# MEXICO – U.S. – CARIBBEAN NATIONS MELON TRADE: A SIMULATION ANALYSIS OF ECONOMIC FORCES AND GOVERNMENT POLICIES

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*TAMRC International Market*
*Research Report No. IM 2-98*
*June 1998*

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## EXECUTIVE SUMMARY

Historically, Mexico was the primary foreign source of melons for the U.S. market. However, in recent years, Mexico's share of the U.S. melon markets has significantly declined while that of Caribbean nations increased. For example, during the 1970s and early 1980s, Mexico supplied more than 90% of U.S. cantaloupe imports whereas in recent years Mexico has supplied about 30% of the U.S. market. Similar declines in market share have been observed for honeydew and watermelon. The objective of this study is to empirically identify, measure, and forecast the effects of primary economic forces affecting United States, Mexico and Caribbean nations melon trade in winter and spring seasons. Analysis is accomplished with a price equilibrium econometric model of the U.S., Mexico and Caribbean nations cantaloupe, honeydew and watermelon industries.

Initially a baseline forecast of endogenous variables in the melon trade model was carried out for the 1996-2004 period. The U.S. per capita consumption of cantaloupe and honeydew were projected to increase 31 and 14 percent, respectively, by 2004 while per capita consumption of watermelon declines by 8 percent. In addition, Mexico's share of the U.S. melon market continues to decline at the expense of gains by the Caribbean nations. Next, simulations are carried out to measure the effect of five alternative scenarios on melon trade. The analysis shows the 1994-1995 peso devaluation to have the greatest short-run influence on Mexico's ability to export while the largest long-run impact was associated with improvements in Mexican melon yields. Mexican agricultural labor cost and accelerated growth in Mexican per capita income have important impacts on melon exports but are of less importance than yields. In general, the tariff-reducing provisions of NAFTA have a comparatively modest influence on Mexico's ability to export to the United States. Mexican exports of melons to the U.S. during the December-May period have a limited impact on Texas shipments. This is because Texas production/shipments normally commence in the third week of May when Mexico has dramatically reduced exports to the U.S. The decline in Mexican exports is in response to the normal decline in U.S. market prices in this period.

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The Mexican economy has been affected by a severe crisis during the past several decades. Some of the characteristics of this crisis have been increasing external debt, high inflation and unemployment rates, decreasing purchasing power and a deficit in the trade balance.

The trade balance reports, during the 1991-1994 period, showed an annual average deficit of about $13.5 billion (Table 1.1). During this period, imports significantly increased while exports increased modestly. The external debt increased from $94 billion in 1984 to $135.4 billion in 1994. The real gross domestic product declined 6% in 1995 while the general unemployment rate was higher than 6% (Banco de Mexico).

The situation in Mexico's agriculture sector has been similar to that in the rest of the economy. During the early 1980's, the agriculture trade balance was negative for the first time in its history. During the 1992-1994 period, the trade balance was an annual average deficit of about $563 million (Table 1.2). Meanwhile, the rural migration to urban areas and to the United States continues at an increasing rate.

In this context, some of the priorities of the Mexican agricultural policy are to increase the domestic output and the supply of exports. It is imperative that Mexico increase foreign exchange earnings, increase rural income, improve living conditions of the rural population, reduce rural migration and gain social stability.

Melons have been a traditional export product of Mexico and an important source of foreign currency and rural employment. Melon exports provide earnings to the Mexican economy of more than $90 million a year. Further, about 35% of the total melon production costs are attributable to labor, thus their importance as a source of employment for the Mexican rural population.

About 35% of total Mexican melon production is exported. The U.S. is the most important market, importing more than 96% of Mexico's annual exports. Mexico's export season extends from December to May with peaks in April and May.

The U.S. consumption of melons has increased over time. Increased imports, lower retail prices, higher income, and an increased preference for fruits and vegetables have significantly increased the consumption of melons. The U.S. per capita consumption of melons during the Winter season (December - May) increased from 2.82 lbs. in 1970 to 6.83 lbs. in 1994.

Historically Mexico was the dominant foreign source of melons for the U.S. market. However, through the years, Mexico has been losing its competitive position. During 1980 to 1983, Mexico's share of the U.S. cantaloupe market averaged 92 %. In 1990, Mexico's market share declined to 61 % and in 1994 it was 30 %. Mexico's share of the U.S. honeydew and watermelon market has changed similarly over time. In the early 1980s, Mexico's share of the U.S. honeydew market was 60%; however, by 1990 and 1994 Mexico's respective market share were 57% and 36%. For watermelon, Mexico's market share was 44%, 35%, and 25% in the early 1980's, 1990 and 1994, respectively.

Government policies and adoption of better production technologies in countries involved in melon trade are responsible for changes in Mexico's competitive position. Policies dealing with exchange rates, trade policies, and investments in improved production technologies have had important effects on melon trade.

Recent events emphasize the importance of the exchange rate policy on Mexican trade. To curtail inflation, the Mexican peso was allowed to only modestly depreciate in the late 1980's, thus the peso became increasingly overvalued. The overvalued currency acted as a tax on exports and a subsidy to imports creating a growing trade deficit. The effects of this policy on Mexico-U.S. melon trade are thought to have been important.

In August 1983, The Caribbean Basin Initiative (CBI) Act was signed. This Act offered twenty-seven Caribbean and Central American countries duty-free access to U.S. markets. Presumably, as a result of this agreement, increased investment in melon production technology flowed to these countries. Subsequent to the CBI, U.S. imports of melons from the region increased substantially.

In January 1994, a Free Trade Agreement between Mexico, U.S., and Canada (NAFTA) came into effect. The purpose of this agreement was to eliminate trade barriers and promote economic growth. The current U.S. melon tariffs include *ad valorem* tariffs ranging from 8.5% to 35%, depending on the season and type of melon. Under NAFTA, tariffs will be phased out over a 5 to 15 year period. Mexico may have a great opportunity to increase exports under this agreement.

Economic growth also has an influence on the level of trade. Economic growth in exporting countries increases their domestic demand for goods and services, thus directing an increased portion of exports to domestic consumption. Conversely, economic growth in importing countries increase consumption and imports.

Productivity is another important factor influencing countries competitive position in agricultural trade. Higher yields decrease production costs, lowering the per unit price of supplies to be sold in world markets.

How do the above-noted economic forces shape the pattern of melon trade and what are the relative importance of these forces? To know this, it is necessary to carry out a detailed analysis of melon markets in Mexico and the United States and countries with whom Mexico competes in the U.S. melon market. By carrying out this analysis it becomes possible to identify economic variables that govern intercountry trade.

## Justification of the Study

To analyze and measure the effects of domestic and foreign agricultural policies on Mexico/U.S./CBI countries melon trade is important for several reasons. They include: (1) the need for increased foreign exchange earnings for Mexico to service external debt and pay for required imports; (2) the need to improve the living conditions of a large proportion of Mexico's rural workers; (3) the necessity to protect the income of Mexican farmers whose production is continuously subject to changing weather and market conditions; (4) the desirability to reduce migration from rural to urban areas in Mexico; and (5) the need to increase Mexico production to satisfy growing domestic demand requirements and exports that generate additional activities in other sectors of the economy.

## Problem Statement

The Mexican government has the responsibility of increasing farmers' income and employment. One possible way is through appropriate export policies that enhance the competitive position of Mexican products in international markets.

However, for melons there are no previous studies that empirically reveal the variables that determine trade levels between Mexico, U.S., and CBI countries. These studies are needed so that the Mexican government and producer organizations can help Mexico farmers improve their economic well-being by increasing production and exports to world markets.

## Research Objectives

The general objective of this study is to analyze the markets for some of the most important Mexican agricultural exports to assist individuals and organizations to better understand the effects of important economic variables on melon production, quantity traded, prices and consumption. To accomplish the foregoing objective, this study will:

(1) Describe and analyze the structure and characteristics of the melon industries in Mexico, the United States and countries that compete with Mexico in the U.S. market,

(2) Specify and estimate an econometric model that incorporates Mexico's melon sector and its involvement in the domestic and international markets but, in particular, the U.S. market for purposes of evaluating strategies to enhance international competitiveness of Mexico melons,

(3) Evaluate the effect of peso/dollar exchange rates, NAFTA melon provisions, melon production technology, Mexican income growth, Mexican agricultural labor cost, and other economic factors on Mexico-U.S. melon trade with use of the developed model, and

(4) Make policy recommendations based on the study results that might be used by the Mexico melon sector to increase market share and profitability of export sales to the U.S. and other foreign buyers.

**Table 1.1. Mexican Trade Balance**

| Year | Exports | Imports | Balance |
|---|---|---|---|
| | ----------Millions of Dollars---------- | | |
| 1982 | 24,056 | 17,009 | 7,047 |
| 1983 | 25,953 | 11,848 | 14,105 |
| 1984 | 29,101 | 15,915 | 13,186 |
| 1985 | 26,758 | 18,359 | 8,399 |
| 1986 | 21,803 | 16,784 | 5,019 |
| 1987 | 27,599 | 18,813 | 8,786 |
| 1988 | 30,692 | 28,081 | 2,611 |
| 1989 | 35,171 | 34,766 | 405 |
| 1990 | 40,711 | 41,592 | -881 |
| 1991 | 42,687 | 49,966 | -7,279 |
| 1992 | 46,196 | 62,130 | -15,934 |
| 1993 | 51,885 | 65,366 | -13,481 |
| 1994 | 60,879 | 79,346 | -18,467 |

Source: International Monetary Fund. *International Financial Statistics, Yearbook 1996*. Washington, DC.

**Table 1.2. Mexican Agricultural Trade Balance**

| Year | Exports | Imports | Balance |
|---|---|---|---|
| | -----------------------------------Millions of Dollars----------------------------------- | | |
| 1970 | 512 | 251 | 297 |
| 1975 | 892 | 862 | 30 |
| 1980 | 1,795 | 3,062 | -1,267 |
| 1985 | 1,773 | 2,375 | -602 |
| 1990 | 2,111 | 2,062 | 49 |
| 1991 | 2,291 | 2,086 | 205 |
| 1992 | 2,053 | 2,845 | -793 |
| 1993 | 2,450 | 2,617 | -167 |
| 1994 | 2,616 | 3,345 | -729 |

Source: Secretaría de Agricultura y Recursos Hidráulicos (SARH). Subsecretaría de Planeación. *Boletín Mensual de Información Básica del Sector Agropecuario y Forestal.* México, D.F., Agosto de 1995.

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# MELON INDUSTRY CHARACTERISTICS

Melon industry characteristics of countries involved in trade are a good source of information to better understand trade flows. Information on levels of production, seasonality, productivity and consumption provide valuable information to better understand level and direction of trade. In this section, a descriptive analysis of melon production, consumption and trade is presented. The analysis includes melon sectors of Mexico, United States, and Caribbean Basin Initiative (CBI) countries.

## Mexico Melon Sector

*Area, Production, Yields, and Seasonality*

The average harvested area for cantaloupes in Mexico over the 1970-1994 period was 26,800 hectares (ha), with average yields of 12.46 ton/ha and a corresponding total production of 336,667 metric tons (tons) (table 2.1). During 1970-1991, production increased at an average annual rate of 5.4%. After 1991, production declined significantly. Changes in production through time are explained by changes in harvested area and not by changes in yields. Cantaloupe yields grew at an annual average rate of only 0.57%. The low productivity of the Mexican cantaloupe sector is often attributed to increasing incidence of insects and virus in selected production areas as well as limited access to public and private credit by smaller farmers.

The average harvested area for watermelon during 1970-1994 was 30,291 ha with average yields of 13.09 tons/ha and total production of 397,481 tons. Production grew at an annual rate of 2.06%, while the harvested area grew at 1.6% per year. These rates of growth are lower than those of cantaloupe; this may be due to the lower rate of growth in domestic watermelon consumption as compared to that of cantaloupe. As in the cantaloupe case, watermelon yields have grown at a modest annual rate of only 0.5%, increasing from 10.37 tons/ha in 1970 to 14.7 tons/ha in 1994 (table 2.2).

Unfortunately, information on honeydew area, production and yields are not available from the Mexican Ministry of Agriculture, Livestock, and Rural Development (SAGAR). However, in a following section, the honeydew Mexican export sector will be discussed. Information from the U.S. Department of Agriculture (USDA) and The National Confederation of Vegetable Producers of Mexico (CNPH) will provide this background.

Because of the variety of climates in Mexico, melons are produced during the entire year. For statistical purposes, SAGAR divides annual production into two seasons: Fall-Winter and Spring-Summer. The Fall-Winter season for melons includes the production harvested from December of a specific year to May of the next year. The Spring-Summer includes production obtained from June to November. Shown in tables 2.3 and 2.4 are the seasonal distributions of production for cantaloupe and watermelon. For both melons, Fall-Winter season production represents a greater proportion of annual production. For cantaloupes, 66.83% are produced in the Fall-Winter season and 33.17% in Spring-Summer period. For watermelons the proportion produced in the Fall-Winter season is even greater; 73.71% are produced in Fall-Winter versus 26.49% in Spring-Summer. The Fall-Winter production of both cantaloupe and watermelon has been traditionally oriented to the export market, while the Spring-Summer production has supplied the domestic market.

Melon production in Mexico is distributed throughout the country. This characteristic differs from most of the commercial fruit and vegetable production in Mexico where production is concentrated in one or two states (Malaga). Tables 2.5 and 2.6 show cantaloupe and watermelon production by state. Major producers of cantaloupe are the states of Michoacan, Durango, Guerrero, Sonora, Coahuila, and Sinaloa. These states supply around 60% of Mexico's annual cantaloupe production. Production in the states of Michoacan, Guerrero, and Sinaloa is primarily intended for the export market while production in Durango and Coahuila is destined for the domestic market. Sonora production goes into both domestic and export markets. The traditional exporting states of Michoacan and Sinaloa have reported increasing phytosanitary problems, (Banco Nacional de Comercio Exterior -BNCE- )

decreasing yields and increasing pest control costs. As a consequence, production in these states has decreased significantly (table 2.5).

Major producers of watermelon are the states of Sonora, Veracruz, Jalisco, Oaxaca, Sinaloa and Chiapas. The production of Sonora, Veracruz, Jalisco and Sinaloa is intended for exports, while that of Oaxaca and Chiapas, both located in southeast Mexico, is intended for the domestic market. Production in the states of Sinaloa and Chiapas has decreased about 50%, while that in the states of Veracruz and Tabasco has increased by the same proportion (table 2.6).

*Export Sector Characteristics and Problems*

Mexican exports of fruits and vegetables started in 1905 when Mexico registered the first railroad shipments to the United States. However, it was after World War II when Mexico exports increased significantly (Rex). Proximity to the U.S. market, appropriate climatic conditions and relatively good commercial relations between Mexico and the U.S. have been the base for continuing this important economic activity.

Melons have been a traditional export product of Mexico. Melon exports provide earnings to the Mexican economy of more than $90 million a year. The U.S. represents the major market for Mexican melons with more than 96% of Mexican exports destined for the U.S. market. Other foreign markets of less importance are Canada, Germany, France, and Japan.

Relevant questions regarding Mexico's melon export sector are: What proportion of output is exported? How is the melon sector distributed within the country? When do exports occur? What problems do farmers encounter when exporting melons?. To answer these questions, the characteristics of the Mexican export sector are presented.

For both cantaloupe and watermelon, the export market takes on average, 29% of total annual output. The remaining 71% is consumed in the domestic market (tables 2.7 and 2.8). In the Fall-Winter season about 40% of cantaloupe production is exported and 35% of the watermelon production is exported. Cantaloupe exports increased over the 1970-1991 period at an annual average rate of 3.5%, however, after that period exports declined significantly. Watermelon exports have grown at a lower rate but at a more consistent rate of 2.3% over the 1970-1994 period. During the same period, domestic watermelon consumption and exports grew 100%. Domestic consumption of cantaloupe has grown at a faster rate than domestic consumption of watermelon, thus a greater incentive to increase production. From 1970 to 1994, domestic cantaloupe consumption grew about 250%.

Mexican melon exports are seasonal. Monthly exports of cantaloupe, honeydew and watermelon are presented in tables 2.9, 2.10 and 2.11. Between 80% and 94% of Mexico's annual melon exports occur during the Fall-Winter season (Dec-May). Fall-Winter is the traditional export season. Within this shipping season, March, April and May are the most intensive export months. The behavior of Mexican melon exports is closely related to the seasonality of U.S. melon production. U.S. production during the late fall, winter and early spring is very small, thus the U.S. turns to foreign markets to supply domestic demand.

The leading melon export states in Mexico are those that are able to produce during the December-May period. If we consider that melon crops require high temperatures during the growing season, then only those states that have no winter conditions during the December-May period are able to produce export-destined production. Those weather conditions are met by Mexican states located in the Pacific and Gulf coasts and south Mexico. Weather and soil conditions plus irrigation infrastructure determine a state's ability to participate in export markets. Presented in tables 2.12, 2.13 and 2.14 are percentages of each state's melon production that is destined for the export market. Leading export states for cantaloupe and honeydew are Michoacan, Sinaloa, Colima, Guerrero, Sonora and Oaxaca; these states are located in the Pacific coast region and in south Mexico. For watermelon, Pacific and Gulf coast states have the highest export share. The Northern Mexico states of Coahuila and Durango are recognized as leaders in melon quality and productivity (yields). However, because of freezing conditions during the winter months, they are unable to produce melons before June. As a result, they do not participate in the export market.

Production and export activities in Mexico face a number of problems that affect not only the profitability of melon production, but also its competitive position in international markets. Some of these problems are: (a) high inflation rates; (b) small farmers limited access to credit; (c) increasing incidence of insects and virus; (d) technology dependence; (e) increasing competition in international markets; and (f) international trade protectionism.

High inflation rates in the Mexican economy increase production costs, decrease profitability and unfavorably influence Mexican melons competitive position in international markets. Devaluations have partially alleviated the last problem, but devaluations bring more inflation and the positive effect of the devaluation is quickly offset.

Because of the limited resources of horticultural producers, and financial institutions' rigorous loan requirements, many small farmers have no access to credit. As a consequence, investment in the crops of small farmers is limited to personal funds, or to private credit which is expensive. Under these circumstances, farmers purchase lower quality seeds, and use inadequate quantities of pesticides, thus obtaining low yields and reduced quality.

In addition, there is the problem of increasing incidence of insects and virus. This problem has been reported in Michoacan and Sinaloa which are leading production and export states. This problem increases the need for investment in pest control, thus increasing production costs, reducing profitability, reducing product quality and yields.

Most of the melon varieties and hybrids planted in Mexico have originated in the United States. The same is the case for many pesticides and some fertilizers used on melons. This situation is, in part, a result of the limited resources spent in Mexico to develop science and technology. Negative consequences of this situation are the sensitivity of production costs to changes in exchange rates, as well as Mexico's dependence on U.S. technology.

International trade protectionism is another problem facing Mexican melon exporters. Tariffs are the most common measure to restrict imports, thus reducing the comparative advantage of selected exporters. The U.S. has charged Mexican melons with ad valorem tariffs ranging from 8.5% to 35% of import value, depending on the season and type of melon. Under NAFTA, tariffs will be phased out over periods extending from 5 to 15 years (table 2.15).

Trends toward trade liberalization, as evidenced by NAFTA, GATT and other trade agreements, bring about increased competition among countries and regions. This is the situation Mexico is facing regarding its melon exports to the United States. Since 1984, the Caribbean Basin Initiative (CBI), a trade agreement between the U.S. and Caribbean and Central American countries (Brown and Suarez) has increased the competition between Mexico and these countries, thus affecting Mexico's market share. In a following section, the effect of increased competition from CBI countries is treated in more detail.

*Mexican Fall-Winter Supply and Demand*

As discussed above, about 70% of Mexican annual production occurs in the Fall-Winter season (December-May). During this season, most of the production is intended for export. However, there are some isolated, non-irrigated regions that grow low yielding, low quality produce for the domestic market. These marginal producing areas represent about 15% of Fall-Winter melon production. This study will focus on those irrigated areas that supply about 85% of Fall-Winter production and 100% of exports. For cantaloupe, this export-destined supply is represented by the sum of production of the states of Michoacan, Sinaloa, Colima, Guerrero, Tamaulipas, Nayarit, and Jalisco. For watermelon, the export sector is represented by the sum of production of the states of Sinaloa, Jalisco, Sonora, Veracruz, Tabasco, and Tamaulipas.

As stated in the first section, one of the main objectives of this study is to determine the relative importance of factors affecting melon trade in Mexico, U.S. and competing countries. Under this premise, the focus of this study will be the Fall-Winter (December-May) season and, in particular, the export sector. To know more about market characteristics of this season, a description of key variables of supply and demand are presented below.

Cantaloupe and watermelon production, yields and the real farm price of those states supplying the export market are presented in tables 2.16 and 2.17. The seasonal average production and yields of cantaloupe were 192,255 ton and 12.35 ton/ha, respectively (table 2.16). Until 1991, production increased at an average annual rate of 3.8%. After 1991, production decreased significantly. Changes in production have been explained by changes in harvested area. Yield improvements have made almost no contribution to production. Yields have grown at an annual rate of 0.09%.

