +
  FLOWSEED("TUERS") + FLOWSEED("TUJRS") +
  FLOWSEED("TURRS")          =L=   SUPPLY("PDURS") ;
C6R231.. FLOWSEED("TECRS") + FLOWSEED("TEURS") +
  FLOWSEED("TEERS") + FLOWSEED("TEERSS") +
  FLOWSEED("TEJRS") + FLOWSEED("TERRS")
                 =L=   SUPPLY("PDERS") ;
```

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C6R232.. FLOWSEED("TJCRS") + FLOWSEED("TJURS") +
      FLOWSEED("TJERS") + FLOWSEED("TJJRS") +
      FLOWSEED("TJRRS")          =L=  SUPPLY("PDJRS") ;
C6R233.. FLOWSEED("TRCRS") + FLOWSEED("TRURS") +
      FLOWSEED("TRERS") + FLOWSEED("TRJRS") +
      FLOWSEED("TRRRS") + FLOWSEED("TRRRSS")
                    =L=  SUPPLY("PDRRS") ;
C6R234.. FLOWSEED("TCCSB") + FLOWSEED("TCUSB") +
      FLOWSEED("TCESB") + FLOWSEED("TCJSB") +
      FLOWSEED("TCRSB")          =L=  SUPPLY("PDCSB") ;
C6R235.. FLOWSEED("TUCSB") + FLOWSEED("TUUSB") +
      FLOWSEED("TUUSBS") + FLOWSEED("TUESB") +
      FLOWSEED("TUJSB") + FLOWSEED("TURSB")
                    =L=  SUPPLY("PDUSB") ;
C6R236.. FLOWSEED("TECSB") + FLOWSEED("TEUSB") +
      FLOWSEED("TEESB") + FLOWSEED("TEJSB") +
      FLOWSEED("TERSB")          =L=  SUPPLY("PDESB") ;
C6R237.. FLOWSEED("TJCSB") + FLOWSEED("TJUSB") +
      FLOWSEED("TJESB") + FLOWSEED("TJJSB") +
      FLOWSEED("TJRSB")          =L=  SUPPLY("PDJSB") ;
C6R238.. FLOWSEED("TRCSB") + FLOWSEED("TRUSB") +
      FLOWSEED("TRESB") + FLOWSEED("TRJSB") +
      FLOWSEED("TRRSB") + FLOWSEED("TRRSBS")
                    =L=  SUPPLY("PDRSB") ;

C7R240.. YLDOIL("PDCRO")*CRUSH("QCRS") - FLOWOIL("TCCRO") -
      FLOWOIL("TCURO") - FLOWOIL("TCERO") - FLOWOIL("TCJRO")
      - FLOWOIL("TCRRO")
                         =G= 0 ;
C7R241.. YLDOIL("PDURO")*CRUSH("QURS") - FLOWOIL("TUCRO") -
      FLOWOIL("TUURO") - FLOWOIL("TUERO") - FLOWOIL("TUJRO")
      - FLOWOIL("TURRO")
                         =G= 0 ;
C7R242.. YLDOIL("PDERO")*CRUSH("QERS") - FLOWOIL("TECRO") -
      FLOWOIL("TEURO") - FLOWOIL("TEERO") - FLOWOIL("TEJRO")
      - FLOWOIL("TERRO")
                         =G= 0 ;
C7R243.. YLDOIL("PDJRO")*CRUSH("QJRS") - FLOWOIL("TJCRO") -
      FLOWOIL("TJURO") - FLOWOIL("TJERO") - FLOWOIL("TJJRO")
      - FLOWOIL("TJRRO")
                         =G= 0 ;
C7R244.. YLDOIL("PDRRO")*CRUSH("QRRS") - FLOWOIL("TRCRO") -
      FLOWOIL("TRURO") - FLOWOIL("TRERO") - FLOWOIL("TRJRO")
```

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- FLOWOIL("TRRRO") - FLOWOIL("TRRROS")
        =G= - SUPPLYO("PDRROS") ;
C7R245.. YLDOIL("PDCSO")*CRUSH("QCSB") - FLOWOIL("TCCSO") -
    FLOWOIL("TCUSO") - FLOWOIL("TCESO") -FLOWOIL("TCJSO")
    - FLOWOIL("TCRSO")
            =G= 0 ;
C7R246.. YLDOIL("PDUSO")*CRUSH("QUSB") - FLOWOIL("TUCSO") -
    FLOWOIL("TUUSO") - FLOWOIL("TUUSOS") -
    FLOWOIL("TUESO") - FLOWOIL("TUJSO") - FLOWOIL("TURSO")
        =G= - SUPPLYO("PDUSOS") ;
C7R247.. YLDOIL("PDESO")*CRUSH("QESB") - FLOWOIL("TECSO") -
    FLOWOIL("TEUSO") - FLOWOIL("TEESO") -FLOWOIL("TEJSO")
    - FLOWOIL("TERSO")
            =G= 0 ;
C7R248.. YLDOIL("PDJSO")*CRUSH("QJSB") - FLOWOIL("TJCSO") -
    FLOWOIL("TJUSO") - FLOWOIL("TJESO") -FLOWOIL("TJJSO")
    - FLOWOIL("TJRSO")
            =G= 0 ;
C7R249.. YLDOIL("PDRSO")*CRUSH("QRSB") - FLOWOIL("TRCSO") -
    FLOWOIL("TRUSO") - FLOWOIL("TRESO") - FLOWOIL("TRJSO")
    - FLOWOIL("TRRSO") - FLOWOIL("TRRSOS")
        =G= - SUPPLYO("PDRSOS") ;

C8R251.. YLDMEAL("PDCRM")*CRUSH("QCRS") - FLOWMEAL("TCCRM") -
    FLOWMEAL("TCURM") - FLOWMEAL("TCERM") -
    FLOWMEAL("TCJRM") - FLOWMEAL("TCRRM")
            =G= 0 ;
C8R252.. YLDMEAL("PDURM")*CRUSH("QURS") - FLOWMEAL("TUCRM") -
    FLOWMEAL("TUURM") - FLOWMEAL("TUERM") -
    FLOWMEAL("TUJRM") - FLOWMEAL("TURRM")
            =G= 0 ;
C8R253.. YLDMEAL("PDERM")*CRUSH("QERS") - FLOWMEAL("TECRM") -
    FLOWMEAL("TEURM") - FLOWMEAL("TEERM") -
    FLOWMEAL("TEJRM") - FLOWMEAL("TERRM")
            =G= 0 ;
C8R254.. YLDMEAL("PDJRM")*CRUSH("QJRS") - FLOWMEAL("TJCRM") -
    FLOWMEAL("TJURM") - FLOWMEAL("TJERM") -
    FLOWMEAL("TJJRM") - FLOWMEAL("TJRRM")
            =G= 0 ;
C8R255.. YLDMEAL("PDRRM")*CRUSH("QRRS") - FLOWMEAL("TRCRM") -
    FLOWMEAL("TRURM") - FLOWMEAL("TRERM") -
    FLOWMEAL("TRJRM") - FLOWMEAL("TRRRM") -
    FLOWMEAL("TRRRMS")
```

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                    =G= - SUPPLYM("PDRRMS") ;
C8R256.. YLDMEAL("PDCSM")*CRUSH("QCSB") - FLOWMEAL("TCCSM") -
     FLOWMEAL("TCUSM") - FLOWMEAL("TCESM") -
     FLOWMEAL("TCJSM") - FLOWMEAL("TCRSM")
                    =G= 0 ;
C8R257.. YLDMEAL("PDUSM")*CRUSH("QUSB") - FLOWMEAL("TUCSM") -
     FLOWMEAL("TUUSM") - FLOWMEAL("TUUSMS") -
     FLOWMEAL("TUESM") - FLOWMEAL("TUJSM") -
     FLOWMEAL("TURSM")
                    =G= - SUPPLYM("PDUSMS") ;
C8R258.. YLDMEAL("PDESM")*CRUSH("QESB") - FLOWMEAL("TECSM") -
     FLOWMEAL("TEUSM") - FLOWMEAL("TEESM") -
     FLOWMEAL("TEJSM") - FLOWMEAL("TERSM")
                    =G= 0 ;
