5-1999

Economic Impacts of International Trade Agreements on the World Frozen Concentrate Orange Juice Market

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May 3, 1999

To the Graduate School:

This dissertation entitled "Economic Impacts of International Trade Agreements on the World Frozen Concentrate Orange Juice Market" and written by Louis Zabaneh is presented to the Graduate School of Clemson University. I recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy with a major in Applied Economics.

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ABSTRACT

The international FCOJ market is an important source of income for many countries around the world. The international trading environment is continuously changing as the forces of free trade grow and are embraced both regionally and globally. The specific economic effects due to present and proposed international trade agreements on prices, quantities, trade flows and welfare in the international FCOJ market are analyzed in this study. Four trading scenarios are considered. These include removing all tariffs for imports into the European Community, the Free Trade Area of the Americas, the lifting of the U.S. embargo on Cuba, and world free trade, respectively. The results from these scenarios are compared to a Baseline Model that incorporates present and scheduled tariffs changes.

A spatial-equilibrium, quadratic-programming model is used to assess the impact of the four trade scenarios on the international FCOJ market. The model includes four demand regions, accounting for 91% of world FCOJ imports in 1994, and six supply regions, accounting for 97.5% of world exports in 1994. The four demand regions include the United States, the European Community, Canada and Japan. The six supply regions include Brazil, the United States, Central America, Mexico, the Mediterranean and Cuba. Brazil, the United States and Central America are included endogenously in the model, while Mexico, the Mediterranean and Cuba are included exogenously. This study is the first that models Central America endogenously and the Mediterranean and Cuba exogenously in a world FCOJ model. The significant reduction in the number of trees and FCOJ output caused by major diseases in Brazil in 1998 is also explicitly incorporated in the model.

The results of Scenario 1 indicate the United States, Brazilian, Mexican and Cuban producers gain revenues. Central American and Mediterranean producers, who already had free access, lose. Consumers in the European Community gain, while consumers in the United States, Canada and Japan lose. World welfare increases by US$16.40 million under Scenario 1. Scenario 2 benefits all producing regions, but consumer surplus falls in the United States, the European Community and Japan, and rises in Canada. World welfare falls by a small US$1.10 million under Scenario 2. Scenario 3 leads to very small changes in prices and quantities, resulting in a minute fall in world welfare of US$0.08 million. Finally, Scenario 4 results in increased revenues to all producing regions, except Central America and the Mediterranean who already had free access to their export markets under the Baseline Model. Consumer surplus increases in the European Community and Japanese markets and falls in the United States and Canadian markets, under Scenario 4. World welfare increases by US$46.86 million under Scenario 4. These results show that regional trade arrangements do not unambiguously lead to increases in world welfare.

ACKNOWLEDGMENTS

I would like to give special thanks to Dr. Kandice H. Kahl, chairperson of my doctoral committee, for the many hours of guidance, constructive criticism, and patient attention she gave me during the preparation of this dissertation. I would also like to thank the other members of my committee, Drs. James Rathwell, Charles Curtis, and Mather Lindsay, for their assistance.

Thanks also to Drs. Gary Wells and Mike Hammig of the Department of Agricultural Economics at Clemson University, to Drs. William Dougan and Daniel Benjamin of the Economics Department at Clemson University, and especially to Drs. Thomas Spreen and Ronald Muraro of the Department of Food and Resource Economics at the University of Florida, for their very helpful contributions to this dissertation.

I would also like to express my appreciation to the Foundation Francisco Marroquin and USAID for funding most of my doctoral studies, and especially to Rosa Gutierrez who has been very instrumental in securing continued support. Thanks also to Dianne Haselton for formatting this document.

Last but not least I would like to give a very big thanks to my mom, Olga, my dad, Eugene, and to my Grandparents Juanita and Ezekiel, for their example, support, and wisdom.

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CHAPTER I

INTRODUCTION

Problem Statement and Objectives of the Research

Citrus is grown in many regions around the world. Oranges, the most common variety, are produced for fresh and processed consumption. In the last 30 years people around the world, especially in the developed countries, have made oranges and orange juice a main part of their diet. This increase in demand has led to production in many countries and has turned the sale of citrus into a truly international activity.

This study focuses on the global trade of frozen concentrate orange juice (FCOJ) and the impacts of existing and possible trading arrangements on prices, output and trade flows and welfare. In recent times nations have moved towards freer trade in the form of trading blocks and more globally through the General Agreement on Tariffs and Trade (GATT). This movement has led to changes in the flow and value of many goods and services, including FCOJ. Therefore, the problem tackled here is to determine the likely effects of these changes in tariffs and quotas in existing or proposed trading agreements on the future prices, output, trade flows of FCOJ and the welfare implications. Understanding these effects will benefit those participating in the industry, primarily farmers, processors, marketing firms and consumers.

The objective of the research is to forecast annual FCOJ prices, output and trade flows, and analyze changes in welfare, for 1998 to 2007 given different trading scenarios. The forecasts are obtained by using a spatial-equilibrium quadratic-programming model

comprised of the six major supply and four major demand regions. Consumer surplus and producer surplus are maximized after subtracting transportation costs and tariffs yielding prices, output and trade flows.

The six supply regions are Brazil, the United States, Mexico, Central America, the Mediterranean and Cuba, representing approximately 97.5% of world exports in 1994 (Table 1). Demand regions include the European Community, the United States, Canada and Japan, accounting for 91% of imports in 1994 (Table 2). The difference between world exports and imports as shown in Tables 1 and 2 is due mainly to re-exports.[1]

Contributions of the Research

This research offers three major contributions to the literature on the world FCOJ market. First, it adds endogenous supply regions, previously ignored or bulked under the heading "rest of the world." Second, it incorporates the effects of recent diseases on Brazilian output and, in turn, on the world FCOJ market. And third, it updates changes in trade agreements, includes new trade agreements, and looks at the effects of possible future agreements on the world FCOJ market.

Prior research in this area (Spreen and McClain) has included Brazil, the United States and Mexico as suppliers. As is the case in prior studies, Brazil and the United States are included endogenously and Mexico is included exogenously in the model

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[1] Import data include re-exports purchased from non-producing countries. A number of European Community countries re-export FCOJ primarily to other countries in Europe. Export data include exports by producing countries only. Therefore, the import figures are higher than the export figures. Usual measurement errors may also account for part of the discrepancy.

Table 1. Exports of Frozen Concentrate Orange Juice by Country of Origin, 1990 to 1994, with Comparisons to 1971-1981

	Average 1971–1981	1990	1991	1992	1993	1994	Change from 1971-1981 to 1994	1994 Market Share
	thousands of metric tons, 65° brix[a]						percent	
World[b]	597.1	1341.3	1243.3	1219.3	1406.3	1425.0	138.7	100.0
Brazil	448.1	954.0	926.7	968.6	1165.3	1146.9	155.9	80.5
United States	55.1	101.7	94.1	60.2	63.2	50.9	-7.6	3.6
Mexico	7.1	83.2	37.6	24.3	26.5	44.0	519.7	3.1
Central America								
Belize	2.7	7.2	4.6	10.5	7.5	8.1	200.0	0.6
Costa Rica	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Honduras	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Mediterranean								
Israel	37.1	74.3	54.0	30.6	21.7	21.5	-41.6	2.7
Italy	9.8	32.1	39.2	32.2	21.7	25.4	159.2	1.8
Morocco	8.6	32.9	30.0	14.6	10.4	27.1	215.1	1.9
Spain	5.5	22.6	31.6	37.9	43.8	65.3	1087.3	4.6
Cuba	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Source: Citrus Fruit, FAO.

[a] Brix is a measure of the degree of concentration of juice.

[b] Data for Costa Rica, Honduras and Cuba are not reported.

Table 2. Imports of Frozen Concentrate Orange Juice by Country of Destination, 1990 to 1994, with Comparisons to 1971-1981

	Average 1971-1981	1990	1991	1992	1993	1994	Change from 1971-1981 to 1994	1994 Market Share
	----------thousands of metric tons, 65° brix[a]----------							
World	694.3	1592.4	1650.8	1806.7	1710.7	1993.3	187.1	100.0
European Com.	353.9	989.6	1158.9	1189.2	1212.6	1358.8	284.0	68.2
United States	140.3	407.6	229.7	280.4	226.0	283.5	102.1	14.2
Canada	83.4	70.8	81.5	68.1	55.5	65.4	-21.6	3.3
Japan	N/A	23.4	37.3	58.3	63.7	106.6	355.6[b]	5.3

Source: Citrus Fruit, FAO.

[a] Brix is a measure of the degree of concentration of juice.

[b] Given the unavailability of data for 1971-1981, the percent change was computed from 1990 to 1994.

developed in this research.[2] The first main contribution of this study is the inclusion of Central America, the Mediterranean Region, and Cuba as additional suppliers. Central America is included endogenously and the Mediterranean Region and Cuba are included exogenously.

Central America is becoming an increasingly important producing area in the world. Belize, Costa Rica and Honduras are the major FCOJ producing countries in Central America. All three industries share major similarities especially in climatic conditions and cultural practices. The Belizean industry is the most organized of the three industries and is the industry with the best database. Therefore, when data are missing for the other two Central American countries, extrapolations are made from the Belizean industry.

At present these three countries comprise only about 10% of the acreage of the largest industry, the Brazilian industry.[3] However, their output potential is significant. This region has a large percentage of young trees (with about 45% being less than eight years old).[4] This suggests a significant increase in output from this part of the world over the next 20 years.[5] The freezes of the late 1980s that led to historically high prices and

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[2] A producing region is endogenous if the orange tree planting decisions are based on variables produced by the model (e.g., prices). The production of an exogenous producer is assumed to grow at a specified rate. Countries or regions are included exogenously in the model due to lack of data on such variables as acreage and age distribution of trees.

[3] As will be described in more detail in Chapter II, in the 1997/98 season Brazil had about 1.8 million acres while Central America had about 175,000 acres.

[4] Information on the age distribution of trees for Central America was collected during a personal visit by the author to these countries in March 1998.

[5] An orange tree starts bearing after its third year and lives for over 40 years. After the fourth year, it may produce over 1 box (90 pounds) per tree, gradually climb to over 4 boxes per tree after 20 years and start declining after 30 years. With care a tree could live and bear for over 40 years but is usually replaced at this age. Thus, these recently planted trees will reach peak production in the next 20 years.

the free access to the United States after 1983 due to the Caribbean Basin Initiative (CBI) encouraged increased plantings in these Central American countries in the late 1980s and early 1990s.

The Mediterranean Region includes Israel, Italy, Morocco and Spain, accounting for 11% of world exports in 1994 (Table 1). Between 1990 and 1994, exports have declined for Israel, fluctuated for Italy and Morocco, and continuously increased for Spain. Between 1971-1981 and 1994 however, exports more than doubled for each of these countries except Israel (Table 1).

Cuba has been involved in citrus production for over five decades and even though its industry has declined after the collapse of the Soviet Union, its main trading partner at the time, this trend has been reversed in recent years. The quantity of oranges processed in Cuba has jumped from 194,100 metric tons in 1993 to 589,300 metric tons in 1996, an increase of 203.6%. Western European countries have now replaced the former Soviet Union as the major market for Cuban FCOJ exports (Gonzalez et al.).

The second important contribution of this study is the inclusion of the effects of recent diseases in orange groves in Brazil, the world's largest supplier of FCOJ. Two very destructive diseases, Citrus Variegated Chlorosis (CVC) and Citrus Canker, have devastated the Brazilian industry. These diseases are expected to cause a major reduction in output in the 1998/99 season. Total Brazilian production of fresh oranges is estimated to decrease 30.4% from an actual figure of 428 million 90-pound boxes for the 1997/98 season to 298 million 90-pound boxes in the 1998/99 season (Abecitrus).

The third main contribution is the updating of regional and global trade agreements and the consideration of possible future trade arrangements. These include the

GATT, the North American Free Trade Agreement (NAFTA), CBI, the Lome Conventions (LC), the Free Trade Area of the Americas (FTAA) and the United States trade embargo on Cuba.

Overview of the Presentation

Chapter II gives an overview of the world's major producing areas for FCOJ. Even though many countries grow oranges, not all of them trade FCOJ internationally. Some produce oranges mainly for their domestic market, others export only fresh fruits and a few export both fresh and processed fruit. Given the focus on FCOJ, only the six major production regions and four major consumption regions of this product are considered. Each production region is described in more detail mainly in terms of production acreage, industry organization, and export markets. The chapter continues with a description of the following very important present and proposed trade arrangements pertinent to this study:

1. The General Agreement on Tariffs and Trade,
2. The North American Free Trade Agreement,
3. The Caribbean Basin Initiative,
4. The Lome Conventions,
5. The Free Trade Area of the Americas proposal,
6. The United States trade embargo on Cuba.

Chapter III reviews the literature on supply response functions and spatial-equilibrium quadratic-programming models, and discusses the model used in this study. The literature review aids in the development of a supply function for Central America and a forecasting model that will incorporate this new Central American supply function.

Chapter IV describes the results. The model is first estimated with information on the present trading situation, called the Baseline Model. The present trading situation includes tariff reductions or eliminations under GATT, NAFTA, CBI and LC. By implication, the possible future trade agreements, namely the expansion of LC preferences to all other FCOJ producing countries, FTAA, the lifting of the United States embargo on Cuba and total world free trade are not included in the Baseline Model.

The Baseline Model is adjusted to consider the fall in Brazilian production due to diseases. This Baseline Model is used for comparison to four possible future trading scenarios. These four scenarios are:

1. LC preferences being granted to all FCOJ exporters to the European Community;
2. the passage of the FTAA treaty that allows free access into the United States and Canadian markets for all producing countries in the Americas;
3. the lifting of the United States trade embargo on Cuba; and
4. the success of the GATT via the World Trade Organization (WTO) in world free trade in FCOJ.

Each scenario, except the fourth, stands on its own, meaning that it does not include the others. The results are then compared to the Baseline Model results to determine the impacts from these different scenarios on prices, output and trade flows.

Chapter V summarizes the economic implications of the findings, in particular the effects on specific countries' prices, output, trade flows, and welfare under each scenario considered. These considerations are important for policy formulation for the countries involved in the world FCOJ trade.

Will freer trade policies cause prices to fall to such a level that certain countries will not be able to survive? This is a question that individual industries may ask and the

price forecasts from this research may be able to help them with answers. Or will events in other countries, such as the diseases in Brazil, lead to relatively high prices and increased production elsewhere? These are some of the important questions that will be addressed in the final chapter. Finally, suggestions are made for future research in this area.

CHAPTER II

THE GLOBAL PRODUCTION AND TRADE OF FROZEN CONCENTRATE ORANGE JUICE

Introduction

The international citrus market is a dynamic interaction of producing and consuming countries encompassing the entire globe. The world market consists mainly of fresh oranges, grapefruits, tangerines, limes and lemons and their respective concentrates. The portion of this market that is of interest here is the part that trades FCOJ.

The model used in this study has three basic components, i.e., the producing countries/regions, the consuming countries/regions, and the international trade agreements that affect them. This chapter provides information on the producing countries/regions and the trade agreements. A discussion of the consumption regions is left for Chapter III.

The chapter starts with background on the production of oranges and FCOJ. It looks at factors that affect production, such as geographic location, weather and diseases, and describes how yields, productivity, weight, and quality are measured. It also explains the whole process from the picking of the fruit, to the delivery of FCOJ at international ports, and ultimately to retail juice sales. Each producing country or region is then described separately in terms of its orange and FCOJ production, industry structure and export markets.

In the final section, the international trade agreements that affect or have the potential to affect the international trade of FCOJ are presented and discussed. These agreements affect the world FCOJ market by influencing relative tariffs facing the exporters of FCOJ. Tariffs are a major cost that exporters face in the trade of FCOJ and knowledge of changes in these costs is vital information to the viability of their industries.

Background

Oranges are grown in the warm tropical and sub-tropical regions of the world. The majority of the countries/regions considered in this research are located in the Northern Hemisphere. While there are a number of countries in the Southern Hemisphere that produce oranges, such as Argentina, South Africa and Australia, the only significant exporter of FCOJ is Brazil.

The basic difference between the Northern and Southern Hemispheric producers is that the harvest in the Northern Hemisphere begins in September and ends in May of the following year, while in the Southern Hemisphere the harvest begins in May and ends in January of the following year.

The predominant orange variety used in FCOJ production is Valencia. Other varieties such as Hamlins, Parson Browns, Pineapples, Temples and Navels are also grown for both fresh and processed consumption. Harvest-time is dependent both on the orange variety and on the geographic location (above or below the equator) of the orange groves. Hamlins and Parson Browns are harvested earlier in the season than the others, and are called "Earlies." Pineapples, Navels and Temples are harvested in the middle of the season and are called "mid-season." Valencias are among the last to be harvested and are

called "late-season." Valencias do not have the "clean" appearance as other varieties and, therefore, are grown mainly for processing. Temples and Navels go mostly to the fresh market.

Orange trees can live for over 40 years. Yields depend on tree density and care, but in general a tree starts bearing after its third year, reaches peak production after 15 to 20 years, levels off for about 10 years and starts declining after about 30 years.

Hurricanes, droughts, floods, freezes and other weather phenomena can substantially reduce orange grove productivity both in the short and long run. For example, freezes in the 1980s were devastating to the Florida industry. Total orange acreage in Florida fell by 26% between 1980 and 1986 due largely to the freezes (FDOC, 1996).

Diseases are also important determinants of orange grove productivity. Three of the major diseases that affect orange trees are Citrus Tristeza Virus (CTV), Citrus Variegated Chlorosis (CVC), and Citrus Canker. CTV causes varying degrees of damage from mild to severe yield reductions, and ultimately tree death may occur after five years of the infection, depending on the strain of the disease. CVC affects trees seven years or younger causing yield reductions in the first year after infection and death after the second year. Citrus Canker is a bacterial infection that attacks the roots and stems of trees and leads to yield reduction and/or tree death (Inter-American Citrus Network, and Herron and Sabal).

Oranges are usually handpicked, but some growers use mechanical devices that shake the fruit off the tree. Once picked, the fruit is transported to either packinghouses for preparation for the fresh market or processing plants for the juice market. The fresh

market demands an unblemished fruit. Packinghouses select only fruit with these qualities and wash, wax and package them for sale to retail outlets.

At the processing stage, the fruit is squeezed and left as single strength juice or further processed into concentrated juice. Single strength juice, also called not-from-concentrate (NFC), has been gaining popularity in all major world markets in recent years. At the retail level in the United States, sales of NFC as a percentage of FCOJ have increased continuously, from 20.9% to 37.3% between 1990 and 1995 calendar years (Florida Citrus Mutual). In the export market, however, FCOJ is still the most common form of processed orange juice traded.

The process of concentration has traditionally used the evaporation method. Orange juice is heated to evaporate most of the water it contains. A more recent technology freezes the water out of the juice. The FCOJ produced by this latter method is usually called "freeze concentrate." However, the evaporation method is still the most common technology used today.

The concentration of the juice is measured in degrees of brix. Brixs measure the amount of pounds of solids (p.s.), mostly soluble sugars, in a gallon of juice. For example, there are 4.512 p.s. in a gallon of 45 degree brix FCOJ, 6.165 p.s. in a gallon of 58 degree brix FCOJ, and 7.135 p.s. in a gallon of 65 degree brix FCOJ. At single strength concentration, also called a single strength equivalent gallon (SSE) (the equivalent of freshly squeezed orange juice), the degree of brix is 11.8, containing 1.029 pounds of solids, or pound solids for short.

The solids (soluble sugars) in orange juice, along with other characteristics such as color, flavor and defects, determine the quality of the orange juice (Ward and Kilmer).

As the oranges are processed over the crop year, these characteristics that determine quality change. Flavor is determined by a sugar:acid ratio (also called a brix:acid ratio). As the fruit ripens, this ratio gets higher.

Therefore, Florida processors usually blend their juice with imported juice that has characteristics they may be lacking at any point in time. However, storage or inventories may reduce the need for dependency on imports for this purpose. There is a trade-off of costs of holding inventories versus the benefits of being independent.

Typically, FCOJ is transported from the exporting countries in 55-gallon drums, at 65 degree brix. However, Brazil uses very large tanker ships, similar to the ships that transport petroleum. Large storage tanks at the ports in the United States and Europe are also becoming a common way of storing FCOJ upon arrival from exporting countries. Tanker trucks then transport the juice to reconstitution plants, closer to retail markets, where water is added to the concentrate juice to bring it back to single strength for retail sales. A part of FCOJ is also sold as concentrate at the retail level.

Production Regions

One of the main components of the quadratic-programming model used in this research is the production side of the world FCOJ industry. Therefore, it is important to understand the characteristics that define the present output and future output potential of each of the major producing countries/regions of FCOJ.

The major FCOJ producing countries/regions, as mentioned before, include Brazil, the United States, Mexico, Central America (Belize, Costa Rica and Honduras), the Mediterranean (Israel, Italy, Morocco and Spain), and Cuba. This section describes

orange and FCOJ production, industry structure and export markets for each of these countries/regions.

Data that are publicly available are presented in this section. Data on Mexico, Central America, the Mediterranean Region, and Cuba are scant or non-existent. Information on Central America and Cuba comes mainly from a personal visit by the author to these particular industries.

Brazil

Approximately 83% of Brazilian oranges are produced in the state of Sao Paulo in Brazil (Figure 1), and over 70% of this amount is processed into FCOJ. The other 17% that is grown in other states goes mainly to the fresh, domestic market.[6] Brazil is the largest producer of oranges and exporter of FCOJ in the world (Table 3). The Florida Agricultural Service (FAS) estimated Sao Paulo at 1.82 million acres of oranges in the 1997/98 season (Spreen and Muraro). In the 1996/97 season, Brazil produced 363 million boxes of oranges, of which it processed 268 million. In the 1997/98 season, these numbers increased to 428 and 318 million boxes, respectively (Abecitrus).

Four companies, called Brazil's "Big Four," process over 80% of all concentrated orange juice in Brazil. These companies, ranked in 1997 from the largest to the smallest, are Citrosuco (27.7%), Cutrale (24.9%), Dreyfus (16.3%) and Cargill (13.1%) (Spreen and Muraro).

In the 1983/84 season, Brazil sold 52% of its total FCOJ exports to the United States, 4% to Canada, 38% to Europe and the rest to other countries. By the 1995/96

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[6] Brazilian orange and FCOJ output reported in this study are from the state of Sao Paulo only, given that oranges produced in other Brazilian states are sold primarily as fresh fruit.

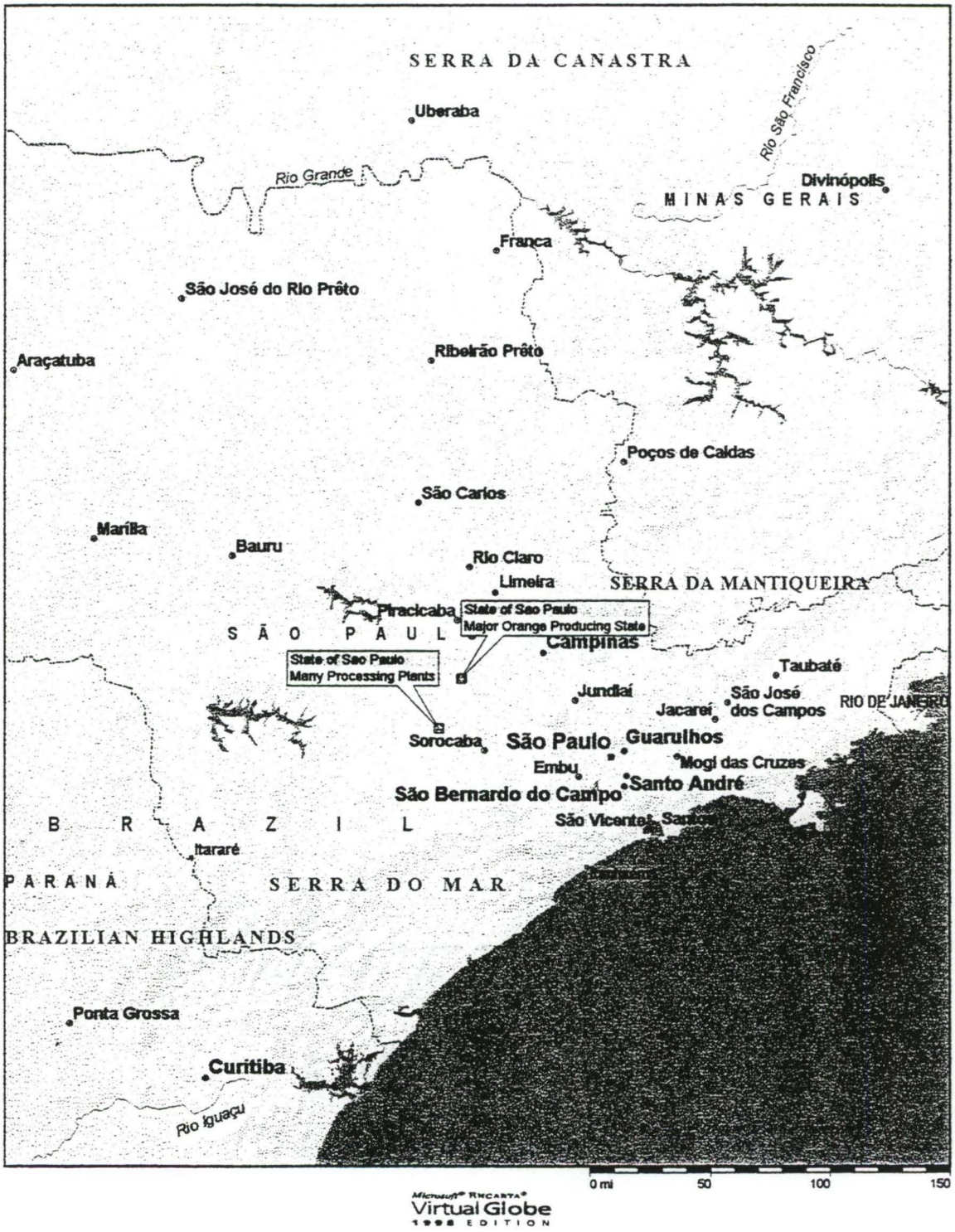

Figure 1. Orange/FCOJ Producing Areas of Brazil. Source: Virtual Globe, 1998 edition, Microsoft Corporation.

Table 3. Acreage, Yield, and Production of Oranges, and Exports of FCOJ by Major Countries/Regions for the Most Recent Crop Year Available

Country/Region	Orange Acreage[a] (1,000s)	Orange Yield[b] (90-lb boxes per acre)	Orange Production (millions of 90-lb boxes)	FCOJ Exports[c] (1,000s of metric tons, 65° brix)
Brazil (Sao Paulo)	1820.0[d]	240.0[e]	428.0[d]	1146.9
United States (Florida)	656.0[f]	380.0[e]	244.0[d]	50.9
Mexico	708.0[f]	148.0[c]	87.4[c]	44.0
Central America				
Belize	50.0[d]	122.0[c]	4.5[e]	8.1
Costa Rica	64.0[d]	N/A	N/A	N/A
Honduras	60.0[d]	N/A	N/A	N/A
Mediterranean Region				
Israel	N/A	N/A	9.9[c]	39.0
Italy	N/A	N/A	44.1[c]	25.4
Morocco	N/A	N/A	16.1[c]	27.0
Spain	N/A	N/A	66.1[c]	65.3
Cuba	148.0[d]	75.0[d]	8.6[c]	N/A

Source: Food and Agricultural Organization (FAO), Florida Department of Citrus (FDOC), Florida Citrus Mutual and a personal visit by the author to the Central American and Cuban industries.

[a] Includes bearing and non-bearing acreage.

[b] By definition the yield is on bearing acres only.

[c] For the 1994/95 season.

[d] For the 1997/98 season.

[e] For the 1996/97 season.

[f] For the 1995/96 season.

Note: All figures for Brazil and the United States are from the states of Sao Paulo and Florida. Almost all orange production in other states in these two countries is sold as fresh fruit. The figures for all other countries in the table represent all orange production in those countries without regard for whether the oranges are sold fresh or are processed.

season, its exports to the United States had dropped to 18%, and to Canada had dropped to almost zero. At the same time 69% of its exports went to Europe, 6.5% to Japan and the rest to other countries (Florida Department of Citrus, 1997a).

The main cause for these changes in trade flows was the large increase in production from the Florida growers. Florida is now able to satisfy most of the United States' demand and in the process it has taken away much of the market share the Brazilians once controlled. Now the Brazilian processors are taking drastic steps to regain their market share by purchasing processing plants in Florida to process Florida oranges. This move also diversifies their supply base making them less susceptible to conditions in any one location (Lesser).

Brazil is the lowest cost processor of FCOJ. When tariffs are subtracted from its total landed costs to the United States market, Brazil is also the lowest cost exporter of FCOJ among the major producing countries exporting to the United States market. The F.O.B. costs, excluding tariffs, were $0.79 per pound solids for Brazil but exceed $0.85 per pound solids for other major producers (Table 4). The United States, the European Community and Japan all impose tariffs for the sale of Brazilian citrus juices in their markets in an attempt to protect their higher cost citrus industries.

The United States

The State of Florida is to the United States what Sao Paulo is to Brazil. Over 70% of all oranges produced in the United States are grown in Florida (Figure 2), of which over 90% are processed. Total acreage of oranges in Florida for the 1995/96 season was

Table 4. Estimated F.O.B. Cost of Bulk Frozen Concentrate Orange Juice Exported To/Sold in the United States

Costs	Producing Countries			
	Sao Paulo, Brazil[a]	Florida, United States[a]	Veracruz, Mexico[b]	Belize, Central America[c]
	----------US$ per pound of solids----------			
Growing Costs	0.3514	0.4681	0.2583	0.3380
Harvesting and Hauling	0.1332	0.2901	0.2352	0.1100
Total Delivered to Processor	0.4846	0.7582	0.4935	0.4480
Processing	0.1491	0.1834	0.1704	0.3400
Domestic Storage & Transportation	0.0289	0.0282	0.0526	0.0200
Total Processing, Domestic Stor. & Trans. Costs	0.1780	0.2116	0.2230	0.3600
Foreign Transportation and Harbor Charges	0.1288	0.0000	0.1494	0.1360
U.S.A. FCOJ Tariff	0.3150	0.0000	0.1839	0.0000
Total Exporting Costs	0.4438	0.0000	0.3333	0.1360
Total F.O.B. Costs[d]	1.1064	0.9698	1.0498	0.9440
Total F.O.B. Costs Less Tariffs	0.7914	0.9698	0.8659	0.9440

[a] Costs for Florida and Sao Paulo are from Spreen and Muraro.

[b] Costs for Veracruz are from Muraro.

[c] Costs are from Zabaneh.

[d] These numbers are the sum of the numbers in bold in their respective columns above.

Figure 2. Orange/FCOJ Producing Areas of the United States. Source: Virtual Globe, 1998 edition, Microsoft Corporation.

656,000 acres[7] (Florida Citrus Mutual). Actual output for the 1996/97 season of oranges in Florida was 226.2 million boxes, and of this amount 215.4 million were processed. In the most recent season, the 1997/98 season, Florida produced 244 million boxes of oranges. The remaining United States oranges are grown mainly in the states of California, Arizona and Texas, and are primarily sold as fresh fruit. California, Arizona and Texas together had 213.5 thousand acres of bearing orange trees in the 1995/96 season. The United States is the second largest grower of oranges in the world (Table 3).

The freezes of the 1960s and 1980s devastated the Florida industry causing prices to rise and production in other countries such as Brazil and Belize to increase. However, the Florida industry has recovered and is growing. This recovery was accomplished by planting freeze-resistant varieties, moving citrus groves south to warmer areas and spending heavily on research that has increased both the quantity and quality of yields (boxes per tree and pound solids per box) dramatically. The 1996/97 crop was 19.5 million boxes more than the previous record set in the 1979/80 season (National Agricultural Statistical Service).

The industry concentration in Florida is not as high as in Brazil. While in Brazil the "Big Four" process over 80% of all oranges processed in Brazil, in Florida the largest four processors account for only about 40% of all oranges processed in that state (Spreen and Muraro).

In the 1996/97 season, 92.7 % of all processed orange juice in Florida was sold to the North American market, mostly to the United States. For that same period, 4.5 % was sold to the European Community, and the rest to other countries (Lesser).

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[7] Acreage surveys are conducted every two years, the next being at the end of the 1997/98 season.

Mexico

Mexico was the third largest orange producer in the world in the 1994/95 season, according to Florida Citrus Mutual. In the 1995/96 season, Mexico had 707,946 acres under oranges (Table 3), more than the number of acres under oranges in Florida (Mondragon). The state of Veracruz accounts for the largest percentage of orange acreage (Figure 3). Total orange production in the 1994/95 season was 87.4 million boxes (Table 3).

The Mexican citrus industry is different from that of Brazil and the United States in that over 75% of its output has traditionally gone to the fresh domestic market. For the ten seasons between 1985/86 and 1994/95, the percent of oranges processed has ranged between 8% and 22% of which the majority was exported (Mondragon et al.).

Middlemen, referred to as "coyotes," buy fresh fruit from farmers and then sell to either processors or packinghouses. The packinghouses then ship the fruit to final domestic destinations, usually to the very large market in Mexico City called the "Central de Abastos."