The real farm price of cantaloupe grew at an annual average rate of 1.6%. Farm prices include the payment received at the packing shed level of the market channel for sales to the export and domestic markets.

Watermelon growth rates for production, yields and farm prices are very similar to those of cantaloupe. Growth in annual yields is a little higher than cantaloupe, but still very low at 0.46%. Over the past twenty-five years, melon yields in Mexico are almost unchanging; this suggests that this lack of productivity may unfavorably influence this sector in international markets. The negative effects of poor productivity may have been partially hidden by direct and indirect subsidies to the melon industry through the price of major inputs such as labor and fertilizers. Agricultural labor represents about 35% of total production costs and fertilizers about 8% (Espinoza, 1983). Labor cost decreased more than 50% in real terms during the 1970-1994 period (table 2.18). Mexican macroeconomic policies that intended to reduce inflation kept nominal wages at low levels to reduce inflationary pressures. Similarly, fertilizer prices, were deliberately subsidized to increase agricultural production. The real price of fertilizer also decreased 50% over this time period (table 2.18).

Key variables affecting melon demand for the Fall-Winter season are presented in tables 2.19 and 2.20. The 1970-1994 average per capita consumption of cantaloupe and watermelon in the Fall-Winter season was 1.86 kg and 2.88 kg, respectively. However, in the long run, the consumption of cantaloupe has grown at an annual rate of 2.0%, while that of watermelon was -1.8%. Therefore, even though the consumption of watermelon was more than double the consumption of cantaloupe in 1970, by 1993-94 the consumption of cantaloupe and watermelon was almost equal.

Retail cantaloupe prices and per capita income grew continually from 1970 to 1982 at annual rates of about 3%. After 1983-1994, both decreased at annual rates of about -1.4%. Perhaps reduction in purchasing power has had some effect on changes in retail prices. Watermelon retail prices, on the other hand, grew at a low but, continuous rate during the whole period.

## U.S. Melon Sector

*U.S. Production and State Share*

U.S. annual production during 1970-1994 for cantaloupe, honeydew and watermelon is presented in table 2.21. Watermelon production, during 1970-1994, averaged 28.73 million cwt.* which is almost double that of cantaloupe (15.12 million cwt) while honeydew production (3.59 million cwt.) represented about one-fourth of cantaloupe production. Data show an upward production trend for all types of melons. However, growth in honeydew production has been more dramatic. While cantaloupe and watermelon production showed a 40% increase over the 1970-1994 period, honeydew production increased more than 100%.

Annual production of leading states during 1992-1994 for cantaloupe, honeydew and watermelon are presented in tables 2.22, 2.23 and 2.24. In general, U.S. melon production is concentrated in a few states. Cantaloupe and honeydew production is concentrated in California, Texas, and Arizona, while watermelon is concentrated in Florida, California, Texas, and Georgia.

For cantaloupe, California, Texas and Arizona accounted for over 90% of production, while for honeydew the same three states accounted for 100% (tables 2.22 and 2.23). Watermelon production in Florida, California, Texas and Georgia accounted for over 70% of total production. The remaining 30% is shared by other states (table 2.24).

Annual labor and fertilizer costs in the United States for 1970-1994 are presented in table 2.25. Fertilizer costs decreased in real terms about 15% while real wages increased by the same proportion over this period. This situation differs significantly from that in Mexico where the real price of these two inputs decreased 50% over the 1970-1994 period.

* 1 Metric Ton = 2,204 lbs = 22.04 cwts

*U.S. Domestic Shipments, Imports and Competition*

As mentioned above, warm temperatures are required for the growth and development of melons. Optimal growing temperatures range from 65-75 Fahrenheit degrees (Tamaro). During the U.S. late fall, winter and early spring seasons, these temperature requirements are not met for most of the country. As a consequence, domestic production during this period is low and domestic consumption is supplied mainly with imports.

U.S. monthly and seasonal domestic shipments during 1980-1994 for cantaloupe, honeydew and watermelon are shown in tables 2.26, 2.27 and 2.28. Early domestic shipments start in April or May, depending on the type of melon, with supply peaking from June to September. During the December-May season only 14%, 10% and 22% of respective cantaloupe, honeydew and watermelon annual production occurs and is shipped. This period is important because it corresponds to the U.S.'s import season.

A relevant question regarding U.S. imports and domestic shipments is: Do imports compete with or complement U.S. domestic production during the December-May period? Monthly export data of Mexico shown in tables 2.9, 2.10 and 2.11, and U.S. monthly domestic shipments shown in this section, indicate an overlapping in May for cantaloupe and honeydew and in April and May for watermelon. However, more detailed information provided by the USDA on weekly melon movements (USDA 1989,1993) helps to provide a more precise answer to the previous question. The analysis of weekly cantaloupe loads during May indicate that imports supply 74% of consumption the first two weeks of May while early shipments from the Imperial Valley of California supply the remaining 26%. For the last half of May, the situation changes and while the domestic shipments from California, Texas and Arizona increase significantly, imports decrease to levels close to zero. The reduction in imports is, in part, a response to a decline in U.S. market prices in this period; as a result, it becomes less profitable for Mexican cantaloupes to enter the United States. As a consequence, during the last half of May, domestic shipments supply 95% of the market and imports only 5%. During the December-April period, cantaloupe imports supply 100% of U.S. demand and, even in May, a complementary situation is observed. Imports supply the first half of May while domestic shipments provide consumption for the second half of May. We conclude that during the December-May period, cantaloupe imports complement domestic production in the United States.

For honeydew, the situation is similar to that of cantaloupe. An apparent overlap in May exists between imports from Mexico and domestic shipments. However, domestic shipments, during the first two weeks of May account for about 8% of May domestic shipments, while the remaining 92% of domestic May shipments are shipped during the last half of May. As in the cantaloupe case, we conclude that honeydew imports are complementary to domestic honeydew production.

During April and May, watermelon imports and domestic shipments tend to overlap. Domestic shipments in April are supplied by Florida. Domestic shipments in May are supplied by Florida, California, and Texas. Domestic shipments in early April comprise about 5% of consumption but this gradually increases to 34% in late April. In early May (first week), the domestic shipments comprise about 50% of consumption but by late May domestic production supplies 90% of consumption. As can be seen, watermelon imports compete with domestic shipments.

Although Mexico cantaloupe and honeydew exports to the U.S. encounter little competition from U.S. producers in the Fall-Winter period, important competition is provided to Mexico by CBI countries. The competition provided by CBI countries is discussed in a following section. In contrast, Mexico watermelon production encounters some competition from U.S. production during April and May.

U.S. annual imports and import share during 1971-1994 for cantaloupes and honeydew are presented in tables 2.29 and 2.30. Supply of watermelon and share in U.S. market for the same period are presented in table 2.31.

U.S. imports of cantaloupes increased significantly during the 1971-1994 period. From an annual average of 178 million pounds[**] in 1971-1972, cantaloupe imports increased to an annual average of 491 million pounds in 1993-1994, a 175% percent increase (table 2.29). Honeydew imports increased even more dramatically. Honeydew imports increased from an annual average of 28.48 million pounds in 1971-1972 to 255.96 million pounds in 1993-

[**] 1 kg = 2.2 lbs

1994, a 750 percent increase (table 2.30). Cantaloupe and honeydew imports increased significantly after 1984 when the CBI was signed.

Increases in the U.S. imports of watermelon have been modest compared to imports of cantaloupe and honeydew. Watermelon imports over the 1971-1994 period increased about 40%. Watermelon imports increased from an average of about 160 million pounds in 1971-1972 to an average of 220 million pounds in 1993-1994.

A question of importance to this study is as follows: How is the U.S. market distributed among melon import sources? During the 1970s and early 1980s, Mexico was the dominant source of cantaloupe imports by the United States: during this period Mexico supplied more than 90% of total U.S. imports. However, after the early 1980s, the Mexican share commenced to gradually decline and by 1993-1994, Mexico supplied about 30% of the Fall-Winter U.S. market (table 2.29). CBI countries share, in particular, the share supplied by Honduras, Costa Rica, and Guatemala, increased dramatically from 6-8% during the 1970s and early 1980s to about 70% in 1994. For honeydew, Mexico's share of the U.S. market declined from about 60% in early 1970s to 37% in 1994 (table 2.30).

For watermelon, as shown above, the market is divided between U.S. domestic production and imports from Mexico. As in the cantaloupe and honeydew cases, Mexico's share of the U.S. watermelon market has declined from an average of 40% in the early 1970s to 25% in 1994 (table 2.31).

*U.S. Annual and Seasonal Melon Demand*

Annual and seasonal per capita consumption during 1970-1994 for cantaloupe, honeydew and watermelon in the United States are shown in tables 2.32, 2.33 and 2.34, respectively. Watermelon comprises about 60% of total annual melon consumption in the United States, followed by cantaloupe with 33% and honeydew with 7% of the total. Average per capita consumption of melons in the U.S. is about 22 pounds.

Annual melon consumption showed an upward trend during the 1970-1994 period. This trend is clearly attributable to the increase in melon consumption during December-May. June-November consumption has been fairly stable for all types of melons. Per capita consumption of cantaloupe in the December-May period increased from 1.15 pounds in 1970-1971 to 2.60 pounds in 1994-1995, a 130% increase. In contrast, June-November per capita consumption increased only 5% for the same period (table 2.32). Honeydew and watermelon show similar consumption patterns. Per capita honeydew consumption during December-May increased 335%, while June-November consumption decreased 5% (table 2.33). The increase in per capita watermelon consumption is modest compared to cantaloupe and honeydew consumption although both follow similar seasonal patterns. December-May per capita consumption during 1970-1994 increased 30% while June-November consumption increased only 13% (table 2.34). This slow growth in watermelon consumption has been previously observed. Allred quotes *The Packer's* "Fresh Trends 1988 Survey" that noted a reduced consumption of watermelon. She explains that U.S. consumers prefer more convenient produce with consistently high quality. In response, the industry is gradually developing smaller melons (for small-sized U.S. households) and seedless hybrids.

Cantaloupe real price decreased 28% over the period 1970-1994 (table 2.35). Per capita increases in December-May melon consumption over the 1970-1994 period may be related to declines in retail prices and rising income. Honeydew, with the greatest increase in per capita consumption, shows the largest decrease in real consumer price over the 1970-1994 period. Honeydew melon price declined from an average of $0.57 /lb in 1970-1971 to $0.32 /lb in 1993-1994, a 40% decrease in real price (table 2.36). Watermelon, with the smallest increase in consumption, showed the smallest decrease in real consumer price. The average real price for watermelon declined from $0.30/lb in 1970-1971 to $0.27/lb in 1993-1994, a 10% decrease (table 2.37). Cantaloupe real price decreased 28% over the same period. The relatively large decline in the real price of honeydew and cantaloupe may be related to the observed high rates of growth in imports. In contrast, watermelon, with the lowest rate of growth in imports, experienced the smallest reduction in consumer prices over the 1970-1994 period. In addition, real per capita U.S. income, a direct determinant of consumption increased from $12,047 in 1970-1971 to $16,617 in 1993-1994, a 40% increase.

## CBI Countries Melon Sector

*CBI Countries Characteristics*

On August 5, 1983 , President Reagan signed Public Law 98-67. Title II of this act is cited as either The Caribbean Basin Initiative (CBI) or The Caribbean Basin Economic Recovery Act (CBERA). This Act offered twenty-seven Caribbean and Central American countries duty-free access to U.S. markets (Brown and Suarez).

The CBI was intended to generate regional political stability and economic growth via trade, economic assistance, and tax incentives for private sector investments. This legislation allowed eligible commodities to enter the United States duty-free from the Caribbean Basin region (Seale).

Prior to the CBI, many of the major vegetable crops grown in the Caribbean Basin region were duty-free under provisions of The Generalized System of Preferences (GSP) or Most Favored Nation (MFN) tariffs (referred to as Not-Dutiable). Not-dutiable products included banana, melons, ornamental plants, cassava, yams and frozen okra. U.S. imports of not-dutiable products have been boosted by continued expansion in the fruit and vegetable industries of many Caribbean Basin countries (Rosa).

Chief suppliers of horticultural products to the United States are Costa Rica, Guatemala, and Honduras. Excluding bananas and plantains, these CBI countries supplied 85% of total U.S. imports of horticultural products from the region.

Costa Rica is by far the dominant CBI supplier of horticultural products to the United States. The production of melons in Costa Rica has grown steadily in recent years because of high international demand and favorable export prices. Melon producers in Costa Rica use a high level of technology, including the use of new hybrid seeds. As a result, yields and quality have improved, especially for cantaloupe melons.

Guatemala's horticultural export sector is the second largest in Central America after Costa Rica. Guatemala exports a variety of fruits and vegetables in fresh and frozen form. Principal fruit and vegetable exports are bananas, broccoli, melons, plantains, and okra. Exports of horticultural products are made by large, independent, producers and by cooperatives comprised of smaller producers.

Honduras enjoys a variety of micro-climates ideal for the production of several fruits and winter vegetables, and its proximity to the U.S. market enhances export opportunities. Other than bananas and plantains, melons, pineapple, ornamental plants, and frozen concentrated orange juice are the largest items exported to the United States. Despite some shortcomings, production and exports of horticultural products are expected to continue to grow at a healthy pace as Honduras improves its market capabilities.

*CBI Countries Melon Exports to the U.S.*

More than 93% of the CBI countries melon exports to the U.S. are shipped during the December - May period. Because Mexican exports to the U.S. are shipped in the same season they compete for the U.S. market. As discussed above, CBI countries have increased their share of the U.S. cantaloupe and honeydew market while displacing Mexico melons. Watermelon exports of CBI countries have also increased, but their share is still low at about 5%.

CBI countries annual exports of cantaloupe and honeydew to the United States over the 1970-1994 period are shown in tables 2.38 and 2.39. Exports of cantaloupe and honeydew have grown tremendously. Cantaloupe exports to the United States increased from 11.57 million pounds in 1970-1971 to 341 million pounds in 1993-1994, a 29 times increase (table 2.38). Honeydew exports increased from 1.21 million pounds in 1970-1971 to 141.12 million pounds in 1993-1994, a 120 times increase (table 2.39). This dramatic increase in exports significantly increased the CBI countries share of the U.S. market.

*Farm Price, Yields and Income*

As Rosa observed, the CBI countries melon industries have grown steadily in recent years because of high international demand, favorable prices, and high levels of technology. In fact, the real farm price index for the CBI countries showed an upward trend for both cantaloupe and honeydew over the 1970-1994 period (tables 2.38 and 2.39). The cantaloupe price index increased 46% during 1970-1994 period, while the honeydew price index grew 160% in the same period. Part of this price increase may be attributable to CBI countries' exchange rate policies. During 1970-1994, the real exchange rate of CBI countries showed an average devaluation with respect to the U.S. dollar of about 65%, thus impacting positively the perceived domestic farm prices.

Melon yields in the CBI countries have increased dramatically as a result of domestic and foreign investment. Cantaloupe yields increased from an annual average of 4.05 ton/ha in 1970-1971 to 18.89 ton/ha in 1993-1994, a 366% increase (table 2.38). It is important to note that, in 1970-1971, Mexico cantaloupe yields were 150% higher than CBI countries' cantaloupe yields. However, in 1993-1994, after continuous growth in productivity, CBI yields surpassed Mexican yields by 42%.

Growth in honeydew yields has been even more significant. Honeydew yields in CBI countries grew from 1.09 ton/ha in 1970-1971 to 15.89 ton/ha in 1993-1994, a 1,480% increase (table 2.39). This improvement in productivity and related reduction in per unit cost, has undoubtedly contributed to the ability of the CBI countries melon industries to gain a significant share of the U.S. market.

The expansion of the melon industries in CBI countries is based on the export market. Domestic demand not only is small in terms of population (Costa Rica 3 million, Honduras 5.7 million, and Guatemala 10 million), but also in terms of purchasing power. During 1970-1994, real income grew only 12% (table 2.38).

## Summary

An analysis of melon sector characteristics of Mexico, U.S., and CBI countries are presented. Changes in melon production in Mexico are explained by changes in harvested area. Cantaloupe and watermelon yields have shown modest growth, increasing at annual rates close to zero. Possible reasons and consequences of the low Mexican productivity were discussed. The focus on the Mexican melon industry is in the Fall-Winter season, since it is during this period that Mexico is involved in international trade. During the Mexican Spring-Summer season the melon industry is focused on the domestic market.

Possible competition between Mexican imports and U.S. production in the U.S. market during the December-May period were analyzed. Monthly and weekly cantaloupe and honeydew shipment data showed Mexican imports complemented U.S. shipments; however, competition does exist between import sources, in particular, Mexico and CBI countries. For watermelon, imports from Mexico compete with U.S. shipments for market share. In general, Mexico's share of the U.S cantaloupe, honeydew, and watermelon markets has significantly declined over time.

Analysis of CBI countries melon industries reflects a tremendous increase in cantaloupe and honeydew exports to the United States. Possible reasons for this situation are technology improvements, higher farm price, gradual and continuous currency devaluation, and better knowledge of market rules and requirements.

A review of existing literature regarding melon studies in Mexico, United States and CBI countries is presented in the following section.

**Table 2.1. Mexican Cantaloupe Area Harvested, Average Yields and Production, 1970-1994**

| Year | Area Harvested | Production | Average Yields |
|---|---|---|---|
| | ---------hectares------- | -----------ton----------- | ----------ton/ha-------- |
| 1970 | 16,621 | 163,114 | 9.81 |
| 1971 | 17,693 | 175,110 | 9.90 |
| 1972 | 17,231 | 206,912 | 12.01 |
| 1973 | 18,030 | 212,981 | 11.81 |
| 1974 | 18,532 | 216,195 | 11.67 |
| 1975 | 13,705 | 170,525 | 12.44 |
| 1976 | 15,647 | 187,370 | 11.97 |
| 1977 | 17,940 | 249,040 | 13.88 |
| 1978 | 26,321 | 354,264 | 13.46 |
| 1979 | 25,621 | 353,476 | 13.80 |
| 1980 | 27,052 | 319,952 | 11.83 |
| 1981 | 21,901 | 321,831 | 14.69 |
| 1982 | 23,922 | 293,119 | 12.25 |
| 1983 | 23,221 | 315,209 | 13.57 |
| 1984 | 27,143 | 328,929 | 12.12 |
| 1985 | 26,056 | 331,789 | 12.73 |
| 1986 | 32,510 | 384,017 | 11.81 |
| 1987 | 28,663 | 339,541 | 11.86 |
| 1988 | 36,393 | 436,819 | 12.00 |
| 1989 | 38,843 | 496,435 | 12.78 |
| 1990 | 40,417 | 523,194 | 12.94 |
| 1991 | 51,506 | 645,254 | 12.53 |
| 1992 | 42,816 | 495,732 | 11.58 |
| 1993 | 30,047 | 394,216 | 13.12 |
| 1994 | 30,727 | 446,674 | 14.54 |
| Average | 26,800 | 335,667 | 12.46 |

Source: SARH. Subsecretaría de Planeación. *Anuarios Estadísticos de la Producción Agrícola de Los Estados Unidos Mexicanos*. México, D.F. Several Issues

**Table 2.2. Mexican Watermelon Area Harvested, Average Yields and Production, 1970-1994**

| Year | Area Harvested | Production | Average Yields |
|---|---|---|---|
| | --------hectares-------- | -----------ton----------- | ---------ton/ha--------- |
| 1970 | 19,636 | 203,605 | 10.37 |
| 1971 | 24,823 | 335,320 | 13.51 |
| 1972 | 25,593 | 281,530 | 11.00 |
| 1973 | 31,956 | 310,481 | 9.72 |
| 1974 | 25,939 | 312,623 | 12.05 |
| 1975 | 20,995 | 273,568 | 13.03 |
| 1976 | 23,663 | 325,118 | 13.74 |
| 1977 | 28,185 | 372,955 | 13.23 |
| 1978 | 33,134 | 474,435 | 14.32 |
| 1979 | 35,587 | 522,098 | 14.67 |
| 1980 | 29,320 | 446,598 | 15.23 |
| 1981 | 23,704 | 337,919 | 14.26 |
| 1982 | 31,636 | 470,539 | 14.87 |
| 1983 | 29,581 | 366,415 | 12.39 |
| 1984 | 37,451 | 494,859 | 13.21 |
| 1985 | 34,617 | 421,753 | 12.18 |
| 1986 | 32,217 | 388,208 | 12.05 |
| 1987 | 35,536 | 494,928 | 13.93 |
| 1988 | 34,618 | 460,073 | 13.29 |
| 1989 | 38,183 | 503,732 | 13.19 |
| 1990 | 29,705 | 404,077 | 13.60 |
| 1991 | 31,787 | 392,688 | 12.35 |
| 1992 | 41,805 | 499,047 | 11.94 |
| 1993 | 28,498 | 387,554 | 13.60 |
| 1994 | 29,097 | 427,957 | 14.71 |
| Average | 30,291 | 397,481 | 13.09 |

Source: SARH. Subsecretaría de Planeación. *Anuarios Estadísticos de la Producción Agrícola de Los Estados Unidos Mexicanos*. México, D.F. Several Issues

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**Table 2.3. Mexican Cantaloupe Production by Season**

| Year | Annual Production | Spring-Summer Production | Spring-Summer Production Share | Fall-Winter Production | Fall-Winter Production Share |
|---|---|---|---|---|---|
| | -----ton----- | -------ton------ | -------%------- | -------ton------- | ---------%--------- |
| 1970 | 163,114 | -- | -- | -- | -- |
| 1971 | 175,110 | -- | -- | -- | -- |
| 1972 | 206,912 | 51,393 | 24.84 | 155,519 | 75.16 |
| 1973 | 212,981 | 38,739 | 18.19 | 174,242 | 81.81 |
| 1974 | 216,195 | 32,001 | 14.80 | 184,194 | 85.20 |
| 1975 | 170,525 | 55,401 | 32.49 | 115,124 | 67.51 |
| 1976 | 187,370 | 44,081 | 23.53 | 143,289 | 76.47 |
| 1977 | 249,040 | 79,831 | 32.06 | 169,209 | 67.94 |
| 1978 | 354,264 | 66,408 | 18.75 | 287,856 | 81.25 |
| 1979 | 353,476 | 89,288 | 25.26 | 264,188 | 74.74 |
| 1980 | 319,952 | 107,149 | 33.49 | 212,803 | 66.51 |
| 1981 | 321,831 | 130,107 | 40.43 | 191,724 | 59.57 |
| 1982 | 293,119 | 110,621 | 37.74 | 182,498 | 62.26 |
| 1983 | 315,209 | 145,127 | 46.04 | 170,082 | 53.96 |
| 1984 | 328,929 | 107,971 | 32.83 | 220,958 | 67.17 |
| 1985 | 331,789 | 111,151 | 33.50 | 220,638 | 66.50 |
| 1986 | 384,017 | -- | -- | -- | -- |
| 1987 | 339,541 | -- | -- | -- | -- |
| 1988 | 436,819 | -- | -- | -- | -- |
| 1989 | 496,435 | 154,838 | 31.19 | 341,597 | 68.81 |
| 1990 | 523,194 | 198,200 | 37.88 | 324,994 | 62.12 |
| 1991 | 645,254 | 227,079 | 35.19 | 418,175 | 64.81 |
| 1992 | 495,732 | 260,472 | 52.54 | 235,260 | 47.46 |
| 1993 | 394,216 | 172,639 | 43.79 | 221,577 | 56.21 |
| 1994 | 446,674 | 218,080 | 48.82 | 228,594 | 51.18 |
| Season Average (%) | | | 33.17 | | 66.83 |

-- = Not available at the season level.
Source: SARH. Subsecretaría de Planeación. *Anuarios Estadísticos de la Producción Agrícola de Los Estados Unidos Mexicanos*. México, D.F. Several Issues.