C8R259.. YLDMEAL("PDJSM")*CRUSH("QJSB") - FLOWMEAL("TJCSM") -
     FLOWMEAL("TJUSM") - FLOWMEAL("TJESM") -
     FLOWMEAL("TJJSM") - FLOWMEAL("TJRSM")
                    =G= 0 ;
C8R260.. YLDMEAL("PDRSM")*CRUSH("QRSB") - FLOWMEAL("TRCSM") -
     FLOWMEAL("TRUSM") - FLOWMEAL("TRESM") -
     FLOWMEAL("TRJSM") - FLOWMEAL("TRRSM") -
     FLOWMEAL("TRRSMS")
                    =G= - SUPPLYM("PDRSMS") ;

C9R262.. CRUSH("QCRS")      =L=    CAPACITY("QCRS") ;
C9R263.. CRUSH("QURS")      =L=    CAPACITY("QURS") ;
C9R264.. CRUSH("QERS")      =L=    CAPACITY("QERS") ;
C9R265.. CRUSH("QJRS")      =L=    CAPACITY("QJRS") ;
C9R266.. CRUSH("QRRS")      =L=    CAPACITY("QRRS") ;
C9R267.. CRUSH("QCSB")      =L=    CAPACITY("QCSB") ;
C9R268.. CRUSH("QUSB")      =L=    CAPACITY("QUSB") ;
C9R269.. CRUSH("QESB")      =L=    CAPACITY("QESB") ;
C9R270.. CRUSH("QJSB")      =L=    CAPACITY("QJSB") ;
C9R271.. CRUSH("QRSB")      =L=    CAPACITY("QRSB") ;

MODEL TRADE  /ALL/ ;

OIL.L("PDCRO") = 775 ;
OIL.L("PDURO") = 780 ;
OIL.L("PDERO") = 770 ;
OIL.L("PDJRO") = 900 ;
OIL.L("PDRRO") = 790 ;
OIL.L("PDCSO") = 800 ;
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```
OIL.L("PDUSO") = 805 ;
OIL.L("PDESO") = 765 ;
OIL.L("PDJSO") = 895 ;
OIL.L("PDRSO") = 750 ;
MEAL.L("PDCRM") = 185 ;
MEAL.L("PDURM") = 190 ;
MEAL.L("PDERM") = 210 ;
MEAL.L("PDJRM") = 220 ;
MEAL.L("PDRRM") = 190 ;
MEAL.L("PDCSM") = 295 ;
MEAL.L("PDUSM") = 290 ;
MEAL.L("PDESM") = 295 ;
MEAL.L("PDJSM") = 310 ;
MEAL.L("PDRSM") = 285 ;
SEED.L("PDCRS") = 395 ;
SEED.L("PDCSB") = 310 ;
SEED.UP("PDCSB") = 375 ;
SEED.L("PDUSB") = 320 ;
SEED.L("PDERS") = 385 ;
SEED.L("PDERS") = 425 ;

FLOWOIL.UP("TURSO") = 0.64 ;

SOLVE TRADE USING NLP MAXIMIZING NR ;
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E.3 Definition of Acronyms and Data Sources used in the Based Model

The endogenous variables solved for in the base model include a price and quantity component. The prices included are for six commodities; rapeseed and soybean oil, meal and seed. The regions considered in the model are Canada, the U.S., the European Union, Japan and the Rest-of-the-World. For any region modelled to have an endogenous stocks function, a stocks price variable is introduced but set equal to the regional commodity price. All prices are converted into Canadian dollars per tonne. The exchange rate used for converting 1993-94 U.S. dollars into Canadian dollars was 1.3471. Quantity variables are included for regional crush levels of soybeans and rapeseed. Each potential regional trade flow for all six commodities are also solved for. In those cases where actual data is not available, an estimated value has been developed (based on a personal understanding of the world oilseeds complex).

E.3.1 Rapeseed and Soybean Oil Prices

Five letter acronyms (six for stocks prices) were used in the GAMS model, with the last two letters indicating the commodity and the middle letter designating the region (as listed in set A of the GAMS input file). Stocks prices are based on the five letter acronym followed by an S. The following price data was combined with regional quantities consumed and the elasticity estimates provided in Chapter IV to develop the linear demand functions used in the model.

PDCRO - price of rapeseed oil in Canada. Averaged weighted f.o.b. crushing plant price. Based on unpublished data from the Agriculture Division, Statistics Canada.

PDURO - price of rapeseed oil in the U.S. This price is estimated in relation to cost of moving Canadian rapeseed oil to the U.S., with consideration given to maintaining a small premium to soybean oil in the U.S..

PDERO - price of rapeseed oil in the EU. The Rotterdam, Dutch, f.o.b. ex-mill rapeseed price as quoted by Oil World and published in Oilseeds: World Markets and Trade, Foreign Agriculture Service (FAS), United States Department of Agriculture (USDA).

PDJRO - price of rapeseed oil in Japan. An estimated price based on a maximum of the cost of importing Canadian rapeseed oil, including the costs of transportation and the Japanese edible oils tariff.

PDRRO - price of rapeseed oil in the Rest-of-the-World. An estimated price based on a reasonable price for rapeseed oil in the Pacific Rim, China and India.

PDRROS - price of rapeseed oil stocks in the Rest-of-the-World. Set equal to PDRRO.

PDCSO - price of soybean oil in Canada. An estimated price based on the Canadian rapeseed oil price and the U.S. soybean oil price.

PDUSO - price of soybean oil in the U.S.. Decatur, Illinois, average wholesale tank crude price. Oilseeds: World Markets and Trade, FAS, USDA (various issues).

PDUSOS - price of soybean oil stocks in the U.S.. Set equal to PDUSO.

PDESO - price of soybean oil in the EU. Rotterdam, Dutch f.o.b. ex-mill price as quoted by Oil World and reported in Oilseeds: World Markets and Trade, FAS, USDA (various issues).