In the 1995 calendar year, Mexico exported about 74% of its total FCOJ exports to the United States, 16% to Europe, 5% to Canada, 2% to Japan and the rest to other countries. Note, however, in actual volume Mexico's total exports are small relative to Brazil's. For example, in one of Mexico's largest export years, 1995, it exported 86.5 million SSE gallons of FCOJ, while in that year Brazil exported 1,448.1 million SSE gallons (Mondragon, and Spreen and Muraro). Thus, Mexico's exports are usually below 6% of Brazil's exports.

Figure 3. Orange/FCOJ Producing Areas of Mexico. Source: Virtual Globe, 1998 edition, Microsoft Corporation.

To this point in time, the inefficiencies in the Mexican orange industry and the instability of the Mexican economy have been bottlenecks to further Mexican expansion of FCOJ exports into the United States market. However, the case of the Persian Lime industry is one that shows the potential of the Mexicans once they gain some organization and focus (Roy, et al.). After hurricane Andrew devastated the Florida Persian Lime industry in 1992, the Mexicans took advantage of the shortage and by 1994 controlled over 90% of the United States market. Although the lime and orange industries are somewhat different and face different international forces, the case of Persian Limes suggests that Mexico has the potential to become a major player in the FCOJ market in the future.

Central America[8]

All seven countries in Central America produce oranges and other citrus products. However, only Belize, Costa Rica and Honduras produce FCOJ for export. El Salvador, Guatemala, Nicaragua and Panama have relatively smaller industries that produce exclusively for fresh domestic consumption.

Belize

The citrus industry of Belize is located in the central and southern districts of Cayo, Stann Creek and Toledo (Figure 4). The industry began in Stann Creek in 1913, and was concentrated there for many years, but by the 1980s had spread to the other districts. At present, Stann Creek accounts for over 70% of the total area of about 50,000 acres (Table 3). Total output for the 1996/97 season was 4.5 million boxes (Belize Citrus

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[8] Most of the information for this region comes from a personal visit to these countries by the author between March 15 and 30, 1998. Personal interviews proved the most effective way of acquiring information since written material is very limited.

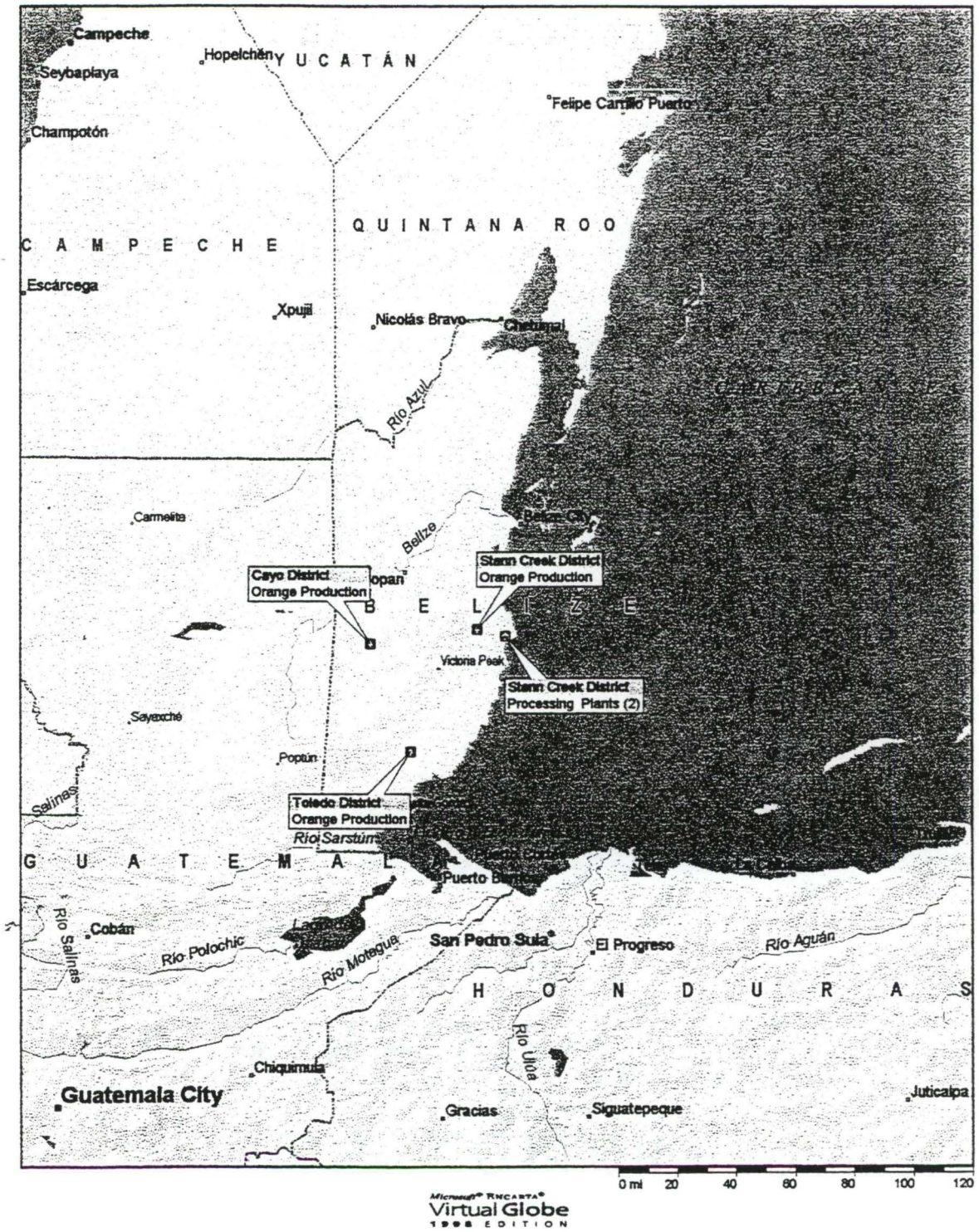

Figure 4. Orange/FCOJ Producing Areas of Belize. Source: Virtual Globe, 1998 edition, Microsoft Corporation.

Growers' Association), relatively small compared to the three countries discussed above. Almost all of the total production is processed every year.

Belize has two processors, Belize Food Products Ltd., and Citrus Company of Belize, both in Stann Creek. These two companies each process about 50% of total output. At present, both processors are in negotiations with the British organization Commonwealth Development Corporation (CDC) for a merger. CDC also has operations in Cost Rica.

Exports are to the United States, Europe and the Caribbean (mainly to the country of Trinidad and Tobago). About 40 to 50% goes to the United States, 30 to 40% to Europe and the rest to the Caribbean.

Belize benefits from three preferential trading arrangements. First, the Caribbean Community, or Caricom, is an area of free trade among the English-speaking Caribbean countries. Second, CBI allows countries of the Caribbean Basin to sell FCOJ to the United States market free of tariffs. And third, the Lome Conventions allow access to the European Community free of duties as well. Therefore, Belize sells its entire FCOJ product without having to pay duties to any of these markets.

Costa Rica

The largest concentration of orange groves is located in the central state of Alajuela (Figure 5). The northwestern state of Guanacaste is also becoming an important area with about 8,000 acres of new plantings made in the mid-1990s. Total acreage is 64,000 acres (Table 3) of which about 70% of output is processed.

Costa Rica has two major processors. TicoFrut is the largest and is located in the traditional orange producing state of Alajuela, near the town of Muelle. Del Oro (owned

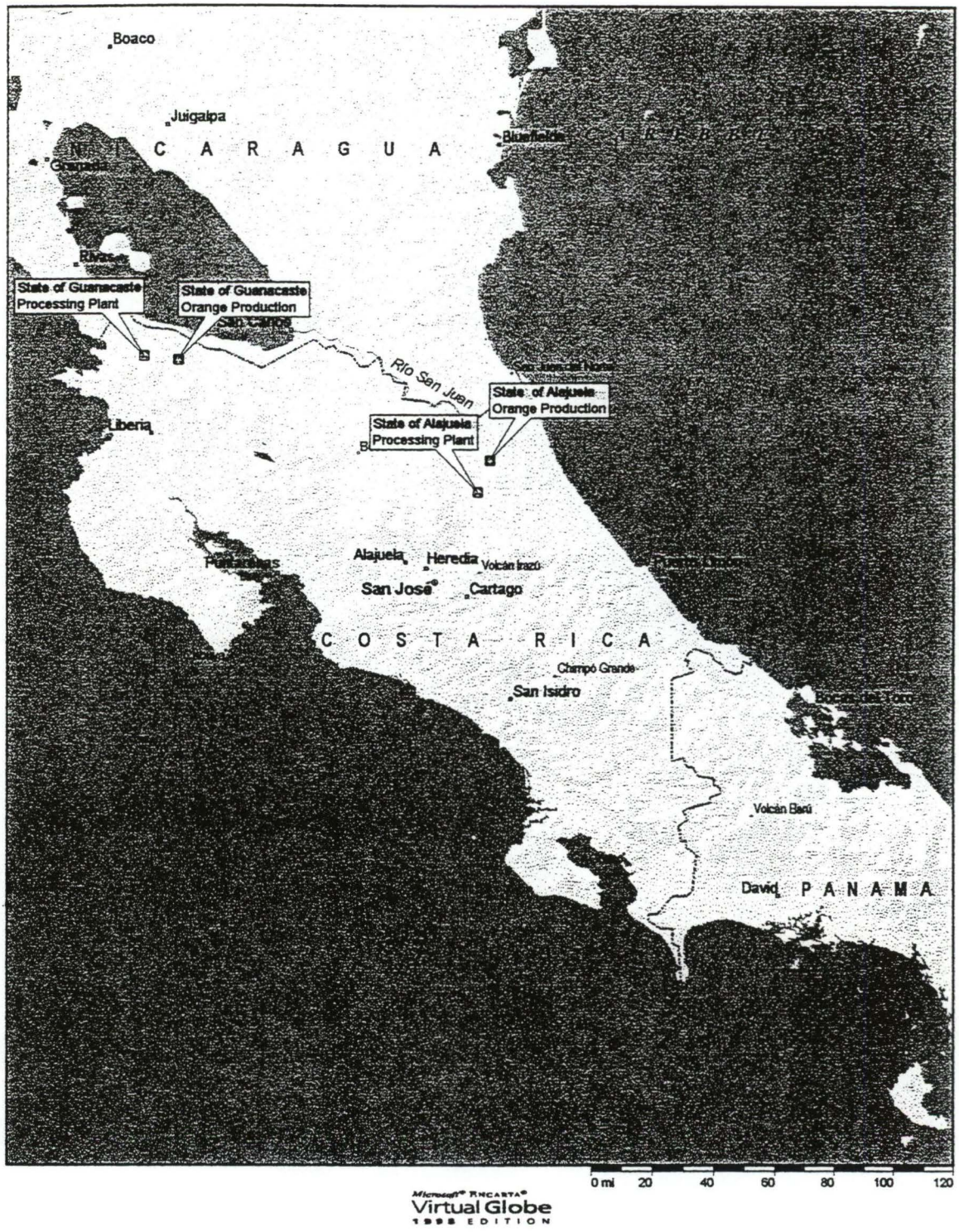

Figure 5. Orange/FCOJ Producing Areas of Costa Rica. Source: Virtual Globe, 1998 edition, Microsoft Corporation.

by CDC) is the newest (beginning operation in 1996) and is located in Guanacaste province, near the town of Santa Cecilia. These two processors sell about 80% to the United States and 20% to the European Market (Costa Rican Ministry of Agriculture).

Costa Rica also gets free access to the United States market because of the Caribbean Basin Initiative. It also receives free access into the European market under a special provision granted to countries outside the African Caribbean and Pacific (ACP) group. Therefore, Costa Rica does not pay tariffs to the United States or the European Community markets.

Both the private and the public sectors are supporting an increase in orange production in Costa Rica. Del Oro is encouraging private farmers in the Guanacaste region to plant by offering technical support to those that enter the industry or to those who extend their present acreage. The government is also supporting diversification into citrus with external assistance from European countries (Costa Rican Ministry of Agriculture).

Honduras

Oranges are grown throughout the northern coastal regions of Honduras (Figure 6). Most of the approximately 60,000 acres of oranges (Table 3) are located in the states of Santa Barbara, Cortes, Yoro, Atlantida and Colon. The largest acreage is found in the states of Atlantida and Colon. Most of the new groves are in Colon. About 40% of the total output of oranges is sold in the fresh market. Of this amount, the majority is exported to El Salvador and Guatemala.

Honduras has two major orange processing plants both located in Colon. These are Colon Fruit Company and Citrus Development Corporation. These two processors sell almost 100% of their product to the United States market. Honduras also benefits

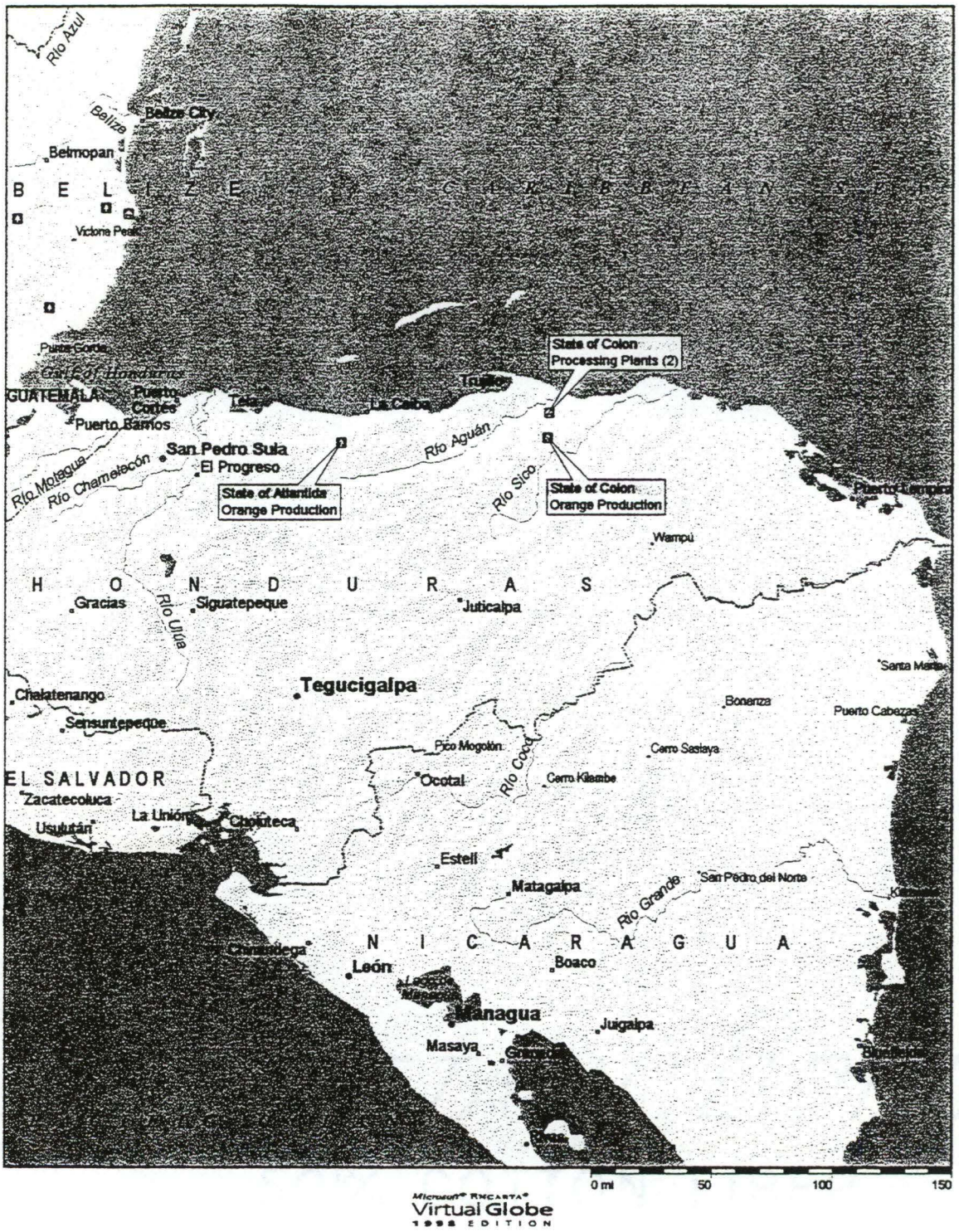

Figure 6. Orange/FCOJ Producing Areas of Honduras. Source: Virtual Globe, 1998 edition, Microsoft Corporation.

from CBI in its duty-free access of FCOJ to the United States market and therefore pays no tariffs to the United States market.

The Mediterranean Region

Israel, Italy, Morocco and Spain (Figure 7) are included because together they represent a significant portion of the world FCOJ exports, 11% in 1994 as reported in Chapter I. Together these four countries produced 136.2 million boxes of oranges in the 1994/95 season (Table 3). Approximately 26% of oranges produced by these four countries were processed into FCOJ in the 1994/95 season. These countries are grouped together given that climatic conditions are relatively similar in this area of the world.

Cuba[9]

Citrus is grown throughout the country of Cuba (Figure 8). The main varieties are oranges and grapefruit. The area under citrus in general peaked at 355,680 acres in 1990 and dropped to 313,690 acres in 1993. In 1993, oranges comprised 181,940 acres (58%) and grapefruits 94,107 acres (30%) (Spreen, Gonzalez and Muraro).

Cuba produced 8.6 million boxes of oranges in the 1994/95 season (Table 3). By 1998, the total orange area had fallen to 148,348 acres due to the abandonment of the most inefficient farms. The drop in citrus acreage and output of oranges in Cuba was directly caused by the massive political changes that occurred in the former Soviet Union and Eastern Europe after 1989. These changes resulted in the elimination of preferential access (mostly via bartering) of Cuban citrus to these countries.

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[9] Some of the information in this section comes from a personal visit by the author to Cuba in March 1998.

Figure 7. Orange/FCOJ Producing Areas of the Mediterranean. Source: Virtual Globe, 1998 edition, Microsoft Corporation.

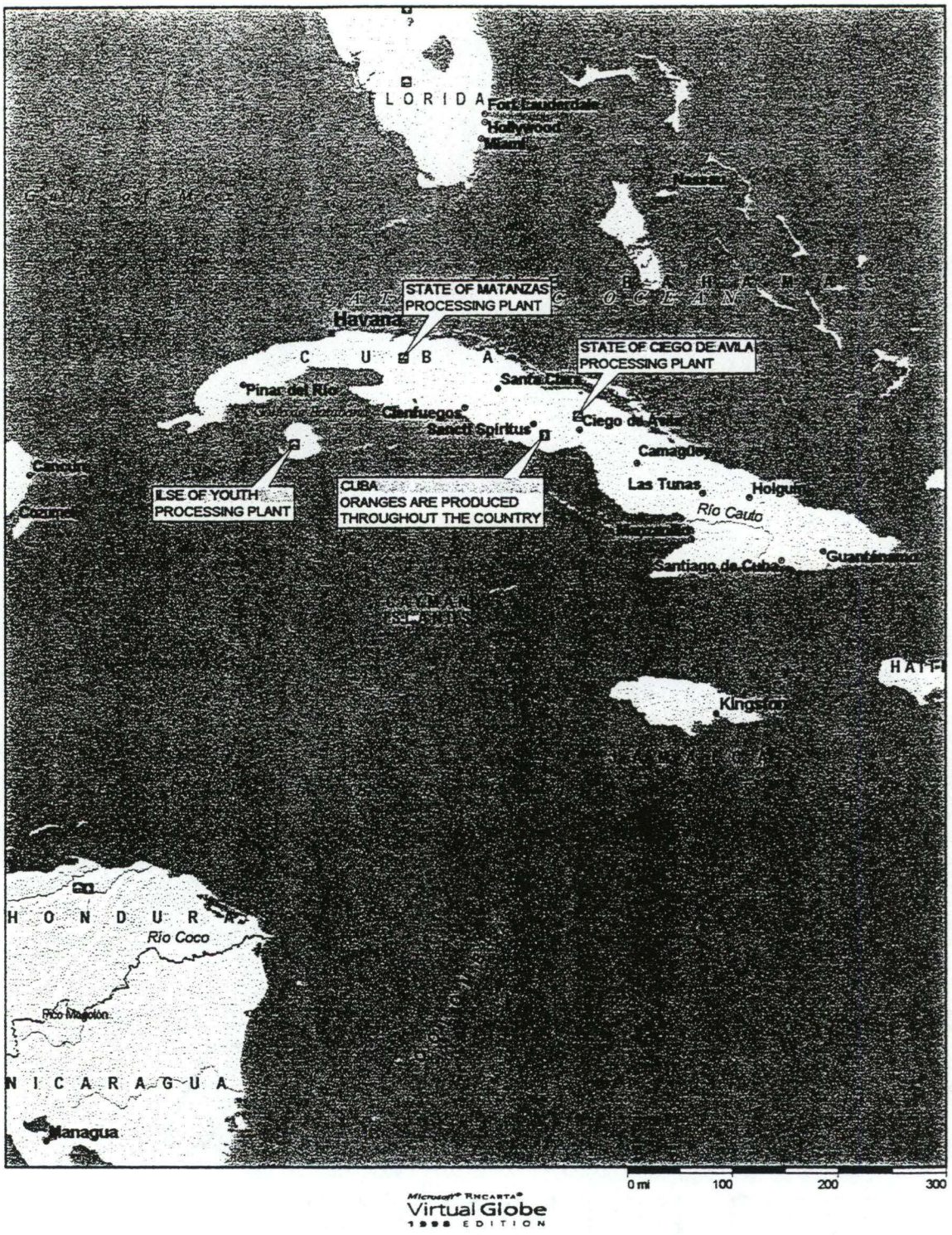

Figure 8. Orange/FCOJ Producing Areas of Cuba. Source: Virtual Globe, 1998 edition, Microsoft Corporation.

The general decline in the Cuban economy thereafter also contributed to the deterioration of the industry. Inputs became scarce and expensive to administer resulting in falling yields and abandonment of the poorest performing groves (Muraro and Spreen).

Of all oranges produced in 1993, 23% was processed and the rest sold as fresh fruit. However, an increase in process utilization is expected from two new processing plants presently under construction under joint ventures between the Cuban Government and foreign firms.[10]

The Cuban government turned to joint ventures with foreign companies to compensate for the lack of capital, marketing capabilities and management skills they needed to sell to other international markets such as Western Europe and Asia. Their strategy has been to focus their very limited resources on the most productive farms, dividing them into smaller units and decentralizing management (Muraro and Spreen).

By 1997 the Cubans had organized orange production into two main types. The first uses military labor and the second continues in the vein of decentralization and market incentives. In the latter, plots of about 35 acres are distributed to family units who manage the farms with almost complete autonomy. Officials are reporting considerable increases in efficiency due to the market incentives being put in place.

The Cuban citrus industry has attracted some foreign investment and shows enormous potential. If conditions become favorable, for example if the United States trade embargo would be lifted, then Cuba could become one of the major producers of citrus and FCOJ in the world. A lifting of the trade embargo would mean the opening of

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[10] These new processing plants are not shown in Figure 8.

the largest FCOJ market to Cuban exports, access to new technologies and investment funds for expansion.

International Trade Arrangements

Another major component of the quadratic-programming model used in this study comprises the trade agreements that presently affect and have the potential to affect the world FCOJ industry. The following describes these trade agreements and discusses the effects of each.

The General Agreement on Tariffs and Trade[11]

During the Second World War, plans were already being made to change the landscape of the international relationships among countries of the world. Experience from the period after the First World War showed that the heavy cost placed on the losers had led to an environment for the start of the Second World War. Germany's forced payments to victims of the first war had strained its economy and given rise to dictatorship and aggression. Thus, to avoid a repeat of such actions, discussions on the need for free trade and assistance to damaged economies began both in the United States and Britain. These discussions were led by Harry Dexter White in the United States and John Maynard Keynes in Britain.

Initially, plans were for the formation of the International Trade Organization (ITO) that would deal with all issues of free trade, such as the reduction of trade barriers and export subsidies. The Havana Charter, during its first session in 1946, took the first

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[11] The majority of the following section is taken from Josling et al.

steps towards the formation of the ITO. However, negotiations took longer than anticipated, as it became apparent that the proposed ITO's power would conflict with domestic policies on many issues including protection and subsidization of national industries.

Given these obstacles, trade officials led mostly by United States negotiators, formed a technical drafting committee to develop an agreement on tariffs and trade. The result was the General Agreement on Tariffs and Trade signed by 23 countries on October 30, 1947. Every effort was made to ensure that the agreement was not perceived as a new organization or as the ITO in disguise. This new agreement had no power over domestic decision-making and was basically just a set of rules of conduct and guidelines on tariff reductions.

The process of negotiations went through many "rounds" over the next five decades. The Dillon, Kennedy, Tokyo and Uruguay Rounds saw continuous friction and debate over ways to arrive at freer world trade. The most contentious item in these debates was agriculture. Governments around the world held their ground when it came to protecting their agricultural sectors, arguing that self-sufficiency was in the national interest. The governments were unwilling to yield on agriculture until the last round of negotiations, the Uruguay Round.

The Uruguay Round lasted for seven years and culminated in the Marrakesh Agreement in April 1994 that established the World Trade Organization (WTO). Basically, the Marrakesh Agreement revamped the old "GATT 1947" with the new "GATT 1994." Essentially these changes or additions were in the form of 12 new agreements, together labeled the Multinational Agreement. Also of great importance is the set of

"country schedules" that showed the reductions WTO members were going to make in the areas of tariffs, export subsidies and domestic support.

All member countries agreed to reduce tariffs on agricultural products by a minimum of 15% and a maximum of 36% on average for a period of six years beginning January 1, 1995. These reductions are part of the "tariffication" process in which all non-tariff barriers must be converted to tariffs and all tariffs reduced by the amounts just mentioned. Table 5 shows how tariffs on FCOJ imports were affected.

Table 5. Tariff Reductions Due to GATT for the Four Major Importing Countries/ Regions for Calendar Years 1994 to 2000 and Beyond

Year	United States	European Community	Japan	Canada
	US$ per p.s.[a]	----------percent----------		
1994	0.3399	19.00	30.00	3.00
1995	0.3314	18.37	29.25	2.93
1996	0.3229	17.74	28.50	2.85
1997	0.3144	17.10	27.75	2.76
1998	0.3059	16.47	27.00	2.70
1999	0.2974	15.84	26.25	2.63
2000 and beyond	0.2889	15.20	25.50	2.55

Source: Spreen, and Spreen and Mondragon.

[a] Transformed to US$/p.s. from its original quotation in US cents/SSE gallon.

[b] EC, Japan and Canada have ad valorem tariffs which are measured in percentages.

The North American Free Trade Agreement[12]

On January 1, 1994, NAFTA became effective, establishing freer trade between Canada, Mexico and the United States. The three countries combined had a population of over 363 million and a combined Gross Domestic Product of over US$6.3 trillion. In comparison, the European Community (EC)[13] had a population of over 375 million and a combined GDP of over US$5 trillion making NAFTA larger in dollars than the EC.

The main difference between this agreement and other regional trade agreements is the fact that the three NAFTA countries are at more diverse economic levels. The United States and Canada are at the developed country level while Mexico is at the developing country stage. This difference within NAFTA has the potential to cause greater economic dislocations given the large wage gap between the United States and Canada on the one hand, and Mexico on the other.

A number of special "side" agreements were negotiated to protect particular industries in the three member countries. One of these industries is FCOJ. The Florida orange and FCOJ industry was able to lobby the United States Congress successfully to delay free-trade in FCOJ under NAFTA until the year 2008. A rather complex tariff-quota schedule was developed to be phased-in over a 15-year period. During the first 12 years of this period, Mexico is to pay $0.1699 per pound solids (called the quota rate) for the sale of FCOJ up to a volume of 40 million SSE gallons per year. Any amount over this level pays a higher rate due to the over-quota rate and the snap-back rate.

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[12] Most of the information in this section comes from Lusting et al.

[13] The European Community (EC) has now been transformed into the European Union (EU) as greater economic integration of the EC has occurred since 1992. In this study, the name "European Community" will still be used instead of "European Union."

The over-quota rate, that applies to exports between 40 and 70 million SSE gallons per year, is to fall from the original rate of $0.3311 per pound solids to $0.2883 in 2000, remain the same from 2000 to 2003 and be phased to zero from 2004 to 2008. At the beginning of 2006, the over-quota rate will be the same as the quota rate. For the final three years, both rates will fall in equal amounts to zero in 2008 (Table 6). The "snap-back" rate is a higher tariff for output beyond given quantities. If Mexico exports more than 70 million SSE gallons of FCOJ per year to the United States between 1994 and 2002, then the snap-back rate becomes applicable on the quantities above 70 million SSE gallons. The snap-back rates for the period 2003 to 2008 will become effective on FCOJ exports to the United States in excess of 90 million SSE gallons per year.

The Caribbean Basin Initiative[14]

The Caribbean Basin Economic Recovery Act of 1983 allowed for duty-free access of most goods from countries in the Caribbean Basin, i.e., countries of the Caribbean and Central America, into the United States market commencing January 1, 1984. The Reagan Administration succeeded in convincing the United States Congress that the United States would benefit if these Caribbean Basin states were strong economically, enabling them to fight off the threat of communism in the region.

Initially, 28 states were beneficiaries of CBI which was to last for 12 years. The Customs and Trade Act of 1990 extended the arrangement permanently (called CBI II). Five of the original 28 states did not request inclusion resulting in 23 countries becoming beneficiaries of CBI II.

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[14] Information in this section comes mostly from the Tradecompass website.

Table 6. Tariff Rate Quota Schedule for United States Imports of Mexican FCOJ under NAFTA.

CalendarYear	Quota Rate[a]	Over-quota Rate[b]	Snap-back Rate[c]
	US$ per pound of solids[d]		
1994	0.1699	0.3311	0.3398
1995	0.1699	0.3233	0.3311
1996	0.1699	0.3146	0.3233
1997	0.1699	0.3058	0.3146
1998	0.1699	0.2971	0.3058
1999	0.1699	0.2893	0.2971
2000	0.1699	0.2883	0.2883
2001	0.1699	0.2883	0.2883
2002	0.1699	0.2883	0.2883
2003	0.1699	0.2883	0.2883
2004	0.1699	0.2311	0.2883
2005	0.1699	0.1728	0.2883
2006	0.1155	0.1155	0.2883
2007	0.0573	0.0573	0.2883
2008	0.0000	0.0000	0.0000

Source: Spreen and Mondragon.

[a] The quota-rate is applied to the first 40 million SSE gallons of FCOJ imported from Mexico per year.

[b] The over-quota rate is applied to FCOJ imports between 40 and 70 million SSE gallons per year.

[c] The snap-back rate is applied to annual imports from Mexico exceeding 70 million SSE gallons from 1994 through 2002 and to imports from Mexico exceeding 90 million gallons from 2003 through 2007.

[d] Transformed to US$/pound of solids from its original quotation in US cents/SSE gallon.

Note: Even if Mexico triggers the quota, over-quota and snap-back rates by exporting over 70 million SSE gallons from 1994 through 2002, and over 90 million SSE gallons from 2003 through 2007, the effective or weighted rate paid to export to the US market will still be lower than the rate mandated by GATT. For the effective rate to be higher than the GATT rate, Mexico would have to export over 700 million SSE gallons, an amount that is very unlikely to be produced.

FCOJ is one of the products from the Caribbean Basin allowed to enter the United States market free of tariffs. Belize, Costa Rica and Honduras took advantage of these added savings (combined with high prices in the late 1980s due to freezes in Florida) and increased their plantings and output in the late 1980s and early 1990s.[15] These new plantings will have the effect of significantly increasing Central American output of oranges and FCOJ in the next decade and beyond.

The Lome Conventions[16]

The initial agreement (Lome I) was signed in Lome, the capital of Togo, in 1975 between the European Economic Community and countries from Africa, the Caribbean and the Pacific, called the ACP group. These ACP countries were former colonies of members of the EC. The ACP group numbered 59 in 1975 and grew to 71 by the end of 1997, with most of the additions coming from colonies getting their independence after 1975. There have been successive revisions in 1980 (Lome II), 1985 (Lome III), 1990 (Lome IV), and 1995 (Lome IVB). The next revision is due in 2000.

The agreement is based on the concept of "non-reciprocity," meaning that the ACP members do not need to give something in return for the benefits they gain from the EC. Many areas are covered under the agreement, including development of all economic sectors; cultural, social, and regional assistance; and environmental protection. Of interest to this study is the agreement on the trade of commodities. Preferential access

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[15] Other countries in the region did not do so for a number of reasons. These include the fact that many had large internal markets they were unable to supply with domestic production and therefore had to import FCOJ. Other countries, particularly Guatemala and El Salvador, were suffering simultaneously from civil wars and/or domestic instability. Therefore, these countries were unable to play a part in the increase in exports to the United States market.

[16] Information in this section comes mainly from Ravenhill and the Tradepoint website.

has been granted to many agricultural products exported from the ACP into the EC, including sugar, bananas and citrus products.

FCOJ enters duty-free into the EC from ACP states, including Belize, the only ACP producing country in this study. Other countries outside the ACP group, such as from the Mediterranean Region and Central America, have also gotten preferential access to the EC under other multilateral or bilateral agreements (called the Generalized System of Preferences, or GSP). One such country relevant to this study is Costa Rica.