**Table 2.4. Mexican Watermelon Production by Season**

| Year | Annual Production | Spring-Summer Production | Spring-Summer Production Share | Fall-Winter Production | Fall-Winter Production Share |
|---|---|---|---|---|---|
| | -----ton----- | -------ton------ | -------%------- | -------ton------- | ---------%--------- |
| 1970 | 203,605 | -- | -- | -- | -- |
| 1971 | 335,320 | -- | -- | -- | -- |
| 1972 | 281,530 | 75,390 | 26.78 | 206,140 | 73.22 |
| 1973 | 310,481 | 80,332 | 25.87 | 230,149 | 74.13 |
| 1974 | 312,623 | 42,468 | 13.58 | 270,155 | 86.42 |
| 1975 | 273,568 | 56,330 | 20.59 | 217,238 | 79.41 |
| 1976 | 325,118 | 43,088 | 13.25 | 282,030 | 86.75 |
| 1977 | 372,955 | 114,382 | 30.67 | 258,573 | 69.33 |
| 1978 | 474,435 | 105,970 | 22.34 | 368,465 | 77.66 |
| 1979 | 552,098 | 81,798 | 14.82 | 470,300 | 85.18 |
| 1980 | 446,598 | 90,388 | 20.24 | 356,210 | 79.76 |
| 1981 | 337,919 | 91,120 | 26.97 | 246,799 | 73.03 |
| 1982 | 470,539 | 133,327 | 28.33 | 337,212 | 71.67 |
| 1983 | 366,415 | 101,299 | 27.65 | 265,116 | 72.35 |
| 1984 | 494,859 | 83,314 | 16.84 | 411,545 | 83.16 |
| 1985 | 421,753 | 89,847 | 21.30 | 331,906 | 78.70 |
| 1986 | 388,208 | -- | -- | -- | -- |
| 1987 | 494,928 | -- | -- | -- | -- |
| 1988 | 460,073 | -- | -- | -- | -- |
| 1989 | 503,732 | 184,807 | 36.69 | 318,925 | 63.31 |
| 1990 | 404,077 | 136,590 | 33.80 | 267,487 | 66.20 |
| 1991 | 392,688 | 126,647 | 32.25 | 266,041 | 67.75 |
| 1992 | 499,047 | 256,148 | 51.33 | 242,899 | 48.67 |
| 1993 | 387,554 | 121,931 | 31.46 | 265,623 | 68.54 |
| 1994 | 427,957 | 149,688 | 34.98 | 278,269 | 65.02 |
| Season Average (%) | | | 26.49 | | 73.51 |

-- = Not available at the season level.
Source: SARH. Subsecretaría de Planeación. *Anuarios Estadísticos de la Producción Agrícola de Los Estados Unidos Mexicanos*. México, D.F. Several Issues.

**Table 2.5. Mexican Cantaloupe Production by State**

| State | 1985-1989 Production Average | State Share | 1990-1994 Production Average | State Share |
|---|---|---|---|---|
| | ----------ton-------- | ----------%-------- | ---------ton--------- | ------------%--------- |
| Michoacan | 81,483 | 20.49 | 51,207 | 10.22 |
| Sinaloa | 35,317 | 8.88 | 26,091 | 5.21 |
| Durango | 30,448 | 7.66 | 69,017 | 13.78 |
| Guerrero | 30,177 | 7.59 | 51,967 | 10.37 |
| Oaxaca | 28,645 | 7.20 | 32,729 | 6.53 |
| Tamaulipas | 27,048 | 6.80 | 22,837 | 4.56 |
| Coahuila | 24,356 | 6.12 | 26,091 | 8.48 |
| Nayarit | 24,039 | 6.04 | 31,370 | 6.26 |
| Colima | 22,627 | 5.69 | 29,003 | 5.79 |
| Baja Cal. Norte | 22,476 | 5.65 | 17,196 | 3.43 |
| Sonora | 22,142 | 5.57 | 54,932 | 10.96 |
| Jalisco | 12,972 | 3.26 | 9,648 | 1.93 |
| Chiapas | 7,778 | 1.96 | 25,815 | 5.15 |
| Morelos | 1,505 | 0.38 | 853 | 0.17 |
| Others | 26,707 | 6.71 | 35,865 | 7.16 |
| Total | 397,720 | 100.00 | 501,014 | 100.00 |

Source: SARH. Subsecretaría de Planeación. *Anuarios Estadísticos de la Producción Agrícola de Los Estados Unidos Mexicanos*. México, D.F. Several Issues.

**Table 2.6. Mexican Watermelon Production by State**

| State | 1985-1989 Production Average | State Share | 1990-1994 Production Average | State Share |
|---|---|---|---|---|
| | ---------ton--------- | ---------%--------- | ---------ton--------- | -----------%---------- |
| Sonora | 68,059 | 15.00 | 65,818 | 15.59 |
| Sinaloa | 58,406 | 12.87 | 29,408 | 6.96 |
| Jalisco | 56,712 | 12.50 | 40,146 | 9.51 |
| Chiapas | 43,639 | 9.62 | 21,549 | 5.10 |
| Veracruz | 38,733 | 8.54 | 55,345 | 13.11 |
| Nayarit | 26,976 | 5.95 | 20,728 | 4.91 |
| Coahuila | 22,436 | 4.94 | 15,088 | 3.57 |
| Oaxaca | 20,012 | 4.41 | 31,262 | 7.40 |
| Guerrero | 17,130 | 3.78 | 20,824 | 4.93 |
| Durango | 16,857 | 3.72 | 16,679 | 3.95 |
| Tabasco | 15,126 | 3.33 | 23,166 | 5.49 |
| Yucatan | 7,848 | 1.73 | 11,108 | 2.63 |
| Michoacan | 6,881 | 1.52 | 2,491 | 0.59 |
| Tamaulipas | 5,874 | 1.29 | 7,335 | 1.74 |
| Others | 49,050 | 10.81 | 61,317 | 14.52 |
| Total | 453,739 | 100.00 | 422,265 | 100.00 |

Source: SARH. Subsecretaría de Planeación. *Anuarios Estadísticos de la Producción Agrícola de Los Estados Unidos Mexicanos*. México, D.F. Several Issues.

**Table 2.7. Mexican Cantaloupe Production, Consumption and Exports, 1970-1994**

| Year | Production[1] | Consumption | Exports[2] | Exports Share |
|---|---|---|---|---|
| | ---------ton-------- | -----------ton----------- | ---------ton--------- | -----------%---------- |
| 1970 | 163,114 | 96,076 | 67,038 | 41.10 |
| 1971 | 175,110 | 94,094 | 81,016 | 46.27 |
| 1972 | 206,912 | 137,293 | 69,619 | 33.65 |
| 1973 | 212,981 | 141,944 | 71,037 | 33.35 |
| 1974 | 216,195 | 140,607 | 75,588 | 34.96 |
| 1975 | 170,525 | 107,687 | 62,838 | 36.85 |
| 1976 | 187,370 | 124,829 | 62,541 | 33.38 |
| 1977 | 249,040 | 167,769 | 81,271 | 32.63 |
| 1978 | 354,264 | 267,044 | 87,220 | 24.62 |
| 1979 | 353,476 | 267,351 | 86,125 | 24.37 |
| 1980 | 319,952 | 244,596 | 75,356 | 23.55 |
| 1981 | 321,831 | 260,274 | 61,557 | 19.13 |
| 1982 | 293,119 | 212,525 | 80,594 | 27.50 |
| 1983 | 315,209 | 245,536 | 69,673 | 22.10 |
| 1984 | 328,929 | 229,222 | 99,707 | 30.31 |
| 1985 | 331,789 | 243,112 | 88,677 | 26.73 |
| 1986 | 384,017 | 266,891 | 117,126 | 30.50 |
| 1987 | 339,541 | 233,514 | 106,027 | 31.23 |
| 1988 | 436,819 | 333,011 | 103,808 | 23.76 |
| 1989 | 496,435 | 349,440 | 146,995 | 29.61 |
| 1990 | 523,194 | 376,444 | 146,750 | 28.05 |
| 1991 | 645,254 | 481,610 | 163,644 | 25.36 |
| 1992 | 495,732 | 395,501 | 100,231 | 20.22 |
| 1993 | 394,216 | 325,941 | 68,275 | 17.32 |
| 1994 | 446,674 | 379,836 | 66,838 | 14.96 |
| Exports Period Average (%) | | | | 28.46 |

[1]Source: SARH. Subsecretaría de Planeación. *Anuarios Estadísticos de la Producción Agrícola de Los Estados Unidos Mexicanos*. México, D.F. Several Issues.

[2]Source: Pollack, S. and L. Calvin. *U.S.-Mexico Fruit and Vegetable Trade, 1970-1992*. USDA, ERS. Washington, DC, 1995; and Bureau of the Census, U.S. Department of Commerce (1993,1994).

**Table 2.8. Mexican Watermelon Production, Consumption and Exports, 1970-1994**

| Year | Production[1] | Consumption | Exports[2] | Exports Share |
|---|---|---|---|---|
| | --------ton--------- | -----------ton----------- | ---------ton--------- | -----------%---------- |
| 1970 | 203,605 | 150,206 | 53,399 | 26.23 |
| 1971 | 335,320 | 284,730 | 50,590 | 15.09 |
| 1972 | 281,530 | 209,488 | 72,042 | 25.59 |
| 1973 | 310,481 | 234,334 | 76,147 | 24.53 |
| 1974 | 312,623 | 237,515 | 75,108 | 24.03 |
| 1975 | 273,568 | 208,228 | 65,340 | 23.88 |
| 1976 | 325,118 | 239,613 | 85,505 | 26.30 |
| 1977 | 372,955 | 293,425 | 79,530 | 21.32 |
| 1978 | 474,435 | 383,934 | 90,501 | 19.08 |
| 1979 | 552,098 | 452,820 | 99,278 | 17.98 |
| 1980 | 446,598 | 353,407 | 93,191 | 20.87 |
| 1981 | 337,919 | 281,102 | 56,817 | 16.81 |
| 1982 | 470,539 | 362,930 | 107,609 | 22.87 |
| 1983 | 366,415 | 282,108 | 84,307 | 23.01 |
| 1984 | 494,859 | 366,954 | 127,905 | 25.85 |
| 1985 | 421,753 | 324,997 | 96,756 | 22.94 |
| 1986 | 388,208 | 307,603 | 80,605 | 20.76 |
| 1987 | 494,928 | 361,111 | 133,817 | 27.04 |
| 1988 | 460,073 | 344,551 | 115,522 | 25.11 |
| 1989 | 503,732 | 347,165 | 156,567 | 31.08 |
| 1990 | 404,077 | 304,920 | 99,157 | 24.54 |
| 1991 | 392,688 | 292,165 | 100,523 | 25.60 |
| 1992 | 499,047 | 417,282 | 81,765 | 16.38 |
| 1993 | 387,554 | 303,071 | 84,483 | 21.80 |
| 1994 | 427,957 | 321,243 | 106,714 | 24.94 |
| Exports Period Average (%) | | | | 28.94 |

[1]Source: SARH. Subsecretaría de Planeación. *Anuarios Estadísticos de la Producción Agrícola de Los Estados Unidos Mexicanos*. México, D.F. Several Issues.

[2]Source: Pollack, S. and L. Calvin. *U.S.-Mexico Fruit and Vegetable Trade, 1970-1992*. USDA, ERS. Washington, DC, 1995; and Bureau of the Census, U.S. Department of Commerce (1993,1994).

**Table 2.9. Mexican Cantaloupe Exports by Month**

| Month | 1985/1986 Harvest Season | Month Share | 1989/1990 Harvest Season | Month Share |
|---|---|---|---|---|
| | ---------ton---------- | ----------%--------- | ---------ton--------- | -----------%---------- |
| October | 558 | 0.45 | 225 | 0.17 |
| November | 1,369 | 1.11 | 5,201 | 3.98 |
| December | 2,774 | 2.23 | 8,188 | 6.26 |
| January | 10,508 | 8.55 | 6,951 | 5.31 |
| February | 6,740 | 5.84 | 8,371 | 6.40 |
| March | 17,909 | 14.57 | 18,078 | 13.82 |
| April | 59,728 | 48.59 | 34,568 | 26.43 |
| May | 17,293 | 14.07 | 30,914 | 23.63 |
| June | 6,005 | 4.89 | 9,668 | 7.39 |
| July | 62 | 0.05 | 8,126 | 6.21 |
| August | 0 | 0.00 | 369 | 0.28 |
| September | 0 | 0.00 | 155 | 0.12 |
| ***Dec - May*** | 114,952 | 93.85 | 107,070 | 81.85 |
| ***Rest of Year*** | 7,994 | 6.15 | 23,744 | 18.15 |
| Total | 122,919 | 100.00 | 130,816 | 100.00 |

Source: CNPH. *Boletín Anual Temporada 1985-86*, and CNPH. *Boletín Anual Temporada 1989-90*. Culiacán, Sinaloa, México.

**Table 2.10. Mexican Honeydew Exports by Month**

| Month | 1985/1986[1] Harvest Season | Month Share | 1989/1990 Harvest Season | Month Share |
|---|---|---|---|---|
| | ---------ton---------- | ---------%---------- | ---------ton--------- | -----------%---------- |
| October | 79 | 1.91 | 711 | 1.75 |
| November | 72 | 1.72 | 5,814 | 14.31 |
| December | 468 | 11.28 | 6,140 | 15.11 |
| January | 533 | 12.86 | 2,598 | 6.39 |
| February | 153 | 3.68 | 925 | 2.27 |
| March | 766 | 18.48 | 6,286 | 15.47 |
| April | 1,821 | 43.94 | 7,918 | 19.48 |
| May | 166 | 3.99 | 8,957 | 22.04 |
| June | 88 | 2.11 | 1,283 | 3.16 |
| July | 0 | 0.00 | 0 | 0.00 |
| August | 0 | 0.00 | 0 | 0.00 |
| September | 0 | 0.00 | 0 | 0.00 |
| ***Dec - May*** | 3,907 | 94.23 | 32,824 | 80.76 |
| ***Rest of Year*** | 238 | 5.77 | 7,808 | 19.24 |
| Total | 4,145 | 100.00 | 40,631 | 100.00 |

Source: CNPH. *Boletín Anual Temporada 1985-86*, and CNPH. *Boletín Anual Temporada 1989-90*. Culiacán, Sinaloa, México.

[1]Exports for this season are significantly different from U.S. source. However, they are included to offer perspective on importance of various months.

**Table 2.11. Mexican Watermelon Exports by Month**

| Month | 1985/1986 Harvest Season | Month Share | 1989/1990 Harvest Season | Month Share |
|---|---|---|---|---|
| | ---------ton---------- | ---------%---------- | ---------ton--------- | ------------%--------- |
| October | 25 | 0.02 | 337 | 0.30 |
| November | 2,765 | 3.10 | 1,157 | 1.05 |
| December | 2,538 | 2.84 | 3,838 | 3.50 |
| January | 3,163 | 3.54 | 10,763 | 9.83 |
| February | 7,358 | 8.25 | 7,305 | 6.67 |
| March | 14,129 | 15.85 | 18,552 | 16.94 |
| April | 29,945 | 33.59 | 22,251 | 20.32 |
| May | 21,024 | 23.59 | 36,535 | 33.36 |
| June | 7,649 | 8.58 | 4,261 | 3.89 |
| July | 417 | 0.46 | 1,260 | 1.15 |
| August | 0 | 0.00 | 101 | 0.09 |
| September | 119 | 0.13 | 139 | 0.12 |
| ***Dec - May*** | 78,157 | 87.66 | 99,244 | 90.62 |
| ***Rest of Year*** | 10,975 | 12.34 | 10,255 | 9.38 |
| Total | 89,132 | 100.00 | 109,499 | 100.00 |

Source: CNPH. *Boletín Anual Temporada 1985-86*, and CNPH. *Boletín Anual Temporada 1989-90*. Culiacán, Sinaloa, México.

**Table 2.12. Mexican Cantaloupe Exports by State**

| State | 1985/1986 Harvest Season | State Share | 1989/1990 Harvest Season | State Share |
|---|---|---|---|---|
| | ----------ton--------- | ----------%-------- | ---------ton-------- | -----------%---------- |
| Michoacan | 51,864 | 42.19 | 26,506 | 20.26 |
| Sinaloa | 16,624 | 13.52 | 20,919 | 15.99 |
| Colima | 12,373 | 10.07 | 17,465 | 13.35 |
| Tamaulipas | 12,350 | 10.05 | 9,900 | 7.57 |
| Guerrero | 8,469 | 6.89 | 14,271 | 10.91 |
| Sonora | 7,301 | 5.94 | 21,392 | 16.35 |
| Jalisco | 6,378 | 5.19 | 845 | 0.65 |
| Nayarit | 2,721 | 2.21 | 7,246 | 5.54 |
| Oaxaca | 2,373 | 1.93 | 5,968 | 4.53 |
| Baja Cal. Norte | 1,816 | 1.48 | 4,818 | 3.68 |
| Others | 650 | 0.53 | 1,486 | 1.17 |
| Total | 122,919 | 100.00 | 130,816 | 100.00 |

Source: CNPH. *Boletín Anual Temporada 1985-86*, and CNPH. *Boletín Anual Temporada 1989-90*.
Source: CNPH. *Boletín Anual Temporada 1985-86*, and CNPH. *Boletín Anual Temporada 1989-90*.
Culiacán, Sinaloa, México. Culiacán, Sinaloa, México.

**Table 2.13. Mexican Honeydew Melon Exports by State**

| State | 1985/1986[1] Harvest Season | State Share | 1989/1990 Harvest Season | State Share |
|---|---|---|---|---|
| | ----------ton-------- | ---------%--------- | --------ton--------- | ----------%----------- |
| Michoacan | 1,237 | 29.85 | 3,103 | 7.64 |
| Colima | 1,000 | 24.12 | 1,564 | 3.85 |
| Oaxaca | 962 | 23.19 | 5,604 | 13.79 |
| Sonora | 248 | 5.98 | 12,529 | 30.84 |
| Tamaulipas | 184 | 4.43 | 1,827 | 4.49 |
| Nayarit | 171 | 4.12 | 140 | 0.35 |
| Baja Cal. Norte | 139 | 3.36 | 877 | 2.15 |
| Jalisco | 103 | 2.48 | 0 | 0 |
| Guerrero | 0 | 0 | 13,644 | 33.58 |
| Others | 101 | 2.47 | 1,343 | 3.31 |
| Total | 4,145 | 100.00 | 40,631 | 100.00 |

Source: CNPH. *Boletín Anual Temporada 1985-86*, and CNPH. *Boletín Anual Temporada 1989-90*. Culiacán, Sinaloa, México.