PDJSO - price of soybean oil in Japan. An estimated price of soybean oil based on a maximum of the cost of importing soybean oil, from the U.S., EU or Rest-of-World, including transportation and Japanese edible oils tariff considerations.

PDRSO - price of soybean oil in the Rest-of-the-World. An estimated price based on a South American soybean oil price as quoted in Oilseeds: World Markets and Trade, FAS, USDA (various issues).

PDRSOS - price of soybean oil stocks in the Rest-of-the-World. Set equal to PDRSO.

E.3.2 Rapeseed and Soybean Meal Prices.

Five letter acronyms (six for stocks prices) were used in the GAMS model, with the last two letters indicating the commodity and the middle letter designating the region (as listed in set B of the GAMS input file). Stocks prices were based on the five letter acronym followed by an S. The prices were combined with regional quantities consumed and the elasticity estimates provided in Chapter IV to develop the linear demand functions used in the model.

PDCRM - price of rapeseed meal in Canada. Averaged weighted f.o.b. crushing plant price. Based on unpublished data from the Agriculture Division, Statistics Canada.

PDURM - price of rapeseed meal in the U.S.. This price is an estimated price based on the cost of moving Canadian rapeseed meal to the U.S., with consideration given to maintaining a reasonable discount to soybean meal in the U.S.. Rapeseed meal is generally considered to have a nutritional value equal to 70 per cent of the nutritional value of soybean meal.

PDERM - price of rapeseed meal in the EU. The Hamburg, f.o.b. ex-mill, 34 per cent protein, rapeseed meal price as quoted by Oil World and published in Oilseeds: World Markets and Trade, FAS, USDA (various issues).

PDJRM - price of rapeseed meal in Japan. An estimated price based on the costs of importing rapeseed meal from Canada or the EU, including transportation costs.

PDRRM - price of rapeseed meal in the Rest-of-the-World. A theoretical price based on a reasonable price for rapeseed meal in the Pacific Rim, China and India.

PDRRMS - price of rapeseed meal stocks in the Rest-of-the-World. Set equal to PDRRM.

PDCSM - price of soybean meal in Canada. An estimated price based on the Canadian rapeseed meal price and the U.S. soybean meal price. Generally should be relatively equal to the soybean meal price in the U.S. and can be cross referenced with unpublished data available from the Livestock Feed

Bureau, Agriculture and Agri-food Canada.

PDUSM - price of soybean meal in the U.S.. Decatur, Illinois, average wholesale price, 48 per cent protein. Oilseeds: World Markets and Trade, FAS, USDA (various issues).

PDUSMS - price of soybean meal stocks in the U.S.. Set equal to PDUSM.

PDESM - price of soybean meal in the EU. Rotterdam, c.i.f. Argentine 45/46 per cent protein as quoted by Oil World and reported in Oilseeds: World Markets and Trade, FAS, USDA (various issues).

PDJSM - price of soybean meal in Japan. An estimated price of soybean meal based on a maximum of the cost of importing soybean meal, from the U.S., EU or the Rest-of-World, including transportation costs.

PDRSM - price of soybean meal in the Rest-of-the-World. An estimated price based on a South American soybean meal price as quoted in Oilseeds: World Markets and Trade, FAS, USDA (various issues).

PDRSMS - price of soybean meal stocks in the Rest-of-the-World. Set equal to PDRSM.

E.3.3 Rapeseed and Soybean Prices

Five letter acronyms (six for stocks prices) were used in the GAMS model, with the last two letters indicating the commodity and the middle letter designating the region (as listed in set E of the GAMS input file). Stocks prices are based on the five letter acronym followed by an S.

PDCRS	- price of rapeseed in Canada. Simple average of Vancouver daily cash price for 1 Canada canola. unpublished data from Market Analysis Division, Policy Branch, Agriculture and Agri-food Canada.
PDCRSS	- price of rapeseed stocks in Canada. Set equal to PDCRS.
PDCRS	- price of rapeseed in the U.S.. An estimated price based on the cost of importing Canadian rapeseed to U.S. crushing facilities in North Dakota.
PDERS	- price of rapeseed in the EU. Hamburg,, c.i.f., European "00" rapeseed. As quoted by Oil World and published in Oilseeds: World Markets and Trade, FAS, USDA (various issues).
PDERSS	- price of rapeseed stocks in EU. Set equal to PDERS.
PDJRS	- price of rapeseed in Japan. An estimated price based on the cost of importing Canadian or European rapeseed, including transportation costs.
PDRRS	- price of rapeseed in the Rest-of-the-World. An estimated price based on a reasonable estimate of the price for rapeseed in India or China (with consideration being given for the inferior quality of the rapeseed in these regions of the world).
PDRRSS	- price of rapeseed stocks in the Rest-of-the-World. Set equal to PDRRS.
PDCSB	- price of soybeans in Canada. Chatham elevator, in-store 2 CE soybeans. Unpublished data from Market Analysis Division, Policy Branch, Agriculture and Agri-food Canada.

PDUSB - price of soybeans in the U.S.. U.S. No.1 Yellow, cash, Central Illinois. As quoted by the Wall Street Journal and published in Oilseeds: World Markets and Trade, FAS, USDA (various issues).

PDUSBS - price of soybean stocks in the U.S.. Set equal to PDUSB.

PDESB - price of soybeans in the EU. Rotterdam, c.i.f., U.S. No.2 Yellow. As quoted by Oil World and published in Oilseeds: World Markets and Trade, FAS, USDA (various issues).

PDJSB - price of soybeans in Japan. An estimated price based on the cost of importing soybeans from the U.S. or South America, including transportation costs.

PDRSB - price of soybeans in the Rest-of-the-World. An estimated price based on South American port prices for soybeans. As published in Oilseeds: World Markets and Trade, FAS, USDA (various issues).

PDRSBS - price of soybean stocks in the Rest-of-the-World. Set equal to PDRSB.

E.3.4 Regional Quantities Crushed of Rapeseed and Soybeans

Four letter acronym were used in the GAMS model, with the last two letters indicating the commodity and the middle letter designating the region (as listed in set F of the GAMS input file).

QCRS - quantity of rapeseed crushed in Canada. Agriculture Division, Statistics Canada, published in Catalogue #22-007.

QURS - quantity of rapeseed crushed in the U.S.. Unpublished data from FAS, USDA. Published periodically in Oil Crops: Situation and Outlook Report, Economic Research Service, USDA and Oil World.

QERS quantity of rapeseed crushed in the EU. Unpublished data from FAS, USDA. Comparable data is published periodically in Oil World weekly and in the Oil World annuals.

QJRS - quantity of rapeseed crushed in Japan. Unpublished data from FAS, USDA. Comparable data is published periodically in Oil World weekly and in the Oil World annuals.

QRRS - quantity of rapeseed crushed in the Rest-of-the-World. Calculated as a residual of total world crush less the crush specified in the other four regions. Oilseeds: World Markets and Trade, FAS, USDA.