The future of LC is uncertain for a number of reasons. The main reason is that the EC has faced the issue of non-compliance with WTO rules regarding preferential access. One of the most serious examples is the Protocol on Bananas, where quotas to ACP members have been allocated at the expense of other banana producing countries. While the issue with FCOJ is not as contentious, any attempt by the EC to offer preferential access to the ACP would be a violation of WTO rules. Thus, the EC may have to give equal free-access to all suppliers of FCOJ in the future.

Discussions on the future of the LC have become heated after the EC released a "Green Paper," published in early 1997. The "Green Paper" lays out the foundation for the 2000 revision. In essence, the EC wants to refocus the agreement such that ACP countries would have to meet certain criteria for assistance and at the same time fulfill their obligation to the WTO. One of the main conditions the EC wants to place on the ACP group is that of good governance (Woza). ACP countries, on the other hand, are calling for more assistance and continued preferential treatment to balance the negative effects of what they consider an unfair international economic order.

If the EC gets its way, then the stage may be set for the lowering of tariffs paid by other FCOJ producers not covered under the Lome Convention or other agreements. One obstacle may come from EC FCOJ producing states, namely Spain and Italy. EC producers would be adversely affected by free trade. Thus, they may lobby to postpone or prevent the elimination of tariffs as U.S. producers successfully did in the NAFTA negotiations discussed earlier. It is left to be seen if these domestic EC producers have the power to prevent the lowering or the elimination of tariffs on FCOJ coming from large exporters like Brazil and the United States.

The Free Trade Area of the Americas Negotiations[17]

In December 1994, the 34 democracies of the Americas met in Miami to construct a "Free Trade Area of the Americas" and agreed that negotiations should be completed by 2005. This agreement is seen by many as an expansion of NAFTA to other countries in the region. However, it is far more challenging than NAFTA since the FTAA must account for the vast disparities in income and population among member nations. Regardless of these obstacles, negotiations have begun with the San Jose Declaration of March 1998 that launched the negotiations in Santiago, Chile on April 18, 1998.

The following nine negotiating groups and their respective chairmanships have been established:

1. market access (chaired by Colombia);
2. investment (Costa Rica);
3. services (Nicaragua);

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[17] Information in this section comes mostly from the Alca website.

4. government procurement (United States);
5. dispute settlement (Chile);
6. agriculture (Argentina);
7. intellectual property rights (Venezuela);
8. subsidies, antidumping and countervailing duties (Brazil); and
9. competition policy (Peru).

These nine negotiating groups reflect the complexity of the issues facing the formation of an FTAA. Agriculture, like in GATT and NAFTA negotiations, receives special attention. Even with all its complexities, a major aim of the negotiations is to go farther than what is required under the WTO or other regional agreements of the Americas, such as NAFTA, Caricom and Mercosur.

The United States will probably secure some protection (mainly from Brazilian exports) on imports of FCOJ, as occurred under NAFTA. As mentioned above, Brazil is the lowest cost processor and exporter of FCOJ to the United States market, net of tariffs. United States producers fear that they could be at a considerable disadvantage if Brazilian exports entered the United States market duty-free.

The United States Trade Embargo on Cuba[18]

The United States embargo on Cuba can be categorized as a unilateral trade arrangement. The embargo is described here as background to one of the trade scenarios being considered in this study, namely the possibility of the lifting of the embargo by the United States.

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[18] Information in this section comes from The Close Up Foundation website.

The United States and Cuba have had an unstable relationship over the past 100 years. In 1898, conflict began between the United States and Spain that led to Cuba becoming practically a United States territory. In 1952, Batista, a friend of the United States, took dictatorial control of Cuba but lost power to Castro in 1959. Castro quickly expressed his communist agenda and developed strong ties to the Soviet Union. The United States placed a total embargo on trade with Cuba in 1960 and tightened sanctions after the Bay of Pigs invasion failed in 1961.

Since then, additional measures have been taken by the United States to pressure changes in Cuba that would lead to the fall of Castro. The Helms-Burton Act was passed in 1996 after Cuba shot down two private United States Cessna airplanes that were flying near Cuba, killing four members of the "Brothers to the Rescue" organization, based in Miami, Florida. The Helms-Burton Act allows United States citizens to take legal action against any foreign national that does business with Cuba using American assets expropriated by the Cuban government during the 1959 Cuban revolution. However, both in 1996 and 1997 President Clinton suspended enforcement of the provisions of the Act.

In early 1998, Pope John Paul II visited Cuba commencing a process of improvement in the relations between Cuba and the United States. By June 1998, the United States had begun to allow remittances by Cuban families in the United States to Cuba and had allowed Cuban passenger airplanes to fly over United States airspace on their way to and from Canada. The United States policy of engagement with China may signal additional easing of sanctions (which have not removed Castro from power) and the ultimate dropping of the embargo may take place in the near future.

Summary

All of these trade agreements are impacting or have the potential to impact the world FCOJ industry. However, none of these agreements has gotten adequate attention in previous research on the world FCOJ market. All prior studies of the world trade of FCOJ were conducted before 1991 making the current analysis of the impacts of these agreements even more valuable. The following chapter reviews the literature on the world FCOJ market and discusses the quadratic-programming model used in this research.

CHAPTER III

THE MODELING PROCESS

Introduction

This chapter contains a description of the model used to forecast on-tree prices, FCOJ output, consumption and production prices, and trade flows under different trade scenarios. The relevant literature is reviewed and the components of the model are explained in detail.

The model chosen needs to replicate the essential features of the world FCOJ market. Each year FCOJ output is determined by the total orange acreage of bearing trees and the age-yield distribution of trees. Each producing region allocates its exports to the different consumption regions based on their demands and the costs of transactions. Transaction costs include transportation and tariff costs. The interaction of supply and demand, accounting for transactions costs as defined here, result in consumption prices in each market. These consumer prices in turn determine returns to growers and new plantings in future years. As described in Chapter II, new trees begin bearing after a three-year lag.

Therefore, the model used in this study requires new plantings equations (supply response functions), beginning tree inventories by age (age-tree stock distributions), expected yields and survival rates by age of trees (age-yield-survival distributions), demand functions and their expected growth rates in each consuming market, and transportation and tariff costs.

As mentioned in Chapter I, an important contribution of this study is the development of a supply response function for Central America. The pertinent literature on supply response functions is first presented. The supply response functions for Brazil and the United States developed by McClain (1989) and Spreen[19] and used in this study are described. The change in the Brazilian supply function made to incorporate the Brazilian disease effects is also presented. Adjusting Brazil's output for the effects of diseases is an important feature of the model. Finally, the section ends with a description of the development of the new Central American supply response function.

Next, the demand equations used in the empirical model are reviewed briefly. These equations have been estimated by the Florida Department of Citrus and have been used in prior world FCOJ models.[20]

The relevant literature on spatial trading models, particularly the literature on the trading of FCOJ, is then presented. A theoretical discussion of the effects of tariffs on international FCOJ trade follows. Next, the general quadratic-programming model used in this study is discussed.

Finally, the empirical quadratic-programming model that produces the ten-year forecasts is explained. The forwardly iterative nature of the empirical model and the way information is incorporated into the model are discussed. The specific manner in which tariffs and transportation costs are incorporated into the model is explained. Transportation and tariff cost is discussed in the context of the third main contribution of

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[19] From discussions with Spreen.

[20] From discussions with Spreen.

this project, that is, the explicit consideration of existing and proposed trade agreements and their impacts on the international FCOJ market.

Supply Response Models

A major component of the quadratic-programming model used in this study is the supply of FCOJ to the world market. The supply of FCOJ is a dynamic process that starts at the orange grower level and depends on different factors that affect new tree plantings. This section reviews the literature on supply response functions and describes the supply functions used in this study to determine new orange trees planted and FCOJ production.

The United States, Brazil and Central America are the three endogenous supply regions in the model and each of their supply response functions is given separate attention below. Exports for the exogenous regions, Mexico, the Mediterranean and Cuba, grow at the predetermined compounded rate of 2% per year.[21] Lack of pertinent data in these three regions prevented the formulation of supply response functions for these supply regions.

Literature Review

Important theoretical developments and research in the area of supply response functions date back to the 1950s. Marc Nerlove was the pioneer in the field and his model, later dubbed the Nerlovian Model, has been used and modified extensively since its publication.

The original Nerlovian Model was formulated to explain planting decisions for annual crops. In its most basic form, the Nerlovian Model considers how the "desired"

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[21] Growth rate of 2% determined from historical averages.

area under cultivation for an annual crop is affected linearly by the "expected normal" crop price and other observable, exogenous factors affecting planting decisions. The "expected normal" crop price is in turn determined by an ad hoc distributed lag of actual and "expected normal" prices. Similarly, the actual area under cultivation is determined by an ad hoc distributed lag of actual and "desired" areas under cultivation.

Nerlove (1979) later criticized the ad hoc nature of the adaptive expectations inherent in his original model and its extensions. He considered the model ad hoc because the forecasted variables are affected only by the fixed coefficients in the adaptive expectations model. Therefore, forecasted future values do not respond to new information in the future.

Nerlove instead proposed a rational expectations approach in the spirit of Muth, where variables adjust to all new information currently available. Instead of relying on ad hoc representations, he suggested using auto-regressive moving average (ARMA) processes that incorporate new information to model time series data.

Nerlove also reviewed the challenges of formulating supply response functions (new planting equations) for perennial crops, such as oranges. The main problems with perennial crops are that output occurs a number of years after planting and the productive life of trees may be dozens of years. Therefore, new plantings are based on the expected returns from investment over many years. Supply response functions require added information on factors such as interest rates and the future effects of weather. Nerlove also noted that the formulation of the supply response function is less ad hoc for perennial crops than for annual crops. The information from the biological nature of tree

growth and productivity, that is, the age-yield distribution of trees, aids in describing the nature of output expectations from investments.

Nerlove also discussed the additional problems faced in formulating supply response functions for developing countries. In developing countries, markets are usually not functional and, therefore, prices may not reflect equilibrium values or may simply be unavailable. Many factors besides price affect planting decisions, including government intervention policies, new technologies and demographics. While these factors also affect planting decisions in developed economies, they are more pronounced in developing economies where markets are less efficient. In fact, data limitations are usually so acute in developing countries that econometric analysis may be inapplicable in many cases. Nerlove suggested that surveys may be the only way to extract such information given the lack of adequate time series data on variables that affect planting decisions.

French et al. studied planting and removal relationships for California Cling Peach trees. Peaches are a perennial crop with many similarities to orange production, particularly with respect to the age-yield distribution. French et al. found that the factors affecting planting decisions included past profitability, a trend term to capture the effects of alternative crops, potential future production from existing acreage, market intervention programs, and total net acreage.

A four-year moving average of deflated returns, in both linear and quadratic forms, was found to be the best representation of past profitability. Farmers judge their future profit potential based on past profits. These variables were found to have a significant positive effect on new plantings.

Other crops also provide alternatives for farmers' investments. French et al. used a trend variable to capture the effects of alternative crops on new plantings and got the expected negative relationship between the trend term and new plantings. New peach plantings were inversely related to the profitability of other alternative crops.

Potential future production from existing acreage was also included in the supply response function. As new technologies and varieties increase future production, farmers require less new acreage for a given level of output. The relationship between future potential output and new plantings was found to be negative, as expected.

Market intervention programs (subsidies for new plantings) have the effect of increasing new plantings beyond average levels. Again this variable was found to have the expected positive effect on new plantings.

Finally, total net acreage (last year's total acres less last year's removals) was used to account for total acreage available in the year of new plantings. Farmers remove trees that are infected with diseases or that reach an age of negative returns. Therefore, new plantings this year will be affected by the amount of removals last year. French et al. found the expected result that higher net acres this year lead to lower new plantings this year, a negative relationship.

French et al. concluded that their research could aid future research in model formulation and variable selection. However, they did emphasize that data were abundant for cling peaches, which may not be the case for many other perennials.

Pompelli and Castaneda developed a supply response function for oranges in California and Arizona using a difference equation. Six independent variables were expected to affect the change in total mature bearing acreage, their dependent variable.

These variables were a moving average of lagged bearing acreage (trees older than three years), a moving average of lagged non-bearing acreage (trees less than three years), the first difference of on-tree returns, a tax dummy, the first difference of land values, and Brazilian orange output divided by U.S. plus Brazilian orange output.

The moving average of lagged bearing acreage variable is akin to the total net acres variable used by French et al., except total net acres include both bearing and non-bearing acreage. The relationship between the moving average of lagged bearing acreage and the dependent variable (change in bearing acreage) was found to be positive, contrary to expectations, but also statistically insignificant.

The moving average of lagged non-bearing acreage variable had the expected significant positive effects on the dependent variable. More non-bearing acreage in the past leads to an increase in bearing acreage in the present.

The differenced on-tree returns variable was found to have the expected significant positive effects on the dependent variable. As returns rise, farmers adjust by increasing bearing acreage through new acreage. This variable is similar to the past profitability variable in French et al.

A dummy tax variable was used to capture the effects of tax incentives granted to orange producers. This variable had the expected positive sign but its coefficient was statistically insignificant. This variable is similar to the marketing intervention program variable in French et al.

Land values, a measure of opportunity cost similar to the trend variable in French et al., exhibited an unexpected positive relationship with the dependent variable. Pompelli and Castaneda's explanation was that growers were holding on to bearing

acreage in anticipation of even higher land values. In other words, growers did not sell their land once the capital gains (the expected annual increase in land values) on the land were higher than the cost of holding on to older acreage.

Finally, the ratio of Brazilian output to U.S. plus Brazilian output variable had a positive and statistically significant relationship with the dependent variable. A priori expectation, according to Pompelli and Castaneda, was that this variable could have either a positive or negative effect on the dependent variable. They argued that given that orange juice and fresh oranges are substitutes at the consumption level, increases in Brazilian production of orange juice could lead to reductions in California and Arizona fresh orange production. On the other hand, Brazilian orange juice and California and Arizona orange juice are complements, since Brazilian juice is used to "even out dips" in California and Arizona orange juice production. Therefore, the authors argued that the latter relationship was the relevant one to consider.

Finally, Kalaitzandonakes studied the supply response of Florida orange and grapefruit production. Freezes in the 1980s had devastated the Florida citrus industry, requiring significant short-term adjustments. The author argued that the understanding of both short- and long-term supply response would be beneficial to the Florida orange and grapefruit industry. He defined new plantings as long-term investment decisions to expand output and re-plantings as short-term investment decisions to adjust for tree losses due to diseases or adverse weather. He reported that while data were adequate for acreage, on-tree returns, age-yield distribution, and total plantings, separate data for new plantings and re-plantings were not available.

Kalaitzandonakes used a "dynamic unobserved components model" to isolate the two variables, new plantings and re-plantings, latent in combined plantings data. Specifically, the Kalman Filter approach was used to predict the future plantings and replantings given past information on total plantings (from which plantings and re-plantings could be deduced) and other relevant variables such as expected prices, weather and replanting costs. The Kalman Filter approach uses an iterative process, starting at some arbitrary point in the past, to make predictions about future values. Once Kalaitzandonakes derived separate series for plantings and re-plantings, he formulated a structural equation system with plantings and re-plantings as dependent variables, and their one year lag values, a weather index, replanting costs, and expected prices as the independent variables. The expected prices variable is akin to the returns variables in the two papers previously cited.

Kalaitzandonakes found that his structural model compared favorably with single equation reduced form models. He found that the interrelationship between new plantings and re-plantings was such that re-plantings discouraged new plantings, while new plantings had no discernible effects on re-plantings. He also found the expected results on the other variables, namely that poor weather leads to more re-plantings, higher re-planting costs leads to less re-plantings and higher expected prices leads to higher new plantings.

As Nerlove indicated, over time more sophisticated econometric techniques would be developed and applied to supply response function development. Kalaitzandonakes's use of the Kalman Filter is an example. However, Nerlove also

mentioned that the lack of data would extremely limit the applicability of econometric methods, regardless of their sophistication.

McClain estimated tree planting equations for the Florida and Brazilian orange industries. These equations were also used by Spreen and Behr. Given that these equations are used in this study, they are described in more detail in the following section.

United States and Brazilian Supply Response Functions

United States Supply Response Function

The U.S. supply response function, presented first in McClain's 1989 dissertation and later in a quadratic-programming model developed by Spreen at the University of Florida (Spreen and Behr, 1991), is described in detail below. The U.S. supply response function is based solely on Florida's production, given that about 95% of all FCOJ produced in the United States is from Florida (FDOC). This U.S. supply function, accredited to both McClain and Spreen, is

$$\underset{(3.20)}{FNEW_t} = \underset{(6.36)}{1.2 + 0.458(MOVAG_t)} - \underset{(-1.86)}{0.013(FINV1_t)} \qquad (1)$$

where

$FNEW_t$ = new plantings (includes re-plantings and new plantings) in Florida in millions of orange trees in year t;

$MOVAG_t$ = three-year real (deflated by U.S. Producer Price Index) moving average orange on-tree prices in US$ per 90-pound box;

$FINV1_t$ = new plantings in Florida in millions of trees lagged two years.

All coefficients were statistically significant. The t-statistics are shown in parentheses and the adjusted R^2 is 0.695.

Based on Equation (1), new plantings in year t increase by 458,000 trees for each $1.00 increase in the three-year moving average of on-tree prices, holding all other relevant factors constant. Also, ceteris paribus, for every one million increase in new plantings two years before, new plantings this year decrease by 13,000 trees. The value for the intercept means that exogenous new plantings are equal to 1.2 million trees per year. Data used for estimating the equations come from the Florida Department of Citrus.

Brazilian Supply Response Function

The Brazilian supply response function used in this study also comes from McClain and Spreen. The estimated equation is

$$BNEW_t = \underset{(6.83)}{13.0} - \underset{(-3.63)}{0.054}(PBS_{t-1}/PBO_{t-1}) \qquad (2)$$

where

$BNEW_t$ = new plantings (includes re-plantings and new plantings) in Brazil in millions of orange trees in year t;

PBS_{t-1} = price of sugar in Brazil in US$ per ton in year t-1;

PBO_{t-1} = on-tree price of oranges in Brazil in US$ per 90-pound box in year t-1.

The values of the coefficients were statistically significant. The t-statistics are shown in parentheses and the adjusted R^2 is 0.379.

Therefore, new plantings decrease by 54,000 trees for each one-unit increase in the ratio of sugar to on-tree orange prices in the previous year. The value of the intercept means that exogenous plantings are 13.0 million trees per year.

Spreen reports that other formulations were attempted, some similar to the Florida supply response equation, but that the above formulation had the best fit. The problem in

using this formulation in this study is that it requires forecasts of Brazilian sugar prices that are not endogenous to the model. Therefore, by using a fixed sugar price, that is, an average expected price, the independent variable actually becomes a constant average expected Brazilian sugar price divided by a one-year lag of Brazilian on-tree prices.

Central American Supply Response Function

One of the main contributions of this study is the formulation of a supply response function for Central America for inclusion in the spatial equilibrium model being used. As forewarned by Nerlove and others, data limitations, especially in developing countries, restrict the inclusion of variables in supply response functions. Central America is an excellent example of this problem.

Belize has the best data of the three countries in Central America that export FCOJ. It also has time series data on orange production and on-tree prices, from the 1986/87 crop year to the 1997/98 crop year. In 1997, the Belize Citrus Growers Association published the results of a survey of the age distribution of its orange trees. Data limitations for Costa Rica were severe, and in the case of Honduras, data were simply non-existent. In a personal visit by the author to these countries in March 1998, unpublished estimates of acreage and informed guesses of the age distribution of trees for these countries were obtained from industry officials.

The data available for Belize were used to develop a supply response function for the entire region, given the data limitations for Costa Rica and Honduras, and the strong similarities in cultural practices and geography among the three countries. Additionally, during the period in which the supply response function was estimated, 1986/87 to 1995/96, all three countries benefited from the high prices due to the freezes in Florida

and the free access into the U.S. market under CBI. This led to similar sized expansions in all three countries at about the same time.

A three-year moving average of real on-tree prices was used as an explanatory variable, following prior orange research on supply function formulations. Peculiar to the Belizean case was the aggressive issuing of development concessions by the 1989/93 government administration. These concessions granted tax holidays (or tax exemptions) of up to 25 years to new investments in citrus. This aggressive policy lasted until the administration changed again in 1993. Plantings doubled over the 1989/90 to 1993/94 crop years, over and above plantings caused by the effects of high prices due to the Florida freezes and the CBI. A dummy variable was used to account for this policy. Data were not available for the inclusion of other variables, such as banana prices, the substitute crop price in Belize.

A number of different models were estimated using alternative lagged lengths and the best estimated equation is

$$\underset{}{NP_t} = \underset{(3.610)}{0.131788} + \underset{(2.724)}{0.018318}\, MAOTP_t + \underset{(14.574)}{0.290076} CONDUM_t \qquad (3)$$

where

NP_t = new plantings in Belize in millions of orange trees in year t;

$MAOTP_t$ = three-year moving average of real[22] on-tree orange prices in Belize, n US$ per 90-pound box;

$CONDUM_t$ = dummy variable for government development concessions (equals 1 for 1989/90 – 1993/94; 0 otherwise).

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[22] The price data were deflated by the Belizean Consumer Price Index, the only available macro price index in Belize.

The t-statistics are given in parentheses. All coefficients are significantly different from zero. The Adjusted R^2 is 0.961 and the Durbin-Watson is 1.42, which is above the upper limit of 1.320, meaning that there is no evidence of positive first-order correlation.

Given that the size of the orange industries in all three Central American countries is similar, this equation, after taking out the dummy, is multiplied by three to arrive at a regional Central American supply response function. Therefore, this function assumes that new plantings in each country will be identical and that the tax concession program in Belize will not be resumed in the future. The function used in the model is

$$CANEW_t = 0.395 + 0.055MOVAVGCA_t \quad (4)$$

where

$CAEW_t$ = new plantings in Central America in million of orange trees in year t ;

$MOVAVGCA_t$ = three-year moving average of real on-tree orange prices for Central America.

Thus, for a $1.00 increase in the three-year moving average of Central American on-tree orange price, new plantings rise by 55,000 trees.

Demand Functions

The second major component of the quadratic-programming model used in this research is the consumption side of the world FCOJ industry. The demand equations are used to determine the allocation of output each year and the price in each market. The own price elasticity of demand and demand growth are also important inputs to the model.

The United States, the European Community, Canada, and Japan represent the most important markets for FCOJ. For the 1995/96 season, consumption in the United States was about 37% of the total world consumption. Europe accounted for about 28% of the total world consumption.[23] The remainder was consumed mostly in Canada and Japan (Spreen and Muraro).

Few own price elasticities of demand at the wholesale level have been estimated for these regions. McClain surveyed the limited papers that estimated these elasticities and then made an educated choice of the ones she thought were best. The elasticities she chose for her study are:

United States	–0.6618,
Canada	–0.8020,
Europe	–0.9555.

No elasticity is reported for Japan in McClain's work. A later paper used –0.4000 for Japan, but offered no description of the method of determining that estimate (Spreen and Behr).

In the model used in this research, own price elasticities of demand and the growth rates of demand for each consumption region are taken from Spreen's world FCOJ model. Spreen reports that the demand equations were estimated by the Florida Department of Citrus (FDOC).[24] The elasticities and growth rates of demand used in this

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[23] Spreen and Muraro estimate that the United States and Brazil together produced 80% of total output in the 1995/96 season. This translates to total world production of 3,620 million SSE gallons. They also reported that total consumption in the United States and the European Community was 1,350 and 1000 million gallons, respectively. The consumption percentages given above assume world consumption equals world production.

[24] From private discussions with Spreen.

study are different from what McClain used, reflecting the wide differences in estimates of FCOJ demand elasticities in the literature. The reason for the choice of these elasticities is to use the most recently reported figures from Spreen. These demand curves are the gross-of-tariffs wholesale demand curves, that is, the prices include tariffs. The demand curve, growth rate and elasticity for the United States are

$$P_{US} = 6.2 - 0.00327Q_{US}, \quad (5)$$

growth rate = 1.5%,

elasticity = -0.2002.

The demand curve, growth rate and elasticity for the European Union are

$$P_{EU} = 4.0 - 0.00246Q_{EU}, \quad (6)$$

growth rate = 4.0%,

elasticity = -0.3838.

The demand curve, growth rate and elasticity for Canada are

$$P_C = 2.7 - 0.01270Q_C, \quad (7)$$

growth rate = 1.5%,

elasticity = -0.6956.

The demand curve, growth rate and elasticity for Japan are

$$P_J = 3.8 - 0.00726Q_J, \quad (8)$$

growth rate[25] = 4.0%,

elasticity = -0.5200.

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[25]Appendix A presents results from the Baseline Model adjusted for a lower 2.5% Japanese growth rate of demand. The results do not change significantly given the lower Japanese demand growth.

The growth rates of demand and the demand elasticities affect the level of consumption in each demand region. The growth rates of demand are actually growth rates of the intercept of the respective demand curves. As will be discussed in Chapter IV on the results, there is a counter-balancing effect between growth rates of demand that increase consumption over time, and demand slopes (or their respective elasticities) that reduce quantity demanded as prices rise. Thus, growth rates of demand, demand elasticities, tariffs and transportation costs, and supplies all interact to determine equilibrium across all markets. This process of equilibrium determination is further discussed below in the section on the empirical model.

World Frozen Concentrate Orange Juice Forecasting Model

The following section includes a literature review of world FCOJ trading models and a description of the theoretical, mathematical and empirical model used in this study.

Literature Review

Technical work on the world FCOJ (and fresh orange) market has not been extensive. While there are numerous descriptive studies, only a few technical studies have been made. Four of the most relevant are described below, and not surprisingly, all are from the University of Florida.

In the first, Ward studied Florida FCOJ trade during the period from 1968 to 1974. Brazilian imports, priced lower than U.S. domestic FCOJ, were being used to "average down" U.S. export prices to the European market. To compete in the European market, U.S. exporters were importing Brazilian FCOJ and exporting an equal quantity to

Europe. As long as re-exports occurred within a specified time, the U.S. exporters did not need to pay import tariffs on the Brazilian imports.

Ward developed an import-export model that showed the theoretical relationships among the major variables and formulated seven simultaneous equations that were estimated empirically. The major variables included the price spread between domestic (U.S.) FCOJ and FCOJ imports from Brazil, U.S. FCOJ export price to Europe, U.S. demand price, and Canadian demand price.

Ward estimated a number of elasticities using the two-stage least squares estimation method. He estimated the own-price elasticities for the three consuming markets in his model, the United States, Europe and Canada. These elasticities were -0.5288 for the United States, -2.2591 for Europe and -0.5014 for Canada. He explained that the higher elasticity of demand in Europe resulted from a larger number of substitute FCOJ (from the Mediterranean Region and Brazil) being supplied to Europe, relative to the United States and Canada.

Ward concluded that a two-pricing strategy (i.e., price discrimination) between the U.S. and the European markets, using only domestically produced FCOJ, would have resulted in higher returns to Florida growers than the system being used at the time of importing Brazilian FCOJ to average down prices. As economic theory predicts, a strategy of a higher price in the less elastic market and a lower price in the more elastic market, would have led to higher returns.

Ward's conclusion was dependent on his estimation of demand elasticities, where the U.S. demand was relatively less elastic than the European demand. According to Ward, the system of "averaging down" prices used at the time was reducing prices in

both markets, resulting in the bearing of opportunity costs by Florida FCOJ producers. Ward's study appears to be the first published analysis of the world FCOJ market and in this sense has no precedent for comparison.

McClain developed a Monte Carlo simulation model of the world orange juice market to make a 20-year forecast of world FCOJ production and prices. The model included four demand regions, namely the United States, Canada, Europe and Japan, and two supply regions, the United States and Brazil. In her study, the addition of supply regions with supply response functions[26] was an advancement over the Ward Model.

The Monte Carlo technique was used to make the model stochastic, primarily to consider the uncertain nature of weather. The technique tries to copy weather patterns and produces probability distributions for yields and death rates for each supply region. For each period, a random choice of yield and death rates was made from the probability distribution and incorporated into the age-yield-survival distribution of orange trees for both supply regions. These distributions are then updated each year by the new plantings equations and a new, independent probability distribution of yield and death rates.

Total world supply in the first year was calculated as the sum of the output for each region. Each region's output was calculated based on its tree inventory and age-yield distributions. Total world demand was calculated as the sum of the tariff-adjusted demands of each consumption region. World demand was equated with world supply in a simultaneous-equations framework, and world price was derived. World price was then

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[26]McClain's supply response functions were described in the above section on the United States and Brazilian supply response functions used in this study.

used to calculate on-tree prices and fed into the new planting equations for the next simulation period. Transportation costs were not included.

Similarly, world price was fed into the separate tariff-adjusted demand equations to arrive at consumption in each demand region. Therefore, information on world price for each period was used to calculate output in the next period and to arrive at consumption in that year. The model was then solved in a forwardly recursive manner.

The results from the Baseline Model (the results using the original assumptions) were compared to the results from alternative modifications of the model. These changes included increased Florida yields, an appreciation of the U.S. dollar, and two trade liberalization scenarios, a 50% and a 100% reduction in U.S. tariffs.

As expected, higher yields led to higher production, lower prices, and lower plantings. An appreciation of the U.S. dollar led to slightly lower U.S. production and, by implication, lower Brazilian prices. In both tariff reduction cases, Brazilian prices increased and Brazilian production increased. U.S. prices fell and U.S. production contracted.

McClain's work adds considerably to the literature with the incorporation of supply response functions. These functions incorporate endogenous information, namely on-tree prices, and produce new output each year in the forwardly recursive manner described above. Therefore, McClain's model better reflects the true nature of the world FCOJ market.

A study by Spreen and Behr looked at the effects of the so-called Rose Garden Agreement. The Rose Garden Agreement was a proposal for free trade between the United States, Brazil, Argentina, Paraguay and Uruguay.

Spreen and Behr did not use the same simultaneous-equations approach as McClain to arrive at prices and consumption. Instead, they used a spatial equilibrium model (in a Takayama and Judge framework) with the same four demand and two supply regions as in McClain's study. This spatial equilibrium, quadratic-programming model maximizes consumer plus producer surplus given certain demand and supply equations and produces equilibrium price, equilibrium quantity and the trade patterns for each supply region. Tariffs and transportation costs are also included. The Monte Carlo method was also used to incorporate the stochastic nature of weather effects on yields and death rates.

The advantage of using the quadratic programming model in Spreen and Behr's study, compared to Ward's and McClain's, was that it also gave information on trade flows, more specifically on exports from each supply to each demand region and that it explicitly incorporated transportation costs. The model is flexible enough that transportation and/or tariff costs could easily be adjusted and the impacts assessed.

Spreen and Behr also used different estimates of demand elasticities compared to those used by McClain, but used the same new plantings equations for both Florida and Brazil. They examined three scenarios, namely a Baseline, the Rose Garden Agreement and world free trade. They found that the Rose Garden Agreement and world free trade causes prices, production, tree plantings and producer returns to increase in Brazil, but decrease in Florida.

The authors concluded that regional trade agreements, such as the Rose Garden Agreement, would adversely impact the Florida orange industry and that the creation of trading blocks (versus total free trade) may reduce world welfare. When considering the

changes in producer surplus, consumer surplus and tariff revenues in all the respective regions, they found that net world welfare would decrease if the Rose Garden Agreement was implemented.

Finally, Brenes used Armington's model, a modified spatial equilibrium model, to study the world fresh orange market. Armington's model allows commodities to be differentiated not only by kind but also by exporting region. This distinction is more important in the fresh orange trade than in FCOJ trade. A number of varieties of fresh oranges are sold with distinctive size, color and flavor characteristics. However, Valencia oranges are the predominant FCOJ variety and differences between juices from different regions are less pronounced.

Brenes's model included 13 relationships for 11 world regions (that basically covers the whole world). Of the 13 relationships, nine were identities, and the other four were estimated using non-linear two-stage least squares. In total, Brenes estimated 242 equations.

Brenes found the expected results for the major trading regions in most cases. The signs for the demand equations were mostly as expected and the coefficients were in many cases significant. The surprise came in the results for the supply equations where the signs for the coefficients on the F.O.B price variables were mixed and those that were positive tended to be insignificant. While his model may be appropriate for the world fresh orange market, Spreen and Behr's approach still remains the best alternative in the world FCOJ literature, given that in addition it yields trade flows and does not require a large number of equations to incorporate differentiated products.

Model Formulation

The theoretical, mathematical and empirical models are presented in this section. The basic theoretical trade model, adjusted to consider the peculiarities of the world FCOJ market, is first presented in graphical form. Next, the general non-linear mathematical representation is made, followed by the formulation used to generate the empirical results.

Theoretical Background

Assume that the world FCOJ market is comprised of two markets, with zero transportation costs, no trade restrictions and zero inventories. Figure 9 shows a simplified graphical exposition of consumer and producer surplus. The total supply curve in the world market is S_w, which is vertical since a fixed quantity is assumed to be produced and sold on the international market each year. The total world demand curve (the horizontal summation of the demands in each market) is D_w. Equilibrium consumption is Q_w and equilibrium price is P_w.