[1]Exports for this season are significantly different from U.S. source. However, they are included to gain perspective on exports by state.

**Table 2.14. Mexican Watermelon Exports by State**

| State | 1985/1986 Harvest Season | State Share | 1989/1990 Harvest Season | State Share |
|---|---|---|---|---|
| | ---------ton--------- | ---------%---------- | ---------ton-------- | -----------%---------- |
| Sonora | 25,151 | 28.21 | 37,970 | 24.67 |
| Sinaloa | 18,166 | 20.38 | 11,192 | 10.22 |
| Jalisco | 17,938 | 20.12 | 23,555 | 21.51 |
| Veracruz | 13,706 | 15.37 | 13,396 | 12.23 |
| Nayarit | 6,858 | 7.70 | 5,803 | 5.32 |
| Tabasco | 1,782 | 2.00 | 7,162 | 6.54 |
| Baja Cal. Norte | 1,691 | 1.90 | 4,825 | 4.42 |
| Oaxaca | 1,323 | 1.42 | 1,429 | 1.30 |
| Tamaulipas | 632 | 0.72 | 2,440 | 2.20 |
| Others | 1,885 | 2.18 | 1,727 | 11.59 |
| Total | 89,132 | 100.00 | 109,499 | 100.00 |
| Total | 122,919 | 100.00 | 130,816 | 100.00 |

Source: CNPH. *Boletín Anual Temporada 1985-86*, and CNPH. *Boletín Anual Temporada 1989-90*. Culiacán, Sinaloa, México.

**Table 2.15. NAFTA Provisions for Melons**

| Item | Season | Tariff | Phase-out | Safeguard base[1] |
|---|---|---|---|---|
| Cantaloupe | Jan 1-May 15 | Free | Immediately | N/A |
| Cantaloupe | May 16-Jul 31 | 35.0% | 15 Years | N/A |
| Cantaloupe | Aug 1-Sep 15 | 20.0% | 10 Years | N/A |
| Cantaloupe | Sep 16-Nov 30 | 35.0% | 15 Years | N/A |
| Cantaloupe | Dec 1-Dec 31 | 35.0% | Immediately | N/A |
| Watermelon | Dec 1-Mar 31 | 20.0% | Immediately | N/A |
| Watermelon | Apr 1-Apr 30 | 20.0% | Immediately | N/A |
| Watermelon | May 1-Sept 30 | 20.0% | 10 Years | 54,400 mt |
| Watermelon | Oct 1-Nov 30 | 20.0% | Immediately | N/A |
| Other Melons | Dec 1-Apr 30 | 8.5% | 5 Years | N/A |
| Other Melons | May 1-May 31 | 8.5% | 10 Years | N/A |
| Other Melons | Jun 1-Nov 30 | 35.0% | 15 Years | N/A |

[1]Will Increase by 3 Percent Annually, Compounded.
Note: There are no non-tariff barriers affecting trade in melons.

**Table 2.16. Mexican Cantaloupe Supply Intended for Export, Yields and Farm Price, 1970-1994**

| Year | Production[1] | Yields[2] | Real Farm Price[2] (1990=100) |
|---|---|---|---|
| | -------------ton------------ | ----------ton/ha---------- | -------pesos/ton-------- |
| 1970 | 119,837 | 10.22 | 0.4874 |
| 1971 | 109,108 | 10.18 | 0.4661 |
| 1972 | 149,967 | 12.71 | 0.5068 |
| 1973 | 158,151 | 13.16 | 0.5126 |
| 1974 | 156,342 | 12.62 | 0.4316 |
| 1975 | 108,048 | 12.43 | 0.6204 |
| 1976 | 138,626 | 13.17 | 0.7165 |
| 1977 | 165,020 | 13.44 | 0.5849 |
| 1978 | 262,598 | 13.83 | 0.5074 |
| 1979 | 225,925 | 14.37 | 0.6016 |
| 1980 | 187,431 | 10.89 | 0.5970 |
| 1981 | 178,585 | 13.62 | 0.6334 |
| 1982 | 174,630 | 11.99 | 0.6638 |
| 1983 | 182,721 | 13.32 | 0.9951 |
| 1984 | 210,461 | 11.47 | 0.6918 |
| 1985 | 192,603 | 12.19 | 0.6105 |
| 1986 | 236,127 | 11.31 | 0.5810 |
| 1987 | 191,635 | 11.67 | 0.6012 |
| 1988 | 268,365 | 11.45 | 0.5832 |
| 1989 | 279,590 | 12.14 | 0.7077 |
| 1990 | 256,614 | 12.44 | 0.7580 |
| 1991 | 304,566 | 13.11 | 0.7015 |
| 1992 | 205,382 | 10.66 | 0.6977 |
| 1993 | 171,558 | 12.06 | 0.8067 |
| 1994 | 172,496 | 14.44 | 0.6239 |
| Average | 192,255 | 12.35 | |

[1]Source: SARH. Subsecretaría de Planeación. *Anuarios Estadísticos de la Producción Agrícola de Los Estados Unidos Mexicanos*. México, D.F. Several Issues. The Production corresponds to the sum of production of the states of Michoacan, Sinaloa, Colima, Guerrero, Tamaulipas, Nayarit, and Jalisco.

[2]Source: SARH. Subsecretaría de Planeación. *Anuarios Estadísticos de la Producción Agrícola de Los Estados Unidos Mexicanos*. México, D.F. Several Issues. The Yields and Farm Price correspond to the weighted averages of yields and farm prices of the states of Michoacan, Sinaloa, Colima, Guerrero, Tamaulipas, Nayarit, and Jalisco.

**Table 2.17. Mexican Watermelon Supply Intended for Export, Yields and Farm Price, 1970-1994**

| Year | Production[1] | Yields[2] | Real Farm Price[2] (1990=100) |
|---|---|---|---|
| | ------------ton----------- | ----------ton/ha---------- | -------pesos/ton-------- |
| 1970 | 64,158 | 10.32 | 0.4407 |
| 1971 | 99,950 | 11.11 | 0.4558 |
| 1972 | 105,002 | 10.89 | 0.4264 |
| 1973 | 123,604 | 8.97 | 0.3813 |
| 1974 | 167,940 | 14.22 | 0.3825 |
| 1975 | 129,690 | 15.49 | 0.4377 |
| 1976 | 142,324 | 17.15 | 0.3395 |
| 1977 | 162,715 | 14.49 | 0.4575 |
| 1978 | 277,704 | 14.34 | 0.4610 |
| 1979 | 239,616 | 14.30 | 0.4795 |
| 1980 | 195,010 | 14.38 | 0.4301 |
| 1981 | 113,561 | 12.31 | 0.4829 |
| 1982 | 142,234 | 12.61 | 0.4496 |
| 1983 | 159,203 | 11.75 | 0.7603 |
| 1984 | 268,756 | 13.56 | 0.4430 |
| 1985 | 188,014 | 11.19 | 0.4322 |
| 1986 | 176,105 | 11.12 | 0.4123 |
| 1987 | 264,004 | 16.84 | 0.5212 |
| 1988 | 298,119 | 13.69 | 0.5572 |
| 1989 | 288,308 | 12.90 | 0.5450 |
| 1990 | 220,557 | 14.94 | 0.5540 |
| 1991 | 204,971 | 12.42 | 0.5612 |
| 1992 | 286,399 | 11.46 | 0.5193 |
| 1993 | 183,649 | 14.11 | 0.4940 |
| 1994 | 210,514 | 13.74 | 0.5358 |
| Average | 188,484 | 13.13 | |

[1]Source: SARH. Subsecretaría de Planeación. *Anuarios Estadísticos de la Producción Agrícola de Los Estados Unidos Mexicanos*. México, D.F. Several Issues. The Production corresponds to the sum of production of the states of Sinaloa, Jalisco, Sonora, Veracruz, Tabasco and Tamaulipas.

[2]Source: SARH. Subsecretaría de Planeación. *Anuarios Estadísticos de la Producción Agrícola de Los Estados Unidos Mexicanos*. México, D.F. Several Issues. The Yields and Farm Price correspond to the weighted averages of yields and farm prices of the states of Sinaloa, Jalisco, Sonora, Veracruz, Tabasco and Tamaulipas.

**Table 2.18. Mexican Labor and Fertilizer Costs, 1970-1994**

| Year | Labor Cost[1] (1990=100) | Labor Cost Index | Fertilizer Cost[2] (1990=100) | Fertilizer Cost Index |
|---|---|---|---|---|
| | -----pesos/day---- | | ------pesos/ton----- | |
| 1970 | 18.76 | 2.18 | 1147.01 | 2.75 |
| 1971 | 17.82 | 2.07 | 919.94 | 2.20 |
| 1972 | 20.08 | 2.34 | 857.26 | 2.05 |
| 1973 | 20.74 | 2.41 | 750.10 | 1.80 |
| 1974 | 19.78 | 2.30 | 687.73 | 1.65 |
| 1975 | 21.86 | 2.54 | 623.25 | 1.49 |
| 1976 | 21.93 | 2.55 | 616.37 | 1.48 |
| 1977 | 20.65 | 2.40 | 472.19 | 1.13 |
| 1978 | 20.51 | 2.39 | 606.95 | 1.45 |
| 1979 | 20.16 | 2.35 | 511.11 | 1.22 |
| 1980 | 18.99 | 2.21 | 473.40 | 1.13 |
| 1981 | 20.02 | 2.33 | 456.35 | 1.09 |
| 1982 | 19.49 | 2.27 | 380.09 | 0.91 |
| 1983 | 14.82 | 1.73 | 404.78 | 0.97 |
| 1984 | 13.37 | 1.56 | 377.78 | 0.90 |
| 1985 | 11.23 | 1.31 | 450.18 | 1.08 |
| 1986 | 11.21 | 1.31 | 428.89 | 1.03 |
| 1987 | 10.43 | 1.21 | 446.51 | 1.07 |
| 1988 | 9.50 | 1.11 | 428.22 | 1.03 |
| 1989 | 9.23 | 1.07 | 416.00 | 1.00 |
| 1990 | 8.59 | 1.00 | 417.76 | 1.00 |
| 1991 | 9.13 | 1.06 | 521.03 | 1.25 |
| 1992 | 8.84 | 1.03 | 564.97 | 1.35 |
| 1993 | 8.81 | 1.03 | 521.76 | 1.25 |
| 1994 | 8.82 | 1.03 | 593.69 | 1.42 |

[1]Source: Comision Nacional de los Salarios Minimos, Mexico, D.F. This is the Official Minimum Wage Deflated by The Wholesale Price Index of the Banco de Mexico.

[2]Source: Fertilizantes Mexicanos (FERTIMEX) (1970-1984); and SARH. *Boletin Mensual de Informacion Basica del Sector Agropecuario y Forestal.* Agosto, 1995.(1985-1994). Fertilizer cost represent the Cost of 46-00-00 fertilizer known commercially as Urea, Deflated by the Wholesale Price Index of the Banco de Mexico.

**Table 2.19. Mexican Cantaloupe Consumption, Retail Prices and Income for the Fall-Winter Season[1], 1970-1994**

| Year | Fall-Winter[2] Total Consumption | Fall-Winter Per capita Consumption | Fall-Winter[3] Retail Price (1990=100) | Per capita[4] Income (1990=100) |
|---|---|---|---|---|
| | ---------ton--------- | ---------kg---------- | -----pesos/kg----- | --------pesos-------- |
| 1970 | 55,495 | 1.133 | 1.03 | 5,539 |
| 1971 | 54,529 | 1.078 | 1.00 | 5,504 |
| 1972 | 85,901 | 1.644 | 0.99 | 5,764 |
| 1973 | 103,205 | 1.913 | 1.06 | 5,944 |
| 1974 | 108,648 | 1.863 | 0.88 | 5,811 |
| 1975 | 52,286 | 0.869 | 1.38 | 5,497 |
| 1976 | 80,748 | 1.303 | 1.35 | 6,084 |
| 1977 | 87,958 | 1.378 | 1.32 | 6,163 |
| 1978 | 200,636 | 3.056 | 1.09 | 6,385 |
| 1979 | 178,048 | 2.637 | 1.37 | 6,857 |
| 1980 | 137,448 | 1.981 | 1.39 | 8,556 |
| 1981 | 130,167 | 1.827 | 1.40 | 8,875 |
| 1982 | 131,884 | 1.804 | 1.44 | 8,494 |
| 1983 | 141,517 | 1.887 | 1.34 | 7,191 |
| 1984 | 121,056 | 1.576 | 1.28 | 7,093 |
| 1985 | 131,961 | 1.694 | 1.20 | 7,265 |
| 1986 | 194,185 | 2.440 | 1.18 | 6,126 |
| 1987 | 148,629 | 1.830 | 1.26 | 6,429 |
| 1988 | 184,492 | 2.228 | 1.20 | 6,094 |
| 1989 | 198,487 | 2.349 | 1.14 | 6,315 |
| 1990 | 178,243 | 2.070 | 1.20 | 6,617 |
| 1991 | 254,531 | 2.899 | 1.10 | 6,668 |
| 1992 | 135,029 | 1.509 | 1.20 | 6,763 |
| 1993 | 153,301 | 1.681 | 1.16 | 6,736 |
| 1994 | 161,753 | 1.739 | 1.06 | 6,878 |

[1]Fall-Winter season corresponds to December-May period.
[2]Fall-Winter production minus exports.
[3]Source: Computed using Banco de Mexico Monthly Price Index.
[4]Source: International Monetary Fund. *International Financial Statistics, Yearbook 1996*. Washington, DC.

**Table 2.20. Mexican Watermelon Consumption, Retail Prices and Income for the Fall-Winter Season[1], 1970-1994**

| Year | Fall-Winter[2] Total Consumption | Fall-Winter Per capita Consumption | Fall-Winter[3] Retail Price (1990=100) | Per capita[4] Income (1990=100) |
|---|---|---|---|---|
| | ---------ton--------- | ---------kg---------- | -----pesos/kg----- | --------pesos-------- |
| 1970 | 105,616 | 2.156 | 0.955 | 5,539 |
| 1971 | 211,303 | 4.176 | 1.254 | 5,504 |
| 1972 | 134,097 | 2.566 | 0.842 | 5,764 |
| 1973 | 154,002 | 2.854 | 0.810 | 5,944 |
| 1974 | 195,047 | 3.344 | 0.775 | 5,811 |
| 1975 | 151,898 | 2.525 | 0.852 | 5,497 |
| 1976 | 197,524 | 3.187 | 0.741 | 6,084 |
| 1977 | 179,125 | 2.807 | 0.928 | 6,163 |
| 1978 | 277,964 | 4.234 | 0.867 | 6,385 |
| 1979 | 371,022 | 5.495 | 0.734 | 6,857 |
| 1980 | 263,020 | 3.790 | 0.841 | 8,556 |
| 1981 | 189,982 | 2.666 | 1.090 | 8,875 |
| 1982 | 227,607 | 3.113 | 1.205 | 8,494 |
| 1983 | 178,765 | 2.384 | 1.163 | 7,191 |
| 1984 | 283,640 | 3.694 | 1.094 | 7,093 |
| 1985 | 235,150 | 3.019 | 1.327 | 7,265 |
| 1986 | 207,388 | 2.605 | 1.096 | 6,126 |
| 1987 | 230,673 | 2.841 | 1.125 | 6,429 |
| 1988 | 224,663 | 2.713 | 1.365 | 6,094 |
| 1989 | 162,358 | 1.921 | 1.391 | 6,315 |
| 1990 | 168,330 | 1.955 | 1.733 | 6,617 |
| 1991 | 165,518 | 1.885 | 1.703 | 6,668 |
| 1992 | 217,134 | 2.426 | 1.848 | 6,763 |
| 1993 | 181,136 | 1.986 | 1.646 | 6,736 |
| 1994 | 171,561 | 1.845 | 1.857 | 6,878 |

[1]Fall-Winter season corresponds to December-May period.
[2]Fall-Winter production minus exports.
[3]Source: Computed using Banco de Mexico Monthly Price Index.
[4]Source: International Monetary Fund. *International Financial Statistics, Yearbook 1996*. Washington, DC.

**Table 2.21. U.S. Annual Melon Production, 1970-1994**

| Year | Cantaloupe[1] Production | Cantaloupe Production Index | Honeydew[2] Production | Honeydew Production Index | Watermelon[1] Production | Watermelon Production Index |
|---|---|---|---|---|---|---|
| | --1000 cwt-- | | --1000 cwt-- | | ---100 cwt---- | |
| 1970 | 13,282 | 1.00 | 1,931 | 1.00 | 27,373 | 1.00 |
| 1971 | 12,382 | 0.93 | 2,039 | 1.06 | 27,094 | 0.99 |
| 1972 | 13,045 | 0.98 | 2,307 | 1.19 | 25,280 | 0.92 |
| 1973 | 11,302 | 0.85 | 2,453 | 1.27 | 26,170 | 0.96 |
| 1974 | 9,720 | 0.73 | 2,185 | 1.13 | 23,034 | 0.84 |
| 1975 | 9,774 | 0.74 | 2,395 | 1.24 | 23,904 | 0.87 |
| 1976 | 10,005 | 0.75 | 2,346 | 1.21 | 25,910 | 0.95 |
| 1977 | 10,760 | 0.81 | 2,591 | 1.34 | 27,020 | 0.99 |
| 1978 | 12,856 | 0.97 | 3,413 | 1.77 | 25,702 | 0.94 |
| 1979 | 12,322 | 0.93 | 3,531 | 1.83 | 24,126 | 0.88 |
| 1980 | 11,890 | 0.90 | 3,180 | 1.65 | 22,716 | 0.83 |
| 1981 | 13,346 | 1.00 | 3,419 | 1.77 | 26,186 | 0.96 |
| 1982 | 16,824 | 1.27 | 3,780 | 1.96 | 27,339 | 1.00 |
| 1983 | 14,537 | 1.09 | 3,918 | 2.03 | 25,340 | 0.93 |
| 1984 | 16,516 | 1.24 | 4,031 | 2.09 | 31,905 | 1.17 |
| 1985 | 18,743 | 1.41 | 4,785 | 2.48 | 30,438 | 1.11 |
| 1986 | 20,562 | 1.55 | 5,438 | 2.82 | 29,296 | 1.07 |
| 1987 | 20,273 | 1.53 | 4,811 | 2.49 | 28,931 | 1.06 |
| 1988 | 16,916 | 1.27 | 5,241 | 2.71 | 31,155 | 1.14 |
| 1989 | 21,714 | 1.63 | 5,131 | 2.66 | 30,949 | 1.13 |
| 1990 | 18,567 | 1.40 | 4,503 | 2.33 | 31,871 | 1.16 |
| 1991 | 16,640 | 1.25 | 3,737 | 1.94 | 30,974 | 1.13 |
| 1992 | 18,111 | 1.36 | 4,740 | 2.45 | 37,783 | 1.38 |
| 1993 | 19,075 | 1.44 | 3,792 | 1.96 | 37,777 | 1.38 |
| 1994 | 18,940 | 1.43 | 4,053 | 2.10 | 39,986 | 1.46 |
| ***Avg. 1970-1994*** | 15,124 | | 3,590 | | 28,730 | |

[1]Source: 1970-1980: USDA. *Agricultural Statistics.* Government Printing Office, Washington, DC. Several Issues 1981-1990: USDA, ERS. *Vegetables and Specialties,* July 1995; 1991-1994: USDA-NASS. *Vegetables, 1994 Summary,* January, 1995.

[2]Source: 1970-1994: USDA. *Agricultural Statistics.* Government Printing Office, Washington, DC. Several Issues.