QCSB - quantity of soybeans crushed in Canada. Canadian Oilseed Processors Association. Also available from unpublished data from FAS, USDA and periodically in Oil World weekly and in the Oil World annuals.

QUSB - quantity of soybeans crushed in the U.S.. Oilseeds: World Markets and Trade, FAS, USDA. Also available from unpublished data from FAS, USDA and periodically in Oil World weekly and in the Oil World annuals.

QESB - quantity of soybeans crushed in the EU. Oilseeds: World Markets and Trade, FAS, USDA. Also available from unpublished data from FAS, USDA and periodically in Oil World weekly and in the Oil World annuals.

QJSB - quantity of soybeans crushed in Japan. Oilseeds: World Markets and Trade, FAS, USDA. Also available from unpublished data from FAS, USDA and periodically in Oil World weekly and in the Oil World annuals.

QRSB - quantity of soybeans crushed in the Rest-of-the-World. Calculated as a residual of total world crush less the crush specified in the other four regions. Oilseeds: World Markets and Trade, FAS, USDA.

E.3.5 Regional Rapeseed and Soybean Oil, Meal and Seed Trade Flows

Within the GAMS input file five letter acronyms (six for regional ending stocks) were used to identify each of the potential oil trade flows. The first letter (T) in the acronym indicates the symbol refers to a trade flow. The second letter in the acronym refers to the region of source, with the third letter referring to the destination. As with the price and crush acronyms, the same letters are used to identify each of the five endogenous regions. The fourth and fifth letters in the acronym refer to the commodity in question (RO for rapeseed oil, SO for soybean oil and so on). For those regions with endogenous ending stocks functions the standard acronym is augmented with an S at the end. For example, TCCRO refers to the quantity of rapeseed oil moving from Canada to Canada. TRRROS refers to the quantity of rapeseed oil moving from the Rest-of-the-World to ending stocks in the Rest-of-the-World. All trade flow and oilseed supply data is based on information contained in Oil World annual publications, with some additional input from Oilseeds: World Markets and Trade, FAS, USDA and unpublished data from FAS, USDA.

Note that oilseed trade flow data must be adjusted to account for trade flows of oilseeds for crushing purposes only. Therefore, some of the equilibrium trade flows (especially for soybeans) will be below the published data due to the shipment of oilseeds for direct feed and food use. Oilseed supplies made available to the model were also adjusted to account for feed, food and dockage losses.

E.3.6 Parameters (required coefficients for developing the objective function and equilibrium constraints)

The required parameters for the model include the estimated coefficients for the regional linear demand functions for each meal and oil, regional crushing costs, trade flow costs (including any fixed tariffs or subsidies), the regional oil and meal extraction rates, the oilseed supplies made available to the model (including beginning stocks), the regional beginning stocks of oil and meal, and the regional oilseed processing capacity constraints.

E.3.6.1 Estimated Regional Linear Oil and Meal Demand Functions

The estimated coefficients are derived using the price and quantity data referenced above, in combination with estimated price elasticities (as determined based a review of relevant previous studies). Refer to Chapter IV section 4.3 for the methodology and elasticities used.

The coefficients of the linear demand functions are broken down into two components, the constant term component and the price sensitive component. The first three subsections of the PARAMETERS in the GAMS input file contain the constant terms of the oil, meal and oilseed stocks demand functions. OILCONS (A) provides the constant terms for the regional oil demand functions, including the relevant regional oil stocks demand functions. MEALCONS(B) provides the constant terms for the regional meal demand functions. SEEDCONS(E) provides the relevant constant terms for the regional oilseed stocks demand functions.

The PARAMETERS section then lists the own-price and cross-price coefficients for each of the regional linear demand functions. For example, the DCRO(A) subsection of the PARAMETERS section of the GAMS input file contains the Demand price coefficients for Canadian Rapeseed Oil. Note that the regional stocks demand functions do not contain a cross-price component.

E.3.6.2 Regional Crushing Costs

The regional costs are based on a survey of the values estimated in previous studies of the oilseeds sector. Important sources of crushing cost estimates include Landell Mills (1991), Johnson (1987) and information obtained through contact with the oilseeds industry. The regional crushing costs (CC(F) in the PARAMETERS section of the GAMS input file) includes an estimated cost for processing rapeseed and for soybeans in each of the five endogenous regions.

E.3.6.3 Regional Trade Flow Costs (including fixed tariffs and subsidies)

The trade flow costs section of the PARAMETERS is broken down into three subsections. The three subsections are oil flow costs (TRANOIL(G)) , meal flow costs (TRANMEAL(H)) and oilseed flow costs (TRANSEED(I)). The transportation costs used are designed to represent the costs of moving the commodity in question between the pricing points specified for the endogenous variables. Estimated costs are based on transportation costs reported in various publications including International Wheat Council publications, various issues of the Oils and Fats International publication, and information obtained from Sparks Companies Incorporated. The transportation costs information contained in previous studies such as Johnson (1987) were also used. Transportation costs within a region are negative in some instances to indicate that the cost of moving the commodity to the local demand is less than the cost required to move the product to the endogenous pricing point used in the model. The costs of moving a commodity into a region's stocks are also including, with the cost set equal to the cost of fulfilling regional demand from domestic supplies.

These transportation costs were then adjusted by the relevant tariffs, as outlined in Chapter IV section 4.5.3. For example, edible oil shipment costs to Japan were inflated by the value of the Japanese edible oils tariff (estimated to be about $255/tonne). U.S. soybean oil export costs were reduced by the estimated average value of the Export Enhancement Program subsidy (based on data maintained by the Market Analysis Division, Policy Branch, Agriculture and Agri-food Canada).

The ad valorem tariffs and export subsidies such as U.S. credit programs, as outlined in Chapter IV section 4.5.3, are based on unpublished information available from Market Analysis Division, Policy Branch, Agriculture and Agri-food Canada. These tariff barriers are incorporated as adjustment coefficients to the price equilibrium conditions contained in the EQUATIONS section of the GAMS input file.

E.3.6.4 Regional Oil and Meal Extraction Rates

The regional oil (YLDOIL(A)) and meal (YLDMEAL(B)) extraction rates are based on the historical data available from Oil World and Oilseeds: World Markets and Trade, FAS, USDA. Extraction rates are provided for each region, providing the model the flexibility to incorporate the price implications of differential extraction rates.

E.3.6.5 Regional Oilseed and Beginning Oil and Meal Stocks Supplies

The regional available supplies of oilseeds (SUPPLY(E)) are based on data obtained from: Oil World; Oilseeds: World Markets and Trade, FAS, USDA; and unpublished data from FAS, USDA. The available regional supplies include beginning stocks, with adjustments for food, feed and dockage made based on market information obtained from the Market Analysis Division, Policy Branch, Agriculture and Agri-food Canada.

The regional beginning stocks of oil (SUPPLYO(A)) and meal (SUPPLYM(B)) are based on data obtained from: Oil World; Oilseeds: World Markets and Trade, FAS, USDA; and unpublished data from FAS, USDA.