The two graphs to the left of the world market show how total supplies are allocated to the two consumption markets. In this case, the number of suppliers is irrelevant given that total world supplies are assumed to be Q_w. Producers allocate their supplies to the market with the highest price. Given world free trade and zero transportation costs, the consumer price is equal to the producer price. As more supplies enter any one market, prices fall in that market. Producers then shift to the other market if prices there are higher. This allocation process continues until equilibrium is achieved at P_w in both markets, and Q_1 and Q_2 in each market, respectively. Therefore, in Figure

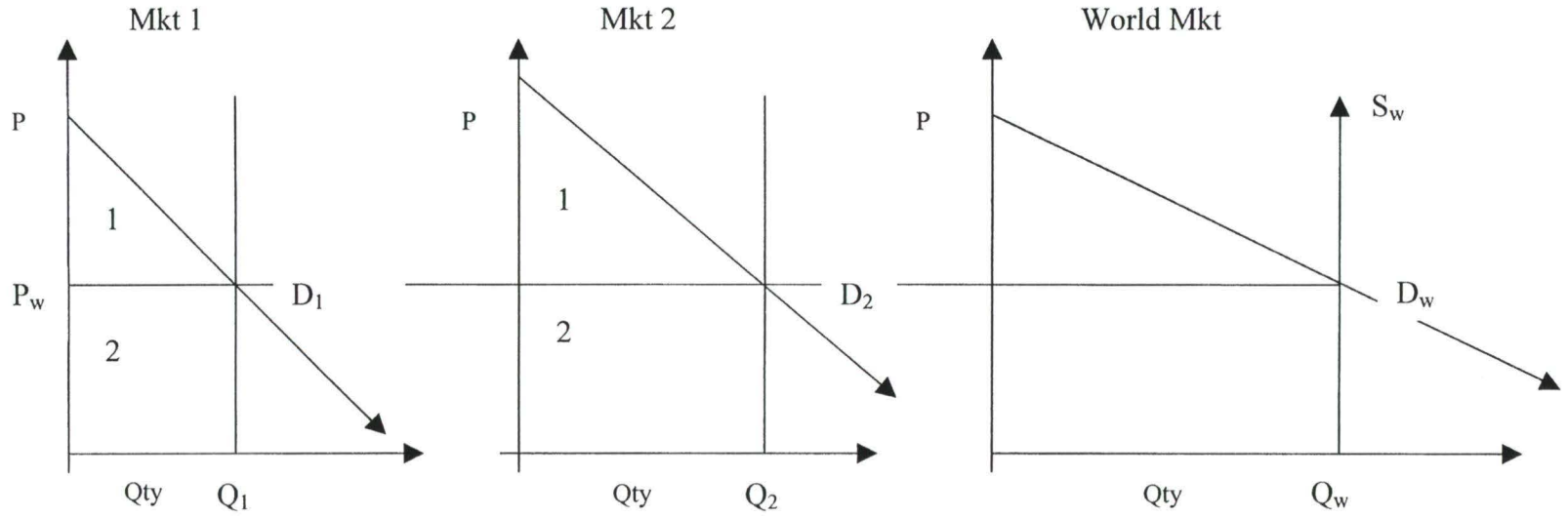

Figure 9. Equilibrium in FCOJ Market Assuming Free World Trade and Two Consuming Regions, where $Q_1 + Q_2 = Q_w$

9, consumer surplus is area 1 in both consumption markets, and likewise, producer surplus[27] is equal to area 2 in both markets.

In Figure 10, a per-unit tariff is imposed in market 1. The tariff has the effect of shifting the demand curve from D_1 to D_{1t} by the amount of the tariff. This, in turn, shifts the world demand curve downward and to the left (not shown in Figure 10). Producers now face lower prices (net returns are lower after subtracting out the tariff) in market 1 and shift supplies to market 2. Quantities consumed fall from Q_1 to Q_{1t} in market 1, and rise from Q_2 to Q_{2t} in market 2. Final equilibrium is achieved at price P_{1p}, which is the same as the new world price, P_{wt}. Consumer price in market 1 is now P_{1c} and producer price is now P_{1p}. The tariff is equal to $P_{1c} - P_{1p}$. In market 2, equilibrium price falls from P_w to P_{1p}.

Consumer surplus falls in market 1 from areas 1 + 2 + 3 + 7 to area 1 only, while producer surplus falls from areas 4 + 5 + 6 + 8 + 9 + 10 to area 6 only. Tariff revenues in market 1 is areas 2 + 3 + 4 + 5. Therefore, the efficiency (deadweight) loss due to the tariff in market 1 is areas 7 + 8 + 9 + 10. In market 2, consumer surplus increases from area 1 to areas 1 + 2 + 4, while producer surplus changes from areas 2 + 3 to areas 3 + 5. The gains in market 2 are areas 4 + 5. Thus, the effects of a tariff imposition or a tariff removal can be analyzed in this manner.

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[27]Producer surplus in the model in this study is not equal to the traditional producer surplus measured as the area below price and above the supply curve. In this case, given that supplies are "placed" on the world market, the supply curve is vertical and there is no upward sloping supply curve. Therefore, the entire area under price, that is, total revenues, is producer surplus.

$Q_w = Q_1 + Q_2$

Tariff to Market 1 : $P_{1c} - P_{1p} = t$

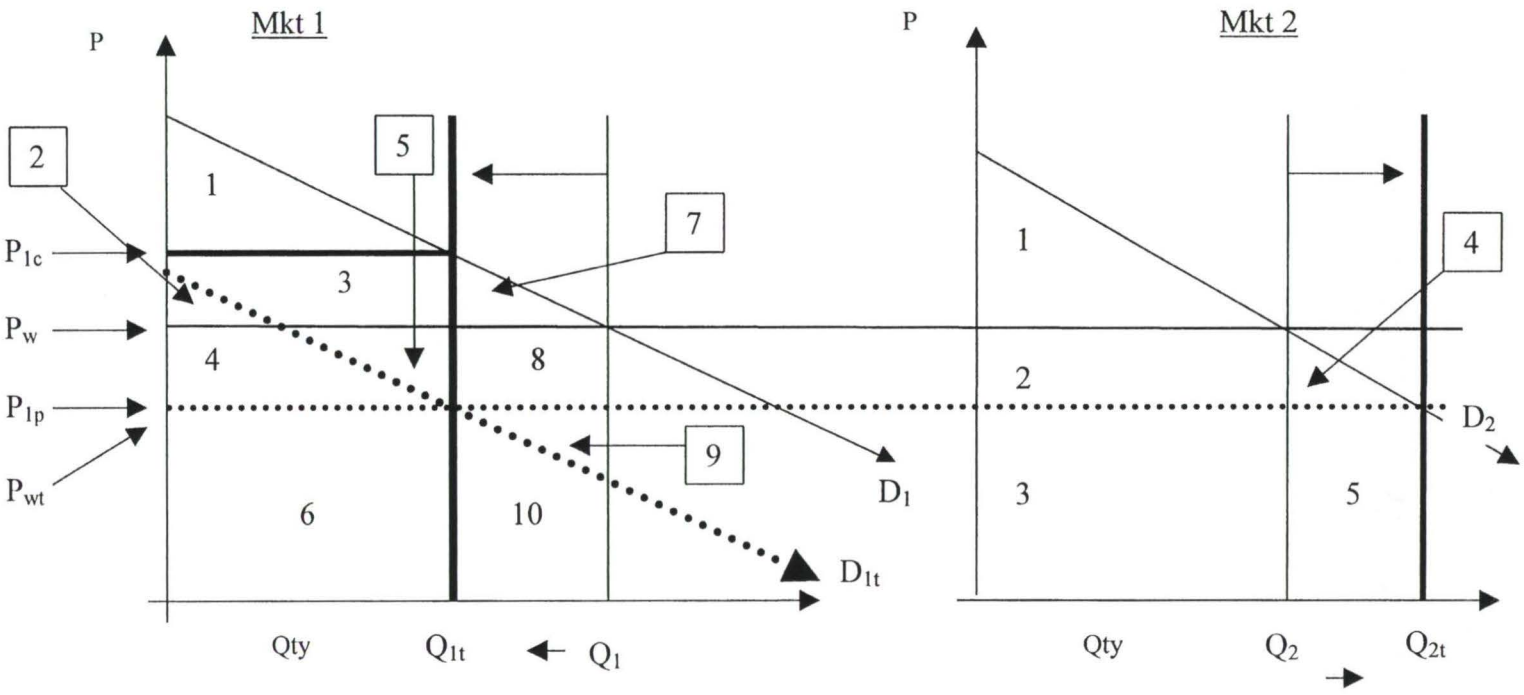

Figure 10. FCOJ Market Assuming a Per Unit Tariff Placed on Market 1 and a Consequent Re-allocation of Supplies to Market 2

Mathematical Model

The spatial-equilibrium, quadratic-programming model, popularized by Takayama and Judge in 1973 and applied to the world FCOJ market by Spreen, is described in the following paragraphs.

A "quasi-welfare" function for each region can be defined as the area between the demand and supply curves or

$$W_j\left(Q_j^d, Q_j^s\right) = \int_0^{Q_j^d} P_j^d dQ_j^d - \int_0^{Q_j^s} P_j^s dQ_j^s \tag{9}$$

where

P_j^d, P_j^s = the demand and supply prices, respectively, for the product in region j;

Q_j^d, Q_j^s = the quantity demanded and quantity supplied, respectively, in region j.

Then the net welfare function (NW) across all regions is the sum of the welfare functions less transportation costs and tariffs is

$$NW = \sum_j \left(\int_0^{Q_j^d} P_j^d dQ_j^d - \int_0^{Q_j^s} P_j^s dQ_j^s \right) - \sum_i \sum_j X_{ij} T_{ij} \tag{10}$$

where

i = 1,…,n producing regions and j = 1,…,m consuming regions;

X_{ij} = the amount of the good shipped from region I to region j;

T_{ij} = a per-unit cost matrix that includes tariffs and transportation costs.

The "consumer plus producer" surpluses are summed for all regions in the model, given world prices. Demand curves in each market are adjusted by the costs of tariffs

and transportation. The problem then is one of maximizing Equation (10) subject to three constraints

$$\sum_{j} X_{ij} \leq Q_i^s, \text{for all i};$$

$$\sum_{i} X_{ij} \geq Q_j^d, \text{for all j};$$

$$Q_j^d, Q_j^s, X_{ij} \geq 0, \text{for all i and j}.$$

The first constraint ensures that outgoing shipments do not exceed regional supply. The second constraint requires that incoming shipments to a region be greater than or equal to regional demand. The last is self-explanatory. This general model is adjusted below to account for the particular nature of the world FCOJ market.

Empirical Model

The model used in this study is an augmentation of the model used by Spreen and Behr. As explained earlier, this spatial-equilibrium, quadratic-programming model maximizes consumer plus producer surplus, less transportation and tariff costs, given certain demand and supply equations. The model produces equilibrium price, equilibrium quantity and the trade patterns for each supply region.

The model assumes that over the forecast period transportation costs and exchange rates are constant. It also assumes no technological improvements, that is, constant yields and survival rates by age.

The model uses recent estimates of these demands produced by the Florida Department of Citrus, as described above in the section on demand equations. The supply response equations are unique to each endogenous exporting region, and are those described above in the section on supply response functions.

One of the major improvements of Spreen's world FCOJ model in this study is the addition of Central America as a new endogenous producing region. This supply response function has also been described above. In addition, the Mediterranean Region and Cuba are added exogenously, which along with Mexico are assumed to grow at an annual compounded rate of 2%.[28] Spreen's model included only three supply regions, namely the U.S. and Brazil endogenously, and Mexico exogenously.

The empirical model can be expressed mathematically as

$$MAX \sum_j \left((1/(1+t_j)) \int_0^{Qdj} P_j^d \, dQ_j^d \right) - \sum_i \sum_j X_{ij} T_{ij} = \tag{11}$$

$$MAX \sum_j \left((1/(1+t_j)) \int_0^{Qdj} (a_j - b_j Q_j^d) \, dQ_j^d \right) - \sum_i \sum_j X_{ij} T_{ij} = \tag{12}$$

$$MAX \sum_j \left((1/(1+t_j)) (a_j Q_j^d - 0.5 b_j Q_j^{d2}) \right) - \sum_i \sum_j X_{ij} T_{ij} \tag{13}$$

subject to

$$\sum_j X_{ij} \leq Q_i^s, \text{for all i;}$$

$$\sum_i X_{ij} \geq Q_j^d, \text{for all j;}$$

$$Q_j^d, Q_j^s, X_{ij} \geq 0, \text{for all i and j;}$$

where the four demand regions are

j = 1,…,4 (United States, European Union, Canada, Japan);

and the six supply regions are

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[28]Regions are included exogenously due to lack of data on acreage, the age-yield distribution of trees, and on-tree prices. The 2% annually compounded rate of growth for the exogenous regions was determined by taking an average from historical growth rates.

$i = 1,\ldots,6$ (United States, Brazil, Central America, Mexico, Mediterranean, Cuba); and where

t_j = the ad valorem tariff in the jth demand region, expressed in decimal form;

a_j = the intercept of the demand function in the j^{th} demand region;

b_j = the slope of the demand function in the j^{th} demand region;

and all other variables are as defined above.

In this empirical formulation, following Spreen, the area under the tariff-adjusted demand curves is maximized, since the world supply curve is vertical. Note that, as mentioned above in the section on demand equations, the observed prices are wholesale consumption prices that include tariffs. Therefore, in the case of ad valorem tariffs, it is necessary to adjust these demand curves by multiplying by $1/(1 + t_j)$ to arrive at net-of-tariffs demand curves. Thus, the demand curves adjusted for ad valorem tariffs will have a lower intercept and a flatter slope. In the case of per unit tariffs, the tariffs are subtracted out directly, causing the demand curve to shift downwards parallel to the original curve.

This empirical quadratic equation, Equation (13), is solved using the quadratic-programming software GAMS (Generalized Algebraic Mathematical Software). Other important information inputted into GAMS includes the age-yield-survival distribution of trees, the stock of trees available by age, a transportation matrix, and both ad valorem and per unit tariffs.

The age-yield-survival distribution of trees is critical information for the establishment of regions as endogenous to the model. As described in Chapter II, orange trees begin bearing after three years and will gradually increase yields (boxes per tree) up

to some age, level off for some years, and gradually fall in yields after some point. The maximum yields attained and the age at which this level is achieved, and the survival rate of trees at different ages depends on inputs, weather and disease effects.

Table 7 presents these age-yield-survival distributions for the United States, Brazil and Central America. While U.S. data were available for up to 25 year-old trees, information on Brazil was limited to trees up to 21 years old. Limited data on Central America showed that its age-yield-survival distribution was similar to Brazil's and, therefore, the same numbers for Brazil were used for Central America. The Citrus Tristeza Virus has been detected in most Central and South American regions and is expected to affect the survival rate of Central American orange trees. This effect is included and reflected in the relatively high death rates for Central American orange trees.

Another important portion of these distributions is the stock of orange trees by age (Table 8). The stock of trees for each endogenous supply region is updated each year by the new plantings equations. The updated stock, along with the age-yield-survival information determines total output of oranges on an annual basis for each endogenous supply region. Given the number of bearing trees and the yields in 90-pound boxes per tree by age, the total number of 90-pound boxes produced can be determined.

Recent CVC and Canker diseases in Brazil have reduced its orange tree inventory by 11 million trees, from 210 to 199 million trees between the 1997/98 and 1998/99 crop years. This decline represents about 5% of the total orange tree inventory in Brazil. In turn, orange output in Brazil is expected to fall from 428 to 298 million boxes between the 1997/98 and 1998/99 crop years. Yields are expected to fall by 26%, from 2.38 to

Table 7. Age-Yield-Survival Distribution of Orange Trees for Each of the Three Endogenous Supply Regions

	Florida		Sao Paulo		Central America	
Age[a]	Yield[b]	Survival	Yield[b]	Survival	Yield[b]	Survival
1	0.000	1.000	0.000	1.000	0.000	1.000
2	0.000	1.000	0.000	1.000	0.000	1.000
3	0.000	0.990	0.000	1.000	0.000	1.000
4	0.810	0.990	0.500	0.990	0.500	0.990
5	1.230	0.990	1.000	0.990	1.000	0.990
6	1.650	0.985	1.250	0.990	1.250	0.990
7	1.980	0.985	1.500	0.980	1.500	0.980
8	2.220	0.985	1.750	0.980	1.750	0.980
9	2.470	0.980	2.000	0.980	2.000	0.980
10	2.560	0.980	2.250	0.970	2.250	0.970
11	2.650	0.980	2.500	0.960	2.500	0.960
12	2.740	0.980	2.800	0.940	2.800	0.940
13	2.986	0.980	2.800	0.920	2.800	0.920
14	3.110	0.975	2.600	0.890	2.600	0.890
15	3.200	0.975	2.600	0.870	2.600	0.870
16	3.290	0.975	2.500	0.850	2.500	0.850
17	3.380	0.975	2.500	0.850	2.500	0.850
18	3.460	0.975	2.400	0.850	2.400	0.850
19	3.540	0.975	2.200	0.850	2.200	0.850
20	3.630	0.975	2.100	0.850	2.100	0.850
21[c]	3.710	0.975	2.000	0.850	2.000	0.850
22	3.790	0.975				
23	3.870	0.975				
24	3.925	0.960				
25+	3.980	0.960				

Source: Data for Florida and Sao Paulo are from Spreen's unpublished world FCOJ model. Data for Central America follow the Sao Paulo distribution given the close similarities of the two regions' Age-Yield-Survival distribution.

[a] Age is in years.

[b] Yield in 90-pound boxes per tree.

[c] Age is 21+ years for Sao Paulo and Central America.

Table 8. Age-Tree Stock Distribution of Orange Trees, in Millions of Trees, for Each of the Three Endogenous Supply Regions, in the 1995/96 Crop Year

Age[a]	Florida	Sao Paulo	Central America
1	2.4786	7.5	1.6
2	2.1246	7.5	3.2
3	4.4066	7.5	2.6
4	7.3093	7.5	1.3
5	8.6976	15.0	1.3
6	7.0905	15.0	1.3
7	7.9800	15.0	1.3
8	5.4584	15.0	1.3
9	7.1356	9.3	1.3
10	4.1446	9.3	0.2
11	2.0986	9.3	0.2
12	1.7843	11.0	0.2
13	2.8448	11.0	0.2
14	1.5822	9.0	0.2
15	1.5077	9.0	0.2
16	0.9781	9.0	0.2
17	0.9676	8.0	0.2
18	0.5682	8.0	0.2
19	0.5475	8.0	0.2
20	0.4980	6.0	0.3
21[b]	0.5054	6.0	0.3
22	0.4546		
23	0.2333		
24	0.7080		
25+	13.7205		

Source: Data for Florida and Sao Paulo are from Spreen's unpublished world FCOJ model. Data for Central America were collected by the author during a visit to the region. The model updates these distributions each year using new plantings generated by the supply response function for each respective region.

[a] Age is in years.

[b] Age is 21+ years for Sao Paulo and Central America.

1.76 boxes per tree due to the diseases over the same period (Abecitrus). It is this stock distribution of trees for Brazil (Table 8) that was adjusted for CVC and Canker disease effects. This was done by reducing the number of Brazilian trees by 5%, for each age, in the 1998/99 crop year.

The amount of oranges used for FCOJ production can be easily converted to pound solids, the measure used for FCOJ quantities. The amount of pound solids derived from a 90-pound box varies by region, depending again on inputs, weather and disease effects. The average yields of pound solids per 90-pound box for each supply region are presented in Table 9. The transportation matrix, which includes the per unit transportation cost from the exporting ports to the importing ports, is presented in Table 10. Per unit and ad valorem tariffs for each of the other four demand regions are presented in Table 11.

Table 9. Yields of Pound Solids[a] of FCOJ per 90-Pound Box of Oranges Produced by Each of the Six Supply Regions

Region	U.S.	Brazil	Central America	Mexico	Mediter-ranean	Cuba
Pound solids per 90-pound box	6.15	5.95	5.70	5.80	6.00	5.50

Source: Spreen's unpublished FCOJ model and author's personal visit to Central America and Cuba.

[a] See Chapter II for a description of pound solids.

Table 10. Matrix of Transportation Costs between the Six Supply and Four Demand Regions at the Beginning of the Forecast Period

Country/Region Production Region	U.S.	EC	Canada	Japan
:		US$ per pound of solids		
Brazil	0.07	0.10	0.10	0.17
U.S.	0.00	0.11	0.03	0.22
Cent. America	0.11	0.14	0.14	0.24
Mexico	0.08	0.14	0.11	0.24
Med.	0.17	0.08	0.17	0.30
Cuba	1.0	0.11	1.0	0.24

Source: Spreen's unpublished FCOJ model and author's personal visit to Central America and Cuba.

[a] Includes per unit tariffs.

Table 11. Per Unit and Ad Valorem Tariffs for the Four Demand Regions at the Beginning of the Forecast Period

U.S.[a]	EC[b]	Canada[b]	Japan[b]
0.3059	16.47%	2.70%	27.00%

Source: Spreen and Muraro, and Spreen and Mondragon.

[a] Per unit tariff, that is, per pound solids of FCOJ. Not applicable to Mexico. See section on NAFTA in Chapter II for Mexico's tariffs.

[b] Ad valorem tariff.

The empirical model then allocates each year's total supply among the demand regions, producing equilibrium prices, quantities and trade flows. Information on price is then used to calculate on-tree price, which is then fed back into the supply response functions to determine new plantings for the following year. The model is then solved in a forwardly recursive manner, similar to the approach of McClain and Spreen.

Given all this information, the model is then solved each year producing FCOJ output, consumption prices, consumption quantities and trade flows. Using the consumption price data, the model also produces on-tree prices for each producing region. These data are also used to determine welfare effects on gross revenues to each producing region, consumer and producer surplus, and net world welfare. These results are presented in the next chapter.

CHAPTER IV

EMPIRICAL RESULTS

Introduction

In this chapter, the results from the Baseline Model are presented in detail. The results from the four alternative trade scenarios are compared to those from the Baseline Model. This comparison shows the relative effects of each scenario on on-tree prices of oranges, FCOJ output, FCOJ consumption quantities and consumption prices, and FCOJ trade flows. In addition, the effect of each scenario on net world welfare is determined by comparison to the Baseline Model results.

The actual implementation dates of the trade scenarios considered in this study are uncertain. Scenario 1, European Community Free Trade in FCOJ, may not occur by the year 2000, but freer trade could become a reality by then, as described in more detail below. Scenario 2, FTAA, is scheduled to begin in the year 2005 and even so it is not certain if there will be free trade in all goods and services traded in the Americas. Scenario 3, the lifting of the U.S. trade embargo on Cuba, is more unpredictable. And lastly, total world free trade may be many years off into the future.

In this analysis, all trade scenarios are assumed to begin in the 2000/01 crop year given that it is not expected that any trade scenario will occur before that date. Therefore, all results in the first two years of the forecast period will be the same in all scenarios. By allowing the trade policies to change in the same year, uniform comparisons can be made with the Baseline Model.

Baseline Model

The Baseline Model incorporates the tariff structure facing FCOJ imports into the four major consuming countries/regions as it exists at the time of this publication, that is, 1998. The 1994 conclusion of the GATT that led to trade barrier reductions, beginning January 1, 1995, and continuing through the year 2000, has resulted in specific historical and planned FCOJ tariff reductions. The 1993 conclusion of NAFTA also imposed reductions on FCOJ tariffs beginning January 1, 1994 and continuing through the year 2008. These scheduled FCOJ tariff reductions due to GATT and NAFTA are included explicitly in the Baseline Model.

Brazil's production of oranges in the 1998/99 season has been reduced due to damage caused by the CVC and Citrus Canker diseases. As mentioned in Chapter III, these diseases have killed approximately 5% of Brazil's trees. This reduction in tree inventory for the world's largest FCOJ producer is also explicitly incorporated in the Baseline Model.

The 10-year forecasts of on-tree prices of oranges, FCOJ output, FCOJ consumption quantities and consumption prices, and FCOJ trade flows are described below. The forecast period starts with crop year 1998/99 and ends with crop year 2007/08.

On-tree Prices

The on-tree price is calculated as the wholesale consumption FCOJ price minus all costs, from the picking stage to the wholesale consumption stage in the countries/regions of final destination. Given that a producing country may sell its FCOJ in more than one market, the export price received is a weighted-average consumption

price. All costs incurred, including tariffs, transportation, processing, picking and hauling are subtracted from the wholesale consumer price to arrive at the on-tree price.

On-tree prices fall between the first and second years of the forecast period (Table 12). On-tree prices are relatively high in the first year (1998/99) because CVC and Canker diseases in Brazil reduced both Brazilian yields and total output, and in turn world production in that year. Brazilian producers have undertaken a disease eradication and prevention program to fight the CVC and Canker problems (Abecitrus). This program has the effect of returning yields to normal levels in the 1999/2000 crop year causing an increase in Brazilian and world output and a fall in prices relative to the first year of the forecast period. Therefore, while the Brazilian tree inventory is smaller due to the removal of diseased trees, yields are restored to normal levels because of the prevention programs undertaken by the Brazilian producers. This causes Brazilian output to increase from 1998/99 to 1999/2000, but not to the level of production prior to 1998/99.

On-tree prices for all locations then rise from the second to the last year of the forecast period. This rise in price is caused by the assumed higher growth rate of demand relative to the growth rate of supply. Supply growth depends on the age-yield distribution of trees and new plantings. New plantings, which produce after three years, in turn depend on lagged prices. A higher price in one year causes more new plantings in the following year and more output three years later. Thus over the forecast period, the lagged response in output causes supply growth to be lower than demand growth, resulting in an overall rise in on-tree prices.

Table 12. On-tree Orange Prices by Country/Region for the Period 1998/99 to 2007/08, as Forecasted by the Baseline Model[a]

Year	United States	Brazil	Central America	Mexico	Mediter-ranean Region	Cuba
	----------US$ per 90-pound box----------					
1998/99	3.79	3.98	3.43	3.01	4.17	3.36
1999/00	2.45	2.80	2.03	1.85	2.80	2.27
2000/01	2.84	3.14	2.67	2.19	3.18	2.59
2001/02	3.47	3.70	3.60	2.73	3.81	3.10
2002/03	4.02	4.36	4.51	3.21	4.56	3.71
2003/04	4.61	4.98	5.20	3.83	5.27	4.29
2004/05	5.15	5.63	5.92	4.46	6.01	4.89
2005/06	5.77	6.18	6.52	5.00	6.63	5.39
2006/07	6.37	6.71	7.11	5.52	7.23	5.88
2007/08	6.93	7.20	7.66	6.01	7.79	6.34
% Change from 1998/99 to 2007/08	82.8	80.9	123.3	99.7	86.8	88.7
Annual % Change[b]	9.20	8.99	13.70	11.08	9.64	9.86

[a] The Baseline Model takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA.

[b] The annual percentage change is calculated by dividing the total change over the period by nine, the number of changes over the period.

For the United States, on-tree prices grow at an average annual rate of 9.20% over the forecast period. The forecast of growth for Brazil's on-tree prices is an average of 8.99% annually, only slightly lower than in the United States. Central America's on-tree price growth is the highest of the six producing countries/regions, averaging 13.70% annually. For Mexico, the Mediterranean and Cuba, the average annual growth rates of on-tree prices are 11.08%, 9.64% and 9.86%, respectively (Table 12). These growth rates are a direct result of the growth rate of consumption prices, which are discussed below.

FCOJ Output

As mentioned above, FCOJ output for the endogenous countries/regions is determined by the stock of trees, yields and survival rates, new plantings and lagged on-tree prices. The output for the exogenous producers is set at 2% compounded per year or an average of 2.17% per year for the nine annual changes over the forecast period. Over the forecast period, FCOJ output rises for all producers, except for Brazil.

The United States is forecasted to increase its FCOJ output at an average annual rate of 2.44%, from 1556.21 to 1897.82 million p.s. over the forecast period (Table 13). The prior section on prices shows that relatively high prices are forecasted over this period. These high prices are responsible for the increases in U.S. output. As described above in Chapter III, the United States responds to rising prices with increases in new plantings and in turn larger outputs of oranges.

Brazil's FCOJ production is expected to fall slightly over the period in question at an average annual rate of 0.41%, a decrease from 1317.41 to 1268.51 million p.s. over the forecast period (Table 13). This reduction is expected for two reasons. First, the age

Table 13. FCOJ Production by Country/Region for the Period 1998/99 to 2007/08, as Forecasted by the Baseline Model[a]

Year	United States[b]	Brazil	Central America	Mexico[c]	Mediter-ranean Region[c]	Cuba[c]
	millions of pounds of solids					
1998/99	1556.21	1317.41	119.42	54.60	215.95	53.06
1999/00	1616.49	1547.49	130.65	55.70	220.27	54.12
2000/01	1667.06	1521.91	138.55	56.81	224.67	55.20
2001/02	1711.16	1467.74	144.45	57.95	229.16	56.30
2002/03	1750.98	1413.10	148.13	59.11	233.74	57.43
2003/04	1785.68	1366.10	150.09	60.29	238.41	58.58
2004/05	1816.95	1325.49	150.29	61.50	243.18	59.75
2005/06	1844.42	1298.04	147.36	62.73	248.04	60.95
2006/07	1870.86	1279.23	139.93	63.98	253.00	62.17
2007/08	1897.82	1268.51	130.45	65.26	258.06	63.41
% Change from 1998/99 to 2007/08	22.0	-3.7	9.2	19.5	19.5	19.5
Annual % Change[b]	2.44	-0.41	1.02	2.17	2.17	2.17

[a] The Baseline Model takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA.

[b] These figures represent production in Florida and do not include approximately 68 million p.s. produced annually on average by other U.S. producing states.

[c] Lack of data on tree distribution by age resulted in this country being included in the model exogenously. An annual growth rate of 2.00% was used for FCOJ exports from this country derived from historical data. Note that the FCOJ production listed above for all the supplying regions is completely exported, except for the U.S., which "exports" to itself.

[d] The annual percentage change is calculated by dividing the total change over the period by nine, the number of changes over the period.

distribution of Brazilian trees is such that a higher percentage of older trees than younger trees exist at the beginning of the forecast period (Table 8). Thus, over the forecast period, a greater number of trees than average are dying than would be the case for a more evenly distributed tree inventory. Second, new plantings do not compensate for the losses due to the diseases and the old tree deaths. The Brazilian tree planting equation requires considerably high prices (even higher than those forecasted) to induce higher new plantings. Continuous higher new plantings would be required to compensate (in production of oranges and FCOJ) for the losses due to the diseases and old tree deaths in the forecast period. Therefore, although Brazil was the largest producer in the world before 1997/98, throughout the forecast period Brazil is the second largest FCOJ producer in the world after the United States.

Over the same period, Central America's output of FCOJ increases at an average annual rate of 1.02%, from 119.42 to 130.45 million p.s. over the forecast period (Table 13). The Central American tree planting equation is similar in structure to Florida's equation in that new plantings for Central America are a function of a three-year moving average of prices, but yields are lower in Central America.

Central American FCOJ production does not increase continuously as it does in Florida, but instead peaks at 150.29 million p.s. in the 2004/05 crop year and falls to 130.45 million p.s. by the end of the forecast period. The reason for this can be traced to the higher death rate of older trees in the Central American tree inventory (Table 7). As mentioned in Chapter III, the Citrus Tristeza Virus is expected to increase the death rate of older trees in Central America, and has a greater impact in the latter part of the forecast period when there is a greater percentage of older trees.

Mexico, the Mediterranean and Cuba all grow by the prescribed 2.17% average annual growth rate (2% compounded) and are included in Table 13 for comparison purposes only.

Consumption Quantities

Two main factors affect the growth rate of consumption. First, the slopes, or responsiveness, of the demand curves determine the extent to which quantity demanded will change given a certain change in price. As prices rise, the quantity demanded in the more responsive markets falls relatively more than in the less responsive markets. As first reported in Chapter III, the order of elasticities of the demand curves for these consuming countries/regions, from most to least responsive, is Canada, Japan, the EC and the United States.

Second, each market is programmed to grow at specific rates in the model. Canada and the United States grow at 1.5% annually, while Japan and the European Union grow at 4% annually.[29] Therefore, two countervailing forces affect consumption. On the one hand, rising prices lead to varying degrees of reduction in consumption depending on the responsiveness of demand, while on the other hand, the growth of demand (an outward shift of the demand curve) increases consumption due to the specified positive annual growth rates in the model.

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[29]Appendix A gives the results of the Baseline Model adjusted for a lower annual growth rate of demand of 2.5% for Japan, to account for a possible prolonged Asian crisis. This lower demand growth for Japan has the effect of reducing consumption prices and on-tree prices, and reducing endogenous FCOJ output in all regions. Consumption rises in all regions, except of course, in Japan. Trade patterns remain essentially the same, with slight shifting between consumption regions in a few cases. Therefore, changing the growth rate of demand for Japan to 2.5% does not affect the general implications derived from the Baseline Model.

The U.S. market is the largest demand market in the world, with consumption of 1635.08 million p.s. at the beginning of the forecast period. The EC is the second largest, consuming 1257.03 in that same year. Japan and Canada are the third and fourth largest with consumption of 363.71 and 129.07 million p.s. at the beginning of the forecast period, respectively. These rankings remain the same throughout the forecast period.