**Table 2.22. U.S. Cantaloupe Production by State, 1992-1994**

| State | 1992 Production | 1993 Production | 1994 Production | 1992-1994 Average | State Share |
|---|---|---|---|---|---|
| | ------------------------------------1000 cwt | | | ------------------------------------ | -----%---- |
| Arizona | 2,376 | 2,856 | 3,168 | 2,800 | 14.97 |
| California | 11,520 | 12,350 | 11,267 | 11,712 | 62.60 |
| Colorado | 108 | 240 | 324 | 224 | 1.20 |
| Georgia | 828 | 560 | 875 | 754 | 4.03 |
| Indiana | 360 | 480 | 492 | 444 | 2.37 |
| Maryland | 132 | 147 | 153 | 144 | 0.77 |
| Michigan | 64 | 99 | 86 | 83 | 0.44 |
| Ohio | 48 | 81 | 90 | 73 | 0.39 |
| Pennsylvania | 125 | 118 | 127 | 123 | 0.66 |
| Texas | 2,550 | 2,144 | 2,358 | 2,351 | 12.56 |
| United States | 18,111 | 19,075 | 18,940 | 18,709 | 100.00 |

Source: USDA, NASS. *Vegetables, 1994 Summary*, January, 1995.
Note: 1 Metric Ton (ton) = 22.04 cwt = 2,204 lbs

**Table 2.23. U.S. Honeydew Melon Production by State, 1992-1994**

| State | 1992 Production | 1993 Production | 1994 Production | 1992-1994 Average | State Share |
|---|---|---|---|---|---|
| | ------------------------------------1000 cwt | | | ------------------------------------ | ----%----- |
| Arizona | 350 | 320 | 533 | 401 | 9.42 |
| California | 3,150 | 2,640 | 2,806 | 2,865 | 67.31 |
| Texas | 1,240 | 832 | 900 | 991 | 23.27 |
| United States | 4,740 | 3,792 | 4,239 | 4,257 | 100.00 |

Source: USDA, NASS. *Vegetables, 1994 Summary*, January, 1995.
Note: 1 Metric Ton (ton) = 22.04 cwt = 2,204 lbs

**Table 2.24. U.S. Watermelon Production by State, 1992-1994**

| State | 1992 Production | 1993 Production | 1994 Production | 1992-1994 Average | State Share |
|---|---|---|---|---|---|
| | ----------------------------------1000 cwt | | | ------------------------------------- | -----%---- |
| Alabama | 443 | 1,001 | 570 | 671 | 1.74 |
| Arizona | 1,782 | 2,035 | 2,108 | 1,975 | 5.13 |
| Arkansas | 700 | 612 | 540 | 617 | 1.60 |
| California | 6,000 | 7,350 | 7,181 | 6,844 | 17.77 |
| Delaware | 315 | 539 | 408 | 421 | 1.09 |
| Florida | 9,000 | 8,325 | 8,510 | 8,612 | 22.36 |
| Georgia | 5,270 | 4,200 | 5,100 | 4,857 | 12.61 |
| Indiana | 1,550 | 1,736 | 1,728 | 1,671 | 4.34 |
| Louisiana | 330 | 273 | 252 | 285 | 0.74 |
| Maryland | 525 | 585 | 378 | 496 | 1.29 |
| Mississippi | 720 | 585 | 700 | 668 | 1.74 |
| Missouri | 1,460 | 1,260 | 1,564 | 1,428 | 3.71 |
| North Carolina | 1,263 | 1,230 | 1,242 | 1,245 | 3.23 |
| Oklahoma | 737 | 1,100 | 765 | 867 | 2.25 |
| South Carolina | 1,128 | 840 | 1,000 | 989 | 2.57 |
| Texas | 6,480 | 6,000 | 7,800 | 6,760 | 17.55 |
| United States | 37,783 | 37,777 | 39,986 | 38,515 | 100.00 |

Source: USDA, NASS. *Vegetables, 1994 Summary*, January, 1995.
Note: 1 Metric Ton (ton) = 22.04 cwt = 2,204 lbs

**Table 2.25. U.S. Labor and Fertilizer Costs, 1970-1994**

| Year | Real Index of Prices Paid by Farmers for Fertilizers[1] | Real Index of Prices Paid by Farmers for Wage Rates[1] |
|---|---|---|
| | ---------------------------------1990 = 100------------------------------------ | |
| 1970 | 115.95 | 93.95 |
| 1971 | 116.91 | 93.84 |
| 1972 | 111.19 | 91.91 |
| 1973 | 100.11 | 84.16 |
| 1974 | 144.80 | 84.84 |
| 1975 | 172.19 | 83.22 |
| 1976 | 137.32 | 85.43 |
| 1977 | 130.49 | 89.03 |
| 1978 | 120.78 | 88.18 |
| 1979 | 112.78 | 84.07 |
| 1980 | 126.75 | 81.97 |
| 1981 | 127.08 | 83.09 |
| 1982 | 122.82 | 83.80 |
| 1983 | 117.64 | 86.71 |
| 1984 | 120.49 | 87.38 |
| 1985 | 116.71 | 90.84 |
| 1986 | 112.42 | 98.97 |
| 1987 | 104.13 | 99.95 |
| 1988 | 108.10 | 97.02 |
| 1989 | 107.58 | 100.39 |
| 1990 | 100.00 | 100.00 |
| 1991 | 101.08 | 103.45 |
| 1992 | 98.23 | 107.44 |
| 1993 | 93.32 | 107.95 |
| 1994 | 104.29 | 105.04 |

[1]Indexes of Prices Paid by Farmers for Fertilizers and Wage Rates, deflated by Index of Prices paid by farmers total of production items. Source: E*conomic Report of the President*, Washington, DC, February, 1995.

**Table 2.26. U.S. Monthly Domestic Cantaloupe Shipments, 1980-1994**

| Month | 1980-1984 Average | 1985-1989 Average | 1990-1994[1] Average | 1980-1994 Average | 1980-1994 Monthly Share |
|---|---|---|---|---|---|
| | -----------------------------1000 cwt | ----------------------------- | | | ---------%--------- |
| January | 0 | 0 | 0 | 0 | 0.00 |
| February | 0 | 0 | 0 | 0 | 0.00 |
| March | 0 | 0 | 0 | 0 | 0.00 |
| April | 0 | 0 | 0 | 0 | 0.00 |
| May | 757 | 1,997 | 1,914 | 1,556 | 13.87 |
| June | 3,069 | 4,166 | 2,814 | 3,350 | 29.78 |
| July | 3,120 | 3,083 | 1,122 | 2,442 | 21.71 |
| August | 2,558 | 2,521 | 418 | 1,832 | 16.29 |
| September | 1,560 | 1,443 | 271 | 1,091 | 9.70 |
| October | 669 | 1,063 | 399 | 710 | 6.31 |
| November | 202 | 372 | 172 | 249 | 2.21 |
| December | 24 | 13 | 3 | 13 | 0.12 |
| ***June-Nov*** | 11,177 | 12,649 | 5,196 | 9,674 | 86.02 |
| ***Dec-May*** | 782 | 2,012 | 1,924 | 1,572 | 13.98 |
| Total | 11,959 | 14,661 | 7,120 | 11,247 | 100.00 |

Source: USDA, AMS. *Fresh Fruit and Vegetable Shipments by Commodities, States and Months.* Several Issues.

[1]Note: Cantaloupe shipments beginning with 1989 are not comparable with prior years due to reduced reporting.

**Table 2.27. U.S. Monthly Domestic Honeydew[1] Shipments, 1980-1994**

| Month | 1980-1984 Average | 1985-1989 Average | 1990-1994 Average | 1980-1994 Average | 1980-1994 Monthly Share |
|---|---|---|---|---|---|
| | -----------------------------1000 cwt | ----------------------------- | | | ----------%-------- |
| January | 0 | 0 | 0 | 0 | 0.00 |
| February | 0 | 0 | 0 | 0 | 0.00 |
| March | 0 | 0 | 0 | 0 | 0.00 |
| April | 0 | 0 | 0 | 0 | 0.00 |
| May | 244 | 328 | 434 | 335 | 9.11 |
| June | 688 | 1,042 | 596 | 775 | 18.79 |
| July | 799 | 1,151 | 441 | 797 | 19.32 |
| August | 932 | 1,217 | 554 | 901 | 21.84 |
| September | 850 | 905 | 408 | 721 | 17.47 |
| October | 440 | 436 | 195 | 357 | 8.65 |
| November | 229 | 190 | 68 | 163 | 3.94 |
| December | 67 | 40 | 2 | 36 | 0.88 |
| ***June-Nov*** | 3,938 | 4,941 | 2,261 | 3,714 | 90.01 |
| ***Dec-May*** | 371 | 424 | 442 | 412 | 9.99 |
| Total | 4,309 | 5,365 | 2,703 | 4,126 | 100.00 |

Source: USDA, AMS. *Fresh Fruit and Vegetable Shipments by Commodities, States and Months.* Several Issues.

[1]Note: Includes “Honeydew” category plus “Mixed and Miscellaneous” which are primarily Honeydew melons.

**Table 2.28. U.S. Monthly Domestic Watermelon Shipments, 1980-1994**

| Month | 1980-1984 Average | 1985-1989 Average | 1990-1994[1] Average | 1980-1994 Average | 1980-1994 Monthly Share |
|---|---|---|---|---|---|
| | ----------------------------------1000 cwt | | ---------------------------------- | | ---------%--------- |
| January | 0 | 0 | 0 | 0 | 0.00 |
| February | 0 | 0 | 0 | 0 | 0.00 |
| March | 0 | 0 | 0 | 0 | 0.00 |
| April | 155 | 116 | 288 | 186 | 0.96 |
| May | 2,508 | 3,787 | 4,194 | 3,496 | 17.58 |
| June | 7,517 | 8,407 | 7,946 | 7,957 | 40.01 |
| July | 6,208 | 5,706 | 5,196 | 5,703 | 28.68 |
| August | 1,860 | 1,645 | 2,493 | 1,999 | 10.05 |
| September | 195 | 259 | 479 | 311 | 1.56 |
| October | 60 | 43 | 160 | 88 | 0.44 |
| November | 35 | 96 | 181 | 104 | 0.52 |
| December | 20 | 44 | 51 | 38 | 0.19 |
| ***June-Nov*** | 15,874 | 16,156 | 16,455 | 16,162 | 81.26 |
| ***Dec-May*** | 2,689 | 3,950 | 4,540 | 3,726 | 18.74 |
| Total | 18,563 | 20,106 | 20,994 | 19,888 | 100.00 |

Source: USDA, AMS. *Fresh Fruit and Vegetable Shipments by Commodities, States and Months.* Several Issues.

**Table 2.29. Mexico, CBI and Other Countries Market Share in U.S. Cantaloupe Market, 1971-1994**

| Year | U.S. Imports | U.S. Import Quantity Index | Mex. Share of total U.S. Imports | CBI Share of total U.S. Imports | Others Share of total U.S. Imports |
|---|---|---|---|---|---|
| | ----1000 lb---- | | ----------------------------- | -% | -------------------------------- |
| 1971 | 190,848 | 1.00 | 93.59 | 6.20 | 0.22 |
| 1972 | 165,173 | 0.87 | 92.92 | 7.06 | 0.02 |
| 1973 | 168,459 | 0.88 | 92.97 | 6.88 | 0.15 |
| 1974 | 178,208 | 0.93 | 93.46 | 6.54 | 0.00 |
| 1975 | 150,916 | 0.79 | 91.80 | 8.21 | 0.00 |
| 1976 | 151,012 | 0.79 | 91.30 | 8.70 | 0.00 |
| 1977 | 192,860 | 1.01 | 92.88 | 7.12 | 0.00 |
| 1978 | 205,569 | 1.08 | 93.54 | 6.41 | 0.05 |
| 1979 | 204,663 | 1.07 | 92.79 | 7.16 | 0.05 |
| 1980 | 179,916 | 0.94 | 92.34 | 7.58 | 0.08 |
| 1981 | 148,003 | 0.78 | 91.69 | 8.31 | 0.00 |
| 1982 | 192,480 | 1.01 | 92.31 | 7.46 | 0.22 |
| 1983 | 166,096 | 0.87 | 92.48 | 7.38 | 0.15 |
| 1984 | 247,099 | 1.29 | 89.13 | 10.79 | 0.08 |
| 1985 | 246,032 | 1.29 | 79.46 | 20.19 | 0.35 |
| 1986 | 317,314 | 1.66 | 81.20 | 18.28 | 0.53 |
| 1987 | 300,753 | 1.58 | 77.72 | 21.25 | 1.03 |
| 1988 | 327,036 | 1.71 | 69.98 | 29.79 | 0.23 |
| 1989 | 476,156 | 2.49 | 66.26 | 33.63 | 0.11 |
| 1990 | 530,255 | 2.78 | 61.01 | 38.84 | 0.15 |
| 1991 | 602,483 | 3.16 | 59.88 | 40.07 | 0.05 |
| 1992 | 481,868 | 2.52 | 45.86 | 54.10 | 0.04 |
| 1993 | 458,140 | 2.40 | 32.86 | 67.03 | 0.12 |
| 1994 | 523,899 | 2.75 | 28.13 | 71.86 | 0.01 |

Source: U.S. Department of Commerce. Bureau of the Census. Washington, DC.

**Table 2.30. Mexico, CBI and Other Countries Market Share in U.S. Honeydew Market, 1971-1994**

| Year | U.S. Imports | U.S. Import Quantity Index | Mex. Share of total U.S. Imports | CBI Share of total U.S. Imports | Others Share of total U.S. Imports |
|---|---|---|---|---|---|
| | ----1000 lb---- | | ----------------------------- | -%- | ------------------------------- |
| 1971 | 29,881 | 1.00 | 51.59 | 3.46 | 44.95 |
| 1972 | 27,083 | 0.91 | 59.46 | 6.21 | 34.32 |
| 1973 | 35,196 | 1.18 | 71.91 | 7.61 | 20.47 |
| 1974 | 48,252 | 1.61 | 69.37 | 11.07 | 19.56 |
| 1975 | 23,924 | 0.80 | 66.13 | 16.99 | 16.88 |
| 1976 | 29,978 | 1.00 | 71.68 | 11.56 | 16.76 |
| 1977 | 36,107 | 1.21 | 66.55 | 11.37 | 22.08 |
| 1978 | 38,468 | 1.29 | 68.58 | 13.23 | 18.20 |
| 1979 | 41,235 | 1.38 | 68.62 | 14.28 | 17.10 |
| 1980 | 44,831 | 1.50 | 67.98 | 15.19 | 16.83 |
| 1981 | 51,825 | 1.73 | 61.93 | 22.62 | 15.45 |
| 1982 | 56,514 | 1.89 | 59.73 | 21.87 | 18.40 |
| 1983 | 54,891 | 1.84 | 49.47 | 24.31 | 26.22 |
| 1984 | 98,225 | 3.29 | 45.31 | 31.15 | 23.54 |
| 1985 | 99,028 | 3.31 | 53.29 | 25.47 | 21.24 |
| 1986 | 144,036 | 4.82 | 41.09 | 43.27 | 15.64 |
| 1987 | 166,052 | 5.56 | 67.20 | 27.49 | 5.31 |
| 1988 | 154,410 | 5.17 | 55.66 | 36.82 | 7.52 |
| 1989 | 240,729 | 8.06 | 58.90 | 36.98 | 4.12 |
| 1990 | 201,117 | 6.73 | 58.76 | 37.63 | 3.61 |
| 1991 | 286,061 | 9.57 | 57.13 | 38.87 | 4.01 |
| 1992 | 228,235 | 7.64 | 43.21 | 53.48 | 3.31 |
| 1993 | 257,436 | 8.62 | 38.42 | 57.27 | 4.31 |
| 1994 | 254,477 | 8.52 | 36.59 | 59.27 | 4.14 |

Source: U.S. Department of Commerce. Bureau of the Census. Washington, DC.

**Table 2.31. Total Supply of Watermelon in U.S. Market and Market Share Supplied by Different Sources for the Fall-Winter Season[1], 1971-1994**

| Year | Total Supply | Total Supply Index | U.S. Domestic[2] Shipments | Imports[3] from Mex. | Imports[3] from Other Countries |
|---|---|---|---|---|---|
| | ----1000 lb--- | | ------------------------------- | % | ------------------------------ |
| 1971 | 321,191 | 1.00 | 64.76 | 34.72 | 0.52 |
| 1972 | 479,191 | 1.49 | 66.80 | 33.14 | 0.06 |
| 1973 | 364,401 | 1.13 | 53.76 | 46.07 | 0.17 |
| 1974 | 378,420 | 1.18 | 56.00 | 43.76 | 0.25 |
| 1975 | 477,080 | 1.49 | 69.49 | 30.19 | 0.32 |
| 1976 | 529,958 | 1.65 | 63.87 | 35.57 | 0.56 |
| 1977 | 496,059 | 1.54 | 64.69 | 35.31 | 0.00 |
| 1978 | 336,419 | 1.05 | 40.66 | 59.31 | 0.03 |
| 1979 | 431,538 | 1.34 | 49.22 | 50.72 | 0.06 |
| 1980 | 395,227 | 1.23 | 47.95 | 51.98 | 0.07 |
| 1981 | 460,663 | 1.43 | 72.72 | 27.19 | 0.09 |
| 1982 | 607,840 | 1.89 | 60.94 | 39.03 | 0.03 |
| 1983 | 305,538 | 0.95 | 39.05 | 60.83 | 0.12 |
| 1984 | 612,750 | 1.91 | 53.74 | 46.02 | 0.24 |
| 1985 | 688,524 | 2.14 | 68.04 | 30.98 | 0.98 |
| 1986 | 718,917 | 2.24 | 72.44 | 24.72 | 2.84 |
| 1987 | 522,107 | 1.63 | 41.08 | 56.50 | 2.41 |
| 1988 | 597,528 | 1.86 | 56.08 | 42.62 | 1.30 |
| 1989 | 799,024 | 2.49 | 54.95 | 43.20 | 1.85 |
| 1990 | 861,714 | 2.68 | 73.47 | 25.37 | 1.16 |
| 1991 | 617,337 | 1.92 | 62.59 | 35.90 | 1.51 |
| 1992 | 617,824 | 1.92 | 65.78 | 29.18 | 5.04 |
| 1993 | 526,933 | 1.64 | 58.96 | 35.35 | 5.69 |
| 1994 | 760,299 | 2.37 | 70.13 | 25.14 | 4.73 |

[1]December-May.
[2]Source: USDA, AMS. *Fresh Fruit and Vegetable Shipments by Commodities, States and Months.* Several Issues.
[3]Source: U.S. Department of Commerce. Bureau of the Census. Washington, DC.

**Table 2.32. U.S. Annual and Seasonal per Capita Cantaloupe Consumption, 1970-1994**

| Year | Annual[1] | Dec-May[2] | Dec-May Quantity Index | June-Nov. | June-Nov. Quantity Index |
|---|---|---|---|---|---|
| | ----------------lb----------------- | | | -------lb------ | |
| 1970 | 7.20 | 1.17 | 1.00 | 6.03 | 1.00 |
| 1971 | 6.80 | 1.13 | 0.96 | 5.67 | 0.94 |
| 1972 | 7.00 | 1.36 | 1.16 | 5.64 | 0.94 |
| 1973 | 6.10 | 0.85 | 0.73 | 5.25 | 0.87 |
| 1974 | 5.30 | 1.05 | 0.90 | 4.25 | 0.70 |
| 1975 | 5.20 | 0.92 | 0.79 | 4.28 | 0.71 |
| 1976 | 5.30 | 0.86 | 0.74 | 4.44 | 0.74 |
| 1977 | 5.80 | 0.97 | 0.83 | 4.83 | 0.80 |
| 1978 | 6.60 | 1.20 | 1.03 | 5.40 | 0.89 |
| 1979 | 6.10 | 1.17 | 1.00 | 4.93 | 0.82 |
| 1980 | 5.80 | 0.94 | 0.81 | 4.86 | 0.81 |
| 1981 | 6.10 | 0.97 | 0.83 | 5.13 | 0.85 |
| 1982 | 7.70 | 0.97 | 0.83 | 6.73 | 1.12 |
| 1983 | 6.50 | 0.91 | 0.78 | 5.59 | 0.93 |
| 1984 | 7.70 | 1.65 | 1.41 | 6.05 | 1.00 |
| 1985 | 8.50 | 1.63 | 1.40 | 6.87 | 1.14 |
| 1986 | 9.40 | 2.63 | 2.25 | 6.77 | 1.12 |
| 1987 | 9.10 | 1.61 | 1.38 | 7.49 | 1.24 |
| 1988 | 7.90 | 1.94 | 1.66 | 5.96 | 0.99 |
| 1989 | 10.40 | 3.04 | 2.60 | 7.36 | 1.22 |
| 1990 | 9.20 | 2.69 | 2.30 | 6.51 | 1.08 |
| 1991 | 8.70 | 2.92 | 2.50 | 5.78 | 0.96 |
| 1992 | 8.50 | 2.97 | 2.54 | 5.53 | 0.92 |
| 1993 | 8.70 | 2.51 | 2.15 | 6.19 | 1.03 |
| 1994 | 8.80 | 2.72 | 2.33 | 6.08 | 1.01 |
| ***1970-1994 Average*** | 7.38 | 1.63 | | 5.74 | |

[1]Source: USDA, ERS. *Vegetables and Specialties; Situation and Outlook Yearbook.* July, 1995.
[2]Source: Estimation based on Dec-May Shipments Data (USDA, AMS. *Fresh Fruit and Vegetable Shipments by Commodities, States and Months.* Several Issues).