E.3.6.6 Regional Crush Capacities

The regional crush capacity data is based on market information made available from the Market Analysis Division, Policy Branch, Agriculture and Agri-food Canada.

Appendix F

Model Results from:

1) Eliminating the Canadian canola crush capacity constraint

2) Eliminating the Japanese edible oils tariff

and 3) Combination of 1) and 2)

relative to the 1993-94 Base Period.

Refer to Appendix E for symbol definitions

F.1. Results for Scenario One: Eliminating the Canadian Canola Crush Capacity Constraint

The following nine tables provide details on the estimated changes from eliminating the Canadian canola crush capacity constraint relative to the base solution simulating the 1993-94 world oilseeds market conditions.

Table F.1.1 Change in Edible Oil Prices: Scenario One

Region / Commodity	Revised Value ($/t)	Base Value ($/t)	Difference ($/t)	Per Cent Change
PDCRO	809.55	815.16	-5.61	-0.7%
PDURO	820.55	826.16	-5.61	-0.7%
PDERO	766.06	771.67	-5.61	-0.7%
PDJRO	885.02	890.63	-5.61	-0.6%
PDRRO	854.85	861.00	-6.15	-0.7%
PDCSO	811.38	812.05	-0.67	-0.1%
PDUSO	836.38	837.05	-0.67	-0.1%
PDESO	729.57	729.85	-0.28	-0.0%
PDJSO	917.29	917.65	-0.36	-0.0%
PDRSO	828.71	829.04	-0.33	-0.0%

Table F.1.2 Change in Protein Meal Prices: Scenario One				
Region / Commodity	Revised Value ($/t)	Base Value ($/t)	Difference ($/t)	Per Cent Change
PDCRM	181.73	183.22	-1.49	-0.8%
PDURM	196.73	198.22	-1.49	-0.7%
PDERM	224.93	226.52	-1.59	-0.7%
PDJRM	216.73	218.22	-1.49	-0.7%
PDRRM	192.59	194.01	-1.42	-0.7%
PDCSM	300.63	301.19	-0.56	-0.0%
PDUSM	292.38	292.94	-0.56	-0.0%
PDESM	317.66	318.29	-0.63	-0.0%
PDJSM	306.65	307.28	-0.63	-0.0%
PDRSM	281.65	282.28	-0.63	-0.0%

Table F.1.3 Change in Oilseed Prices: Scenario One				
Region / Commodity	Revised Value ($/t)	Base Value ($/t)	Difference ($/t)	Per Cent Change
PDCRS	407.00	410.22	-3.22	-0.8%
PDURS	415.56	418.79	-3.23	-0.8%
PDERS	405.67	408.89	-3.22	-0.8%
PDJRS	442.32	445.54	-3.22	-0.7%
PDRRS	405.67	408.89	-3.22	-0.8%
PDCSB	351.17	351.74	-0.57	-0.0%
PDUSB	341.25	341.82	-0.57	0.0%
PDESB	351.52	352.08	-0.56	0.0%
PDJSB	357.12	357.68	-0.56	0.0%
PDRSB	333.47	334.03	-0.56	-0.0%

Table F.1.4 Change in Regional Oilseed Crushing: Scenario One				
Region / Commodity	Revised Value (mln tonne)	Base Value (mln tonne)	Difference (mln tonne)	Per Cent Change
QCRS	4.27	2.20	2.07	94.1%
QURS	0.35	0.35	0.00	0.0%
QERS	4.33	5.91	-1.58	-26.7%
QJRS	1.96	1.96	0.00	0.0%
QRRS	13.73	14.14	-0.41	-2.9%
QCSB	1.05	1.05	0.00	0.0%
QUSB	34.03	34.03	0.00	0.0%
QESB	11.88	12.43	-0.55	-4.4%
QJSB	3.73	3.73	0.00	0.0%
QRSB	50.37	49.86	0.51	1.0%

Table F.1.5 Change in Regional Oil Trade Flows: Scenario One				
Region / Commodity	Revised Value (mln tonne)	Base Value (mln tonne)	Difference (mln tonne)	Per Cent Change
TCCRO	0.51	0.51	0.00	0.0%
TCURO	0.43	0.41	0.02	4.9%
TCRRO	0.83	0.00	0.83	100.0%
TUURO	0.15	0.15	0.00	0.0%
TEURO	0.00	0.02	-0.02	-100.0%
TEERO	1.77	1.76	0.01	0.6%
TERRO	0.00	0.64	-0.64	-100.0%
TJJRO	0.82	0.81	0.01	1.2%
TRRRO	5.31	5.47	-0.16	-2.9%
TRRROS	0.39	0.39	0.00	0.0%
TCCSO	0.16	0.16	0.00	0.0%
TCUSO	0.03	0.03	0.00	0.0%
TUUSO	5.81	5.81	0.00	0.0%
TUUSOS	0.46	0.46	0.00	0.0%
TURSO	0.64	0.64	0.00	0.0%
TEESO	1.79	1.79	0.00	0.0%
TERSO	0.46	0.56	-0.1	-17.9%
TJJSO	0.68	0.68	0.00	0.0%
TRRSO	9.29	9.20	0.09	1.0%
TRRSOS	0.83	0.83	0.00	0.0%

Table F.1.6 Change in Regional Protein Meal Trade Flows: Scenario One				
Region / Commodity	Revised Value (mln tonne)	Base Value (mln tonne)	Difference (mln tonne)	Per Cent Change
TCCRM	0.44	0.44	0.00	0.0%
TCURM	0.73	0.73	0.00	0.0%
TCJRM	0.15	0.14	0.01	7.1%
TCRRM	1.24	0.01	1.23	12300.0%
TUURM	0.21	0.21	0.00	0.0%
TEERM	2.53	3.46	-0.93	-26.9%
TJJRM	1.18	1.18	0.00	0.0%
TRERM	1.66	0.71	0.95	104.4%
TRRRM	6.57	7.77	-1.20	-15.4%
TRRRMS	0.48	0.48	0.00	0.0%
TCCSM	0.84	0.84	0.00	0.0%