Over the forecast period, consumption is forecasted to grow at average annual rates of 0.57% for the United States, from 1635.08 to 1718.52 million p.s., and 2.24% for the European Community, from 1257.03 to 1510.47 million p.s. Over the same period, consumption growth forecast is -1.83% for Canada, from 129.07 to 107.77 million p.s., and 1.57% for Japan, from 363.71 to 414.99 million p.s. (Table 14). However, note that for the four consuming countries/regions, the first year of the forecast period is affected by the high prices due to the drop in Brazilian output. These relatively high prices reduce consumption significantly in the first year making the annual growth rates of consumption over the forecast period higher than they would otherwise be without the drop in Brazilian output.

The two countervailing forces of demand responsiveness and demand growth (1.5% annual demand growth and relatively low responsiveness to price increases) almost neutralize each other in the U.S. market. Over the forecast period, consumption in the U.S. market changes little, only fluctuating between 1718.52 and 1730.32 million p.s., except for the first crop year, when it is 1635.08 million p.s.

The European Community, with a high 4% growth rate of demand and the second lowest demand elasticity, has the highest average annual growth in consumption. This allows for continuous growth in EC consumption over the forecast period.

Table 14. Consumption in Each Country/Region of Destination for the Period 1998/99 to 2007/08, as Forecasted by the Baseline Model

Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99	1635.08	1257.03	129.07	363.71
1999/00	1722.74	1407.18	147.75	415.29
2000/01	1730.32	1435.43	145.15	421.54
2001/02	1726.62	1447.30	139.49	421.59
2002/03	1726.46	1451.09	134.70	418.48
2003/04	1724.54	1457.37	129.37	416.10
2004/05	1725.17	1462.48	124.65	413.11
2005/06	1721.82	1476.10	118.80	413.06
2006/07	1719.27	1491.56	113.08	413.49
2007/08	1718.52	1510.47	107.77	414.99
% Change from 1998/99 to 2007/08	5.1	20.2	-16.5	14.1
Annual % Change[a]	0.57	2.24	-1.83	1.57

[a] The annual percentage change is calculated by dividing the total change over the period by nine, the number of changes over the period.

The annual growth rate of demand for Canada (1.5%) is not high enough to compensate for the high price responsiveness characteristic of the Canadian market. Except for the increase from the 1998/99 crop year to the 1999/2000 crop year, consumption falls continuously for Canada.

Japan has a high growth rate of demand (4%) and a relatively high degree of responsiveness to price increases. Japan's annual growth rate of demand does not compensate, after discounting the first year of the forecast period, for the price effect, resulting in fairly constant consumption over the period. Except for the first crop year, Japanese consumption fluctuates between 413.06 and 421.59 million p.s. This shows, like in the case of the United States, the countervailing forces of price responsiveness and demand growth causing consumption in Japan to fluctuate over the forecast period.

Consumption Prices

Consumption price growth mirrors on-tree price growth, as expected since the latter is derived from the former. Over the forecast period, consumption prices grow continuously in every market, except between the first and second crop years. These first two crop years defy the norm for the same reason given for the other forecasts above, that is, the drop in Brazilian and in turn world production in the 1998/99 crop year.

Over the forecast period, consumption prices are forecasted to rise at an average annual rate of 5.0% for the United States, 5.56% for the European Community, 4.83% for Canada and 5.16% for Japan (Table 15). Therefore, growth in demand has out-paced growth in supply over the forecast period. As mentioned above, one reason for this slower supply growth is the negative growth in Brazilian FCOJ output. Another reason is the fact that the supply response is lagged, that is, new trees take three years before they

Table 15. Consumption Price in Each Country/Region of Destination for the Period 1998/99 to 2007/08, as Forecasted by the Baseline Model

Year	United States	European Community	Canada	Japan
	----------US$ per pound of solids----------			
1998/99	1.09	1.30	1.15	1.51
1999/00	0.88	1.06	0.94	1.24
2000/01	0.94	1.13	1.00	1.31
2001/02	1.04	1.24	1.10	1.44
2002/03	1.13	1.37	1.19	1.58
2003/04	1.22	1.50	1.28	1.72
2004/05	1.30	1.63	1.36	1.86
2005/06	1.40	1.74	1.46	1.98
2006/07	1.49	1.85	1.56	2.10
2007/08	1.58	1.95	1.65	2.21
% Change from 1998/99 to 2007/08	45.0	50.0	43.5	46.4
Annual % Change[a]	5.00	5.56	4.83	5.16

[a] The annual percentage change is calculated by dividing the total change over the period by nine, the number of changes over the period.

produce, and new tree plantings depend on one and three-year moving averages of on-tree prices.

Trade Flows

Tables 16 through 21 present the forecasts of trade flows from each of the six producing countries/regions to each of the four consuming countries/regions. Producing countries/regions will export to those markets where the net returns (that is, net returns to processors) are greatest. Net returns are defined as the wholesale consumption price per unit of export less transportation and tariff costs per unit of export, to a particular market.

As described in Chapter III, equilibrium is established when net returns to each producing region are equal across all markets to which the region exports. In the model used in this study, net returns among producing regions differ because of different transportation and tariff costs.

As any one supplier sends more and more FCOJ to a particular market, the prices in that market keep falling. As soon as the fall in prices causes net returns from that particular market to fall below that of another "new" market, the producing country will begin to export to the "new" market. This process continues until the producing country/region exhausts all of its supplies. As seen below, a country/region may exhaust all of its supply before its net returns cause it to switch to another market.

The United States is the largest consuming market and the largest producer of FCOJ in the world (given the negative effects of Brazilian diseases) over the forecast period. As expected, the United States is forecasted to "export" to itself over the whole forecast period (Table 16). The United States is also forecasted to export to Canada over the whole period and to the EC from 2004/05 to the end of the period. In the 2004/05

Table 16. Exports of FCOJ from the United States[a] to the Four Consuming Countries/ Regions for the 1998/99 to the 2007/08 Crop Years, as Forecasted by the Baseline Model

Crop Year	United States	European Community	Canada	Japan
	millions of pounds of solids			
1998/99	1549.98		74.46	
1999/00	1595.12		89.60	
2000/01	1646.96		88.33	
2001/02	1697.86		81.53	
2002/03	1726.46		92.75	
2003/04	1724.54		129.37	
2004/05	1725.17	35.37	124.65	
2005/06	1721.82	72.03	118.80	
2006/07	1719.27	106.74	113.08	
2007/08	1718.52	139.76	107.77	

[a] Includes an additional 68.232 million p.s. per year that are produced in other states besides Florida.

Table 17. Exports of FCOJ from Brazil to the Four Consuming Countries/Regions for the 1998/99 to the 2007/08 Crop Years, as Forecasted by the Baseline Model

Crop Year	United States	European Community	Canada	Japan
	millions of pounds of solids			
1998/99		953.70		363.71
1999/00		1129.76	2.45	415.29
2000/01		1100.37		421.54
2001/02		1046.15		421.59
2002/03		994.62		418.48
2003/04		949.99		416.10
2004/05		912.38		413.11
2005/06		884.98		413.06
2006/07		865.74		413.49
2007/08		853.52		414.99

Table 18. Exports of FCOJ from Central America to the Four Consuming Countries/ Regions for the 1998/99 to the 2007/08 Crop Years, as Forecasted by the Baseline Model

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99	85.10	34.32		
1999/00	127.62	3.03		
2000/01	83.36	55.19		
2001/02	28.76	115.69		
2002/03		148.13		
2003/04		150.09		
2004/05		150.29		
2005/06		147.36		
2006/07		139.93		
2007/08		130.45		

Table 19. Exports of FCOJ from Mexico to the Four Consuming Countries/Regions for the 1998/99 to the 2007/08 Crop Years, as Forecasted by the Baseline Model

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99			54.60	
1999/00			55.70	
2000/01			56.81	
2001/02			57.95	
2002/03		17.17	41.94	
2003/04		60.29		
2004/05		61.50		
2005/06		62.73		
2006/07		63.98		
2007/08		65.26		

Table 20. Exports of FCOJ from the Mediterranean Region to the Four Consuming Countries/Regions for the 1998/99 to the 2007/08 Crop Years, as Forecasted by the Baseline Model

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99		215.95		
1999/00		220.27		
2000/01		224.67		
2001/02		229.16		
2002/03		233.74		
2003/04		238.41		
2004/05		243.18		
2005/06		248.04		
2006/07		253.00		
2007/08		258.06		

Table 21. Exports of FCOJ from Cuba to the Four Consuming Countries/Regions for the 1998/99 to the 2007/08 Crop Years, as Forecasted by the Baseline Model

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99		53.06		
1999/00		54.12		
2000/01		55.20		
2001/02		56.30		
2002/03		57.43		
2003/04		58.58		
2004/05		59.75		
2005/06		60.95		
2006/07		62.17		
2007/08		63.41		

season, net returns from Canada decreased sufficiently to warrant exports from the United States to the EC.

To explain further, consider the 2003/04 and 2004/05 crop years. In 2003/04, 1724.54 million p.s. are sold to the U.S. market. The additional production, 129.37 million p.s., is sold to Canada where net returns are now higher in Canada than in the United States. As more and more p.s. are sold in the U.S. market, the consumption price keeps falling until they cause net returns to fall below the next best alternative, which in this case is Canada. In 2003/04, Canada's net returns are high enough to attract all United States' supplies in excess of those sold to the United States. However, this is no longer true in the following year where net returns from exports to Canada have fallen below the next best alternative, which turns out to be the EC. From 2004/05 to the end of the forecast period, the United States exports to itself, Canada and the EC. Net returns to the EC do not fall below that of Japan to warrant exports to the Japanese market.[30]

Exports from Brazil over the forecast period go exclusively to the EC and Japan, with the exception of the 1999/2000 season, when a small quantity is exported to Canada (Table 17). As prices change across markets, so do net returns. This explains the small quantity exported in the 1999/2000 crop year to Canada, when net returns are high enough in Canada to attract 2.45 million p.s. of FCOJ.

Exports from Central America go to the United States market from the 1998/99 season to the 2001/02 season (Table 18), because of the proximity to the United States market. Central America exports to the EC over the whole forecast period. Central

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[30]In reality, the United States does export citrus products to Japan, but these are mostly in fresh fruit form for the high quality end of the market (FDOC Website).

America makes a complete switch to the EC market by the 2002/03 crop year, again because of net returns. The United States supplies all of its domestic demand in 2002/03, and prices rise relatively more in the EC. These combined factors are able to compensate for the added transportation costs from Central America to the EC to the extent that all of Central American exports eventually go to the EC.

Mexican exports are forecasted to go exclusively to Canada from the 1998/99 crop year to the 2001/02 crop year. Mexican FCOJ has lower tariff cost for entry into Canada as compared to the EC and Japan, and relatively low transportation costs. Mexico begins to switch its exports to the EC in the 2002/03 crop year and makes a complete switch by the following crop year, continuing exports only to the EC until the end of the forecast period (Table 19). Note that even though Mexico is closer to the United States than Central America, Central America exports to the United States but Mexico does not. The reason for this is that CBI grants free access for Central American exports, while under NAFTA Mexico pays tariffs to the United States until the year 2008 (Table 6, Chapter II).

The Mediterranean and Cuba export exclusively to the EC (Tables 20 and 21). The proximity and free entry of FCOJ exports from the Mediterranean to the EC makes the EC market deliver the highest returns over the forecast period.[31] In the case of Cuba,

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[31] The Mediterranean countries of Israel and Morocco receive preferential access into the EC market under unilateral agreements with the EC. In this study, they are assumed to enter the EC free of all duties.

the U.S. embargo restricts exports to the United States and Canadian markets,[32] and transportation costs to Japan make net returns from that market uneconomical. Therefore, Cuba exports all of its supplies to the EC over the forecast period.

Scenario 1: European Community Free Trade

At present, the EC arrangement discriminates against the larger FCOJ producing countries in favor of the smaller ones, as can be seen with Brazil and the United States paying tariffs while Central America and the Mediterranean Region do not. The EC has been under pressure to comply with the WTO rules, primarily in Agriculture, requiring equal treatment for all exporters. In Scenario 1, all tariffs for entry into the EC are removed.

The EC has made its position clear in a 1997 position statement, or "Green Paper," that contains the guidelines for the 2000 revision of Lome IVB (Tradepoint). The EC plans to conform to WTO rules and the result may be equal access (or the equalizing of access over time) to all suppliers of FCOJ into the EC market. While total free trade in FCOJ for the EC is still unlikely to commence in the year 2000, it is expected that steps will be taken in this direction by that time. Scenario 1 is the most probable of the scenarios considered in this study to occur in 2000.

In the Baseline Model, tariffs of FCOJ into the EC were reduced from calendar years 1994 to 2000 due to GATT. GATT caused the ad valorem tariff into the EC to

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[32] In reality, Canada does not import FCOJ from Cuba. U.S. FCOJ producers supply the Canadian market and have ensured Canadian support for the prevention of Cuban FCOJ exports to Canada. For more details on the U.S. trade embargo on Cuba, see the section below on Scenario 3 and the section in Chapter II on the U.S. embargo on Cuba.

decrease from 19.0 to 15.2 over the 1994 to 2000 period (Table 5, Chapter II). In the Baseline Model, Brazil, the United States, Mexico and Cuba pay these tariffs, while Central America and the Mediterranean do not. Under Scenario 1, the EC ad valorem tariff is set equal to zero for all producers from crop year 2000/01 to the end of the forecast period.

The following sections compare the results from Scenario 1 with the results from the Baseline Model in the final year of the forecast period. Detailed forecasts for each year are presented in Appendix B.

On-tree Prices

The removal of all tariffs on FCOJ into the EC in Scenario 1, starting in the 2000/01 crop year, has the effect of increasing the average annual percentage change of on-tree prices for all four producing countries/regions that pay tariffs under the Baseline Model (Table 22). These countries include the United States, Brazil, Mexico and Cuba. Increased exports enter the EC market from these suppliers causing consumption price in the EC to fall.

The two suppliers that do not pay tariffs under the Baseline Model, Central America and the Mediterranean Region, have a lower average annual percentage change of on-tree prices over the forecast period as compared to the Baseline Model. On-tree prices do not increase as much for Central America and the Mediterranean because the consumption price in their main export market does not increase as much.

On-tree prices for the United States, from crop year 2000/01 to the end of the forecast period, rise almost parallel (the difference between the two gets slightly larger

Table 22. Comparison of the Annual Percentage Change in On-tree Prices and FCOJ Output from the Baseline Model and Scenario 1[a] for the Six Producing Countries/ Regions over the Forecast Period 1998/99 to 2007/08

Model	United States	Brazil	Central America	Mexico	Mediter-ranean Region	Cuba
On-tree Prices[b]						
Baseline Model	9.20	8.99	13.70	11.08	9.64	9.86
Scenario 1	11.26	10.72	10.97	13.32	7.36	11.74
FCOJ Output[c]						
Baseline Model	2.44	-0.41	1.02	2.17	2.17	2.17
Scenario 1	2.48	-0.39	1.01	2.17	2.17	2.17

[a] Scenario 1 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the EC market.

[b] Table B-1 includes on-tree price information for all the years of the forecast period as predicted by Scenario 1.

[c] Table B-2 includes FCOJ output information for all the years of the forecast period as predicted by Scenario 1.

over time) to those of the Baseline Model forecasts (Figure 11). This pattern is similar for Brazil and Mexico. Central American on-tree prices are higher in the Baseline Model forecasts, as compared to Scenario 1, from 2001/02 to the end of the forecast period (Figure 12). This pattern is similar for the Mediterranean Region.

FCOJ Output

The annual percentage change of FCOJ output over the forecast period for the United States and Brazil increases slightly under Scenario 1 as compared to the Baseline Model (Table 22). Compared to the Baseline Model, output is 4.97 and 3.15 million p.s.

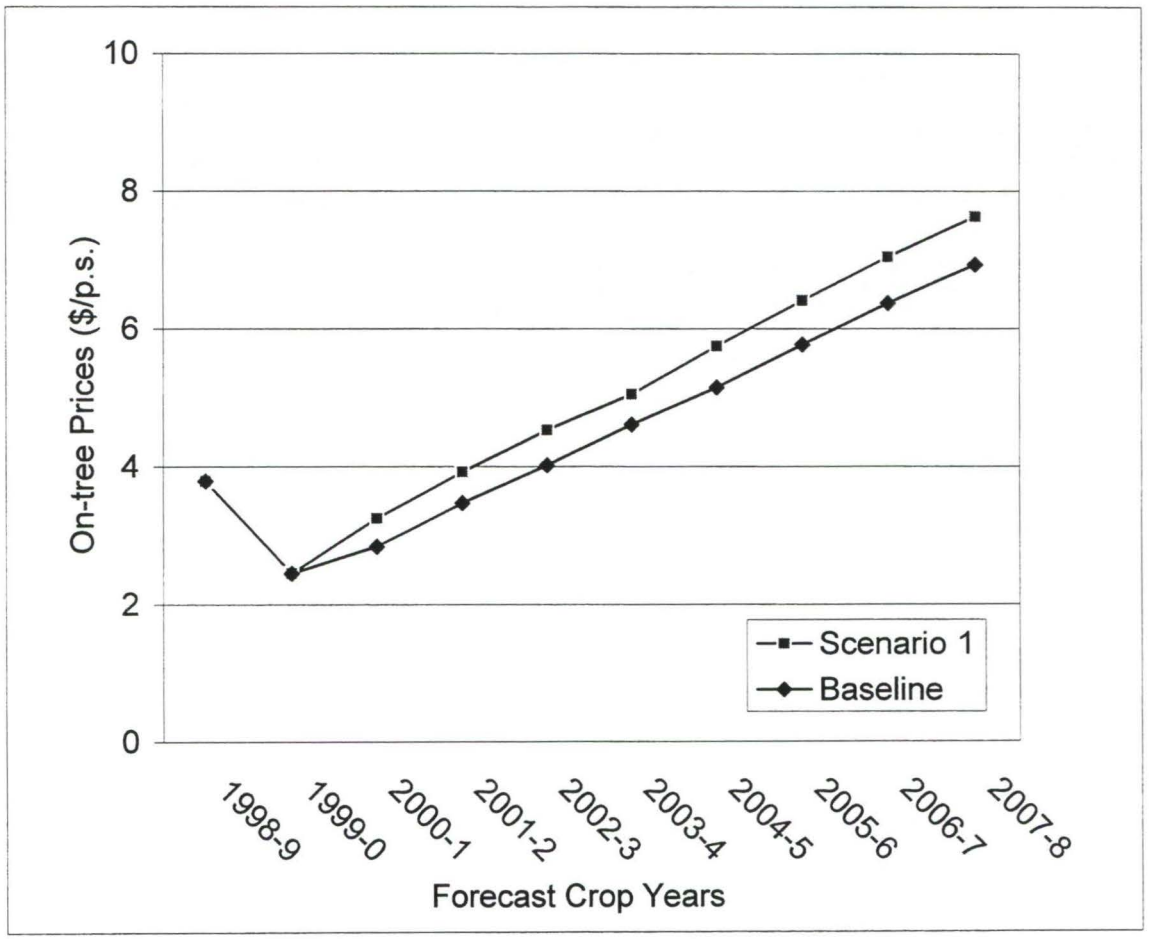

Figure 11. Baseline Model vs. Scenario 1: On-tree Prices – United States

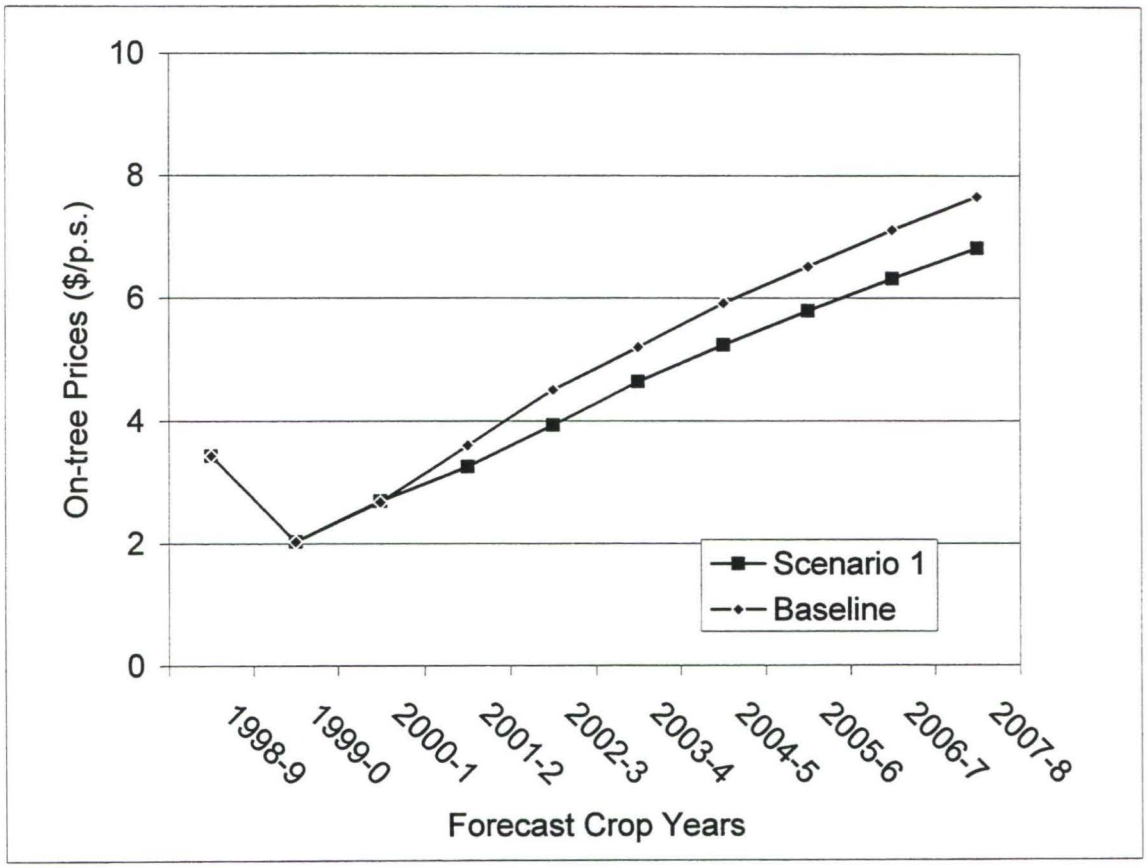

Figure 12. Baseline Model vs. Scenario 1: On-tree Prices – Central America

more under Scenario 1 at the end of the forecast period for the United States and Brazil, respectively (Tables 13 and B-2). It is 0.16 million lower for Central America.

On-tree prices are higher for the United States and Brazil and lower for Central America leading to the changes in production just mentioned. Note that although on-tree prices have also changed for Mexico, the Mediterranean and Cuba, these countries/ regions are exogenous and their output is set to rise by a fixed 2.17% average annual growth per year.

Consumption Quantities

Given that EC tariffs are removed for all countries, quantities sold to the EC increase, at the expense of consumption in the other three consuming countries/regions (Table 23). At the end of the forecast period, consumption is 76.71 million p.s. higher in the EC than under the Baseline Model (Tables 14 and B-3). Consumption is 35.83, 9.47 and 23.46 million p.s lower in the United States, Canada and Japan, respectively, at the end of the forecast period under Scenario 1 as compared to the Baseline Model. This result is consistent with trade theory, which states that trade barrier reductions/removals lead to lower consumption prices and increased consumption quantities in the country removing the trade barrier.

Consumption Prices

The average annual growth rate of consumption prices rises for the United States, Canada and Japan, and falls for the EC (Table 23). Consumption prices are higher, relative to the Baseline Model forecasts, in the United States, Canada and Japan due to the diverting of supplies to the European market. As mentioned above, the larger

Table 23. Comparison of the Annual Percentage Change of Consumption Quantities and Prices from the Baseline Model and Scenario 1[a] for the Four Consuming Countries/Regions over the Forecast Period 1998/99 to 2007/08

Model	United States	European Community	Canada	Japan
Consumption Quantities[b]				
Baseline Model	0.57	2.24	-1.83	1.57
Scenario 1	0.32	2.92	-2.64	0.84
Consumption Prices[c]				
Baseline Model	5.00	5.56	4.83	5.16
Scenario 1	6.01	4.19	5.89	6.18

[a] Scenario 1 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the EC market.

[b] Table B-3 includes consumption quantity information for all the years of the forecast period as predicted by Scenario 1.

[c] Table B-4 includes consumption price information for all the years of the forecast period as predicted by Scenario 1.

quantities entering the EC causes consumption prices to fall in the EC, relative to the Baseline Model forecasts.

Trade Flows

Trade flow shifts are minor as a result of the trading environment of Scenario 1. As in the Baseline Model, the exports from the U.S to its own market rise and then fall (Tables 16 and B-5). This reflects the changing net returns vis-a-vis the other markets, where net returns are relatively higher in the later years of the forecast period. Higher net returns to the EC market induce higher United States exports to the EC market which begin one crop year earlier, 2003/04, compared to the Baseline Model forecasts (Table B-5). United States exports to Canada are lower from the 2000/01 crop year to the end of

the forecast period relative to the Baseline Model forecasts, but continue throughout the period. As in the case of the Baseline Model, no U.S. exports are made to the Japanese market. Thus, this policy causes the United States to divert supplies from its own market and from Canada to the EC (Table 24).

Table 24. Differences in Exports from Each Endogenous Producing Region to Each Consuming Region in 2007/08 between Scenario 1[a] and the Baseline Model[b]

Region	United States	EC	Canada	Japan
	----------millions of pounds of solids----------			
U.S.	-35.83	50.26	-9.47	
Brazil		26.61		-23.46
Central America.		-0.16		

[a] Scenario 1 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the EC market.

[b] No change in trade for all other producers.

The trade flow pattern for Brazilian exports also remains essentially the same under Scenario 1 (Table B-6). Brazil's exports continue throughout the forecast period to the EC and Japan, increasing to the EC and falling to Japan. Exports to Canada and the United States are zero, except for crop year 1999/2000 when a small amount is exported to Canada. The trade policy causes Brazil to divert supplies from Japan to the EC (Table 24).

The trade patterns for Central America did not shift from its Baseline Model pattern due to the freeing of the EC market (Table B-7). In the Baseline Model, exports

were forecasted from Central America to the United States market for 1998/99 to 2001/02. This remained the case under Scenario 1, although the quantities exported were lower for the two years following the policy change, that is, 2000/01 to 2001/02 crop years. As in the Baseline Model, exports to the EC market occur throughout the forecast period and no exports are made to the Canadian or the Japanese markets.

Mexican trade flow patterns remain the same in Scenario 1 as compared to the Baseline Model (Table B-8). In the 2002/03 crop year, when Mexican exports begin to shift from the Canadian market to the EC market, more is exported to the EC market than is exported to the Canadian market under Scenario 1 as compared to the Baseline Model. Trade patterns remain the same for the Mediterranean region and Cuba under Scenario 1 (Tables B-9 and B-10). All exports from these two supply regions are made to the EC market, as is the case under the Baseline Model.

Welfare Analysis

The data presented above on on-tree prices, FCOJ output, consumption quantities and consumption prices is used below to analyze the welfare implications for the different participants in the world FCOJ market. Gross revenues and on-tree returns, consumer and producer surplus, and net world welfare are defined and presented in this section.

Gross Revenues and On-tree Returns

Gross revenues measure the income to the final exporters, that is, the processors of FCOJ in the producing countries/regions. Gross revenues are calculated as the weighted-average F.O.B. price (net of international transportation and tariff cost) multiplied by total exports.

The on-tree returns are defined as gross payments made to farmers by processors, less domestic transportation, and picking and hauling costs. For any one producing country in any one year, on-tree returns can be calculated by simply multiplying the on-tree price by the number of 90-pound boxes used in the production of FCOJ in that region.

Therefore, gross revenues and on-tree returns are different due to the costs of production between the fruit on trees and FCOJ at the shipping docks in the exporting countries. These costs include picking and hauling, domestic transportation and processing costs.

The output and consumption tables presented in this study measure the quantity of FCOJ in millions of pound solids. These pound solid figures are derived from the quantity of 90-pound boxes of oranges produced, the percentage used for processing, and the yields of FCOJ in pound solids per box for the endogenous producers (Table 9).

Table 25 compares gross revenues and on-tree returns in the last year of the forecast period between the Baseline Model and the Scenario 1. The last year is chosen given that on-tree returns tend to increase for all countries over the forecast period. Even for producing countries with falling output, for example Brazil, on-tree returns still rise due to the higher percentage increase in prices.

Table 25. Comparison of the Baseline Model and Scenario 1[a] Gross Revenues and On-tree Returns, in Millions of Dollars, for 2007/08, the Last Year of the Forecast Period[b]

Model	United States	Brazil	Central America	Mexico	Mediter-ranean	Cuba
	----------millions of US$----------					
Gross Revenues:						
Baseline Model	2989.1	2010.6	235.6	100.8	481.5	99.9
Scenario 1	3202.4	2152.9	215.4	107.9	442.1	106.7
Difference	213.3	142.3	-20.2	7.1	-39.4	6.8
On-tree Returns:						
Baseline Model	2138.5	1535.0	175.3	67.6	335.0	73.1
Scenario 1	2360.7	1671.3	155.9	74.5	298.1	79.7
Difference	222.2	136.3	-19.4	6.9	-36.9	6.6

[a] Scenario 1 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the EC market.

[b] The discrepancy between the gross revenues difference and the on-tree returns differ-ence is due to rounding errors. GAMS, the software program used to produce the results, rounds to three decimal places. The information used to calculate gross revenues (total FCOJ produced and the weighted-average F.O.B. price) is produced by GAMS. However, the information used to calculate on-tree returns is produced partly by GAMS (total FCOJ production and on-tree price) and partly from other sources (pound solids per 90-pound box, Table 9, where this latter information is rounded to two decimal places.

In Scenario 1, Central America and the Mediterranean suffer losses due to the removal of tariffs to the EC market. They enjoy preferential free access in the Baseline Model, but lose their special benefits when all other exporters are allowed free access into the EC under Scenario 1. By allowing the other exporters free access, consumption prices in the EC do not increase as much. Therefore, gross revenues and on-tree returns in Central America and the Mediterranean are less in Scenario 1 than in the Baseline Model. The other four supply regions gain gross revenues and on-tree returns given the reduction of costs to enter the EC market.

Consumer Surplus

Comparing consumer surplus between the Baseline Model and Scenario 1 for the last year of the forecast period is also fairly straightforward. Note that the demand curves for each consumption region are identical in any one year for the Baseline Model and Scenario 1. However, the consumption quantities do change as supplies are shifted among markets due to changes in tariff policy.

Given a fixed demand curve and changing consumption quantities between the Baseline Model and Scenario 1 in any one year, consumer surplus changes. If consumption increases then the price is lower, and there is an unambiguous increase in consumer surplus.

Table 26 compares consumer surplus between the Baseline Model and Scenario 1. Consumer surplus falls in the United States, Canada and Japan, and rises in the EC. Consistent with trade theory, consumer surplus rises in the market where trade barriers are removed as consumption in that market increases. Conversely, consumer surplus in

Table 26. Comparison of Consumer Surplus between the Baseline Model and Scenario 1[a] for the four Consuming Regions in Crop Year 2007/08, in Millions of Dollars

Model	U.S.	EC	Canada	Japan
	----------millions of US$----------			
Baseline Model	4430.34	2281.56	67.95	499.43
Scenario 1	4247.12	2518.85	56.52	444.58
Change	-183.22	237.29	-11.43	-54.85

[a] Scenario 1 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the EC market.

the other markets falls due to the lower quantities available in those markets. The change in consumer surplus across all markets is -$12.21 million.

Producer Surplus

Producer surplus is calculated for each consumption region and includes tariff revenues. The reason for including tariff revenues in producer surplus can be explained by reference to Figure 10, Chapter III. Areas 2 + 3 + 4 + 5 represent tariff revenue in market 1. However, in the world FCOJ market being studied, some exporters enter consumption markets free of tariffs. Thus, a part of areas 2 + 3 + 4 + 5 is captured by those countries that do not pay tariffs.

Therefore, including tariff revenues with producer surplus accounts for all of the economic value not included in consumer surplus in any one consuming market. This calculation of accounting for tariff revenues with producer surplus is necessary to derive

net world welfare.[33] The change in producer surplus between the Baseline Model and Scenario 1 for the United States and Japan is positive, $125.31 million and $1.44 million, respectively, while for EC and Canada it is negative, -$93.48 million and -$4.66 million respectively. The change in producer surplus across all consuming markets is $28.61 million. Scenario 1 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the EC market. Only changes are presented here given that this information is used to calculate the change in world welfare, and given that the levels of producer surplus for each consumption region do not give a clear picture of which individual producers are gaining or losing. Table 25 provides clear information on individual producers' gains and loses.

World Welfare

Under Scenario 1, in the last year of the forecast period, the decrease in consumer surplus across all markets is $12.21 million, while the increase in producer surplus is $28.61 million. Total world welfare increases by $16.40 million under Scenario 1.

Scenario 2: Free Trade Area of the Americas

The first formal meeting by leaders of the Americas to discuss FTAA took place in December 1994 in Miami, Florida. The leaders agreed that by the year 2005, negotiations on the bold concept of free trade throughout the Americas should be concluded. As described in Chapter II, nine negotiating committees have been formed to

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[33] Note that Gross Revenues measured above give an accurate account of the gains and losses of individual producing countries/regions. Producer surplus in each market combines the surpluses of all producers selling to each respective market, and does not account for the surplus of individual producing countries/regions.

address the many areas of importance. Among these is the negotiating group on agriculture. All of these groups, including the Agriculture group, are already working on the various issues concerned with the removal of trade barriers in the region.