**Table 2.33. U.S. Annual and Seasonal per Capita Honeydew Consumption, 1970-1994**

| Year | Annual[1] | Dec-May[2] | Dec-May Quantity Index | June-Nov. | June-Nov. Quantity Index |
|---|---|---|---|---|---|
| | ---------------lb--------------- | | | -------lb------ | |
| 1970 | 0.90 | 0.26 | 1.00 | 0.64 | 1.00 |
| 1971 | 0.90 | 0.21 | 0.80 | 0.69 | 1.08 |
| 1972 | 1.00 | 0.21 | 0.80 | 0.79 | 1.24 |
| 1973 | 1.10 | 0.18 | 0.69 | 0.92 | 1.44 |
| 1974 | 1.00 | 0.32 | 1.23 | 0.68 | 1.06 |
| 1975 | 1.10 | 0.17 | 0.64 | 0.93 | 1.46 |
| 1976 | 1.00 | 0.21 | 0.82 | 0.79 | 1.23 |
| 1977 | 1.10 | 0.23 | 0.88 | 0.87 | 1.36 |
| 1978 | 1.60 | 0.26 | 0.99 | 1.34 | 2.10 |
| 1979 | 1.60 | 0.31 | 1.17 | 1.29 | 2.03 |
| 1980 | 1.40 | 0.31 | 1.17 | 1.09 | 1.72 |
| 1981 | 1.50 | 0.35 | 1.33 | 1.15 | 1.81 |
| 1982 | 1.80 | 0.38 | 1.43 | 1.42 | 2.23 |
| 1983 | 1.80 | 0.41 | 1.55 | 1.39 | 2.18 |
| 1984 | 1.80 | 0.64 | 2.43 | 1.16 | 1.82 |
| 1985 | 2.10 | 0.59 | 2.25 | 1.51 | 2.37 |
| 1986 | 2.40 | 0.87 | 3.31 | 1.53 | 2.40 |
| 1987 | 2.20 | 0.73 | 2.77 | 1.47 | 2.31 |
| 1988 | 2.40 | 0.82 | 3.14 | 1.58 | 2.47 |
| 1989 | 2.50 | 1.13 | 4.29 | 1.37 | 2.15 |
| 1990 | 2.10 | 0.93 | 3.52 | 1.17 | 1.84 |
| 1991 | 1.90 | 1.30 | 4.97 | 0.60 | 0.93 |
| 1992 | 2.10 | 1.08 | 4.13 | 1.02 | 1.59 |
| 1993 | 1.70 | 1.13 | 4.30 | 0.57 | 0.90 |
| 1994 | 1.80 | 1.16 | 4.41 | 0.64 | 1.01 |
| ***1970-1994 Average*** | 1.63 | 0.57 | | 1.06 | |

[1]Source: USDA, ERS. *Vegetables and Specialties; Situation and Outlook Yearbook.* July, 1995.
[2]Source: Estimation based on Dec-May Shipments Data (USDA, AMS. *Fresh Fruit and Vegetable Shipments by Commodities, States and Months.* Several Issues).

**Table 2.34. U.S. Annual and Seasonal per Capita Watermelon Consumption, 1970-1994**

| Year | Annual[1] | Dec-May[2] | Dec-May Quantity Index | June-Nov. | June-Nov. Quantity Index |
|---|---|---|---|---|---|
| | ------------------lb------------------ | | | -------lb------ | |
| 1970 | 13.50 | 1.84 | 1.00 | 11.66 | 1.00 |
| 1971 | 13.00 | 1.49 | 0.81 | 11.51 | 0.99 |
| 1972 | 12.30 | 2.20 | 1.20 | 10.10 | 0.87 |
| 1973 | 12.70 | 1.67 | 0.91 | 11.03 | 0.95 |
| 1974 | 11.30 | 1.73 | 0.94 | 9.57 | 0.82 |
| 1975 | 11.40 | 2.13 | 1.16 | 9.27 | 0.80 |
| 1976 | 12.60 | 2.39 | 1.30 | 10.21 | 0.88 |
| 1977 | 12.60 | 2.21 | 1.20 | 10.39 | 0.89 |
| 1978 | 11.90 | 1.48 | 0.81 | 10.42 | 0.89 |
| 1979 | 11.40 | 1.92 | 1.04 | 9.48 | 0.81 |
| 1980 | 10.70 | 1.70 | 0.92 | 9.00 | 0.77 |
| 1981 | 11.70 | 1.96 | 1.07 | 9.74 | 0.84 |
| 1982 | 12.50 | 2.57 | 1.40 | 9.93 | 0.85 |
| 1983 | 11.30 | 1.26 | 0.68 | 10.04 | 0.86 |
| 1984 | 14.40 | 2.55 | 1.38 | 11.85 | 1.02 |
| 1985 | 13.50 | 2.86 | 1.55 | 10.64 | 0.91 |
| 1986 | 12.80 | 2.95 | 1.60 | 9.85 | 0.84 |
| 1987 | 13.00 | 2.12 | 1.15 | 10.88 | 0.93 |
| 1988 | 13.50 | 2.40 | 1.31 | 11.10 | 0.95 |
| 1989 | 13.60 | 3.18 | 1.73 | 10.42 | 0.89 |
| 1990 | 13.30 | 3.39 | 1.84 | 9.91 | 0.85 |
| 1991 | 12.80 | 2.39 | 1.30 | 10.41 | 0.89 |
| 1992 | 14.80 | 2.29 | 1.25 | 12.51 | 1.07 |
| 1993 | 14.60 | 1.92 | 1.04 | 12.68 | 1.09 |
| 1994 | 15.40 | 2.96 | 1.61 | 12.44 | 1.07 |
| ***1970-1994 Average*** | 12.82 | 2.22 | | 10.60 | |

[1]Source: USDA, ERS. *Vegetables and Specialties; Situation and Outlook Yearbook.* July, 1995.
[2]Source: Estimation based on Dec-May Shipments Data (USDA, AMS. *Fresh Fruit and Vegetable Shipments by Commodities, States and Months.* Several Issues).

**Table 2.35. Fall-Winter[1] U.S. Cantaloupe Consumption, Consumer Price and Income, 1970-1994**

| Year | Per capita[1] Consumption (lb) | Consumer Price[2] (1990=100) (dol/lb) | Per capita Income[3] (1990=100) (dol) |
|---|---|---|---|
| 1970 | 1.17 | 0.657 | 11,865 |
| 1971 | 1.13 | 0.626 | 12,229 |
| 1972 | 1.36 | 0.647 | 12,697 |
| 1973 | 0.85 | 0.738 | 13,393 |
| 1974 | 1.05 | 0.672 | 13,059 |
| 1975 | 0.92 | 0.740 | 13,082 |
| 1976 | 0.86 | 0.732 | 13,477 |
| 1977 | 0.97 | 0.754 | 13,829 |
| 1978 | 1.20 | 0.741 | 14,378 |
| 1979 | 1.17 | 0.475 | 14,313 |
| 1980 | 0.94 | 0.765 | 13,595 |
| 1981 | 0.97 | 0.651 | 13,581 |
| 1982 | 0.97 | 0.639 | 13,509 |
| 1983 | 0.91 | 0.749 | 13,953 |
| 1984 | 1.65 | 0.513 | 14,664 |
| 1985 | 1.63 | 0.601 | 14,976 |
| 1986 | 2.63 | 0.608 | 15,508 |
| 1987 | 1.61 | 0.697 | 14,898 |
| 1988 | 1.94 | 0.578 | 15,999 |
| 1989 | 3.04 | 0.560 | 15,968 |
| 1990 | 2.69 | 0.542 | 16,240 |
| 1991 | 2.92 | 0.470 | 16,053 |
| 1992 | 2.97 | 0.487 | 16,451 |
| 1993 | 2.51 | 0.498 | 16,458 |
| 1994 | 2.72 | 0.431 | 16,776 |

[1]Dec-May period.
[2]Source: Dec-May weighted average of wholesale prices at New York terminal market (USDA, AMS. *Fresh Fruit and Vegetable Prices, Wholesale Chicago and New York Prices*)
[3]Source: IMF. *International Financial Statistics.* Yearbook 1996.

**Table 2.36. Fall-Winter[1] U.S. Honeydew Consumption, Consumer Price and Income, 1970-1994**

| Year | Per capita[1] Consumption (lb) | Consumer Price[2] (1990=100) (dol/lb) | Per capita Income[3] (1990=100) (dol) |
|---|---|---|---|
| 1970 | 0.26 | 0.562 | 11,865 |
| 1971 | 0.21 | 0.587 | 12,229 |
| 1972 | 0.21 | 0.544 | 12,697 |
| 1973 | 0.18 | 0.571 | 13,393 |
| 1974 | 0.32 | 0.479 | 13,059 |
| 1975 | 0.17 | 0.633 | 13,082 |
| 1976 | 0.21 | 0.491 | 13,477 |
| 1977 | 0.23 | 0.603 | 13,829 |
| 1978 | 0.26 | 0.441 | 14,378 |
| 1979 | 0.31 | 0.576 | 14,313 |
| 1980 | 0.31 | 0.534 | 13,595 |
| 1981 | 0.35 | 0.457 | 13,581 |
| 1982 | 0.38 | 0.456 | 13,509 |
| 1983 | 0.41 | 0.461 | 13,953 |
| 1984 | 0.64 | 0.387 | 14,664 |
| 1985 | 0.59 | 0.430 | 14,976 |
| 1986 | 0.87 | 0.451 | 15,508 |
| 1987 | 0.73 | 0.403 | 14,898 |
| 1988 | 0.82 | 0.427 | 15,999 |
| 1989 | 1.13 | 0.416 | 15,968 |
| 1990 | 0.93 | 0.415 | 16,240 |
| 1991 | 1.30 | 0.333 | 16,053 |
| 1992 | 1.08 | 0.345 | 16,451 |
| 1993 | 1.13 | 0.301 | 16,458 |
| 1994 | 1.16 | 0.353 | 16,776 |

[1]Dec-May period.
[2]Source: Dec-May weighted average of wholesale prices at New York terminal market USDA, AMS. *Fresh Fruit and Vegetable Prices*, *Wholesale Chicago and New York Prices*)
[3]Source: IMF. *International Financial Statistics.* Yearbook 1996.

**Table 2.37. Fall-Winter[1] U.S. Watermelon Consumption, Consumer Price and Income, 1970-1994**

| Year | Per capita[1] Consumption (lb) | Consumer Price[2] (1990=100) (dol/lb) | Per capita Income[3] (1990=100) (dol) |
|---|---|---|---|
| 1970 | 1.84 | 0.316 | 11,865 |
| 1971 | 1.49 | 0.284 | 12,229 |
| 1972 | 2.20 | 0.256 | 12,697 |
| 1973 | 1.67 | 0.279 | 13,393 |
| 1974 | 1.73 | 0.307 | 13,059 |
| 1975 | 2.13 | 0.252 | 13,082 |
| 1976 | 2.39 | 0.294 | 13,477 |
| 1977 | 2.21 | 0.302 | 13,829 |
| 1978 | 1.48 | 0.311 | 14,378 |
| 1979 | 1.92 | 0.309 | 14,313 |
| 1980 | 1.70 | 0.320 | 13,595 |
| 1981 | 1.96 | 0.283 | 13,581 |
| 1982 | 2.57 | 0.260 | 13,509 |
| 1983 | 1.26 | 0.339 | 13,953 |
| 1984 | 2.55 | 0.255 | 14,664 |
| 1985 | 2.86 | 0.214 | 14,976 |
| 1986 | 2.95 | 0.290 | 15,508 |
| 1987 | 2.12 | 0.314 | 14,898 |
| 1988 | 2.40 | 0.254 | 15,999 |
| 1989 | 3.18 | 0.229 | 15,968 |
| 1990 | 3.39 | 0.225 | 16,240 |
| 1991 | 2.39 | 0.250 | 16,053 |
| 1992 | 2.29 | 0.281 | 16,451 |
| 1993 | 1.92 | 0.328 | 16,458 |
| 1994 | 2.96 | 0.260 | 16,776 |

[1]Dec-May period.
[2]Source: Dec-May weighted average of wholesale prices at New York terminal market (USDA, AMS. *Fresh Fruit and Vegetable Prices, Wholesale Chicago and New York Prices*)
[3]Source: IMF. *International Financial Statistics.* Yearbook 1996.

**Table 2.38. CBI Countries Cantaloupe Exports to U.S., Farm Price, Yields and Income, 1970-1994**

| Year | Exports to U.S.[1] (1000 lb) | Real Farm Price (Index)[2] (1990=100) | Yields[3] (ton/ha) | Real Income (Index)[4] (1990=100) |
|---|---|---|---|---|
| 1970 | 11,577 | 0.556 | 4.02 | 0.923 |
| 1971 | 11,826 | 0.727 | 4.08 | 0.948 |
| 1972 | 11,654 | 0.503 | 4.10 | 0.988 |
| 1973 | 11,596 | 0.714 | 4.10 | 1.026 |
| 1974 | 11,661 | 0.533 | 4.15 | 1.035 |
| 1975 | 12,384 | 0.798 | 4.25 | 1.023 |
| 1976 | 13,134 | 0.663 | 4.25 | 1.108 |
| 1977 | 13,736 | 0.555 | 4.42 | 1.162 |
| 1978 | 13,184 | 0.675 | 4.32 | 1.187 |
| 1979 | 14,656 | 0.550 | 4.27 | 1.208 |
| 1980 | 13,636 | 0.696 | 4.37 | 1.218 |
| 1981 | 12,297 | 0.823 | 4.39 | 1.194 |
| 1982 | 14,369 | 0.671 | 4.39 | 1.118 |
| 1983 | 12,250 | 0.707 | 5.95 | 1.061 |
| 1984 | 26,654 | 0.500 | 7.17 | 1.036 |
| 1985 | 49,666 | 0.454 | 7.17 | 1.001 |
| 1986 | 57,993 | 0.613 | 7.43 | 0.974 |
| 1987 | 63,898 | 0.795 | 7.37 | 0.980 |
| 1988 | 97,418 | 0.944 | 7.37 | 0.989 |
| 1989 | 160,110 | 0.941 | 8.00 | 0.998 |
| 1990 | 205,938 | 1.000 | 8.00 | 1.000 |
| 1991 | 241,431 | 0.918 | 11.00 | 1.007 |
| 1992 | 260,700 | 0.959 | 15.42 | 1.026 |
| 1993 | 307,088 | 1.002 | 18.83 | 1.035 |
| 1994 | 376,495 | 0.884 | 18.95 | 1.047 |

[1]Source: U.S. Department of Commerce. Bureau of the Census.
[2]Source: U.S. Department of Commerce. Bureau of the Census. Border price (value/quantity of imports) used as a proxy of farm price converted to an index value. This index is a weighted average of Costa Rica, Guatemala and Honduras border prices (major suppliers of cantaloupe).
[3]Source: FAO, *Production Yearbook*. Rome. Several Issues. Weighted average of yields of Costa Rica, Guatemala and Honduras.
[4]Source: IMF. *International Financial Statistics.* Yearbook 1996. This index is a weighted average of indexes of Costa Rica, Guatemala and Honduras.

**Table 2.39. CBI Countries Honeydew Exports to U.S., Farm Price, Yields and Income, 1970- 1994**

| Year | Exports to U.S.[1] (1000 lb) | Real Farm Price (Index)[2] (1990=100) | Yields[3] (ton/ha) | Real Income (Index)[4] (1990=100) |
|---|---|---|---|---|
| 1970 | 1,397 | 0.737 | 1.10 | 0.923 |
| 1971 | 1,035 | 0.719 | 1.08 | 0.948 |
| 1972 | 1,683 | 0.743 | 1.02 | 0.988 |
| 1973 | 2,680 | 0.650 | 1.10 | 1.026 |
| 1974 | 5,342 | 0.682 | 1.15 | 1.035 |
| 1975 | 4,066 | 0.868 | 1.25 | 1.023 |
| 1976 | 3,466 | 1.213 | 1.25 | 1.108 |
| 1977 | 4,105 | 1.123 | 1.42 | 1.162 |
| 1978 | 5,088 | 1.084 | 1.32 | 1.187 |
| 1979 | 5,888 | 1.153 | 1.27 | 1.208 |
| 1980 | 6,810 | 0.987 | 1.37 | 1.218 |
| 1981 | 11,720 | 1.579 | 1.39 | 1.194 |
| 1982 | 12,361 | 1.379 | 1.39 | 1.118 |
| 1983 | 13,343 | 1.121 | 4.18 | 1.061 |
| 1984 | 30,601 | 0.994 | 4.17 | 1.036 |
| 1985 | 25,221 | 1.168 | 4.17 | 1.001 |
| 1986 | 62,325 | 1.140 | 4.43 | 0.974 |
| 1987 | 45,646 | 1.455 | 4.37 | 0.980 |
| 1988 | 56,853 | 1.550 | 4.37 | 0.989 |
| 1989 | 89,029 | 1.130 | 5.00 | 0.998 |
| 1990 | 75,690 | 1.000 | 5.00 | 1.000 |
| 1991 | 111,179 | 2.042 | 5.00 | 1.007 |
| 1992 | 122,060 | 1.802 | 12.42 | 1.026 |
| 1993 | 147,421 | 1.942 | 15.83 | 1.035 |
| 1994 | 150,820 | 1.869 | 15.95 | 1.047 |

[1]Source: U.S. Department of Commerce. Bureau of the Census.
[2]Source: U.S. Department of Commerce. Bureau of the Census. Border price (value/quantity of imports) used as a proxy of farm price converted to an index value. This index is a weighted average of Costa Rica, Guatemala and Honduras border prices (major suppliers of honeydew).
[3]Source: FAO, *Production Yearbook.* Rome. Several Issues. Weighted average of yields of Costa Rica, Guatemala and Honduras.
[4]Source: IMF. *International Financial Statistics.* Yearbook 1996. This index is a weighted average of indexes of Costa Rica, Guatemala and Honduras.

# LITERATURE REVIEW

The following review of literature focuses on studies that have examined the Mexican, United States, and CBI countries melon industries. Literature on melons is scant with little empirical work. Most of the studies are descriptive. They are included here because they provide a better understanding of industry characteristics and their problems.

## Mexican Studies

The Banco Nacional de Comercio Exterior (BNCE) (1972) conducted a study of Mexican fresh vegetable exports to the United States for the period 1966-70. Their analysis included tomatoes, cantaloupes, watermelons, and cucumbers. They observe melon exports take place during the winter season when U.S. production, because of climate, is low or non-existent. Because of the latter reason the Mexican exports were considered complementary rather than competitive with U.S. domestic production. The study shows season is important and must be taken into consideration when specifying the melon model. The BNCE study investigated only a very short period of time and lacks quantitative analysis.

The Instituto Mexicano de Comercio Exterior (IMCE) (1973), provided an analysis of Mexico's foreign cantaloupe trade with emphasis on European markets. They found that Mexican cantaloupe faced no trade barriers in Europe and the quality satisfied market requirements. However, the high cost of air transportation and product quality problems associated with maritime transportation were difficult barriers to overcome for cantaloupe, fruits and vegetables.

The IMCE study focuses its analysis on European markets rather than the U.S. market which is the most important foreign market for Mexico melons. Also, the focus of the IMCE study is on European demand; thus, it fails to give consideration to both supply and demand of Mexico and United States.

A Banco Nacional de Comercio Exterior (BNCE) (1975) study analyzed trends in vegetable acreage for the period 1969-1975 in the "Valle de Apatzingan", a region in the state of Michoacan in south Mexico which has traditionally been a vegetable exporting area. The study finds an upward trend in vegetable acreage from 1969 to 1975. According to the author, the upward trend was the result of increasing demand in high income countries with low domestic vegetable production during certain seasons of the year.

During the 1960s and 1970s the "Valle de Apatzingan" was an important producer of melons for the export industry. However, during the 1980s and 1990s its relative importance declined. Increasing costs that result from a high incidence of insects and virus brought about a decline in melon acreage. A current study of the melon export industry should include not only the production of a particular state, but the total production of the Fall-Winter season, which is primarily motivated by the foreign market.

The Comision Nacional de Fruticultura (CONAFRUT) (1975) provided a survey of the domestic cantaloupe industry for 1972. They found the shipping season to last almost all year, with a peak during the March-June period. The analysis indicated that cantaloupes were marketed in boxes of about 36 kg. The number of pieces in each box varied; in particular, boxes included 12, 18, 21, 27, 36 or 45 melons. The most popular presentation was the # 27 (27 melons in a 36 kg box), which is a melon of medium size. Small melons like the # 45 were sold at lower prices.

The CONAFRUT study provided a better understanding of the domestic melon industry in Mexico. However, no mention was made of foreign markets in this study. Additionally, the analysis was for a specific year, while the melon industry is a dynamic activity that changes over time. No quantitative analysis was carried out in the CONAFRUT study.

The Direccion General de Economia Agricola (DGEA) (1982) conducted an analysis of the melon industry in the state of Baja California Norte (North of Mexico) to determine its potential as an exporter. The proximity of this region to the U.S. border and the high yields in this state suggested the region could be an important exporter. However, the authors report two factors have made it difficult to take advantage of this favorable situation. First, there is the coincidence of the Baja California shipping period with U.S. production (summer and fall) and the other is the high U.S. tariff applied to imports coming from Mexico during these seasons.

The DGEA analysis mentions important factors affecting Mexico-U.S. melon trade. Tariffs and yields play an important role regarding the competitive position of both countries. However, no empirical analysis is carried out regarding the likely effects of these variables on competitiveness.