TUCSM	0.46	0.47	-0.01	2.1%
TUUSM	22.75	22.74	0.01	0.0%
TUUSMS	0.14	0.14	0.00	0.0%
TUESM	3.96	3.97	-0.01	0.0%
TURSM	0.00	0.00	0.00	0.0%
TEESM	9.54	9.98	-0.44	-4.4%
TJJSM	2.95	2.95	0.00	0.0%
TRESM	6.95	6.51	0.44	6.8%
TRJSM	0.74	0.73	0.01	1.4%
TRRSM	31.34	31.37	-0.03	0.0%
TRRSMS	4.77	4.77	0.00	0.0%

Table F.1.7 Change in Regional Oil Consumption: Scenario One				
Region / Commodity	Revised Value (mln tonne)	Base Value (mln tonne)	Difference (mln tonne)	Per Cent Change
CRO	0.51	0.51	0.00	0.0%
URO	0.58	0.58	0.00	0.0%
ERO	1.77	1.76	0.01	0.6%
JRO	0.82	0.81	0.01	1.2%
RRO	6.14	6.11	0.03	0.1%
CSO	0.16	0.16	0.00	0.0%
USO	5.84	5.84	0.00	0.0%
ESO	1.79	1.79	0.00	0.0%
JSO	0.68	0.68	0.00	0.0%
RSO	10.39	10.40	-0.01	-0.1%

Table F.1.8 Change in Regional Protein Meal Consumption: Scenario One				
Region / Commodity	Revised Value (mln tonne)	Base Value (mln tonne)	Difference (mln tonne)	Per Cent Change
CRM	0.44	0.44	0.00	0.0%
URM	0.94	0.94	0.00	0.0%
ERM	4.19	4.17	0.02	0.0%
JRM	1.33	1.32	0.01	0.1%
RRM	7.81	7.78	0.03	0.4%
CSM	1.30	1.31	-0.01	-0.8%
USM	22.75	22.74	0.01	0.0%
ESM	20.45	20.46	-0.01	-0.0%
JSM	3.69	3.68	0.01	0.3%
RSM	31.34	31.37	-0.03	0.1%

Table F.1.9 Estimated Change in Oilseed Trade Flows: Scenario One				
Region / Commodity	Revised Value (mln tonne)	Base Value (mln tonne)	Change (mln tonne)	Per Cent Change
TCCRS	4.27	2.20	2.07	94.1%
TCCRSS	0.28	0.27	0.01	3.7%
TCURS	0.25	0.25	0.00	0.0%
TCERS	0.00	0.2	-0.20	-100.0%
TCJRS	0.59	1.96	-1.37	-71.0%
TCRRS	0.00	0.41	-0.41	-100.0%
TUURS	0.10	0.10	0.00	0.0%
TEERS	4.33	5.70	-1.37	-24.0%
TEERSS	0.17	0.17	0.00	0.0%
TEJRS	1.38	0.00	1.38	100.0%
TERRS	0.00	0.00	0.00	0.0%
TRRRS	13.73	13.73	0.00	0.0%
TRRRSS	0.39	0.39	0.00	0.0%
TCCSB	1.05	1.05	0.00	0.0%
TCUSB	0.45	0.45	0.00	0.0%
TUUSB	33.58	33.58	0.00	0.0%
TUUSBS	4.56	4.53	0.03	0.1%
TUESB	0.00	0.00	0.00	0.0%
TUJSB	3.73	3.73	0.00	0.0%
TURSB	14.91	14.45	0.46	3.2%
TRESB	11.88	12.43	-0.55	-4.4%
TRJSB	0.00	0.00	0.00	0.0%
TRRSB	35.96	35.42	0.54	1.5%
TRRSBS	11.99	11.98	0.01	0.0%

F.2. Results for Scenario Two: Elimination of the Japanese Edible Oils Tariff

The following nine tables provide details on the estimated impact of eliminating the Japanese edible oils tariff, relative to the base period solution simulationg the 1993-94 world oilseeds market conditions.

Table F.2.1 Change in Edible Oil Prices: Scenario Two

Region / Commodity	Revised Value ($/t)	Base Value ($/t)	Difference ($/t)	Per Cent Change
PDCRO	811.67	815.16	-3.49	-0.4%
PDURO	822.67	826.16	-3.49	-0.4%
PDERO	769.36	771.67	-2.31	-0.3%
PDJRO	834.36	890.63	-56.27	-6.3%
PDRRO	858.48	861.00	-2.52	0.3%
PDCSO	818.17	812.05	6.12	0.8%
PDUSO	843.17	837.05	6.12	0.7%
PDESO	730.01	729.85	0.16	0.0%
PDJSO	795.01	917.65	-122.64	-13.4%
PDRSO	829.23	829.04	0.19	0.0%

Table F.2.2 Change in Protein Meal Prices: Scenario Two				
Region / Commodity	Revised Value ($/t)	Base Value ($/t)	Difference ($/t)	Per Cent Change
PDCRM	183.49	183.22	0.27	0.1%
PDURM	198.49	198.22	0.27	0.1%
PDERM	225.93	226.52	-0.59	-0.3%
PDJRM	218.49	218.22	0.27	0.1%
PDRRM	193.49	194.01	-0.52	-0.3%
PDCSM	299.57	301.19	-1.62	-0.5%
PDUSM	291.32	292.94	-1.62	-0.6%
PDESM	318.04	318.29	-0.25	-0.1%
PDJSM	307.02	307.28	-0.26	-0.1%
PDRSM	282.02	282.28	-0.26	-0.1%

Table F.2.3 Change in Oilseed Prices: Scenario Two				
Region / Commodity	Revised Value ($/t)	Base Value ($/t)	Difference ($/t)	Per Cent Change
PDCRS	408.94	410.22	-1.28	-0.3%
PDURS	417.50	418.79	-1.39	-0.3%
PDERS	407.61	408.89	-1.28	-0.3%
PDJRS	444.26	445.54	-1.28	-0.3%
PDRRS	407.61	408.89	-1.28	-0.3%
PDCSB	351.57	351.74	-0.17	-0.0%
PDUSB	341.64	341.82	-0.18	-0.0%
PDESB	351.91	352.08	-0.17	-0.0%
PDJSB	346.04	357.68	-11.64	-3.3%
PDRSB	333.86	334.03	-0.17	-0.0%

Table F.2.4 Change in Regional Oilseed Crushing: Scenario Two				
Region / Commodity	Revised Value (mln tonne)	Base Value (mln tonne)	Difference (mln tonne)	Per Cent Change