As mentioned above, in this scenario tariffs on FCOJ imports into the United States and Canada from suppliers in the Americas are removed completely in 2000. This is done to make consistent comparisons between the results from the Baseline Model and all trade scenarios considered. However, in reality it is uncertain when FTAA negotiations on FCOJ tariff reductions or removals will be concluded. These negotiations could be concluded before or after the 2005 deadline, but the implementation of tariff reductions/removals would not be before 2005.

In this section, Scenario 2 results are compared to the Baseline Model results to determine the effects on on-tree prices, FCOJ output, consumption quantity and prices, trade flows, gross revenues and on-tree returns, and consumer and producer surplus due to the removal of FCOJ tariffs into the United States and Canadian markets. As in the case for Scenario 1, detailed information is presented in Appendix C for each year of the forecast period. The comparisons made below are for the final year of the forecast period.

On-tree Prices

On-tree prices for all six producing countries/regions rise marginally faster under Scenario 2 as compared to the Baseline Model (Table 27). Recall that in Scenario 1, the countries that already had free access to the market removing the tariffs received lower on-tree returns because of lower consumption prices. However, in Scenario 2, Central America, the CBI beneficiary with free entry into the United States market, does not face

Table 27. Comparison of the Annual Percentage Change of On-tree Prices and FCOJ Output from the Baseline Model and Scenario 2[a] for the Six Producing Countries/ Regions over the Forecast Period 1998/99 to 2007/08

Model	United States	Brazil	Central America	Mexico	Mediter-ranean Region	Cuba
On-tree Prices[b]						
Baseline Model	9.20	8.99	13.70	11.08	9.64	9.86
Scenario 2	9.23	9.04	13.77	11.11	9.70	9.89
FCOJ Output[c]						
Baseline Model	2.44	-0.41	1.02	2.17	2.17	2.17
Scenario 2	2.44	-0.41	1.02	2.17	2.17	2.17

[a] Scenario 2 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT, and assumes zero tariffs into the U.S. and Canadian markets from the 2000/01 crop year to the end of the forecast period.

[b] Table C-1 includes on-tree price information for all the years of the forecast period as predicted by Scenario 2.

[c] Table C-2 includes FCOJ output information for all the years of the forecast period as predicted by Scenario 2.

lower on-tree prices. In fact, Central American on-tree prices are slightly higher in Scenario 2 as compared to the Baseline Model.

This result occurs because two consuming countries remove their tariffs in Scenario 2. Both Canada and the United States now have zero tariffs. The United States is also a producer, and as will be shown below, shifts some of its exports from its own market to the Canadian market, and in the process increases prices in the United States market. Therefore, Central America now has slightly higher net returns to the U.S. market and exports a slightly larger amount to the United States market in Scenario 2.

Consumption prices also rise in the EC and Japan as supplies are removed from those markets and exported instead to Canada. Thus, on-tree prices increase for all other producers given that they all export to either the EC or Japan, or to both.

FCOJ Output

Scenario 2 leads to no noticeable change in the annual percentage growth of FCOJ output as compared to the Baseline Model (Table 27). The changes in on-tree prices are too small to affect the FCOJ output (rounded to two decimal places) over the forecast period.

Consumption Quantities

The annual percentage growth of consumption drops slightly for the United States, the EC, and Japan, but rises for Canada between the Baseline Model and Scenario 2 forecasts (Table 28). In the final year of the forecast period, consumption under Scenario 2 is 0.92, 1.55 and 0.58 million p.s. lower in the United States, the EC and Japan, respectively, compared to the Baseline Model (Tables 14 and C-3). Consumption in Canada is 3.31 million p.s. higher.

Consumption quantities begin to fall, relative to the Baseline Model, for all consuming regions in 2000/01 (the year in which the tariffs are removed), except for Canada for which it rises (Table C-3). Removing tariffs to Canada increases returns for sales to that market. By the last crop year of the forecast period, consumption in Canada is 111.08 million p.s. compared to 107.77 million p.s. in the Baseline Model forecast.

Table 28. Comparison of the Annual Percentage Change of Consumption Quantities and Prices from the Baseline Model and Scenario 2[a] for the Four Consuming Countries/ Regions over the Forecast Period 1998/99 to 2007/08

Model	United States	European Community	Canada	Japan
Consumption Quantities[b]				
Baseline Model	0.57	2.24	-1.83	1.57
Scenario 2	0.56	2.22	-1.54	1.54
Consumption Prices[c]				
Baseline Model	5.00	5.56	4.83	5.16
Scenario 2[d]	5.00	5.56	4.44	5.16

[a] Scenario 2 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the U.S. and Canadian markets from the 2000/01 crop year to the end of the forecast period.

[b] Table C-3 includes consumption quantity information for all the years of the forecast period as predicted by Scenario 2.

[c] Table C-4 includes consumption price information for all the years of the forecast period as predicted by Scenario 2.

[d] The annual percentage changes reported here are the same for the U.S., the EC and Japan because of rounding. They would be only slightly higher than the Baseline Model numbers without rounding.

Consumption Prices

The increased supplies into Canada reduce the growth rate of annual consumption prices in the Canadian market relative to the Baseline Model results (Table 28). As exports are diverted to the Canadian market away from the United States, EC and Japanese markets (by producers from the United States, Brazil, Central America and Mexico), consumption prices in all of these markets rise. However, when prices are rounded to two decimal places, prices are identical.

Trade Flows

The trade flow changes produced by the model under Scenario 2 are surprising. One might have expected (that is, before estimating the Scenario 2 results) that the removal of trade barriers to the United States market would cause increased imports, primarily from Brazil, the lowest cost producer as described in Chapter II. However, these results do not occur, as is explained below.

First, the U.S. trade pattern does not change under Scenario 2. As in the Baseline Model forecasts, the United States exports to itself and to Canada throughout the forecast period, and to the EC from the 2004/05 crop year to the end of the forecast period. The important difference is that supplies are diverted from the U.S. and EC markets to the Canadian market (Tables 29 and C-5). As mentioned above, this diversion occurs because the Canadian market has relatively higher returns due to the removal of tariffs.

Table 29. Differences in Exports from Each Endogenous Producing Region to Each Consuming Region in 2007/08 between Scenario 2[a] and the Baseline Model[b]

Region	United States	EC	Canada	Japan
	----------millions of pounds of solids----------			
U.S.	-0.92	-2.22	3.31	
Brazil		0.67		-0.58

[a] Scenario 2 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT, and assumes zero tariffs into the U.S. and Canadian markets from the 2000/01 crop year to the end of the forecast period.

[b] No change in trade for all other producers.

Recall that the results of the Baseline Model show that Brazil does not export to the United States market over the forecast period. This occurs in the model because of the relatively high tariffs Brazil faces to enter the United States market and given the fact that the United States satisfies its own demand after the 2002/03 crop year. Under Scenario 2, with free entry into the U.S. market, Brazil's exports to the United States are still zero. In fact, its trade pattern remains almost identical to that under the Baseline Model, except for a small quantity exported to Canada in the third crop year of the forecast period (Table C-6) and a small quantity diverted from the Japanese market to the EC market (Table 29). If the model used in this study accurately represents the real world, then this result will change the views of many participants of the world FCOJ market.

The reason for this unexpected result from Scenario 2 is that net returns to Brazilian producers from exporting to the EC and Japan are higher than from exporting to the United States and Canadian markets, even with the reduction in tariffs to these latter markets. These higher net returns are caused by the considerably higher annual growth rates of demand for the EC and Japan (4%) as compared to the others (1.5%). These higher annual growth rates translate into considerably higher prices for the EC and Japanese markets relative to the United States and Canadian markets (Figure 13).

In 1997, Brazilian F.O.B costs, landed in the United States, were estimated to be about US$0.18 per pound solids lower than the U.S. F.O.B. cost (Table 4, Chapter II). Therefore, even assuming this same difference throughout the forecast period, Brazil would still export to the EC and Japan once the net returns to exporting to either of these markets is higher than the net returns to exporting to the U.S. market, as shown below in

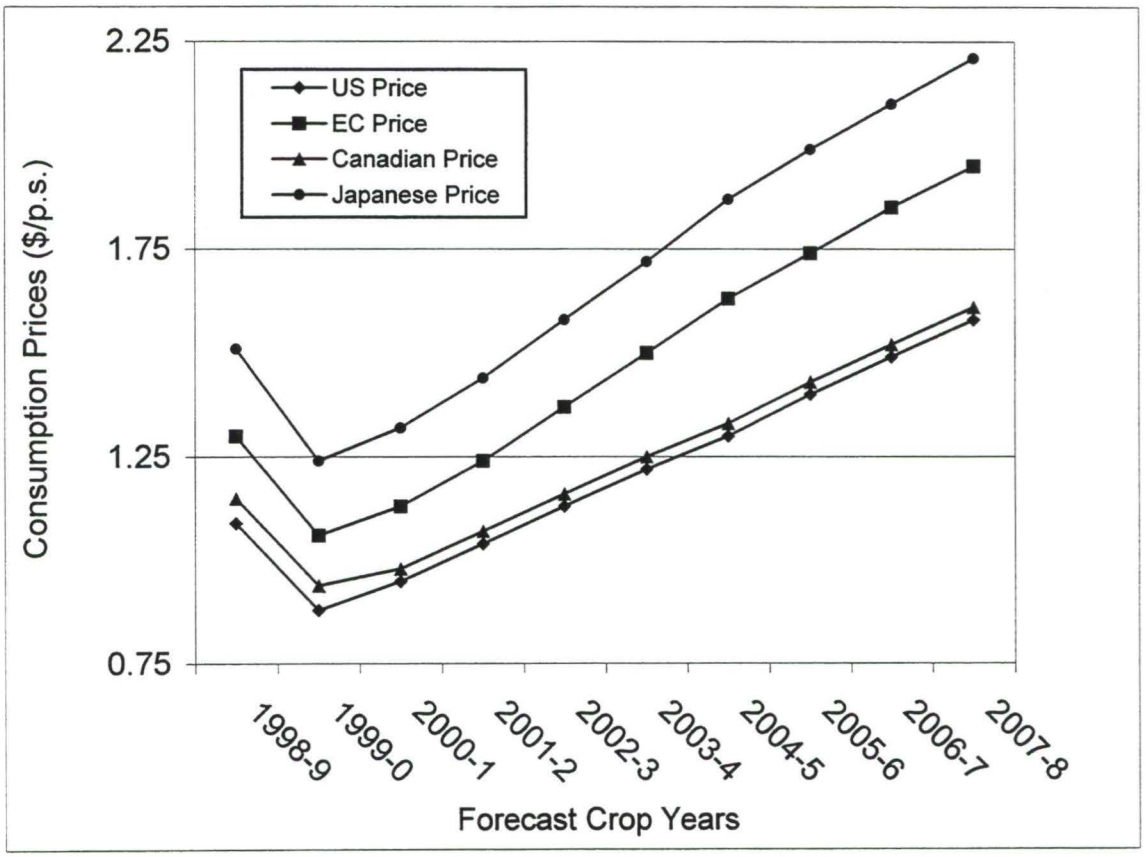

Figure 13. Scenario 2 Consumption Price Forecasts

Table 30. Even though Brazil is competitive in the United States market with U.S. producers, it earns higher net returns in the EC and Japanese markets. Once again, this result hinges on the higher demand growth rates assumed for these two markets.

Table 30. Comparison of Net Returns to Brazilian Producers from Exports to the EC and U.S. Markets after Removal of Tariffs to the U.S. Market under Scenario 2, in 2007/08

Prices and Costs	EC	United States
	----------U.S.$ per pound of solids----------	
Consumption Price	1.95	1.58
Tariff	0.30	0.00
Transportation Costs	0.10	0.07
Net Returns	1.55	1.51

[a] Scenario 2 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT, and assumes zero tariffs into the U.S. and Canadian markets from the 2000/01 crop year to the end of the forecast period.

The trade patterns for the other four exporters remain the same under Scenario 2 as compared to the Baseline Model. Central America exports slightly more to the United States and a little less to the EC in the third and fourth years of the forecast period (Table C-7). Note also that Central America is the only exporter into the United States market in the forecast period and that these exports occur when the United States is "exporting" less to itself than is demanded.

Mexico exports slightly more to the Canadian market and slightly less to the EC in the fifth year of the forecast period (Table C-8). These slight shifts in exports are

again due to slight changes in relative returns. Exports from the Mediterranean Region and Cuba still go exclusively to the EC market under Scenario 2 (Tables C-9 and C-10).

Welfare Analysis

Gross Revenues and On-tree Returns

Gross revenues and on-tree returns are slightly higher for all producing regions in Scenario 2 as compared to the Baseline Model (Table 31). This comparison shows that reducing trade barriers increases returns, and in this case, the returns to all producing countries/regions increase.

As mentioned above, in this Scenario tariffs to two consuming countries, Canada and the United States are reduced. This change causes the United States to shift supplies to Canada, causing prices to rise very slightly in its own market. The United States and Brazil both enjoy higher on-tree returns as consumption prices increase in their principal markets, the United States and the EC, respectively.

The rise in the U.S. consumption price increases returns to Central America, the only region that had prior free access to the U.S. market, besides the United States itself. Mexico, which exports to Canada from 1998/09 to 2002/03 and to the EC from 2002/03 to 2007/08, benefits slightly due to higher consumption prices in the EC that compensates for the lower prices in Canada. The Mediterranean and Cuba both benefit from the higher consumption price in the EC, their sole export market.

Consumer Surplus

The removal of tariffs under Scenario 2 increases consumer surplus in Canada, but reduces consumer surplus in all other markets (Table 32). Trade theory states that

Table 31. Comparison of the Baseline Model and Scenario 2[a] Gross Revenues and On-tree Returns, in Millions of Dollars, for 2007/08, the Last Year of the Forecast Period[b]

Model	United States	Brazil	C.A.	Mexico	Med.	Cuba
	----------millions of US$----------					
Gross Revenues						
Baseline Model	2989.1	2010.6	235.6	100.8	481.5	99.9
Scenario 2	2993.1	2013.3	236.0	101.0	482.3	100.0
Difference	4.0	2.7	0.4	0.2	0.8	0.1
On-tree Returns						
Baseline Model	2138.5	1535.0	175.3	67.6	335.0	73.1
Scenario 2	2144.9	1539.4	175.8	67.7	335.9	73.2
Difference	6.4	4.4	0.5	0.1	0.9	0.1

[a] Scenario 2 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT, and assumes zero tariffs into the U.S. and Canadian markets from the 2000/01 crop year to the end of the forecast period.

[b] The discrepancy between the gross revenues difference and the on-tree returns difference is due to rounding errors. GAMS, the software program used to produce the results, rounds to three decimal places. The information used to calculate gross revenues (total FCOJ produced and the weighted-average F.O.B. price) is produced by GAMS. However, the information used to calculate on-tree returns is produced partly by GAMS (total FCOJ production and on-tree price) and partly from other sources (pound solids per 90-pound box, Table 3.4), where this latter information is rounded to two decimal places.

Table 32. Comparison of Consumer Surplus between the Baseline Model and Scenario 2[a] for the Four Consuming Regions for Crop Year 2007/08, in Millions of Dollars

Model	United States	EC	Canada	Japan
	----------millions of US$----------			
Baseline Model	4430.34	2281.56	67.95	499.43
Scenario 2	4426.24	2276.96	72.20	498.12
Change	-4.1	-4.6	4.3	-1.3

[a] Scenario 2 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT, and assumes zero tariffs into the U.S. and Canadian markets from the 2000/01 crop year to the end of the forecast period.

consumer surplus should increase in the market(s) where tariffs are removed. In the case of the United States, the removal of tariffs in Canada causes U.S. producers to shift exports away from the U.S. market to the Canadian market. This reduces quantities and increases prices (rounded to three decimal places) in the U.S. market, causing the reduction in consumer surplus in the U.S. market. Net consumer surplus across all markets falls by $5.70 million.

Producer Surplus

Producer surplus increases in all markets, except in the Japanese market (-0.03). The change in producer surplus between the Baseline Model and Scenario 2 for the United States, EC, and Canada is positive, $1.99, 1.51, and 1.13 million, respectively. This results in an overall increase in producer surplus of $4.60 million for all markets. Scenario 2 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the U.S. and Canadian markets from 2000/01 crop year to the end of the forecase period. Only changes are presented here given that this information is used to calculate the change in world welfare, and given that the levels of producer surplus for each consumption region do not give a clear picture of which individual producers are gaining or losing. Table 31 provides clear information on individual producers' gains and loses.

World Welfare

Under Scenario 2, in the final year of the forecast period, world welfare falls slightly from the removal of tariffs to both the U.S. and Canadian markets. As described above, the U.S. shifts supplies from its domestic market to the Canadian market. This

results in a world consumer surplus change of -$5.70 million. Producer surplus increases by $4.60 million for all producers, resulting in a world welfare loss of $1.10 million. This small figure may be attributed to measurement error, resulting in the conclusion that the FTAA scenario has no effect on world welfare.

Scenario 3: Lifting of the United States Trade Embargo on Cuba

Relations between the United States and Cuba have been improving over the past few years and the pace of improvement has picked up with the 1998 visit of the Pope to Cuba. The stage seems to be almost set for some concrete moves towards the partial or complete lifting of the embargo on Cuba. The effects of such an event on the international trade of FCOJ are of great interest to all involved in the industry. As is the case in the other trade scenarios, the date of the lifting of the U.S. trade embargo on Cuba is uncertain. In this study, the change is assumed to occur in 2000 for consistency and ease of comparison with the Baseline Model results.

The lifting of the U.S. trade embargo on Cuba removes barriers into the markets of the United States and Canada for Cuban FCOJ exports. In the Baseline Model, access of Cuban FCOJ is prohibited into U.S. and Canadian markets. The Canadians have supported the U.S. embargo on many of Cuba's exports, including FCOJ, but recently Canadian support, like EC support (which has historically been even lower than Canadian support), has been diminishing. This waning of support became more evident after the passing of the Helms-Burton Act in the U.S. Congress that attempts to punish all foreign ownership of properties in Cuba that were once owned by U.S. concerns but that were

nationalized by the Castro regime (The Closeup Foundation). Under Scenario 3, all barriers facing FCOJ exports from Cuba into Canada are also removed.

Note that because Cuba is included in the model exogenously, it is not able to react by increasing output. Also, the lifting of the embargo is expected to increase capital flows to Cuba, and this is not captured in the Model. As in the case of the prior scenarios, a detailed presentation of the results can be found in the Appendices. The results from Scenario 3 are in Appendix D. Comparisons to the Baseline Model are made below for the final year of the forecast period.

On-tree Prices

The annual percentage growth of on-tree prices remains the same (to two decimal places) for all supply regions in Scenario 3 as compared to the Baseline Model (Table 33). For some years within the period, prices change slightly due to the shift in Cuban exports from the EC market to the Canadian market between crop years 2000/01 and 2002/03 (Table D-1).

Cuban net returns from exporting to Canada rise higher than from other alternative markets for the three crop years just mentioned. This is due directly to the removal of tariffs for its exports to Canada. In the process of shifting supplies from the EC to Canada, the expected result of lowering prices in Canada and rising prices in the EC occurs, for the period during which the shift occurs. Therefore, other exporters to the EC receive temporarily higher returns from their exports to the EC and exporters to Canada receive temporarily lower returns from their exports to Canada.

However, given the relatively higher growth rate of demand for the EC, net returns become higher for Cuban exports to the EC. After the 2002/03 crop year, Cuba

Table 33. Comparison of the Annual Percentage Change in On-tree Prices and FCOJ Output from the Baseline Model and Scenario 3[a] for the Six Producing Countries/ Regions over the Forecast Period 1998/99 to 2007/08

Model	United States	Brazil	Central America	Mexico	Mediter-ranean Region	Cuba
On-tree Prices[b]						
Baseline Model	9.20	8.99	13.70	11.08	9.64	9.86
Scenario 3	9.20	8.99	13.70	11.08	9.64	9.86
FCOJ Output[c]						
Baseline Model	2.44	-0.41	1.02	2.17	2.17	2.17
Scenario 3	2.43	-0.41	1.04	2.17	2.17	2.17

[a] Scenario 3 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT, and assumes zero tariffs into the U.S. and Canadian markets for Cuban exports.

[b] Table D-1 includes on-tree price information for all the years of the forecast period as predicted by Scenario 3.

[c] Table D-2 includes FCOJ output information for all the years of the forecast period as predicted by Scenario 3.

again exports only to the EC market. During the entire forecast period, Cuba does not export to the U.S. market given higher net returns from other markets.

FCOJ Output

FCOJ output changes only slightly under Scenario 3 as compared to the Baseline Model. Annual percentage growth declines very slightly for the United States, and rises slightly for Brazil and Central America (Table 33). However, the increase for Brazil is not large enough to change the annual percentage growth rate reported to two decimal places.

In the final forecasted year, FCOJ output is 0.44 million p.s. lower in the United States and 0.15 million p.s. higher in Brazil under Scenario 3 than under the Baseline Model. The increase in Brazil's output is not enough to affect the rounded annual percentage change for that supply region. For Central America, FCOJ output is 0.14 million p.s. higher under Scenario 3 than the Baseline Model in the final year of the forecast period. Given the smaller output for Central America, this increase is enough to increase the reported annual percentage growth.

For the three endogenous FCOJ producers, output is affected only very slightly by changes in Cuba's trading pattern. The United States, which suffers a small deterioration in on-tree prices, produces slightly lower quantities of FCOJ in the last three years of the forecast period. Brazil and Central America produce slightly more in the last three and four years, respectively, of the forecast period (Table D-2).

Consumption Quantities

The annual growth rates remain practically the same for all consumption regions under Scenario 3 as compared to the Baseline Model (Table 34). EC growth decreases slightly from 2.24% to 2.23% as supplies from Cuba are diverted to Canada.

Consumption rises slightly in the United States and Canada, and falls slightly in the EC and Japan (Tables 14 and D-3). As Cuban exports increase to Canada reducing prices there, the United States shifts some supplies back to its own market. Brazil, the only exporter to Japan over the forecast period, shifts some exports to the EC in 2001/02, where prices are a little higher due to the removal of Cuban supplies.

The changes in consumption are negligible in all crop years, except in crop year 2001/02. Cuban exports to Canada last only three years, and Cuba exports exclusively to

Table 34. Comparison of the Annual Percentage Change in Consumption Quantities and Prices from the Baseline Model and Scenario 3[a] for the Four Consuming Countries/ Regions over the Forecast Period 1998/99 to 2007/08

Model	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
Consumption Quantities[b]				
Baseline Model	0.57	2.24	-1.83[c]	1.57
Scenario 3	0.57	2.23	-1.83[c]	1.57
Consumption Prices[d]				
Baseline Model	5.00	5.56	4.83	5.16
Scenario 3	5.00	5.56	4.83	5.16

[a] Scenario 3 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the United States and Canadian markets for Cuban exports.

[b] Table D-3 includes consumption quantity information for all the years of the forecast period as predicted by Scenario 3.

[c] Canada's un-rounded figures rise slightly, but not enough to change the annual percentage change of consumption quantities.

[d] Table D-4 includes consumption quantity information for all the years of the forecast period as predicted by Scenario 3.

the EC for the remainder of the forecast period. The relatively high growth rate of demand in the EC causes this result, with net returns being relatively high for exports to this market as compared to the other three markets.

Consumption Prices

The annual growth rates of consumption prices change little between the Baseline Model and Scenario 3 (Table 34). The reported growth rates are identical to three decimal places. Again, crop year 2001/02 is the only year in which consumption prices

(rounded to two decimal places) change between the Baseline Model and Scenario 3. Consumption prices fall for the United States and Canada, and rise for the EC and Japan in 2001/02 (Table D-4). This reflects the changes in quantities exported to these markets in that year.

As mentioned above, Cuba shifts exports to Canada due to the removal of tariffs from this market. Note that net returns are not high enough to the U.S. market, even after the removal of tariffs, for Cuba to shift exports from the EC to the United States. Increased supplies to Canada reduce prices in that market, causing the U.S. to shift supplies to its own market, reducing prices in the U.S. market.

The reduction of supplies by Cuba from the EC to Canada increases prices in the EC. The shift by Brazil from Japan to the EC is not high enough to compensate for the removal by Cuba, that is, to reduce prices back to where they were before the Cuban shift to Canada. The shift by Brazil reduces supplies to Japan leading to the higher prices in the Japanese market.

Trade Flows

The United States' trade pattern does not change over the forecast period, only quantities exported to Canada and to itself shift from the 2000/01 to the 2002/03 crop years (Table D-5). Also, in the final four years of the forecast period, the United States shifts small quantities of exports from the EC to Canada and to its own market (Table 35). The Brazilian trade pattern also remains essentially the same (Table D-6). From crop year 2001/02 to the end of the forecast period, Brazil shifts small quantities of exports from Japan to the EC (Table 35).

Table 35. Differences in Exports from Each Endogenous Producing Region to Each Consuming Region between Scenario 3[a] and the Baseline Model in 2007/08, the Final Year of the Forecast Period[b]

Region	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
United States	0.11	-0.58	0.03	
Brazil		0.23		-0.08
Central America		0.14		

[a] Scenario 3 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the United States and Canadian markets for Cuban exports.

[b] No change in trade for all other producers.

In the case of Central America, exports to the United States occurred for the first four years in the Baseline Model, but dropped to only the first three years in Scenario 3 (Table D-7). This drop is in response to the higher relative prices in the EC in the 2001/02 crop year, as described above.

The Mexican trade pattern changes slightly under Scenario 3 as compared to the Baseline Model (Table D-8). Mexico starts exporting to the EC one year earlier (2001/02) in Scenario 3. In 2001/02, Mexico splits its exports between Canada and the EC, while before this year it exports only to Canada. It also stops exporting to Canada one year earlier, 2002/03. The reason for the change in Mexico's trade pattern is again due to the reduction of Cuban exports to the EC, which increases net returns to Mexican exports to this market, and the increase in Cuban exports to Canada, which simultaneously decreases Mexican returns to Canada.

Exports from the Mediterranean continue exclusively to the EC in Scenario 3, as is the case in the Baseline Model (Table D-9). However, as expected and reported above, Cuban exports shift completely from the EC to Canada when the embargo on Cuba is lifted (Table D-10). However, exports begin to shift back to the EC in 2002/03 as prices continue to rise in the EC given its high growth rate of demand.

Welfare Analysis

Gross Revenues and On-tree Returns

Scenario 3 causes almost no change in gross revenues and on-tree returns (Table 36). The United States receives slightly lower gross revenues, while Brazil and Central America receive slightly higher gross revenues. There is no change in gross revenues for the other suppliers.

The United States suffers a small loss of on-tree returns due to the removal of the embargo on Cuba. Cuban exports to Canada reduce consumption price in that market and on-tree prices received by U.S. producers, who export to Canada throughout the forecast period, are lower as a consequence. Brazil and Central America receive slightly higher on-tree returns due to slightly higher prices in the EC market.

Consumer Surplus

There is no detectable change (to two decimal places) in consumer surplus under Scenario 3.

Table 36. Comparison of the Baseline Model and Scenario 3[a] Gross Revenues and On-tree Returns in Millions of Dollars in 2007/08, the Final Year of the Forecast Period[b]

Model	Unites States	Brazil	Central America	Mexico	Med.	Cuba
	----------millions of US$----------					
Gross Revenues						
Baseline Model	2989.1	2010.6	235.6	100.8	481.5	99.9
Scenario 3	2988.4	2010.8	235.8	100.8	481.5	99.9
Difference	-0.7	0.2	0.2	0.0	0.0	0.0
On-tree Returns						
Baseline Model	2138.5	1535.0	175.3	67.6	335.0	73.1
Scenario 3	2138.0	1535.2	175.5	67.6	335.0	73.1
Difference	-0.5	0.2	0.2	0.0	0.0	0.0

[a] Scenario 3 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the United States and Canadian markets for Cuban exports.

[b] The discrepancy between the gross revenues difference and the on-tree returns difference is due to rounding errors. GAMS, the software program used to produce the results, rounds to three decimal places. The information used to calculate gross revenues (total FCOJ produced and the weighted-average F.O.B. price) is produced by GAMS. However, the information used to calculate on-tree returns is produced partly by GAMS (total FCOJ production and on-tree price) and partly from other sources (pound solids per 90-pound box, Table 3.4), where this latter information is rounded to two decimal places.

Producer Surplus

Producer surplus changes between the Baseline Model and Scenario 3 are negligible. The change in producer surplus for the United States is 0.29, for the European Community it is -0.30, for Canada it is 0.02 and for Japan it is -0.09. The net change across all markets is -$0.08 million. Scenario 3 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the United States and Canadian markets for Cuban exports. Only changes are

presented here given that this information is used to calculate the change in world welfare, and given that the levels of producer surplus for each consumption region do not give a clear picture of which individual producers are gaining or losing. Table 36 on gross revenues and on-tree returns provides clear information on individual producers' gains and loses.

World Welfare

Given no change in consumer surplus and a small change of -$0.08 million in producer surplus, the change in world welfare under Scenario 3 is a negligible -$0.08 million. This small change is a result of the fact that Cuban exports as a percentage of total world exports are very small. In addition, the shifts in Cuban exports are themselves small, making the effect on world welfare even smaller.

Scenario 4: World Free Trade

Since the end of World War II the world's countries, starting with the more developed economies, have been working towards world free trade in all goods and services. However, protectionist pressures in most countries have hindered progress significantly. It was not until 1994, with the establishment of the World Trade Organization, that barriers to trade were reduced, commencing January 1, 1995. Even so, many barriers remain in place, some disguised as non-tariff barriers, for example, as quality standards for imports.

As reviewed in Chapter II, the WTO imposed specific reductions in FCOJ tariffs for the main FCOJ consuming countries/regions. These reductions will continue until 2000 after which a new round of negotiations is anticipated to reduce tariffs even further.

In Scenario 4, all tariffs are removed in all consuming countries in 2000/01. The effects of world free trade on on-tree prices, FCOJ output, consumption quantities and price, trade flows, and welfare are presented below. A detailed presentation of the results for each year of the forecast period is given in Appendix E. Below, the results of Scenario 3 are compared to the Baseline Model for the last year of the forecast period.

On-tree Prices

In Scenario 4, the annual percentage growth of on-tree prices is larger for the U.S., Brazil, Mexico and Cuba than under the Baseline Model (Table 37). Each of these countries benefits from reduced trading costs for their exports and thus receives higher on-tree prices after world free trade. The annual percentage growth of on-tree prices is lower for Central America and the Mediterranean Region for most of the forecast period (Table E1). These two supply regions that originally had free access under the Baseline Model, now are no longer protected by tariffs placed on other suppliers.

Central America receives a higher on-tree price in 2000/01, when world free trade is assumed to begin. The total removal of tariffs to the Japanese market shifts Brazilian exports to that market. Therefore, in 2000/01, the EC consumes all of Central America's exports. Unlike the Baseline Model, net returns do not fall enough to shift to the next best alternative, which would be the U.S. market. As will be described below, Central America sends all of its exports to the EC from 2000/01 to the end of the forecast period in the Scenario 4 forecasts.

However, consumption prices grow more slowly in the EC as more is exported to this market from the United States and Mexico than is removed by Brazil's shifting of

Table 37. Comparison of the Annual Percentage Change in On-tree Prices and FCOJ Output from the Baseline Model and Scenario 4[a] for the Six Producing Countries/Regions over the Forecast Period 1998/99 to 2007/08

Model	United States	Brazil	Central America	Mexico	Mediter-ranean Region	Cuba
On-tree Prices[b]						
Baseline Model	9.20	8.99	13.70	11.08	9.64	9.86
Scenario 4	12.67	12.17	12.28	14.84	8.48	13.03
FCOJ Output[c]						
Baseline Model	2.44	-0.41	1.02	2.17	2.17	2.17
Scenario 3	2.49	-0.37	1.03	2.17	2.17	2.17

[a] Scenario 4 assumes zero world free trade beginning in crop year 2000/01.

[b] Table E-1 includes on-tree price information for all the years of the forecast period as predicted by Scenario 4.

[c] Table E-2 includes FCOJ output information for all the years of the forecast period as predicted by Scenario 4.

exports to Japan. The lower consumption prices result in lower Central American on-tree prices from crop year 2001/02 to the end of the forecast period under Scenario 4 as compared to the Baseline Model.

The Mediterranean also experiences lower on-tree prices throughout the forecast period in Scenario 4 as compared to the Baseline Model. The Mediterranean still receives the highest net return from exporting to the EC and does not shift exports to any other consuming region. Therefore, its on-tree prices grow more slowly with the slower growth in EC consumption prices.

FCOJ Output

The annual percentage growth of FCOJ output is larger for all the endogenous suppliers under Scenario 4 as compared to the Baseline Model (Table 37). Output increases are not seen until the seventh year of the forecast period (Table E-2), as explained below. In the last year of the forecast period, FCOJ output is 7.29, 5.40 and 0.06 million p.s. higher for the United States, Brazil and Central America, respectively, under Scenario 4 as compared to the last year under the Baseline Model.