The Direccion General de Economia Agricola (DGEA) (1985) provided a diagnosis of the problems facing the cantaloupe industry in the state of Michoacan. They divided the problems into technical and marketing problems. The marketing problems were divided between those faced in the domestic market and those in the foreign market. The problems in the foreign market included the following: (1) disorganized supply, (2) lack of diversification into external markets, (3) insufficient information about external markets and (4) insufficient commercial assistance. As possible solutions, they proposed additional commercial assistance to exporters, studies into the external market for cantaloupe and communication of study results to people involved in the industry. The study being proposed here will carry out a quantitative analysis of domestic and foreign markets (primarily U.S. market) for the different types of melons produced in Mexico.

Espinoza (1987) developed an econometric model to analyze the foreign market for Mexican cantaloupe. The model consisted of three structural equations and two identities. The structural equations were representative of the supply for exports, yields and U.S. demand for imports. The changes in supply were determined by the relative price of cantaloupe with respect to watermelon, labor wages and lagged supply. The U.S. demand for imports was determined by the import price and U.S. population. The price elasticities of both supply and demand were inelastic (0.37 and -0.94, respectively). This model provided good insight into the cantaloupe market, although it ignored important forces like Mexican domestic demand, exchange rate, and tariff policies.

Gomez Cruz, *et al.* (1991) at Chapingo University provided an analysis of recent trends in Mexican fresh vegetable demand. They reported that Mexican per capita consumption has been growing faster than in the U.S.. They provided evidence that fresh vegetable consumption increased sharply with income. In a survey of two cities, per capita melon consumption of low, medium and high income individuals was found to average 5, 17 and 33 kg., respectively. The study did not estimate income elasticities of Mexican melon demand. Regardless, the study concluded that Mexican vegetable exports are not likely to expand dramatically, given the projected growth of the Mexican domestic market and the superiority of U.S. technology.

To summarize, the review of the Mexican literature provided very good insight into that country's melon industry characteristics, problems and need for further research. Updating these descriptive studies and reinforcing them with empirical analysis will provide farmers and governmental agencies with a better understanding of the current situation and possible future policies and strategies to increase exports.

### United States Studies

Suits (1955) estimated a demand response equation for the U.S. watermelon using a double log functional form and a data base for the 1930 to 1951 period. The objective of this model was to forecast the watermelon market a year into the future. Elasticity estimates indicated that watermelon was a superior good with an income elasticity of 1.37, and a price elasticity of 0.90. Although this study is one of few that includes empirical estimates, it needs to be updated and extended by incorporating supply and international markets.

Fuller and Hall (1990) provided an analysis of trends important to the melon industry (cantaloupe, honeydew and watermelon) in Texas and United States. Texas is a major producer of melons in the United States supplying about 15% of the Nations' cantaloupe supply, 15 to 20% of the honeydew supply, and about 10 to 15% of the watermelons. Due to climatological factors, Texas is a dominant shipper during the early portion of the domestic melon shipping season. Melon prices in Texas are generally at the peak during the early part of the shipping season when they average 20 to 30% above the season-average price. Available cost information shows Texas grower costs are similar or lower than other domestic producing regions.

Although Fuller and Hall provided useful information, no mention was made of the Mexican melon industry, or possible effects of variables like tariffs and exchange rates that are known to have important effects on Mexico-U.S. melon trade.

Allred and Lucier (1990) conducted a detailed analysis of the U.S. watermelon industry. This study reviewed supply and utilization trends, prices, transportation, packaging, marketing, cash receipts, and costs of producing watermelon. This study found that watermelon production and utilization declined from 1960 to 1980. However, recent evidence indicates that since 1980 both aggregate production and domestic utilization have expanded. In 1989, growers voted for a national program to increase watermelon research, advertising, and sales promotion. This program would attempt to bring the industry closer and improve the image and sales of U.S. watermelon.

Although this study is interesting and very detailed in a descriptive sense, it lacks empirical estimates in both the supply and demand. Empirical work is important to determine relative impact of market variables and assess possible future conditions of the watermelon industry.

Fuller and Hall (1991) examined issues and implications of a U.S.- Mexico Free Trade Agreement (FTA) for the fresh vegetable and melon industries in the U.S. and Texas. The report focused primarily on dry onions, bell peppers, cucumbers, broccoli, cantaloupe, honeydew and watermelons. According to their analysis, the removal of U.S. tariffs, especially on those high-dutied products, such as melons, would likely increase imports from Mexico. They observe that Mexico imports would also be facilitated by a weakening of the peso relative to the dollar. Fuller and Hall indicate among non-tariff impediments affecting melon trade between the U.S. and Mexico, were inadequate infrastructure, lengthy and unpredictable administration procedures at the border, lack of market knowledge, and limited availability of financing.

The Fuller and Hall study explicitly mentions the importance of tariffs and exchange rates as important factors influencing U.S.-Mexico trade. However, no empirical analysis was provided regarding their effects.

Cook *et al*. (1991) conducted a study to explore the implications of NAFTA on the U.S. horticultural sector. They examined the relative competitive position of both the fresh and processed sectors. The authors infer that melon production in Mexico tends to be complementary to U.S. production, supplying the U.S. market during the December to April period when U.S. production is unavailable. The primary exception is in May, when Tamaulipas, Texas, the California desert, Arizona and the Mexicali-San Luis Valley compete. The competitive analysis was based on production and marketing costs. The analysis showed a robust melon industry in the San Joaquin Valley of California. Nevertheless, they show the melon imports from Mexico should continue to expand during the Fall through Spring period. On the other hand, Mexico will continue to face competition in the U.S. Atlantic coast markets from Central America as their industry grows and matures.

The competitive analysis presented in the Cook *et al.* study was based on production and marketing costs in 1990. However, because of the different inflation rates in the U.S. and Mexico, the distinct evolution of yields and variations in exchange rates, the analysis is valid only for the 1990 season. It is necessary to carry out an analysis that explicitly accounts for various changes in the short and long run.

Brown and Suarez (1991) conducted a study that provided an annual and monthly market overview and a data base from 1975 to 1987 on U.S. production, trade, consumption and prices of fifteen fresh fruits and vegetables and two frozen vegetables. They found the demand for fresh cantaloupes to be seasonal, peaking in June and lowest in January. California, Texas and Arizona dominated the market from May to December, while Mexico and the Caribbean Basin Initiative (CBI) countries dominated the market from January to April. United States was found to be a net importer of cantaloupes. Mexico supplied 80 percent of U.S. imports from December through April. CBI countries supplied most of the remaining imports. Nominal prices in Chicago and New York terminal markets were at their lowest in August and September and tended to peak in March and December. Real melon prices were found to decline over the 1975 to 1987 period. The authors conclude that Mexico remains the primary source of several fresh and frozen fruit and vegetable items in the U.S. market. However, growers in CBI countries have increased their share of the U.S. import market for some commodities like cantaloupes, honeydews, fresh pineapples, and frozen okra.

The Brown and Suarez study provided a very good overview of the U.S. melon industry. However, because the analyzed data corresponded to the 1975-1987 period, no mention is made about how this industry will be affected by NAFTA, nor about Mexican melon industry characteristics and its potential competitive position under the new economic conditions.

Buxton (1992) estimated supply response equations for fourteen major vegetable commodities including honeydew and watermelon. The equations were estimated using a distributed lag adjustment model and with data extending over the 1970 to 1991 period. This model was justified by the fact that changes in production usually lag price changes because of the time elapsing between the decision to produce and the realization of production. The estimated supply elasticity for watermelon was found to be substantially less than one at 0.34, while that of honeydew was 1.16. Lagged prices of other vegetables that might compete with and, therefore, affect production of each vegetable crop were included in the specified equations; however, the results show the cross-price effects to be generally of no significance. This supports the hypothesis that the production of each of the fourteen vegetables is independent of the prices of other vegetable crops and depends largely on its own lagged price.

This study is one of the few that provides empirical estimates on melons. Unfortunately, the study failed to include input prices in the specification of the supply equations and the simultaneity of supply/demand was not considered in estimation.

### CBI Countries Studies

Seale (1992) analyzed impacts of the CBI trade agreement on agricultural development and exports of CBI countries. The central objective of the CBI was to increase economic growth and generate political stability in the region. Seale observed that the CBI agreement boosted exports of fruits, vegetables, and melons to the U.S., but the really important exports, such as sugar and textiles, were exempt from duty-free status or were constrained by other measures. No empirical work was performed regarding market forces of supply and demand.

Rosa (1995) conducted a study regarding trends of U.S. horticultural imports from Caribbean Basin countries. The author indicates that strong emphasis on the production and export of fruit and vegetables combined with their proximity to the U.S. market has boosted CBI countries exports. The fruit and vegetable industries in many CBI countries have continued expanding and have become far more organized and accustomed to U.S. regulations. This study included an analysis of the melon industries of the primary country suppliers; the report indicates the use of high levels of technology in melon production, including the use of new hybrid seeds. This study provided valuable information regarding characteristics of fruit and vegetable industries of CBI countries. However, no empirical analysis was performed.

### Summary

The U.S., Mexico, and CBI countries literature on melons provided a good overview of the market characteristics. However, there is a lack of empirical analysis and the emphasis is on domestic markets with limited analysis of interaction among countries. The analysis is concentrated on a specific type of melon, thus it fails to consider the competitive nature of the various types of melons in production and consumption. Updating these descriptive studies and reinforcing them with empirical analysis will provide farmers and governmental agencies with a better understanding of the current situation and offer perspectives on future policies and strategies to increase trade.

This study will attempt to overcome the deficiencies found in past studies. This study will incorporate the melon sectors of Mexico, United States, and CBI countries into an economic model that includes supply and demand of cantaloupes, honeydews and watermelons in involved countries; in addition, it will include a quantitative analysis that gives consideration to exchange rates, technology growth and wages in supplying countries.

# CONCEPTUAL MODEL OF MELON TRADE

This section presents a conceptual model of the U.S.-Mexico-CBI countries melon trade. First, alternative approaches to modeling agricultural trade are discussed for purposes of selecting the most appropriate model to accomplish study objectives. Second, a theoretical review of economic policy variables and their effects on agricultural trade and prices is performed. These variables will be the subject of the following empirical analysis. Finally, the full conceptual model of melon trade is presented.

## Alternative Approaches to Model Agricultural Trade

Trade theory has evolved to incorporate developments in production and consumer theory as well as macroeconomic theory, industrial organization theory, and game theory. The empirical modeling of agricultural trade has followed the developments in theory as well as those in quantitative methods. Consequently, a number of alternatives for modeling international agricultural trade have been developed. The selected model should be consistent with the underlying theory and the commodity sector being analyzed, and allow the researcher to focus on variables that are critical to the analysis. Different modeling approaches are considered for purposes of accomplishing study objectives.

Armington's approach (Armington Model) presents a general theory of demand for products that are distinguished not only by their kind, but also by their place of production. Such products are distinguished from one another in the sense that they are assumed to be imperfect substitutes in demand. Not only is each good, such as chemicals, different from any other good but also each good is assumed to be differentiated (from the buyers' viewpoint) according to the origin of supply.

Under Armington's approach, import demand functions can be determined in a separable, two step procedure. In the first step, the demand for any good, such as chemicals, can be obtained by maximizing a utility function subject to a budget constraint. Then, in the second step, the demand for any product, such as chemicals from Japan, can be obtained by minimizing the cost of purchasing the quantity of the good just determined.

Armington's framework has been applied to numerous international agricultural markets that have the objective of modeling import demand. However, for purposes of this study, Armington's approach has several shortcomings. First, the Armington model focuses on demand, while the proposed study must address issues that relate to both supply and demand. Second, Armington assumes products are imperfect substitutes in demand, while we assume that melons are perfect substitutes in demand. This means that consumers do not distinguish melons from different origins (homogeneous product assumption). Further, the Armington model makes important assumptions about homotheticity and separability that have been rejected on empirical grounds (Alston *et al.*)

The GNP function approach (Kohli) is also useful to analyze questions dealing with international trade. Kohli's GNP function approach has been used extensively with aggregate national data and has been successful in addressing research questions in the United States, Canada, and Australia (Kohli).

The GNP function approach provides a sound theoretical framework for export supply and import demand based on production theory. This approach treats imports as an additional input in a profit maximizing production process and exports as output distinct from output produced for domestic consumption. Considering the duality between production possibility sets and profit or cost functions, the sector's competitive equilibrium can be characterized as the solution to a profit maximization or cost minimization problem subject to technological and resource constraints. Using the profit maximization approach, a complete system of input demand and output supply functions can be derived using Hotteling's lemma.

For purposes of this study, the GNP function approach was removed from consideration because of several shortcomings. First, with this approach, the focus is at the aggregated national level while the subject of this study are particular crops. Second, traded goods are treated as intermediate goods with the GNP function approach, while melons in the proposed study are considered final goods for consumption.

Complete demand systems (CDS) approach was considered to analyze the demand side of the melon markets. A complete demand system consists of a set of demand equations which describes the allocation of expenditures among an exhaustive set of goods or consumption categories which can be derived from a “well-behaved” preference ordering. Consumption categories may be broad aggregates such as food and clothing or they may be specific goods in the consumer’s choice set. However, for purposes of this study, CDS has several shortcomings. First, CDS focuses only on the demand side while we are interested in both supply and demand. Second, CDS have not been shown to perform particularly well in simulation when integrated into a trade model that includes a dynamic supply component (Malaga, Garcia-Vega, Tsai). These researchers were forced to abandon the theoretically desirable CDS and utilize single demand formulations to represent consumer behavior in their trade models.

The model to be developed for this study must be in the context of neoclassical trade theory that reflects conditions of perfect competition in a partial equilibrium framework. Virtually all empirical models must be classified as partial equilibrium because not all economic factors that bear on the solution are included. Excluded elements are assumed to remain constant during an adjustment process (Tweeten). The selection of this approach is based on characteristics of the international melon market. Perfect competition assumptions such as many producers, price-takers in output and input markets, homogeneous good, domestic factor mobility, and many buyers and sellers tend to characterize the melon industry.

Neoclassical trade theory holds that each trading region has an excess supply or excess demand function for a commodity. Figure 4.1 illustrates a typical two country, one-commodity trade model with the familiar price-quantity panels. Supply and demand functions for each region determine the excess functions in the world market. When the world market clears, imports ($QC_m$-$QS_m$) equal exports ($QS_x$-$QC_x$), at world price $P_w$. In the absence of restrictions to trade (free trade), the world price determines the quantities consumed and produced in each region. In the absence of trade (autarky), domestic markets clear when supply equals demand at the domestic price, $P_a$.

Since the world is not made up of a single exporter and a single importer, it is often necessary to use a model of multilateral trade. This can be accomplished by simply adding the excess demand and supply schedules of additional exporters and importers (McCalla). The addition of countries will increase the slope of the world export supply and import demand functions relative to the slope of individual country functions. As we will see in the following section, the basic neoclassical trade model is a straightforward approach to analyzing the most basic questions dealing with international trade.

### Theoretical Effects of Policy Variables on Agricultural Trade

A country’s decision regarding trade policy issues can have an important effect on that country and its trading partners. In this section, under conditions of perfect competition, the expected effects on trade and prices that result from changes in tariffs, exchange rates, technology, economic growth, and production costs are examined.

Tariffs are one of the most common barriers to trade. Tariffs are designated to protect domestic production against the economic effects of imported goods. Figure 4.2 illustrates the effects of a tariff in a single competitive market. The effect of a tariff, $t_m$, is to drive a wedge between the price of the good in exporting and importing countries. The tariff is shown in figure 4.2 as increasing the internal price in the importing country, while lowering the price in the exporting country. Exports and imports decrease in domestic markets as shown by the arrows in figure 4.2 and world trade decreases from $Q_w^0$ to $Q_w^1$. As discussed in the Melon Industry Characteristics section, Mexican melons entering the U.S. market have been charged with tariffs that depend on the season and type of melon. Under NAFTA these tariffs will be phased out over an extended period. Based on the above analysis we expect Mexico to increase exports as a result of U.S. tariff elimination.

The exchange rate is another important factor influencing international trade. The exchange rate functions as a relative price between currencies of different countries. Changes in the exchange rate affect the supply and demand for commodities. The changes in supply and demand alter trade levels and flows (Paarlberg *et al.*). A distinction is made between nominal changes in exhange rate and real changes in exchange rate. Nominal exhange rates refer to those quoted at banks and newspapers for business transactions. Real exchange rates adjust the nominal exhange rate by the relative inflation between two countries or group of countries (Paarlberg *et al.*). High inflation rates in countries that export agricultural goods will partially offset the nominal depreciation of their currencies.

Figure 4.3 illustrates the effects of a real devaluation in the currency of an exporting country. Real devaluation is represented by a downward rotation of the excess supply schedule from $ES^0$ to $ES^1$. Farmers in the exporting country perceive a higher price that increases exports, while consumers in an importing country perceive a lower price that increases imports. In general, a devaluation in countries that export will boost production and exports and increase the quantity of trade from $Q_w^0$ to $Qw^1$.

As mentioned above, nations are connected by trade. Suppose an exporting country has improved crop yields because of better production technology, thus shifting domestic supply from $S_x$ to $S_x^1$ in figure 4.4. This shifts the world excess supply (ES) to the right, resulting in a decrease in world price to $P_w^1$ and an increase in the quantity of trade to $Q_w^1$. Prices decline in the importing country to $P_m^1$, increasing domestic consumption, decreasing production, and therefore, expanding imports. Thus, an internal event in one country is transmitted to another country through price changes in the international market. Clearly, those countries with higher yields have more opportunities to increase their export supply.

Changes in factor prices also affect trade. If the price of factors used in the production process (or production costs) increase, other things being equal, producers will reduce output. Suppose the exporting country has an increase in factor (e.g., labor, fertilizer, pesticides) price in a given year, thus shifting supply from $S_x$ to the left to $S_x^1$ in figure 4.5. This shifts the world excess supply (ES) to the left, resulting in an increase in world price to $P_w^1$ and a decrease in the quantity of trade to $Q_w^1$. Prices increase in the importing country, reducing domestic consumption, increasing production, and reducing imports. There are several reasons for increases in factor prices. These include high inflation rates, domestic agricultural policies regarding factor prices and factor price increases in world markets when factors are imported.

Changes in the level of per capita income also affect trade levels and prices. In general, there is a positive relationship between the demand for a product and the level of income. As consumers' income rises, the demand for a commodity is expected to increase. Suppose consumers in an exporting country have an increase in real income in a given year, thus shifting domestic demand from $Dx^0$ to $D_x^1$ in figure 4.6. This shifts the world excess supply (ES) to the left, resulting in an increase in world price to $P_w^1$ and a decrease in the quantity of trade to $Q_w^1$. Price increases in the importing country, reducing domestic consumption, increasing production, and decreasing imports. It is important to note that in the exporting country the supply increases, but because of the increase in income an increasing portion of production is domestically consumed.

## Conceptual Model of Melon Trade

In accordance with neoclassical trade theory, the melon model specified here includes domestic supply and demand equations of countries involved in trade, as well as the corresponding price linkage and trade equations. As discussed in the Melon Industry Characteristics section, Mexico and CBI countries are net exporters of melons to the United States and are represented in trade by excess supply equations, while an excess demand is formulated for the U.S. as a net importer.

As stated in chapter I, the purpose of this study is to predict future trade conditions, and evaluate the relative importance of key policy variables. A model should never be judged on how complete it is; rather it should be judged on its predictive ability (Tweeten). The conceptual model of U.S.-Mexico-CBI countries melon trade is presented in table 4.1. The definition of variables is presented in table 4.2.

Economic theory suggests the supply of a product is a function of its own price, price of related commodities, factor prices, technology, and other relevant exogenous variables (Tomek and Robinson). In general, based on the maximization principle where producers are assumed to behave so as to maximize profits, the relationship between quantity supplied of a commodity and its own price is positive. That is, producers are willing to increase production as output price increases. However, since there are biological cycles involved in the production of agricultural commodities, (because of the lag between farmers' production decisions and the realization of the final output) producers are assumed to develop expectations with respect to price.

Also, since crops compete for the available factors of production, as prices of competing crops increase, producers are likely to reduce production of the crop in question. Additionally, if the price of inputs used in the production process (or production costs) increase, other things being equal, producers will reduce crop output. Technology and weather also influence production. With an increase in production technology, output of a crop is expected to increase, while if weather conditions become adverse (e.g. freezes, droughts, flood) production will decline. Pest and plant diseases will adversely affect the level of output. To incorporate the effects of weather and pest and plant diseases, dummy variables may be added to the model.

The specified Mexican supply equations for cantaloupes, honeydew, and watermelon are shown in equations [4.1] to [4.6] in table 4.1. This specification assumes that planted melon area is explained by its lagged own price, price of competing crops and production costs. The use of lagged variables incorporates farmers' price expectations as discussed previously. The specified equations emphasize the major forces thought to influence supply. It is not possible to include an exhaustive set of variables. For example, the price of a single major input or an index of input prices is commonly used to represent production costs. Production for every type of melon is represented by identities [4.4] to [4.6]. Production is represented as a product of area harvested and yields. Technology is assumed to be exogenous to the model through its impact on crop yields. Specifications similar to the Mexican supply equations are used for U.S. melon supplies in equations [4.16] to [4.21] and for CBI countries supplies in equations [4.34] to [4.39].