QCRS	2.20	2.20	0.00	0.0%
QURS	0.35	0.35	0.00	0.0%
QERS	7.14	5.91	1.23	20.8%
QJRS	0.00	1.96	-1.96	-100.0%
QRRS	14.92	14.14	0.78	5.5%
QCSB	1.05	1.05	0.00	0.0%
QUSB	33.83	34.03	-0.2	-0.6%
QESB	18.00	12.43	5.57	44.8%
QJSB	0.00	3.73	-3.73	-100.0%
QRSB	48.21	49.86	-1.65	-3.3%

Table F.2.5 Change in Regional Oil Trade Flows: Scenario Two				
Region / Commodity	Revised Value (mln tonne)	Base Value (mln tonne)	Difference (mln tonne)	Per Cent Change
TCCRO	0.51	0.51	0.00	0.0%
TCURO	0.05	0.41	-0.36	-87.8%
TCRRO	0.35	0	0.35	+ ∞
TUURO	0.15	0.15	0.00	0.0%
TEURO	0.38	0.02	0.36	1800.0%
TEERO	1.77	1.76	0.01	0.6%
TEJRO	0.78	0.00	0.78	+ ∞
TERRO	0.00	0.64	-0.64	-100.0%
TJJRO	0.00	0.81	-0.81	-100.0%
TRRRO	5.77	5.47	0.30	5.5%
TRRROS	0.39	0.39	0.00	0.0%
TCCSO	0.16	0.16	0.00	0.0%
TCUSO	0.03	0.03	0.00	0.0%
TUUSO	5.78	5.81	-0.03	-0.5%
TUUSOS	0.45	0.46	-0.01	-2.2%
TURSO	0.64	0.64	0.00	0.0%
TEESO	1.79	1.79	0.00	0.0%
TERSO	1.61	0.56	1.05	187.5%
TJJSO	0.00	0.68	-0.68	-100.0%
TRJSO	0.76	0.00	0.76	+ ∞
TRRSO	8.14	9.20	-1.06	-11.5%
TRRSOS	0.83	0.83	0.00	0.0%

Table F.2.6 Change in Regional Protein Meal Trade Flows: Scenario Two				
Region / Commodity	Revised Value (mln tonne)	Base Value (mln tonne)	Difference (mln tonne)	Per Cent Change
TCCRM	0.43	0.44	-0.01	-2.3%
TCURM	0.73	0.73	0.00	0.0%
TCJRM	0.16	0.14	0.02	14.3%
TCRRM	0.00	0.01	-0.01	-100.0%
TUURM	0.21	0.21	0.00	0.0%
TEERM	4.18	3.46	0.62	17.9%
TJJRM	0.00	1.18	-1.18	-100.0%
TRERM	0.00	0.71	-0.71	-100.0%
TRJRM	1.16	0.00	1.16	+ ∞
TRRRM	7.79	7.77	0.02	0.3%
TRRRMS	0.48	0.48	0.00	0.0%
TCCSM	0.84	0.84	0.00	0.0%
TUCSM	0.47	0.47	0.00	0.0%
TUUSM	22.79	22.74	0.05	0.2%
TUUSMS	0.14	0.14	0.00	0.0%
TUESM	3.76	3.97	-0.21	-5.3%
TEESM	14.45	9.98	4.47	44.8%
TJJSM	0.00	2.95	-2.95	-100.0%
TRESM	2.24	6.51	-4.27	-65.6%
TRJSM	3.69	0.73	2.96	405.5%
TRRSM	31.36	31.37	-0.01	-0.0%
TRRSMS	4.77	4.77	0.00	0.0%

Table F.2.7 Change in Regional Oil Consumption: Scenario Two				
Region / Commodity	Revised Value (mln tonne)	Base Value (mln tonne)	Difference (mln tonne)	Per Cent Change
CRO	0.51	0.51	0.00	0.0%
URO	0.58	0.58	0.00	0.0%
ERO	1.77	1.76	0.01	0.6%
JRO	0.78	0.81	-0.03	-3.7%
RRO	6.12	6.11	0.01	0.2%
CSO	0.16	0.16	0.00	0.0%
USO	5.81	5.84	-0.03	-0.5%
ESO	1.79	1.79	0.00	0.0%
JSO	0.76	0.68	0.08	11.8%
RSO	10.39	10.40	-0.01	0.1%

Table F.2.8 Change in Regional Protein Meal Consumption: Scenario Two				
Region / Commodity	Revised Value (mln tonne)	Base Value (mln tonne)	Difference (mln tonne)	Per Cent Change
CRM	0.43	0.44	-0.01	-2.3%
URM	0.94	0.94	0.00	0.0%
ERM	4.18	4.17	0.01	0.2%
JRM	1.32	1.32	0.00	0.0%
RRM	7.79	7.78	0.01	0.1%
CSM	1.31	1.31	0.00	0.0%
USM	22.79	22.74	0.05	0.2%
ESM	20.45	20.46	-0.01	0.0%
JSM	3.69	3.68	0.01	0.3%
RSM	31.36	31.37	-0.01	0.0%

Table F.2.9 Estimated Change in Oilseed Trade Flows: Scenario Two				
Region / Commodity	Revised Value (mln tonne)	Base Value (mln tonne)	Change (mln tonne)	Per Cent Change
TCCRS	2.20	2.20	0.00	0.0%
TCCRSS	0.28	0.27	0.01	3.7%
TCURS	0.25	0.25	0.00	0.0%
TCERS	1.44	0.20	1.24	6200.0%
TCJRS	0.00	1.96	-1.96	-100.0%
TCRRS	1.19	0.41	0.78	190.2%
TUURS	0.10	0.10	0.00	0.0%
TEERS	5.70	5.70	0.00	0.0%
TEERSS	0.17	0.17	0.00	0.0%
TRRRS	13.73	13.73	0.00	0.0%
TRRRSS	0.39	0.39	0.00	0.0%
TCCSB	1.05	1.05	0.00	0.0%
TCUSB	0.45	0.45	0.00	0.0%
TUUSB	33.38	33.58	-0.20	-0.6%
TUUSBS	4.54	4.53	0.01	0.2%
TUJSB	0.00	3.73	-3.73	-100.0%
TURSB	18.36	14.45	3.91	27.1%
TRESB	18.00	12.43	5.57	44.8%
TRRSB	29.85	35.42	-5.57	-15.7%
TRRSBS	11.98	11.98	0.00	0.0%

F.3. Results for Scenario Three: A Combination of Scenario One and Two

The final nine table provide details on the estimated changes from eliminating the Canadian canola crush capacity constraint and the Japanese edible oils tariff relative to the base solution simulating the 1993-94 world oilseeds market conditions.