On-tree prices rise for all three endogenous producers in 2000/01, when free trade in the model begins. This increase in on-tree price affects new plantings the following year, 2001/02. Recall that the new plantings equations include three-year moving averages of on-tree prices for the United States and Central America, and the one-year lagged on-tree price for Brazil. These new trees bear fruit after their third year, that is, the seventh year (2004/05) of the forecast period. In the case of Central America, output still increases slightly due to the one-time increase in on-tree price in 2000/01, as described above. Lower prices after that year do not have an effect on Central American output in the forecast period, but would if output in later years had been forecast.

Consumption Quantities

The high barriers in Japan and the EC under the Baseline Model kept out significant quantities of imports to these two markets. World free trade causes a shifting of exports from the United States and Canada to both Japan and the EC markets, increasing the annual percentage growth of consumption in both of these latter markets (Table 38). Therefore, the U.S. and Canada have lower annual percentage growth of consumption quantities under Scenario 4 as compared to the Baseline Model.

Table 38. Comparison of the Annual Percentage Change in Consumption Quantities and Prices from the Baseline Model and Scenario 4[a] for the Four Consuming Countries/ Regions over the Forecast Period 1998/99 to 2007/08

Model	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
Consumption Quantities[b]				
Baseline Model	0.57	2.24	-1.83	1.57
Scenario 4	0.16	2.58	-2.86	2.98
Consumption Prices[c]				
Baseline Model	5.00	5.56	4.83	5.16
Scenario 3	6.83	4.87	6.19	3.17

[a] Scenario 4 assumes world free trade, beginning in crop year 2000/01.

[b] Table E-3 includes consumption quantity information for all the years of the forecast period as predicted by the Scenario 4 Model.

[c] Table E-4 includes consumption quantity information for all the years of the forecast period as predicted by the Scenario 4 Model.

Compared to the last year of the Baseline Model forecast, consumption falls in the United States by 60.03 million p.s., and also falls in Canada by 11.91 million p.s (Tables 14 and E-3). In a similar comparison, consumption rises in the EC by 38.55 million p.s. and also rises in Japan by 46.13 million p.s.

Consumption Prices

The annual percentage growth in consumption prices increases in the United States and Canadian markets as supplies are diverted to the EC and Japanese markets, where annual growth in consumption prices falls (Table 38). As mentioned above, the

removal of relatively high barriers to the EC and Japanese markets leads to increased exports to these two markets and to the consequent fall in consumption prices.

Trade Flows

In Scenario 4, with zero tariffs to all markets, the determining factor for trade flows is consumption price minus transportation costs. Therefore, transportation costs differentials determine allocations at the margins.

The United States begins exporting to the EC one year earlier, 2003/04, in Scenario 4 than in the Baseline Model (Table E-5). Removing trade barriers reduces trading costs for U.S. exports to the EC. Free trade ultimately causes the United States to divert supplies from its own market and Canada to the EC (Table 39).

Table 39. Differences in Exports from Each Endogenous Producing Region to Each Consuming Region between Scenario 4[a] and the Baseline Model in 2007/08, the Final Year of the Forecast Period[b]

Region	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
United States	-60.03	79.22	-11.91	
Brazil		-40.73		-46.13
Central America		-0.06		

[a] Scenario 4 assumes world free trade, beginning in crop year 2000/01.

[b] No change in trade for all other producers.

Brazil's trade pattern remains the same under Scenario 4, except that relatively more is exported to Japan than to the EC (Tables 39 and E-6). Brazil is the only exporter in both the Baseline Model and Scenario 4 that exports to Japan over the forecast period. Brazil has a transportation cost advantage over other exporters to Japan due to the use of very large tanker ships. Even though Japan's consumption price increases returns to all suppliers, Brazil is able to satisfy all of Japan's demand given its transportation cost advantage.

Central America exports exclusively to the EC from 2000/01 to the end of the forecast period under Scenario 4 (Table E-7), unlike the Baseline Model where it exported to the United States in the first four years of the period. This change in trade pattern is due to the reduction of Brazilian exports to the EC. The Brazilian reduction of exports to the EC makes Central American net returns from exporting to the EC remain above net returns from its next best alternative, the U.S. market.

Mexico begins exporting to the EC one year earlier, 2001/02, in Scenario 4 as compared to the Baseline Model (Table E-8). However, all exports prior to this year still go to Canada and after this year still go to the EC.

The Mediterranean's trade pattern remains the same under both the Baseline Model and Scenario 4 (Table E-9). The Mediterranean has an obvious transportation cost advantage that makes exports to the EC yield the highest net returns in all scenarios. This is the case under Scenario 4 even with lower consumption prices in the EC market.

Cuba's trade pattern remains the same except for crop year 2000/01, when it sends part of its exports to the United States. Cuba has a transportation cost advantage to

the U.S. market over all other suppliers, except of course the United States itself. However, after 2000/01 net returns from exports to the EC are still higher.

Welfare Analysis

Gross Revenues and On-tree Returns

In Scenario 4, gross revenues and on-tree returns rise for those countries that did not have free access into their export markets and fall for those countries that had free access (Table 40). Central America and the Mediterranean lose their special benefits with world free trade. Consumption prices fall in their export markets as supplies from other exporters are diverted to their markets. This is consistent with trade theory as described in the other trade scenarios already considered.

Consumer Surplus

Under Scenario 4, consumer surplus rises in the EC and Japanese markets, where tariffs are relatively high. Scenario 4 assumes world free trade, beginning in crop year 2000/01. Consumer surplus falls in the United States and Canadian markets, -304.84 and -14.22, respectively. For the European Community and Japan, the results are positive: 120.19 and 118.47, respectively. The net change in consumer surplus across all markets is -$80.4 million.

Producer Surplus

Producer surplus increases in the U.S. market (205.65) and falls in the other three markets under Scenario 4. Scenario 4 assumes world free trade, beginning in crop year 2000/01. The results for the European Community, Canada and Japan are -48.91, -6.17, and -23.31, respectively. The change in producer surplus across all markets is $127.26

Table 40. Comparison of Gross Revenues and On-tree Returns for the Baseline Model and Scenario 4[a] in Millions of Dollars for 2007/08, the Last Year of the Forecast Period[b]

Model	United States.	Brazil	Central America	Mexico	Med.	Cuba
	----------millions of US$----------					
Gross Revenues						
Baseline Model	2989.1	2010.6	235.6	100.8	481.5	99.9
Scenario 4	3345.4	2249.7	225.3	112.6	460.9	111.3
Difference	356.3	239.1	-10.3	11.8	-20.6	11.4
On-Tree Returns						
Baseline Model	2138.5	1535.0	175.3	67.6	335.0	73.1
Scenario 4	2511.0	1764.4	165.3	79.1	316.0	84.2
Difference	372.5	229.4	-10.0	11.5	-19.0	11.1

[a] Scenario 4 assumes world free trade, beginning in crop year 2000/01.

[b] The discrepancy between the gross revenues difference and the on-tree returns difference is due to rounding errors. GAMS, the software program used to produce the results, rounds to three decimal places. The information used to calculate gross revenues (total FCOJ produced and the weighted-average F.O.B. price) is produced by GAMS. However, the information used to calculate on-tree returns is produced partly by GAMS (total FCOJ production and on-tree price) and partly from other sources (pound solids per 90-pound box, Table 9), where this latter information is rounded to two decimal places.

million. Only changes are presented here given that this information is used to calculate the change in world welfare, and given that the levels of producer surplus for each consumption region do not give a clear picture of which individual producers are gaining or losing. Table 40 on gross revenues and on-tree returns provides clear information on individual producers' gains and loses.

World Welfare

Given the change in consumer surplus of -$80.40 million and the change in producer surplus of $127.26 million, the change in world welfare is $46.86 million under

Scenario 4. Compared to the other three scenarios, the increase in world welfare is the largest under world free trade as expected.

Summary of Results

The results presented in this chapter show the effects of the four alternative trade scenarios on the international FCOJ market. Specifically, the effects of different tariff removals on on-tree prices, FCOJ production quantities, FCOJ consumption quantities and prices, trade flows, and welfare were presented.

In Scenario 1, the removal of EC tariffs, the annual percentage growth of on-tree prices rises for all exporters who did not have free access to the EC under the Baseline Model. These exporters include the United States, Brazil, Mexico and Cuba. Central America and the Mediterranean, exporters to the EC that already had free access, have lower on-tree price growth under Scenario 1.

FCOJ output rises for the United States and Brazil, and falls slightly for Central America under Scenario 1. Consumption quantities go up for the EC and fall for the United States, Canadian, and Japanese markets. Consumption prices fall in the EC market and rise in the other three markets, as expected. The higher net returns to the EC market result in shifting of trade flows to that market. World welfare rises by $16.40 million under Scenario 1 as compared to the Baseline Model, in the last year of the forecast period, 2007/08.

Under Scenario 2, FTAA, the average annual percentage growth in on-tree prices rises slightly for all supply regions. However, given the very small effects on prices, FCOJ output growth is about the same over the forecast period. Consumption quantities rise slightly in Canada, but fall in all other markets. This results in slightly lower

consumption prices in Canada, and slightly higher (un-rounded) consumption prices in the other three markets.

Trade flows under Scenario 2 are unexpected, but explainable. Contrary to expectations, Brazil does not export to the U.S. market given the higher prices in the EC and Japanese markets relative to the U.S. market. Higher prices in Canada shift U.S. supplies from the United States and the European Community to the Canadian market. This shift results in slightly higher prices in the U.S. market and a reduction in welfare in that market. Under Scenario 2, world welfare falls very slightly by $1.10 million, a negligible amount.

In Scenario 3, the trade embargo is lifted on Cuba, making Cuban supplies enter free of tariffs into the U.S. and Canadian markets. However, Cuban supplies are a very small percent of world supplies and trade patterns shift only slightly. There is little change in the annual percentage growth of on-tree prices for the six producing regions. The annual percentage growth of FCOJ changes only slightly, falling for the United States and rising for Central America. Consumption quantities remain about the same for all consumption regions, except for the EC, where it falls slightly. Average annual consumption growth rates remain essentially unchanged[34] under Scenario 3. Note again that the model does not allow for capital flows and that Cuba is included exogenously. Therefore, Cuba is not able to increase its output in reaction to price increases and new investments that would most likely occur from the lifting of the embargo are not allowed in the model.

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[34] There are minute changes after two decimal places.

The lower prices in Canada, due to shifts by Cuba away from the EC to the Canadian market, lead to reduced on-tree returns to the United States in the three years in which the shifts occur (2000/01 to 2002/03). This causes the slight fall in U.S. output by the end of the forecast period. The lower U.S. output under Scenario 3 causes a small world welfare loss of $0.08 million, also a negligible amount.

Under free world trade, Scenario 4, on-tree prices are higher for all countries that originally paid tariffs under the Baseline Model. The two regions that already had free access, Central America and the Mediterranean, receive lower on-tree prices under free world trade as compared to the Baseline Model. FCOJ output in turn rises for all endogenous suppliers, as expected.[35] Consumption quantities and prices respond as expected as well. Consumption quantities fall in the U.S. and Canadian markets and rise in the EC and Japanese markets. Consumption prices rise in the U.S. and Canadian markets and fall in the EC and Japanese markets.

In Scenario 4, exports are shifted towards the two consumption regions that had the highest barriers under the Baseline Model, that is, the EC and Japan. The result is lower prices in those markets than under the Baseline Model and higher prices in the United States and Canada, from where the supplies were diverted. Under world free trade, world welfare increases by $46.86 million in the last year of the forecast period.

0Thus, the tariff removals lead to the expected results. The negative world welfare results from Scenarios 2 and 3 are negligible and may be attributed to measurement error. However, the theory of the "second best" may also explain the

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[35] As mentioned above in the section on FCOJ output under Scenario 4, Central American output increases because of a one-time increase in on-tree prices. A longer forecast period would show the effects of lower prices to Central America resulting in lower FCOJ output in Central America.

negative world welfare results under Scenario 2 and 3. The removal of one or more distortions, but leaving other distortions in place, may lead to a less preferred optimum (Lipsey). In Scenario 2, one distortion is removed, that is, tariffs to the EC. In Scenario 3, two distortions are removed, that is, tariffs to the United States and Canada. As the results show, the new optimum solutions in each of these scenarios have a lower value than before, consistent with the theory of the "second best." The largest gain in world welfare is under free world trade, where all distortions are removed. This result under world free trade is consistent with trade theory.

CHAPTER V

CONCLUSIONS

As world population increases and the freeing of world trade continues, information on the international trade of goods and services, particularly on food, becomes more important. The results of this study add to the information database on one important food type, FCOJ.

Future trends in FCOJ prices, quantities and trade flows, under the four trade scenarios developed in this study, are of great interest to participants in the world FCOJ market. Orange producers, FCOJ processors, FCOJ importers, and FCOJ wholesalers and retailers are the primary groups interested in these trends. However, governments of producing and consuming countries will also find forecasts of these variables valuable for policy formulation purposes. Knowledge of the likely impacts of proposed and probable trade agreements on the international FCOJ market is important to the successful negotiations of these agreements.

The results of this study provide ten-year forecasts for crop years 1998/99 to 2007/08 of the most important economic variables affecting the international trade of FCOJ under the current scenario (called the Baseline Model) and under four alternative trade scenarios. These variables include on-tree prices, FCOJ output, consumption quantities, and consumption prices. The study also includes measures of the impact of each scenario on consumer and producer surplus (which includes tariff revenues) in each of the consuming markets considered in this analysis, namely the United States, the

European Community (EC), Canada and Japan. This information is then used to calculate changes in world welfare in the FCOJ markets because of each scenario.

The model includes supplies from the six major FCOJ producing countries/ regions in the world. Brazil, the United States and Central America are included endogenously, while Mexico, the Mediterranean and Cuba are included exogenously. The exogenous producers are assumed to have export growth of 2% compounded annually.

Four trade scenarios are analyzed. The first is the extension of Lome Convention preferences to all importers to the EC market. The second is the FTAA agreement, which removes all tariffs in the United States and Canada to producers in the Americas (except Cuba). The third is the lifting of the U.S. trade embargo on Cuba. And the fourth is world free trade. All trade scenario changes are assumed to take place in 2000/01 and the results of each are compared to the results of the Baseline Model. The Baseline Model incorporates present and scheduled information on the FCOJ trading environment and assumes no further changes in international trade agreements.

The EC's Lome Conventions agreement is under scrutiny by the WTO for its granting of preferential import access to ACP countries. Compliance with the WTO rules would require equal access to all imports of FCOJ into the EC market. Therefore, the first scenario considered in this study is the removal of tariffs in crop year 2000/01 to all imports of FCOJ into the EC market. Thus, in addition to free access for imports from Central America and the Mediterranean, free access is also allowed for imports from the other four suppliers considered in this study, namely the United States, Brazil, Mexico and Cuba.

On-tree prices and FCOJ output variables are used to calculate gross revenues that accrue to orange growers. On-tree prices rise for all producing regions, except Central America and the Mediterranean. FCOJ output increases by a small amount for the United States and Brazil, and falls by a small amount for Central America. As expected, all producers gain revenues, relative to revenues received under the Baseline Model, except for Central America and the Mediterranean. Net revenues across all producers are US$309.9 million higher under Scenario 1 than in the Baseline Model.

Consumption increases in the EC and falls in the other three demand regions under Scenario 1, as compared to the Baseline Model. As expected, consumption price falls in the EC and rises in the other three demand regions, relative to the Baseline Model. Consumer surplus increases in the EC but is not large enough to offset the reductions in the United States, Canada and Japan. Thus, consumer surplus decreases by US$12.21 million. Producer surplus (which includes tariff revenues) rises in the United States and Japanese markets, which is larger than the reductions in the EC and Canadian markets. Producer surplus increased by US$28.61 million. Overall, world FCOJ welfare increases by US$16.40 million under Scenario 1.

The FTAA negotiations are expected to be concluded by 2005. In this study, it is assumed that all tariffs on FCOJ exports to the United States and Canadian markets are set to zero in crop year 2000/01 for uniformity with all other scenarios. The only country in the Americas that does not get free access to the United States and Canada under FTAA is Cuba.

The on-tree prices increase slightly for all supply regions under Scenario 2 as compared to the Baseline. The small increases in on-tree price lead to a net increase in gross revenues of US$8.20 million for all six suppliers combined.

Consumption under FTAA rises in Canada, and falls in the United States, the EC and Japan compared to the Baseline. U.S. producers divert supplies away from the U.S. market to the Canadian market where net returns are slightly higher. However, changes in consumption prices are very small, with reductions in Canada, and increases in the United States, the EC and Japan, relative to the Baseline Model.

Consumer surplus falls in the United States, the EC and Japan, and rises in Canada. The result is a net reduction in consumer surplus of US$5.70 million. Producer surplus (which includes tariff revenues) rises for the U.S., the EC and Canada, and falls for Japan. The result is an increase in producer surplus of US$4.60 million. World welfare in the FCOJ markets changes by -$1.10 million.

One surprising result from Scenario 2 is that Brazil does not shift supplies to the U.S. market as some in the FCOJ industry might have expected. However, given the assumptions of the model used in this study, Brazil receives higher net returns from exports to other markets, namely the EC and Japan, even after the total removal of U.S. tariffs on Brazilian imports.

Under Scenario 3, the removal of the U.S. trade embargo on Cuba is modeled to occur in crop year 2000/01. This is done for comparative purposes only, since a date for such an event is unpredictable.

The effect of Scenario 3 on on-tree prices is negligible. Slight changes in on-tree prices result in a tiny net reduction of US$0.30 million in gross revenues to all suppliers

combined. In the demand regions, consumption quantities and consumption prices are essentially the same for all demand regions as compared to the Baseline. This results in no detectable change in consumer surplus across all regions. Therefore, world welfare falls by a minute US$0.08 million under Scenario 3.

Note, however, that the model does not allow for capital flows that would most likely occur if the embargo on Cuba were lifted. Also, Cuba is modeled exogenously and cannot react to changes in prices with increases in output. Without these two constraints in the model it would be expected that Cuba's output would increase with the lifting of the embargo.

World free trade in FCOJ, assumed to begin in crop year 2000/01 for uniformity, leads to all the expected results. On-tree prices increase for all supply regions that did not have free access to markets before world free trade, relative to the Baseline Model. As theory predicts, the two regions that had free access, Central America and the Mediterranean, experience lower growth in on-tree prices relative to the Baseline Model. FCOJ output rises for all endogenous regions, relative to the Baseline Model. Net gross revenues for all suppliers rise by US$587.70 million, as compared to the Baseline Model.

Supplies are shifted to the markets that were most heavily protected under the Baseline Model. Consumption falls in the United States and Canada and rises in the EC and Japan, as compared to the Baseline Model. As a result, the consumption price rises in the United States and Canada, and falls in the EC and Japan, relative to the Baseline Model.

Consumer surplus under Scenario 4 falls for the United States and Canada and rises for the EC and Japan. Across all consuming regions, consumer surplus falls by

US$80.4 million. Producer surplus (which includes tariff revenue) falls for all regions except the United States, leading to an increase in overall producer surplus of US$127.26 million. World FCOJ welfare rises by US$48.86 million, the largest net increase of all scenarios, as expected.

Therefore, the results from this analysis show that regional trade agreements may not increase world welfare. Although the numbers are close to zero, world welfare actually falls under Scenarios 2 and 3. This could be attributed to calculation error, but it also shows that regional trade agreements do not necessarily guarantee unambiguous increases in world welfare.

Spreen and Behr's results led to the same conclusions, where they studied the effects of the proposed Rose Garden Agreement, that is, the proposal for free trade among the United States, Brazil, Argentina, Paraguay, and Uruguay, on the world FCOJ market. The theory of the "second best," which states that correcting one distorted market while leaving other markets distorted may lead to an inferior optimum, supports this result.

Scenarios 1 and 4 yield increases in world welfare. Scenario 1, which is also a regional agreement, shows the other possible result, that in some cases removing one distortion could lead to higher welfare. Scenario 4 produces the expected result that total free trade, that is, removing all distortions, clearly leads to an increase in world welfare.

Thus, this research provides important information to the world FCOJ literature and to participants in the industry. The inclusion of Central America endogenously gives information on the growth of the industry in response to on-tree prices. The inclusion of Cuba and the Mediterranean exogenously, along with Central America, gives a more

complete picture of the world FCOJ market and the impact of these regions on it. Also, the effect of the diseases in Brazil is seen through price increases in the 1998/99 season and through the consequent impact on production in other regions. And, finally, the impacts of the four trade scenarios on prices, quantities and welfare, all of great importance to the world FCOJ industry, are presented in detail.

There are three important areas in this study that could benefit from future research. First, the Brazilian supply response function needs to be re-estimated using more recent data. As discussed in Chapter III, the Brazilian supply response function used in this analysis has essentially one independent variable, the on-tree orange price, given the lack of forecasts of Brazilian sugar prices. The required use of this modified Brazilian equation may have led to far less accurate forecasts of new plantings in Brazil. If a reasonable supply response formulation that used only variables endogenous to the model could be derived, the need for using forecasted sugar prices would be eliminated.

Second, more research needs to focus on the demand side of the model. The demand functions need to be re-estimated using more recent data to determine if the coefficients have changed. More accurate elasticity estimates for FCOJ demands need to be determined to increase the confidence of the choices of demand parameters. Also, consideration needs to be given to NFC juice in the future, given that it is becoming a significant portion of the total processed orange juice market.

Lastly, more research needs to be conducted on the three exogenous regions included in this study. Mexico, the Mediterranean and Cuba are important supply regions in the world FCOJ market. Information on age-yield-survival distributions for each region needs to be collected so that the regions could be included endogenously into the

model. More meaningful analysis could be made if these regions had their own supply response functions that would produce information on their output reactions to changes in on-tree prices, as is the case for Central America and the other endogenous producers. Also, the impacts of changing trade arrangements could be accessed more accurately if these countries had their own supply response functions. Once these three issues are addressed and incorporated in the model used in this study, the accuracy of the results will increase even further.

APPENDICES

Appendix A

Adjustments to the Baseline Model

Appendix A adjusts the Baseline Model by reducing the growth rate of demand for Japan from 4% to 2.5% per year. Given that there is a possibility of a prolonged Asian crisis, the Baseline Model was adjusted by reducing the Japanese demand growth rate. As can be seen with comparisons to the Baseline Model results (Tables 12 to 21), the reduction of Japan's demand growth does not affect the Baseline Model results in a significant way.

Table A-1. On-tree Orange Prices by Country/Region for the Period 1998/99 to 2007/08, as Forecasted by the Baseline Model,[a] with 2.5% Demand Growth for Japan

Year	United States	Brazil	Central America	Mexico	Mediter-ranean Region	Cuba
	----------US$ per 90-pound box----------					
1998/99	3.71	3.91	3.32	2.94	4.09	3.30
1999/00	2.34	2.70	1.91	1.75	2.68	2.18
2000/01	2.69	3.01	2.48	2.05	3.03	2.46
2001/02	3.28	3.53	3.34	2.56	3.62	2.94
2002/03	3.79	4.15	4.28	3.01	4.33	3.52
2003/04	4.42	4.71	4.90	3.56	4.96	4.03
2004/05	4.85	5.37	5.63	4.21	5.71	4.64
2005/06	5.44	5.89	6.20	4.72	6.30	5.12
2006/07	6.01	6.39	6.76	5.21	6.87	5.59
2007/08	6.55	6.87	7.28	5.68	7.41	6.03
% Change from 1998/99 to 2007/08	76.5	75.7	119.3	93.2	81.2	82.7
Annual % Change[b]	8.50	8.41	13.26	10.36	9.02	9.19

[a] The Baseline Model takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA.

[b] The annual percentage change is calculated by dividing the total percentage change over the period by nine, the number of changes over the period.

Table A-2. FCOJ Production by Country/Region for the Period 1998/99 to 2007/08, as Forecasted by the Baseline Model,[a] with 2.5% Demand Growth for Japan

Year	United States[b]	Brazil	Central America	Mexico[c]	Mediter-ranean Region[c]	Cuba[c]
	----------millions of pound of solids----------					
1998/99	1556.21	1317.41	119.42	54.60	215.95	53.06
1999/00	1616.49	1547.49	130.65	55.70	220.27	54.12
2000/01	1667.06	1521.91	138.55	56.81	224.67	55.20
2001/02	1711.13	1467.74	144.45	57.95	229.16	56.30
2002/03	1750.85	1413.03	148.12	59.11	233.74	57.43
2003/04	1785.31	1365.78	150.07	60.29	238.41	58.58
2004/05	1816.15	1324.77	150.24	61.50	243.18	59.75
2005/06	1842.96	1296.82	147.26	62.73	248.04	60.95
2006/07	1868.49	1277.47	139.76	63.98	253.00	62.17
2007/08	1894.33	1266.14	130.20	65.26	258.06	63.41
% Change from 1998/99 to 2007/08	21.7	-3.9	9.03	19.5	19.5	19.5
Annual % Change[b]	2.41	-0.43	1.00	2.17	2.17	2.17

[a] The Baseline Model takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA.

[b] These figures do not include approximately 68 million p.s. produced annually on average by other United States producing states.

[c] Lack of data on tree distribution by age resulted in this country being included in the model exogenously. An annual growth rate of 2.0% was used for FCOJ exports from this country derived from historical data.

[d] The annual percentage change is calculated by dividing the total percentage change over the period by nine, the number of changes over the period.

Table A-3. Consumption in each Country/Region of Destination for the Period 1998/99 to 2007/08, as Forecasted by the Baseline Model,[a] with 2.5% Demand Growth for Japan

Year	United States	European Community	Canada	Japan
		----------millions of pounds of solids----------		
1998/99	1638.86	1262.94	130.07	353.02
1999/00	1728.21	1415.78	149.20	399.78
2000/01	1737.70	1447.19	147.10	400.46
2001/02	1735.95	1462.36	141.95	394.70
2002/03	1737.73	1469.51	137.67	385.61
2003/04	1733.97	1482.50	131.86	378.34
2004/05	1739.95	1487.55	128.55	367.77
2005/06	1738.26	1504.39	123.14	361.21
2006/07	1737.30	1523.05	117.84	354.92
2007/08	1738.09	1545.17	112.93	349.46
% Change from 1998/99 to 2007/08	6.1	23.1	-13.2	-1.01
Annual % Change[b]	0.68	2.57	-1.47	-0.11

[a] The Baseline Model takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA.

[b] The annual percentage change is calculated by dividing the total percentage change over the period by nine, the number of changes over the period.

Table A-4. Consumption Price in each Country/Region of Destination for the Period 1998/99 to 2007/08, as Forecasted by the Baseline Model,[a] with 2.5% Demand Growth for Japan

Year	United States	European Community	Canada	Japan
	----------US$ per pound of solids----------			
1998/99	1.08	1.29	1.14	1.49
1999/00	0.87	1.04	0.92	1.22
2000/01	0.92	1.10	0.98	1.28
2001/02	1.01	1.20	1.07	1.40
2002/03	1.09	1.33	1.15	1.54
2003/04	1.19	1.44	1.25	1.66
2004/05	1.25	1.58	1.32	1.81
2005/06	1.35	1.68	1.41	1.92
2006/07	1.43	1.78	1.50	2.03
2007/08	1.52	1.88	1.59	2.13
% Change from 1998/99 to 2007/08	40.7	45.7	39.5	43.0
Annual % Change[b]	4.52	5.08	4.39	4.78

[a] The Baseline Model takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA.

[b] The annual percentage change is calculated by dividing the total percentage change over the period by nine, the number of changes over the period.

Table A-5. Exports of FCOJ from the United States[a] to the Four Consuming Countries/ Regions for the 1998/99 to 2007/08 Crop Years, as Forecasted by the Baseline Model,[b] with 2.5% Demand Growth for Japan

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99	1548.98		75.46	
1999/00	1597.29		87.43	
2000/01	1644.93		90.36	
2001/02	1695.20		84.16	
2002/03	1738.72		80.35	
2003/04	1735.41		118.13	
2004/05	1741.86	13.45	129.05	
2005/06	1740.69	46.69	123.78	
2006/07	1740.25	77.77	118.62	
2007/08	1741.54	107.01	113.85	

[a] Includes an additional 68.232 million p.s. per year that are produced in other States besides Florida.

[b] The Baseline Model takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA.

Table A-6. Exports of FCOJ from Brazil to the Four Consuming Countries/Regions for the 1998/99 to 2007/08 Crop Years, as Forecasted by the Baseline Model,[a] with 2.5% Demand Growth for Japan

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99		964.39		353.02
1999/00		1141.56	6.09	399.84
2000/01		1121.26		400.65
2001/02		1072.68		395.06
2002/03		1026.85		386.18
2003/04		986.61		379.17
2004/05		955.87		368.88
2005/06		934.15		362.62
2006/07		920.76		356.64
2007/08		914.54		351.48

[a] The Baseline Model takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA.

Table A-7. Exports of FCOJ from Central America to the Four Consuming Countries/ Regions for the 1998/99 to 2007/08 Crop Years, as Forecasted by the Baseline Model,[a] with 2.5% Demand Growth for Japan

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99	89.88	29.54		
1999/00	131.03			
2000/01	93.11	46.57		
2001/02	41.38	105.20		
2002/03		151.53		
2003/04		155.00		
2004/05		156.87		
2005/06		155.77		
2006/07		150.22		
2007/08		142.63		

[a] The Baseline Model takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA.

Table A-8. Exports of FCOJ from Mexico to the Four Consuming Countries/Regions for the 1998/99 to 2007/08 Crop Years, as Forecasted by the Baseline Model,[a] with 2.5% Demand Growth for Japan

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99			54.60	
1999/00			55.70	
2000/01			56.81	
2001/02			57.95	
2002/03		2.80	56.32	
2003/04		48.00	12.29	
2004/05		61.50		
2005/06		62.73		
2006/07		63.98		
2007/08		65.26		

[a] The Baseline Model takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA.

Table A/9. Exports of FCOJ from the Mediterranean Region to the Four Consuming Countries/Regions for the 1998/99 to 2007/08 Crop Years, as Forecasted by the Baseline Model,[a] with 2.5% Demand Growth for Japan

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99		215.95		
1999/00		220.27		
2000/01		224.67		
2001/02		229.16		
2002/03		233.74		
2003/04		238.41		
2004/05		243.18		
2005/06		248.04		
2006/07		253.00		
2007/08		258.06		

[a] The Baseline Model takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA.

Table A-10. Exports of FCOJ from Cuba to the Four Consuming Countries/Regions for the 1998/99 to 2007/08 Crop Years, as Forecasted by the Baseline Model,[a] with 2.5% Demand Growth for Japan

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99		53.06		
1999/00		54.12		
2000/01		55.20		
2001/02		56.30		
2002/03		57.43		
2003/04		58.58		
2004/05		59.75		
2005/06		60.95		
2006/07		62.17		
2007/08		63.41		

[a] The Baseline Model takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA.

Appendix B

Results from Scenario 1

Appendix B reports the results from Scenario 1. Scenario 1 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the EC market after the 2000/01 crop year.

Table B-1. On-tree Orange Prices by Country/Region for the Period 1998/99 to 2007/08, as Forecasted by Scenario 1[a]

Year	United States	Brazil	Central America	Mexico	Mediter-ranean Region	Cuba
	----------US$ per 90-pound box----------					
1998/99	3.79	3.98	3.43	3.01	4.17	3.36
1999/00	2.45	2.80	2.03	1.85	2.80	2.27
2000/01	3.25	3.51	2.69	2.54	2.69	2.92
2001/02	3.92	4.10	3.25	3.13	3.27	3.47
2002/03	4.53	4.81	3.93	3.65	3.97	4.12
2003/04	5.05	5.55	4.64	4.38	4.70	4.81
2004/05	5.75	6.17	5.24	4.99	5.31	5.38
2005/06	6.41	6.75	5.79	5.56	5.88	5.92
2006/07	7.04	7.30	6.32	6.11	6.42	6.43
2007/08	7.63	7.82	6.82	6.62	6.93	6.91
% Change from 1998/99 to 2007/08	101.3	96.5	98.8	119.9	66.2	105.7
Annual % Change[b]	11.26	10.72	10.97	13.32	7.36	11.74

[a] Scenario 1 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the EC market.

[b] The annual percentage change is calculated by dividing the total percentage change over the period by nine, the number of changes over the period.

Table B-2. FCOJ Production by Country/Region for the Period 1998/99 to 2007/08, as Forecasted by Scenario 1[a]

Year	United States[b]	Brazil	Central America	Mexico[c]	Mediter-ranean Region[c]	Cuba[c]
	----------millions of pound of solids----------					
1998/99	1556.21	1317.41	119.42	54.60	215.95	53.06
1999/00	1616.49	1547.49	130.65	55.70	220.27	54.12
2000/01	1667.06	1521.91	138.55	56.81	224.67	55.20
2001/02	1711.16	1467.74	144.45	57.95	229.16	56.30
2002/03	1750.98	1413.10	148.13	59.11	233.74	57.43
2003/04	1785.68	1366.10	150.09	60.29	238.41	58.58
2004/05	1817.27	1325.96	150.29	61.50	243.18	59.75
2005/06	1845.58	1299.33	147.35	62.73	248.04	60.95
2006/07	1873.63	1281.41	139.87	63.98	253.00	62.17
2007/08	1902.79	1271.66	130.29	65.26	258.06	63.41
% Change from 1998/99 to 2007/08	22.3	-3.5	9.1	19.5	19.5	19.5
Annual % Change[b]	2.48	-0.39	1.01	2.17	2.17	2.17

[a] Scenario 1 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the EC market.

[b] These figures represent production in Florida and do not include approximately 68 million p.s. produced annually on average by other U.S. producing states.

[c] Lack of data on tree distribution by age resulted in this country being included in the model exogenously. An annual growth rate of 2.00% was used for FCOJ exports from this country derived from historical data. Note that the FCOJ production listed above for all the supplying regions is completely exported, except for the U.S., which "exports" to itself.

[d] The annual percentage change is calculated by dividing the total percentage change over the period by nine, the number of changes over the period.

Table B-3. Consumption in each Country/Region of Destination for the Period 1998/99 to 2007/08, as Forecasted by Scenario 1[a]

Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99	1635.08	1257.03	129.07	363.71
1999/00	1722.74	1407.18	147.75	415.29
2000/01	1710.88	1471.03	140.01	410.52
2001/02	1704.76	1487.61	133.71	408.92
2002/03	1701.75	1496.93	128.17	403.87
2003/04	1702.65	1503.75	123.59	397.39
2004/05	1695.08	1519.89	116.70	394.52
2005/06	1689.59	1539.59	110.28	392.77
2006/07	1685.12	1561.55	104.06	391.57
2007/08	1682.69	1587.18	98.30	391.53
% Change from 1998/99 to 2007/08	2.9	26.3	-23.8	7.6
Annual % Change[b]	0.32	2.92	-2.64	0.84

[a] Scenario 1 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the EC market.

[b] The annual percentage change is calculated by dividing the total percentage change over the period by nine, the number of changes over the period.

Table B-4. Consumption Price in each Country/Region of Destination for the Period 1998/99 to 2007/08, as Forecasted by Scenario 1[a]

Year	United States	European Community	Canada	Japan
	----------US$ per pounds of solids----------			
1998/99	1.09	1.30	1.15	1.51
1999/00	0.88	1.06	0.94	1.24
2000/01	1.01	1.04	1.06	1.39
2001/02	1.11	1.14	1.17	1.53
2002/03	1.21	1.27	1.27	1.68
2003/04	1.29	1.40	1.35	1.85
2004/05	1.39	1.50	1.46	1.98
2005/06	1.50	1.61	1.56	2.11
2006/07	1.59	1.70	1.66	2.23
2007/08	1.68	1.79	1.76	2.35
% Change from 1998/99 to 2007/08	54.1	37.7	53.0	55.6
Annual % Change[b]	6.01	4.19	5.89	6.18

[a] Scenario 1 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the EC market.

[b] The annual percentage change is calculated by dividing the total percentage change over the period by nine, the number of changes over the period.

Table B-5. Exports of FCOJ from the United States[a] to the Four Consuming Countries/ Regions for the 1998/99 to 2007/08 Crop Years, as Forecasted by Scenario 1[b]

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99	1549.98		74.46	
1999/00	1595.12		89.60	
2000/01	1652.10		83.19	
2001/02	1703.64		75.75	
2002/03	1701.75		117.46	
2003/04	1702.65	27.67	123.59	
2004/05	1695.08	73.72	116.70	
2005/06	1689.59	113.94	110.28	
2006/07	1685.12	152.68	104.06	
2007/08	1682.69	190.02	98.30	

[a] Includes an additional 68.232 million p.s. per year that are produced in other states besides the Florida.

[b] Scenario 1 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the EC market

Table B-6. Exports of FCOJ from Brazil to the Four Consuming Countries/Regions for the 1998/99 to 2007/08 Crop Years, as Forecasted by Scenario 1[a]

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99		953.70		363.71
1999/00		1129.76	2.45	415.29
2000/01		1111.39		410.52
2001/02		1058.83		408.92
2002/03		1009.23		403.87
2003/04		968.70		397.39
2004/05		931.44		394.52
2005/06		906.57		392.77
2006/07		889.84		391.57
2007/08		880.13		391.53

[a] Scenario 1 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the EC market.

Table B-7. Exports of FCOJ from Central America to the Four Consuming Countries/ Regions for the 1998/99 to 2007/08 Crop Years, as Forecasted by Scenario 1[a]

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99	85.10	34.32		
1999/00	127.62	3.03		
2000/01	58.79	79.77		
2001/02	1.12	143.33		
2002/03		148.13		
2003/04		150.09		
2004/05		150.29		
2005/06		147.35		
2006/07		139.87		
2007/08		130.29		

[a] Scenario 1 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the EC market.

Table B-8. Exports of FCOJ from Mexico to the Four Consuming Countries/Regions for the 1998-99 to 2007-08 Crop Years, as Forecasted by Scenario 1[a]

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99			54.60	
1999/00			55.70	
2000/01			56.81	
2001/02			57.95	
2002/03		48.41	10.70	
2003/04		60.29		
2004/05		61.50		
2005/06		62.73		
2006/07		63.98		
2007/08		65.26		

[a] Scenario 1 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the EC market.

Table B-9. Exports of FCOJ from the Mediterranean Region to the Four Consuming Countries/Regions for the 1998/99 to 2007/08 Crop Years, as Forecasted by Scenario 1[a]

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99		215.95		
1999/00		220.27		
2000/01		224.67		
2001/02		229.16		
2002/03		233.74		
2003/04		238.41		
2004/05		243.18		
2005/06		248.04		
2006/07		253.00		
2007/08		258.06		

[a] Scenario 1 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the EC market.

Table B-10. Exports of FCOJ from Cuba to the Four Consuming Countries/Regions for the 1998/99 to 2007/08 Crop Years, as Forecasted by Scenario 1[a]

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99		53.06		
1999/00		54.12		
2000/01		55.20		
2001/02		56.30		
2002/03		57.43		
2003/04		58.58		
2004/05		59.75		
2005/06		60.95		
2006/07		62.17		
2007/08		63.41		

[a] Scenario 1 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the EC market.

Appendix C

Results from Scenario 2

Appendix C reports the results from Scenario 2. Scenario 2 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the U.S. and Canadian markets after the 2000/01 crop year for all FCOJ exporters in the Americas, except Cuba.

Table C-1. On-tree Orange Prices by Country/Region for the Period 1998/99 to 2007/08, as Forecasted by Scenario 2[a]

Year	United States	Brazil	Central America	Mexico	Mediter-ranean Region	Cuba
	----------US$ per 90-pound box----------					
1998/99	3.79	3.98	3.43	3.01	4.17	3.36
1999/00	2.45	2.80	2.03	1.85	2.79	2.27
2000/01	2.85	3.15	2.67	2.20	3.20	2.60
2001/02	3.48	3.71	3.60	2.74	3.83	3.11
2002/03	4.03	4.37	4.52	3.22	4.57	3.72
2003/04	4.65	4.98	5.20	3.83	5.27	4.29
2004/05	5.16	5.65	5.93	4.48	6.03	4.90
2005/06	5.78	6.19	6.54	5.01	6.65	5.41
2006/07	6.38	6.72	7.17	5.54	7.25	5.90
2007/08	6.94	7.22	7.68	6.02	7.81	6.35
% Change from 1998/99 to 2007/08	83.1	81.4	123.9	100.0	87.3	89.0
Annual % Change[b]	9.23	9.04	13.77	11.11	9.70	9.89

[a] Scenario 2 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT, and assumes zero tariffs into the U.S. and Canadian markets from the 2000/01 crop year to the end of the forecast period for all producers in North, Central and South America, except Cuba.

[b] The annual percentage change is calculated by dividing the total percentage change over the period by nine, the number of changes over the period.

Table C-2. FCOJ Production by Country/Region for the Period 1998/99 to 2007/08, as Forecasted by Scenario 2[a]

Year	United States[b]	Brazil	Central America	Mexico[c]	Mediter-ranean Region[c]	Cuba[c]
	----------millions of pounds of solids----------					
1998/99	1556.21	1317.41	119.42	54.60	215.95	53.06
1999/00	1616.49	1547.49	130.65	55.70	220.27	54.12
2000/01	1667.06	1521.91	138.55	56.81	224.67	55.20
2001/02	1711.16	1467.74	144.45	57.95	229.16	56.30
2002/03	1750.98	1413.10	148.13	59.11	233.74	57.43
2003/04	1785.68	1366.10	150.09	60.29	238.41	58.58
2004/05	1816.96	1325.51	150.29	61.50	243.18	59.75
2005/06	1844.45	1298.08	147.36	62.73	248.04	60.95
2006/07	1870.94	1279.30	139.93	63.98	253.00	62.17
2007/08	1897.98	1268.60	130.45	65.26	258.06	63.41
% Change from 1998/99 to 2007/08	22.0	-3.7	9.2	19.5	19.5	19.5
Annual % Change[b]	2.44	-0.41	1.02	2.17	2.17	2.17

[a] Scenario 2 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT, and assumes zero tariffs into the U.S. and Canadian markets from the 2000/01 crop year to the end of the forecast period for all producers in North, Central and South America, except Cuba.

[b] These figures do not include approximately 68 million p.s. produced annually on average by other United States producing states.

[c] Lack of data on tree distribution by age resulted in this country being included in the model exogenously. An annual growth rate of 2.00% was used for FCOJ exports from this country derived from historical data.

[d] The annual percentage change is calculated by dividing the total percentage change over the period by nine, the number of changes over the period.

Table C-3. Consumption in each Country/Region of Destination for the Period 1998/99 to 2007/08, as Forecasted by Scenario 2[a]

Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99	1635.08	1257.03	129.07	363.71
1999/00	1722.74	1407.18	147.75	415.29
2000/01	1729.73	1434.52	146.98	421.20
2001/02	1725.97	1446.28	141.54	421.21
2002/03	1725.76	1449.97	136.94	418.06
2003/04	1722.44	1457.37	131.47	416.10
2004/05	1724.34	1461.18	127.28	412.63
2005/06	1720.95	1474.70	121.70	412.55
2006/07	1718.37	1490.08	116.17	412.95
2007/08	1717.60	1508.92	111.08	414.41
% Change from 1998/99 to 2007/08	5.0	20.0	-13.9	13.9
Annual % Change[b]	0.56	2.22	-1.54	1.54

[a] Scenario 2 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT, and assumes zero tariffs into the U.S. and Canadian markets from the 2000/01 crop year to the end of the forecast period for all producers in North, Central and South America, except Cuba.

[b] The annual percentage change is calculated by dividing the total percentage change over the period by nine, the number of changes over the period.

Table C-4. Consumption Price in each Country/Region of Destination for the Period 1998/99 to 2007/08, as Forecasted by Scenario 2[a]

Year	United States	European Community	Canada	Japan
	----------US$ per pounds of solids----------			
1998/99	1.09	1.30	1.15	1.51
1999/00	0.88	1.06	0.94	1.24
2000/01	0.95	1.13	0.98	1.32
2001/02	1.04	1.24	1.07	1.44
2002/03	1.13	1.37	1.16	1.58
2003/04	1.22	1.50	1.25	1.72
2004/05	1.30	1.63	1.33	1.87
2005/06	1.40	1.74	1.43	1.99
2006/07	1.49	1.85	1.52	2.10
2007/08	1.58	1.95	1.61	2.21
% Change from 1998/99 to 2007/08	45.0	50.0	40.0	46.4
Annual % Change[b]	5.00	5.56	4.44	5.16

[a] Scenario 2 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT, and assumes zero tariffs into the U.S. and Canadian markets from the 2000/01 crop year to the end of the forecast period for all producers in North, Central and South America, except Cuba.

[b] The annual percentage change is calculated by dividing the total percentage change over the period by nine, the number of changes over the period.

Table C-5. Exports of FCOJ from the United States[a] to the Four Consuming Countries/ Regions for the 1998/99 to the 2007/08 crop years, as Forecasted by Scenario 2[b]

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99	1549.98		74.46	
1999/00	1595.12		89.60	
2000/01	1645.36		89.93	
2001/02	1695.82		83.58	
2002/03	1725.76		93.45	
2003/04	1722.44		131.47	
2004/05	1724.34	33.57	127.28	
2005/06	1720.95	70.07	121.66	
2006/07	1718.37	104.63	116.17	
2007/08	1717.60	137.54	111.08	

[a] Includes an additional 68.232 million p.s. per year that are produced in other states besides Florida.

[b] Scenario 2 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT, and assumes zero tariffs into the U.S. and Canadian markets from the 2000/01 crop year to the end of the forecast period for all producers in North, Central and South America, except Cuba.

Table C-6. Exports of FCOJ from Brazil to the Four Consuming Countries/Regions for the 1998/99 to the 2007/08 Crop Years, as Forecasted by Scenario 2[a]

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99		953.70		363.71
1999/00		1129.76	2.45	415.29
2000/01		1100.47	0.23	421.21
2001/02		1046.53		421.21
2002/03		995.04		418.06
2003/04		949.99		416.10
2004/05		912.88		412.63
2005/06		885.54		412.55
2006/07		866.36		412.95
2007/08		854.19		414.41

[a] Scenario 2 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT, and assumes zero tariffs into the U.S. and Canadian markets from the 2000/01 crop year to the end of the forecast period for all producers in North, Central and South America, except Cuba.

Table C-7. Exports of FCOJ from Central America to the Four Consuming Countries/ Regions for the 1998/99 to the 2007/08 Crop Years, as Forecasted by Scenario 2[a]

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99	85.10	34.32		
1999/00	127.62	3.03		
2000/01	84.37	54.18		
2001/02	30.16	114.29		
2002/03		148.13		
2003/04		150.09		
2004/05		150.29		
2005/06		147.36		
2006/07		139.93		
2007/08		130.45		

[a] Scenario 2 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT, and assumes zero tariffs into the U.S. and Canadian markets from the 2000/01 crop year to the end of the forecast period for all producers in North, Central and South America, except Cuba.

Table C-8. Exports of FCOJ from Mexico to the Four Consuming Countries/Regions for the 1998/99 to the 2007/08 Crop Years, as Forecasted by Scenario 2[a]

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99			54.60	
1999/00			55.70	
2000/01			56.81	
2001/02			57.95	
2002/03		15.63	43.48	
2003/04		60.29		
2004/05		61.50		
2005/06		62.73		
2006/07		63.98		
2007/08		65.26		

[a] Scenario 2 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT, and assumes zero tariffs into the U.S. and Canadian markets from the 2000/01 crop year to the end of the forecast period for all producers in North, Central and South America, except Cuba.

Table C-9. Exports of FCOJ from the Mediterranean Region to the Four Consuming Countries/Regions for the 1998/99 to 2007/08 Crop Years, as Forecasted by Scenario 2[a]

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99		215.95		
1999/00		220.27		
2000/01		224.67		
2001/02		229.16		
2002/03		233.74		
2003/04		238.41		
2004/05		243.18		
2005/06		248.04		
2006/07		253.00		
2007/08		258.06		

[a] Scenario 2 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT, and assumes zero tariffs into the U.S. and Canadian markets from the 2000/01 crop year to the end of the forecast period for all producers in North, Central and South America, except Cuba.

Table C-10. Exports of FCOJ from Cuba to the Four Consuming Countries/Regions for the 1998/99 to the 2007/08 Crop Years, as Forecasted by Scenario 2[a]

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99		53.06		
1999/00		54.12		
2000/01		55.20		
2001/02		56.30		
2002/03		57.43		
2003/04		58.58		
2004/05		59.75		
2005/06		60.95		
2006/07		62.17		
2007/08		63.41		

[a] Scenario 2 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT, and assumes zero tariffs into the U.S. and Canadian markets from the 2000/01 crop year to the end of the forecast period for all producers in North, Central and South America, except Cuba.

Appendix D

Results from Scenario 3

Appendix D reports the results from Scenario 3. Scenario 3 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the U.S. and Canadian markets after the 2000/01 crop year for Cuban exports.

Table D-1. On-tree Orange Prices by Country/Region for the Period 1998/99 to 2007/08, as forecasted by Scenario 3[a]

Year	United States	Brazil	Central America	Mexico	Mediter-ranean Region	Cuba
	----------US$ per 90-pound box----------					
1998/99	3.79	3.98	3.43	3.01	4.17	3.36
1999/00	2.45	2.80	2.03	1.85	2.79	2.27
2000/01	2.84	3.14	3.00	2.19	3.18	2.88
2001/02	3.35	3.76	3.85	2.62	3.88	3.30
2002/03	4.02	4.35	4.51	3.21	4.56	3.82
2003/04	4.61	4.98	5.20	3.82	5.27	4.29
2004/05	5.14	5.63	5.92	4.46	6.01	4.89
2005/06	5.76	6.18	6.52	5.00	6.63	5.39
2006/07	6.37	6.71	7.11	5.52	7.23	5.88
2007/08	6.93	7.20	7.66	6.01	7.79	6.34
% Change from 1998/99 to 2007/08	82.8	80.9	123.3	99.7	86.8	88.7
Annual % Change[b]	9.20	8.99	13.70	11.08	9.64	9.86

[a] Scenario 3 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the United States and Canadian markets for Cuban exports beginning in the 2000/01 crop year.

[b] The annual percentage change is calculated by dividing the total percentage change over the period by nine, the number of changes over the period.

Table D-2. FCOJ Production by Country/Region for the Period 1998/99 to 2007/08, as Forecasted by Scenario 3[a]

Year	United States[b]	Brazil	Central America	Mexico[c]	Mediter-ranean Region[c]	Cuba[c]
	millions of pounds of solids					
1998/99	1556.21	1317.41	119.42	54.60	215.95	53.06
1999/00	1616.49	1547.49	130.65	55.70	220.27	54.12
2000/01	1667.06	1521.91	138.55	56.81	224.67	55.20
2001/02	1711.16	1467.74	144.45	57.95	229.16	56.30
2002/03	1750.98	1413.10	148.13	59.11	233.74	57.43
2003/04	1785.68	1366.10	150.09	60.29	238.41	58.58
2004/05	1816.95	1325.49	150.30	61.50	243.18	59.75
2005/06	1844.32	1298.11	147.41	62.73	248.04	60.95
2006/07	1870.61	1279.36	140.02	63.98	253.00	62.17
2007/08	1897.38	1268.66	130.59	65.26	258.06	63.41
% Change from 1998/99 to 2007/08	21.9	-3.7	9.4	19.5	19.5	19.5
Annual % Change[b]	2.43	-0.41	1.04	2.17	2.17	2.17

[a] Scenario 3 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the United States and Canadian markets for Cuban exports beginning in the 2000/01 crop year.

[b] These figures do not include approximately 68 million p.s. produced annually on average by other United States producing states.

[c] Lack of data on tree distribution by age resulted in this country being included in the model exogenously. An annual growth rate of 2.00% was used for FCOJ exports from this country derived from historical data. Note that the FCOJ production listed above for all the supplying regions is completely exported, except for the U.S., which "exports" to itself.

[d] The annual percentage change is calculated by dividing the total percentage change over the period by nine, the number of changes over the period.

Table D-3. Consumption in each Country/Region of Destination for the Period 1998/99 to 2007/08, as Forecasted by Scenario 3[a]

Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99	1635.08	1257.03	129.07	363.71
1999/00	1722.74	1407.18	147.75	415.29
2000/01	1730.32	1435.43	145.15	421.54
2001/02	1732.35	1442.01	141.00	419.64
2002/03	1726.60	1450.96	134.74	418.43
2003/04	1724.54	1457.37	129.37	416.10
2004/05	1725.32	1462.35	124.68	413.06
2005/06	1721.98	1475.97	118.84	413.02
2006/07	1719.41	1491.42	113.11	413.44
2007/08	1718.63	1510.27	107.78	414.91
% Change from 1998/99 to 2007/08	5.1	20.1	-16.5	14.1
Annual % Change[b]	0.57	2.23	-1.83	1.57

[a] Scenario 3 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the United States and Canadian markets for Cuban exports beginning in the 2000/01 crop year.

[b] The annual percentage change is calculated by dividing the total percentage change over the period by nine, the number of changes over the period.

Table D-4. Consumption Price in each Country/Region of Destination for the Period 1998/99 to 2007/08, as Forecasted by Scenario 3[a]

Year	United States	European Community	Canada	Japan
	----------US$ per pounds of solids----------			
1998/99	1.09	1.30	1.15	1.51
1999/00	0.88	1.06	0.94	1.24
2000/01	0.94	1.13	1.00	1.31
2001/02	1.02	1.25	1.08	1.45
2002/03	1.13	1.37	1.19	1.58
2003/04	1.22	1.50	1.28	1.72
2004/05	1.30	1.63	1.36	1.86
2005/06	1.40	1.74	1.46	1.98
2006/07	1.49	1.85	1.56	2.10
2007/08	1.58	1.95	1.65	2.21
% Change from 1998/99 to 2007/08	45.0	50.0	43.5	46.4
Annual % Change[b]	5.00	5.56	4.83	5.16

[a] Scenario 3 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the United States and Canadian markets for Cuban exports beginning in the 2000/01 crop year.

[b] The annual percentage change is calculated by dividing the total percentage change over the period by nine, the number of changes over the period.

Table D-5. Exports of FCOJ from the United States[a] to the Four Consuming Countries/ Regions for the 1998/99 to the 2007/08 Crop Years, as Forecasted by Scenario 3[b]

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99	1549.98		74.46	
1999/00	1595.12		89.60	
2000/01	1702.16		33.13	
2001/02	1732.35		47.04	
2002/03	1726.60		92.61	
2003/04	1724.54		129.37	
2004/05	1725.32	35.18	124.68	
2005/06	1721.98	71.74	118.84	
2006/07	1719.41	106.31	113.12	
2007/08	1718.63	139.18	107.80	

[a] Includes an additional 68.232 million p.s. per year that are produced in other states besides Florida.

[b] Scenario 3 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the United States and Canadian markets for Cuban exports beginning in the 2000/01 crop year.

Table D-6. Exports of FCOJ from Brazil to the Four Consuming Countries/Regions for the 1998/99 to the 2007/08 Crop Years, as Forecasted by Scenario 3[a]

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99		953.70		363.71
1999/00		1129.76	2.45	415.29
2000/01		1100.37		421.54
2001/02		1048.11		419.64
2002/03		994.67		418.43
2003/04		949.99		416.10
2004/05		912.43		413.06
2005/06		885.09		413.02
2006/07		865.92		413.44
2007/08		853.75		414.91

[a] Scenario 3 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the United States and Canadian markets for Cuban exports beginning in the 2000/01 crop year.

Table D-7. Exports of FCOJ from Central America to the Four Consuming Countries/ Regions for the 1998/99 to the 2007/08 Crop Years, as Forecasted by Scenario 3[a]

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99	85.10	34.32		
1999/00	127.62	3.03		
2000/01	28.16	110.39		
2001/02		144.45		
2002/03		148.13		
2003/04		150.09		
2004/05		150.30		
2005/06		147.41		
2006/07		140.02		
2007/08		130.59		

[a] Scenario 3 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the United States and Canadian markets for Cuban exports beginning in the 2000/01 crop year.

Table D-8. Exports of FCOJ from Mexico to the Four Consuming Countries/Regions for the 1998/99 to the 2007/08 Crop Years, as Forecasted by Scenario 3[a]

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99			54.60	
1999/00			55.70	
2000/01			56.81	
2001/02		20.30	37.65	
2002/03		59.11		
2003/04		60.29		
2004/05		61.50		
2005/06		62.73		
2006/07		63.98		
2007/08		65.26		

[a] Scenario 3 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the United States and Canadian markets for Cuban exports beginning in the 2000/01 crop year.

Table D-9. Exports of FCOJ from the Mediterranean Region to the Four Consuming Countries/Regions for the 1998/99 to the 2007/08 Crop Years, as Forecasted by Scenario 3[a]

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99		215.95		
1999/00		220.27		
2000/01		224.67		
2001/02		229.16		
2002/03		233.74		
2003/04		238.41		
2004/05		243.18		
2005/06		248.04		
2006/07		253.00		
2007/08		258.06		

[a] Scenario 3 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the United States and Canadian markets for Cuban exports beginning in the 2000/01 crop year.

Table D-10. Exports of FCOJ from Cuba to the Four Consuming Countries/Regions for the 1998/99 to the 2007/08 Crop Years, as Forecasted by Scenario 3[a]

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99		53.06		
1999/00		54.12		
2000/01			55.20	
2001/02			56.30	
2002/03		15.31	42.12	
2003/04		58.58		
2004/05		59.75		
2005/06		60.95		
2006/07		62.17		
2007/08		63.41		

[a] Scenario 3 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes zero tariffs into the United States and Canadian markets for Cuban exports beginning in the 2000/01 crop year.

Appendix E

Results from Scenario 4

Appendix E reports the results from Scenario 4. Scenario 4 takes into account the trading conditions as of 1998 with known changes in tariffs due to GATT and NAFTA, and assumes World Free Trade after the 2000/01 crop year.

Table E-1. On-tree Orange Prices by Country/Region for the Period 1998/99 to 2007/08, as Forecasted by Scenario 4[a]

Year	United States	Brazil	Central America	Mexico	Mediter-ranean Region	Cuba
	----------US$ per 90-pound box----------					
1998/99	3.79	3.98	3.43	3.01	4.17	3.36
1999/00	2.45	2.80	2.03	1.85	2.80	2.27
2000/01	3.42	3.83	3.00	2.70	3.01	3.22
2001/02	4.13	4.45	3.59	3.30	3.62	3.80
2002/03	4.75	5.20	4.31	4.04	4.36	4.49
2003/04	5.44	5.89	4.97	4.72	5.04	5.13
2004/05	6.17	6.54	5.59	5.35	5.67	5.72
2005/06	6.85	7.14	6.16	5.94	6.26	6.28
2006/07	7.50	7.71	6.71	6.51	6.82	6.81
2007/08	8.11	8.24	7.22	7.03	7.35	7.30
% Change from 1998/99 to 2007/08	114.0	109.5	110.5	133.6	76.3	117.3
Annual % Change[b]	12.67	12.17	12.28	14.84	8.48	13.03

[a] Scenario 4 assumes world free trade beginning in crop year 2000/01.

[b] The annual percentage change is calculated by dividing the total percentage change over the period by nine, the number of changes over the period.

Table E-2. FCOJ Production by Country/Region for the Period 1998/99 to 2007/08, as Forecasted by Scenario 4[a]

Year	United States[b]	Brazil	Central America	Mexico[c]	Mediter-ranean Region[c]	Cuba[c]
	----------millions of pounds of solids----------					
1998/99	1556.21	1317.41	119.42	54.60	215.95	53.06
1999/00	1616.49	1547.49	130.65	55.70	220.27	54.12
2000/01	1667.06	1521.91	138.55	56.81	224.67	55.20
2001/02	1711.16	1467.74	144.45	57.95	229.16	56.30
2002/03	1750.98	1413.10	148.13	59.11	233.74	57.43
2003/04	1785.68	1366.10	150.09	60.29	238.41	58.58
2004/05	1817.41	1326.30	150.30	61.50	243.18	59.75
2005/06	1846.09	1300.28	147.40	62.73	248.04	60.95
2006/07	1874.84	1283.01	139.99	63.98	253.00	62.17
2007/08	1905.11	1273.91	130.51	65.26	258.06	63.41
% Change from 1998/99 to 2007/08	22.4	-3.3	9.3	19.5	19.5	19.5
Annual % Change[b]	2.49	-0.37	1.03	2.17	2.17	2.17

[a] Scenario 4 assumes world free trade beginning in crop year 2000/01.

[b] These figures do not include approximately 68 million p.s. produced annually on average by other United States producing states.

[c] Lack of data on tree distribution by age resulted in this country being included in the model exogenously. An annual growth rate of 2.00% was used for FCOJ exports from this country derived from historical data.

[d] The annual percentage change is calculated by dividing the total percentage change over the period by nine, the number of changes over the period.

Table E-3. Consumption in Each Country/Region of Destination for the Period 1998/99 to 2007/08, as Forecasted by Scenario 4[a]

Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99	1635.08	1257.03	129.07	363.71
1999/00	1722.74	1407.18	147.75	415.29
2000/01	1702.56	1447.77	139.99	442.12
2001/02	1694.95	1461.62	133.55	444.87
2002/03	1691.18	1466.88	128.03	444.64
2003/04	1683.90	1476.23	121.55	445.71
2004/05	1674.70	1489.47	114.50	448.02
2005/06	1667.79	1506.47	107.97	451.51
2006/07	1662.03	1525.82	101.67	455.71
2007/08	1658.49	1549.02	95.86	461.12
% Change from 1998/99 to 2007/08	1.4	23.2	-25.7	26.8
Annual % Change[b]	0.16	2.58	-2.86	2.98

[a] Scenario 4 assumes world free trade beginning in crop year 2000/01.

[b] The annual percentage change is calculated by dividing the total percentage change over the period by nine, the number of changes over the period.

Table E-4. Consumption Price in Each Country/Region of Destination for the Period 1998/99 to 2007/08, as Forecasted by Scenario 4[a]

Year	United States	European Community	Canada	Japan
	----------US$ per pound of solids----------			
1998/99	1.09	1.30	1.15	1.51
1999/00	0.88	1.06	0.94	1.24
2000/01	1.04	1.10	1.07	1.17
2001/02	1.14	1.20	1.17	1.27
2002/03	1.24	1.33	1.27	1.40
2003/04	1.35	1.46	1.38	1.53
2004/05	1.46	1.57	1.49	1.64
2005/06	1.56	1.67	1.60	1.74
2006/07	1.66	1.77	1.70	1.84
2007/08	1.76	1.87	1.79	1.94
% Change from 1998/99 to 2007/08	61.5	43.8	55.7	28.5
Annual % Change[b]	6.83	4.87	6.19	3.17

[a] Scenario 4 assumes world free trade beginning in crop year 2000/01.

[B] The annual percentage change is calculated by dividing the total percentage change over the period by nine, the number of changes over the period.

Table E-5. Exports of FCOJ from the United States[a] to the Four Consuming Countries/ Regions for the 1998/99 to 2007/08 Crop Years, as Forecasted by Scenario 4[b]

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99	1549.98		74.46	
1999/00	1595.12		89.60	
2000/01	1702.56		32.73	
2001/02	1694.95		84.44	
2002/03	1691.18		128.03	
2003/04	1683.90	48.46	121.55	
2004/05	1674.70	96.44	114.50	
2005/06	1667.79	138.57	107.97	
2006/07	1662.03	179.38	101.67	
2007/08	1658.49	218.98	95.86	

[a] Includes an additional 68.232 million p.s. per year that are produced in other States besides Florida.

[b] Scenario 4 assumes world free trade beginning in crop year 2000/01.

Table E-6. Exports of FCOJ from Brazil to the Four Consuming Countries/Regions for the 1998/99 to 2007/08 Crop Years, as Forecasted by Scenario 4[a]

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99		953.70		363.71
1999/00		1129.76	2.45	415.29
2000/01		1079.79		442.12
2001/02		1022.87		444.87
2002/03		968.46		444.64
2003/04		920.38		445.71
2004/05		878.28		448.02
2005/06		848.77		451.51
2006/07		827.30		455.71
2007/08		812.79		461.12

[a] Scenario 4 assumes world free trade beginning in crop year 2000/01.

Table E-7. Exports of FCOJ from Central America to the Four Consuming Countries/ Regions for the 1998/99 to 2007/08 Crop Years, as Forecasted by Scenario 4[a]

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99	85.10	34.32		
1999/00	127.62	3.03		
2000/01		138.55		
2001/02		144.45		
2002/03		148.13		
2003/04		150.09		
2004/05		150.30		
2005/06		147.40		
2006/07		139.99		
2007/08		130.51		

[a] Scenario 4 assumes world free trade beginning in crop year 2000/01.

Table E-8. Exports of FCOJ from Mexico to the Four Consuming Countries/Regions for the 1998/99 to 2007/08 Crop Years, as Forecasted by Scenario 4[a]

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99			54.60	
1999/00			55.70	
2000/01			56.81	
2001/02		8.85	49.10	
2002/03		59.11		
2003/04		60.29		
2004/05		61.50		
2005/06		62.73		
2006/07		63.98		
2007/08		65.26		

[a] Scenario 4 assumes world free trade beginning in crop year 2000/01.

Table E-9. Exports of FCOJ from the Mediterranean Region to the Four Consuming Countries/Regions for the 1998/99 to 2007/08 Crop Years, as Forecasted by Scenario 4[a]

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99		215.95		
1999/00		220.27		
2000/01		224.67		
2001/02		229.16		
2002/03		233.74		
2003/04		238.41		
2004/05		243.18		
2005/06		248.04		
2006/07		253.00		
2007/08		258.06		

[a] Scenario 4 assumes world free trade beginning in crop year 2000/01.

Table E-10. Exports of FCOJ from Cuba to the Four Consuming Countries/Regions for the 1998/99 to 2007/08 Crop Years, as Forecasted by Scenario 4[a]

Crop Year	United States	European Community	Canada	Japan
	----------millions of pounds of solids----------			
1998/99		53.06		
1999/00		54.12		
2000/01	50.44	4.76		
2001/02		56.30		
2002/03		57.43		
2003/04		58.58		
2004/05		59.75		
2005/06		60.95		
2006/07		62.17		
2007/08		63.41		

[a] Scenario 4 assumes world free trade beginning in crop year 2000/01.

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