Table F.3.1 Change in Edible Oil Prices: Scenario Three

Region / Commodity	Revised Value ($/t)	Base Value ($/t)	Difference ($/t)	Per Cent Change
PDCRO	803.17	815.16	-11.99	-1.5%
PDURO	814.17	826.16	-11.99	-1.5%
PDERO	760.93	771.67	-10.74	-1.4%
PDJRO	825.93	890.63	-64.70	-7.3%
PDRRO	849.32	861.00	-11.68	-1.4%
PDCSO	815.83	812.05	3.78	0.5%
PDUSO	840.83	837.05	3.78	0.5%
PDESO	729.44	729.85	-0.41	-0.1%
PDJSO	794.44	917.65	-123.21	-13.4%
PDRSO	828.55	829.04	-0.49	-0.1%

Table F.3.2 Change in Protein Meal Prices: Scenario Three				
Region / Commodity	Revised Value ($/t)	Base Value ($/t)	Difference ($/t)	Per Cent Change
PDCRM	182.06	183.22	-1.16	-0.6%
PDURM	197.06	198.22	-1.16	-0.6%
PDERM	224.34	226.52	-2.18	-1.0%
PDJRM	217.06	218.22	-1.16	-0.5%
PDRRM	192.06	194.01	-1.95	-1.0%
PDCSM	299.26	301.19	-1.93	-0.6%
PDUSM	291.01	292.94	-1.93	-0.7%
PDESM	317.35	318.29	-0.94	-0.3%
PDJSM	306.35	307.28	-0.93	-0.3%
PDRSM	281.35	282.28	-0.93	-0.3%

Table F.3.3 Change in Oilseed Prices: Scenario Three				
Region / Commodity	Revised Value ($/t)	Base Value ($/t)	Difference ($/t)	Per Cent Change
PDCRS	404.55	410.22	-5.67	-1.4%
PDURS	413.12	418.79	-5.67	-1.4%
PDERS	403.22	408.89	-5.67	-1.4%
PDJRS	439.87	445.54	-5.67	-1.3%
PDRRS	403.22	408.89	-5.67	-1.4%
PDCSB	350.89	351.74	-0.85	-0.2%
PDUSB	340.97	341.82	-0.85	-0.2%
PDESB	351.25	352.08	-0.83	-0.2%
PDJSB	345.40	357.68	-12.28	-3.4%
PDRSB	333.20	334.03	-0.83	-0.2%

Table F.3.4 Change in Regional Oilseed Crushing: Scenario Three				
Region / Commodity	Revised Value (mln tonne)	Base Value (mln tonne)	Difference (mln tonne)	Per Cent Change
QCRS	4.37	2.20	2.17	98.6%
QURS	0.35	0.35	0.00	0.0%
QERS	6.26	5.91	0.35	5.9%
QJRS	0.00	1.96	-1.96	-100.0%
QRRS	13.73	14.14	-0.41	-2.9%
QCSB	1.05	1.05	0.00	0.0%
QUSB	33.89	34.03	-0.14	-0.4%
QESB	18.00	12.43	5.57	44.8%
QJSB	0.00	3.73	-3.73	-100.0%
QRSB	48.11	49.86	-1.75	-3.5%

Table F.3.5 Change in Regional Oil Trade Flows: Scenario Three				
Region / Commodity	Revised Value (mln tonne)	Base Value (mln tonne)	Difference (mln tonne)	Per Cent Change
TCCRO	0.51	0.51	0.00	0.0%
TCURO	0.43	0.41	0.02	4.9%
TCRRO	0.87	0	0.87	+ ∞
TUURO	0.15	0.15	0.00	0.0%
TEURO	0.00	0.02	-0.02	-100.0%
TEERO	1.78	1.76	0.02	1.1%
TEJRO	0.79	0.00	0.79	+ ∞
TERRO	0.00	0.64	-0.64	-100.0%
TJJRO	0.00	0.81	-0.81	-100.0%
TRRRO	5.31	5.47	-0.16	-2.9%
TRRROS	0.39	0.39	0.00	0.0%
TCCSO	0.16	0.16	0.00	0.0%
TCUSO	0.03	0.03	0.00	0.0%
TUUSO	5.79	5.81	-0.02	-0.3%
TUUSOS	0.45	0.46	-0.01	-2.2%
TURSO	0.64	0.64	0.00	0.0%
TEESO	1.78	1.79	-0.01	-0.6%
TERSO	1.62	0.56	1.06	189.3%
TJJSO	0.00	0.68	-0.68	-100.0%
TRJSO	0.76	0.00	0.76	+ ∞
TRRSO	8.12	9.20	-1.08	-11.7%
TRRSOS	0.83	0.83	0.00	0.0%

Table F.3.6 Change in Regional Protein Meal Trade Flows: Scenario Three				
Region / Commodity	Revised Value (mln tonne)	Base Value (mln tonne)	Difference (mln tonne)	Per Cent Change
TCCRM	0.44	0.44	0.00	0.0%
TCURM	0.73	0.73	0.00	0.0%
TCJRM	1.32	0.14	1.18	842.9%
TCRRM	0.13	0.01	0.12	1200.0%
TUURM	0.21	0.21	0.00	0.0%
TEERM	3.66	3.46	0.20	5.8%
TJJRM	0.00	1.18	-1.18	-100.0%
TRERM	0.54	0.71	-0.17	-23.9%
TRRRM	7.70	7.77	-0.07	-0.9%
TRRRMS	0.49	0.48	0.01	2.1%
TCCSM	0.84	0.84	0.00	0.0%
TUCSM	0.47	0.47	0.00	0.0%
TUUSM	22.80	22.74	0.06	0.3%
TUUSMS	0.14	0.14	0.00	0.0%
TUESM	3.79	3.97	-0.18	-4.5%
TEESM	14.45	9.98	4.47	44.8%
TJJSM	0.00	2.95	-2.95	-100.0%
TRESM	2.19	6.51	-4.32	-66.4%
TRJSM	3.69	0.73	2.96	405.5%
TRRSM	31.33	31.37	-0.04	-0.1%
TRRSMS		4.77		

Table F.3.7 Change in Regional Oil Consumption: Scenario Three				
Region / Commodity	Revised Value (mln tonne)	Base Value (mln tonne)	Difference (mln tonne)	Per Cent Change
CRO	0.51	0.51	0.00	0.0%
URO	0.58	0.58	0.00	0.0%
ERO	1.78	1.76	0.02	1.1%
JRO	0.79	0.81	-0.02	-2.5%
RRO	6.18	6.11	0.07	1.1%
CSO	0.16	0.16	0.00	0.0%
USO	5.82	5.84	-0.02	-0.3%
ESO	1.78	1.79	-0.01	-0.6%
JSO	0.76	0.68	0.08	11.8%
RSO	10.38	10.40	-0.02	-0.2%

Table F.3.8 Change in Regional Protein Meal Consumption: Scenario Three				
Region / Commodity	Revised Value (mln tonne)	Base Value (mln tonne)	Difference (mln tonne)	Per Cent Change
CRM	0.44	0.44	0.00	0.0%
URM	0.94	0.94	0.00	0.0%
ERM	4.20	4.17	0.03	0.7%
JRM	1.32	1.32	0.00	0.0%
RRM	7.83	7.78	0.05	0.6%
CSM	1.31	1.31	0.00	0.0%
USM	22.80	22.74	0.06	0.3%
ESM	20.43	20.46	-0.03	-0.1%
JSM	3.69	3.68	0.01	0.3%
RSM	31.33	31.37	-0.04	-0.1%

Table F.3.9 Estimated Change in Oilseed Trade Flows: Scenario Three				
Region / Commodity	Revised Value (mln tonne)	Base Value (mln tonne)	Change (mln tonne)	Per Cent Change
TCCRS	4.37	2.20	2.17	98.6%
TCCRSS	0.29	0.27	0.02	7.4%
TCURS	0.25	0.25	0.00	0.0%
TCERS	0.56	0.20	0.46	230.0%
TCJRS	0.00	1.96	-1.96	-100.0%
TCRRS	0.00	0.41	-0.41	-100.0%
TUURS	0.10	0.10	0.00	0.0%
TEERS	5.70	5.70	0.00	0.0%
TEERSS	0.17	0.17	0.00	0.0%
TRRRS	13.73	13.73	0.00	0.0%
TRRRSS	0.39	0.39	0.00	0.0%
TCCSB	1.05	1.05	0.00	0.0%
TCUSB	0.45	0.45	0.00	0.0%
TUUSB	33.44	33.58	-0.14	-0.4%
TUUSBS	4.57	4.53	0.04	8.9%
TUJSB	0.00	3.73	-3.73	-100.0%
TURSB	18.27	14.45	3.82	26.4%
TRESB	18.00	12.43	-5.57	-44.8%
TRRSB	29.83	35.42	-5.59	-15.8%
TRRSBS	12.00	11.98	0.02	0.2%