According to the consumer utility theory, the consumer allocates their fixed budget among goods or services to maximize utility. As price increases, ceteris paribus, the quantity of a good or service demanded will fall. Also, as the price of related goods (substitutes or complements) change, the demand for a given commodity will shift. If the commodities are substitutes, the relationship between price of the substitute and quantity of product in question is direct, while if they are complements, the relationship is expected to be inverse. Also a positive relationship is expected between the demand for a product and the level of income. As consumers' income increases, the demand for a commodity is expected to increase.

The specified Mexican demands for cantaloupe, honeydew, and watermelon are shown in equations [4.7] to [4.12] in table 4.1. The per capita demand is defined as a function of its own price, the prices of other melons, and the Mexican per capita income. Total Mexican demand for every type of melon is represented by identities [4.10] to [4.12]. Total demand is the product of Mexican per capita consumption and Mexican population. The U.S. melon demands are specified as the Mexican melon demands and are represented by equations [4.25] to [4.30] and, for CBI countries, melon demands are represented by equations [4.43] to [4.48].

In addition to supply and demand equations, the model must include price linkage and trade equations. Price equations transmit price from one level of the market channel to another. Equations [4.13] to [4.15], [4.22] to [4.24] and [4.40] to [4.42] represent the price spread equations for Mexico, U.S. and CBI countries, respectively, for cantaloupe, honeydew and watermelon. Price spread equations relate prices at different market levels within a country. It is generally assumed that prices are determined at the retail level and changes in retail level prices are transmitted to the farm level. However, Mexico and CBI countries melon exports to the U.S. in the Fall-Winter season, an exception is made. In these countries during the Fall-Winter season we assume prices are determined in U.S. terminal markets with price changes transmitted to Mexico and CBI countries farm level and domestic consumer prices. That is, prices in U.S. terminal markets determine Mexico and CBI countries farm price and these in turn determine domestic Mexico and CBI countries retail price. This appeared to be a reasonable assumption since the U.S. import market dominates all melon markets during the Fall-Winter season in Mexico and the CBI countries.

Price linkage equations relate commodity prices of countries connected internationally by trade. Equations [4.31] to [4.33] link Mexico and the United States and equations [4.49] to [4.51] link the United States with CBI countries. These equations include the real exchange rate as suggested by Chambers and Just and real tariffs as suggested by trade theory.

Trade equations are presented in four blocks. Three blocks are comprised of excess supply equations and one block represents the equilibrium conditions. Mexico excess supply equations are formulated in equations [4.52] to [4.54] as the difference between domestic quantity supplied during the Fall-Winter season (December-May) and demand in the same period. As discussed in the Melon Industry Characteristics section, Fall-Winter production in Mexico is divided between the export and domestic markets. Production for the domestic market is small (about 15% of Fall-Winter supply): this production is produced in non-irrigated areas, where fertilization levels are low, and modern methods of production are not typically used. Because of its dimension and characteristics, melons for the domestic market are considered to be exogenous and no equations are specified to explain its behavior.

The CBI countries excess supply formulations for cantaloupe, honeydew, and watermelon are presented in equations [4.55] to [4.57]. They are formulated as the difference between domestic supply and domestic demand. As discussed in chapter II, both Mexico and CBI countries are net melon exporters in the Fall-Winter season. In contrast, during the Fall-Winter season (December-May), the United States is a net importer of melons and an excess demand is formulated. Formulations for U.S. excess demand equations for cantaloupe, honeydew, and watermelon are presented in equations [4.58] to [4.60] in table 4.1. Excess demand equations are formulated as the difference between U.S. quantity demanded and U.S. quantity supplied plus exports.

Finally, the model includes the necessary restriction that equilibrium in the international trade market occurs when excess supply equals excess demand. Equilibrium conditions for the melon market are presented in equations [4.61] to [4.63]. Excess demand (U.S. imports) must be equal to total excess supply (exports of Mexico, CBI, and other countries). The trade equations assume that U.S. imports and exports of melons to countries other than Mexico and CBI countries are exogenous. Once the model has been specified, the next step is to obtain empirical estimates.

### Summary

This section has introduced the conceptual model of Mexico-U.S.-CBI countries melon trade. Alternative approaches to modeling international agricultural trade were discussed. The selected model is based on neoclassical theory and is consistent with study objectives, and commodity market characteristics. The theoretical implication of selected variables on prices, production and trade were explored. These variables will be the subject of empirical analysis and knowledge of the theoretical implications will be helpful in evaluating empirical results. Finally, based on theoretical principles, the complete conceptual model of U.S.-Mexico-CBI countries melon trade was specified. The following section will present the empirical results and validation of the full U.S.-Mexico-CBI countries melon trade model.

**Table 4.1. Conceptual Model of the U.S.-Mexico-CBI Countries Melon Trade**

Mexican Supply

[4.1] $MXAHXCN_t = f_1(MXFPCN_{t-1},MXFPHD_{t-1},MXFPWT_{t-1},MXC_{t-1})$
[4.2] $MXAHXHD_t = f_2(MXFPCN_{t-1},MXFPHD_{t-1},MXFPWT_{t-1},MXC_{t-1})$
[4.3] $MXAHXWT_t = f_3(MXFPCN_{t-1},MXFPHD_{t-1},MXFPWT_{t-1},MXC_{t-1})$

[4.4] $MXQSXCN_t = MXAHXCN_t*MXYIXCN_t$
[4.5] $MXQSXHD_t = MXAHXHD_t*MXYIXHD_t$
[4.6] $MXQSXWT_t = MXAHXWT_t*MXYIXWT_t$

Mexican Demand

[4.7] $MXCOCN_t = f_4(MXCPCN_t,MXCPHD_t,MXCPWT_t,MXI_t)$
[4.8] $MXCOHD_t = f_5(MXCPCN_t,MXCPHD_t,MXCPWT_t,MXI_t)$
[4.9] $MXCOWT_t = f_6(MXCPCN_t,MXCPHD_t,MXCPWT_t,MXI_t)$

[4.10] $MXQDCN_t = MXCOCN_t*MXPOP_t$
[4.11] $MXQDHD_t = MXCOHD_t*MXPOP_t$
[4.12] $MXQDWT_t = MXCOWT_t*MXPOP_t$

[4.13] $MXCPCN_t = f_7(MXFPCN_t)$
[4.14] $MXCPHD_t = f_8(MXFPHD_t)$
[4.15] $MXCPWT_t = f_9(MXFPWT_t)$

U.S. Supply

[4.16] $USAHCN_t = f_{10}(USFPCN_{t-1},USFPHD_{t-1},USFPWT_{t-1},USC_{t-1})$
[4.17] $USAHHD_t = f_{11}(USFPCN_{t-1},USFPHD_{t-1},USFPWT_{t-1},USC_{t-1})$
[4.18] $USAHWT_t = f_{12}(USFPCN_{t-1},USFPHD_{t-1},USFPWT_{t-1},USC_{t-1})$

[4.19] $USQSCN_t = USAHCN_t*USYICN_t$
[4.20] $USQSHD_t = USAHHD_t*USYIHD_t$
[4.21] $USQSWT_t = USAHWT_t*USYIWT_t$

[4.22] $USFPCN_t = f_{13}(USCPCN_t)$
[4.23] $USFPHD_t = f_{14}(USCPHD_t)$
[4.24] $USFPWT_t = f_{15}(USCPWT_t)$

U.S. Demand

[4.25] $USCOCN_t = f_{16}(USCPCN_t,USCPHD_t,USCPWT_t,USI_t)$
[4.26] $USCOHD_t = f_{17}(USCPCN_t,USCPHD_t,USCPWT_t,USI_t)$
[4.27] $USCOWT_t = f_{18}(USCPCN_t,USCPHD_t,USCPWT_t,USI_t)$

[4.28] $USQDCN_t = USCOCN_t*USPOP_t$
[4.29] $USQDHD_t = USCOHD_t*USPOP_t$
[4.30] $USQDWT_t = USCOWT_t*USPOP_t$

U.S.-Mexico Price Linkage Equations

[4.31] $MXFPCN_t = f_{19}(USCPCN_t,MXRER_t,USRTCN_t)$
[4.32] $MXFPHD_t = f_{20}(USCPHD_t,MXRER_t,USRTHD_t)$
[4.33] $MXFPWT_t = f_{21}(USCPWT_t,MXRER_t,USRTWT_t)$

(continued on next page)

**Table 4.1. Continued**

CBI Supply

[4.34] $CBIAHCN_t = f_{22}(CBIFPCN_{t-1},CBIFPHD_{t-1},CBIFPWT_{t-1},CBIC_{t-1})$
[4.35] $CBIAHHD_t = f_{23}(CBIFPCN_{t-1},CBIFPHD_{t-1},CBIFPWT_{t-1},CBIC_{t-1})$
[4.36] $CBIAHWT_t = f_{24}(CBIFPCN_{t-1},CBIFPHD_{t-1},CBIFPWT_{t-1},CBIC_{t-1})$

[4.37] $CBIQSCN_t = CBIAHCN_t*CBIYICN_t$
[4.38] $CBIQSHD_t = CBIAHHD_t*CBIYIHD_t$
[4.39] $CBIQSWT_t = CBIAHWT_t*CBIYIWT_t$

[4.40] $CBICPCN_t = f_{25}(CBIFPCN_t)$
[4.41] $CBICPHD_t = f_{26}(CBIFPHD_t)$
[4.42] $CBICPWT_t = f_{27}(CBIFPWT_t)$

CBI Demand

[4.43] $CBICOCN_t = f_{28}(CBICPCN_t,CBICPHD_t,CBICPWT_t,CBII_t)$
[4.44] $CBICOHD_t = f_{29}(CBICPCN_t,CBICPHD_t,CBICPWT_t,CBII_t)$
[4.45] $CBICOWT_t = f_{30}(CBICPCN_t,CBICPHD_t,CBICPWT_t,CBII_t)$

[4.46] $CBIQDCN_t = CBICOCN_t*CBIPOP_t$
[4.47] $CBIQDHD_t = CBICOHD_t*CBIPOP_t$
[4.48] $CBIQDWT_t = CBICOWT_t*CBIPOP_t$

CBI-U.S. Price Linkage Equations

[4.49] $CBIFPCN_t = f_{31}(USCPCN_t,CBIRER_t,USRTCN_t)$
[4.50] $CBIFPHD_t = f_{32}(USCPHD_t,CBIRER_t,USRTHD_t)$
[4.51] $CBIFPWT_t = f_{33}(USCPWT_t,CBIRER_t,USRTWT_t)$

Mexico Excess Supply Equations

[4.52] $MXESCN_t = MXQSXCN_t+MXQSDCN_t-MXQDCN_t$
[4.53] $MXESHD_t = MXQSXHD_t+MXQSDHD_t-MXQDHD_t$
[4.54] $MXESWT_t = MXQSXWT_t+MXQSDWT_t-MXQDWT_t$

CBI Excess Supply Equations

[4.55] $CBIESCN_t = CBIQSCN_t-CBIQDCN_t$
[4.56] $CBIESHD_t = CBIQSHD_t-CBIQDHD_t$
[4.57] $CBIESWT_t = CBIQSWT_t-CBIQDWT_t$

U.S. Excess Demand Equations

[4.58] $USEDCN_t = USQDCN_t-USQSCN_t+USEXCN_t$
[4.59] $USEDHD_t = USQDHD_t-USQSHD_t+USEXHD_t$
[4.60] $USEDWT_t = USQDWT_t-USQSWT_t+USEXWT_t$

Equilibrium Conditions

[4.61] $USEDCN_t = MXESCN_t+CBIESCN_t+OTESCN_t$
[4.62] $USEDHD_t = MXESHD_t+CBIESHD_t+OTESHD_t$
[4.63] $USEDWT_t = MXESWT_t+CBIESWT_t+OTESWT_t$

**Table 4.2. U.S.-Mexico-CBI Countries Melon Trade Model: Definition of Variables**

Mexico

| | |
|---|---|
| MXAHXCN = | Cantaloupe Harvested Area Intended for Export |
| MXAHXHD = | Honeydew Harvested Area Intended for Export |
| MXAHXWT = | Watermelon Harvested Area Intended for Export |
| | |
| MXFPCN = | Cantaloupe Farm Price |
| MXFPHD = | Honeydew Farm Price |
| MXFPWT = | Watermelon Farm Price |
| | |
| MXQSXCN = | Cantaloupe Production Intended for Export |
| MXQSXHD = | Honeydew Production Intended for Export |
| MXQSXWT = | Watermelon Production Intended for Export |
| | |
| MXYIXCN = | Cantaloupe Yields of Area Intended for Export |
| MXYIXHD = | Honeydew Yields of Area Intended for Export |
| MXYIXWT = | Watermelon Yields of Area Intended for Export |
| | |
| MXQDCN = | Cantaloupe Aggregate Consumption |
| MXQDHD = | Honeydew Aggregate Consumption |
| MXQDWT = | Watermelon Aggregate Consumption |
| | |
| MXCOCN = | Cantaloupe Per Capita Consumption |
| MXCOHD = | Honeydew Per Capita Consumption |
| MXCOWT = | Watermelon Per Capita Consumption |
| | |
| MXCPCN = | Cantaloupe Consumer Price |
| MXCPHD = | Honeydew Consumer Price |
| MXCPWT = | Watermelon Consumer Price |
| | |
| MXQSDCN = | Cantaloupe Production Intended for Domestic Market |
| MXQSDHD = | Honeydew Production Intended for Domestic Market |
| MXQSDWT = | Watermelon Production Intended for Domestic Market |
| | |
| MXESCN = | Cantaloupe Excess Supply (Export) |
| MXESHD = | Honeydew Excess Supply (Export) |
| MXESWT = | Watermelon Excess Supply (Export) |
| | |
| MXC = | Production Cost |
| MXI = | Per Capita Income |
| | |
| MXPOP = | Mexican Population |
| MXRER = | Mexico-U.S. Real Exchange Rate |

U.S.

| | |
|---|---|
| USAHCN = | Cantaloupe Harvested Area |
| USAHHD = | Honeydew Harvested Area |
| USAHWT = | Watermelon Harvested Area |

(continued on next page)

**Table 4.2. Continued**

| | |
|---|---|
| USFPCN = | Cantaloupe Farm Price |
| USFPHD = | Honeydew Farm Price |
| USFPWT = | Watermelon Farm Price |
| | |
| USQSCN = | Cantaloupe Production |
| USQSHD = | Honeydew Production |
| USQSWT = | Watermelon Production |
| | |
| USYICN = | Cantaloupe Yields |
| USYIHD = | Honeydew Yields |
| USYIWT = | Watermelon Yields |
| | |
| USQDCN = | Cantaloupe Aggregate Consumption |
| USQDHD = | Honeydew Aggregate Consumption |
| USQDWT = | Watermelon Aggregate Consumption |
| | |
| USCOCN = | Cantaloupe Per Capita Consumption |
| USCOHD= | Honeydew Per Capita Consumption |
| USCOWT= | Watermelon Per Capita Consumption |
| | |
| USCPCN = | Cantaloupe Consumer Price |
| USCPHD = | Honeydew Consumer Price |
| USCPWT = | Watermelon Consumer Price |
| | |
| USEXCN = | Cantaloupe Exports |
| USEXHD = | Honeydew Exports |
| USEXWT = | Watermelon Exports |
| | |
| USEDCN = | Cantaloupe Excess Demand (Imports) |
| USEDHD = | Honeydew Excess Demand (Imports) |
| USEDWT = | Watermelon Excess Demand (Imports) |
| | |
| USC = | Production Costs |
| USI = | Per Capita Income |
| USPOP = | U.S. Population |
| | |
| USRTCN = | U.S. Real Tariff Charged to Cantaloupe Imports |
| USRTHD = | U.S. Real Tariff Charged to Honeydew Imports |
| USRTWT = | U.S. Real Tariff Charged to Watermelon Imports |
| | |
| <u>CBI Countries</u> | |
| | |
| CBIAHCN = | Cantaloupe Harvested Area |
| CBIAHHD = | Honeydew Harvested Area |
| CBIAHWT = | Watermelon Harvested Area |
| | |
| CBIFPCN = | Cantaloupe Farm Price |
| CBIFPHD = | Honeydew Farm Price |
| CBIFPWT = | Watermelon Farm Price |

(continued on next page)

**Table 4.2. Continued**

| | |
|---|---|
| CBIQSCN = | Cantaloupe Production |
| CBIQSHD = | Honeydew Production |
| CBIQSCN = | Watermelon Production |
| | |
| CBIYICN = | Cantaloupe Yields |
| CBIYIHD = | Honeydew Yields |
| CBIYICN = | Watermelon Yields |
| | |
| CBIQDCN = | Cantaloupe Aggregate Consumption |
| CBIQDHD = | Honeydew Aggregate Consumption |
| CBIQDWT = | Watermelon Aggregate Consumption |
| | |
| CBICOCN = | Cantaloupe Per Capita Consumption |
| CBICOHD = | Honeydew Per Capita Consumption |
| CBICOWT = | Watermelon Per Capita Consumption |
| | |
| CBICPCN = | Cantaloupe Consumer Price |
| CBICPHD = | Honeydew Consumer Price |
| CBICPWT = | Watermelon Consumer Price |
| | |
| CBIESCN = | Cantaloupe Excess Supply (Export) |
| CBIESHD = | Honeydew Excess Supply (Export) |
| CBIESWT = | Watermelon Excess Supply (Export) |
| | |
| CBIC = | Production Cost |
| CBII = | Per Capita Income |
| CBIPOP = | CBI Population |
| CBIRER = | CBI-U.S. Real Exchange Rate |
| | |
| Other Countries | |
| | |
| OTESCN= | Cantaloupe Excess Supply (Exports) to U.S. |
| OTESHD= | Honeydew Excess Supply (Exports) to U.S. |
| OTESWT= | Watermelon Excess Supply (Exports) to U.S. |

**Figure 4.1 Two-Country, One-Commodity Model of International Trade**

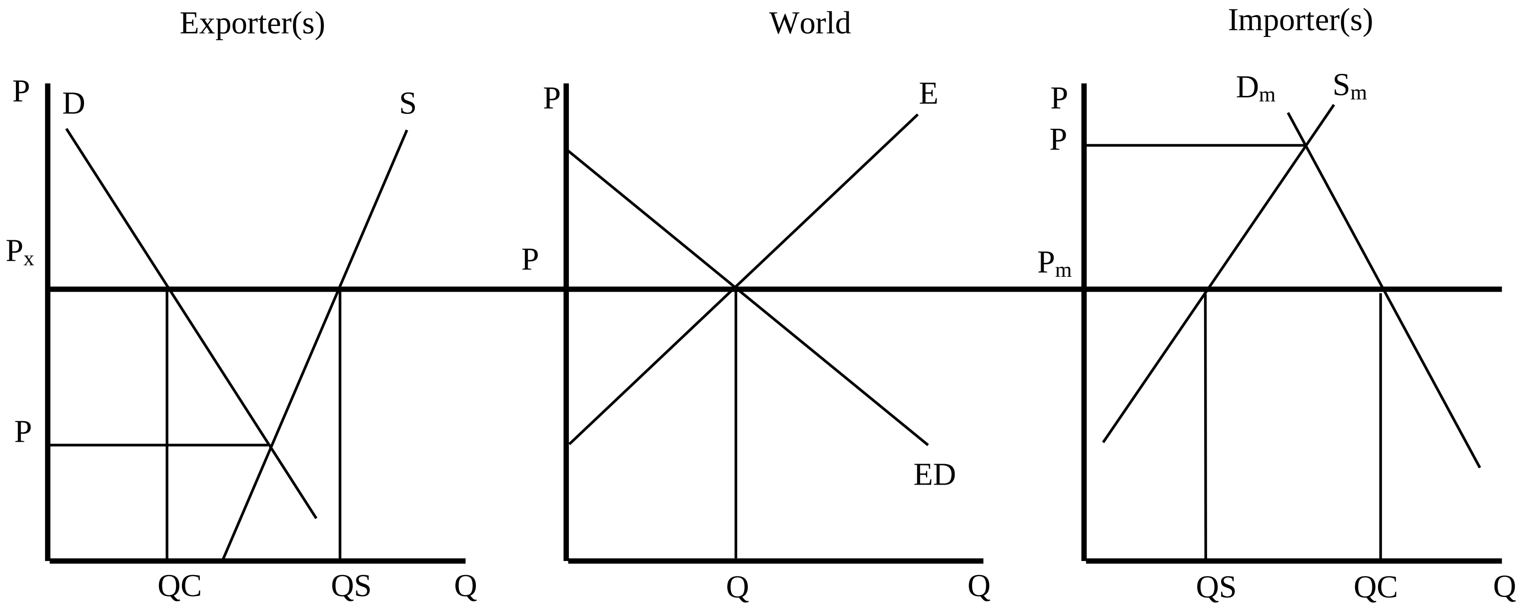


**Figure 4.2 Trade Implications of an Import Tariff**

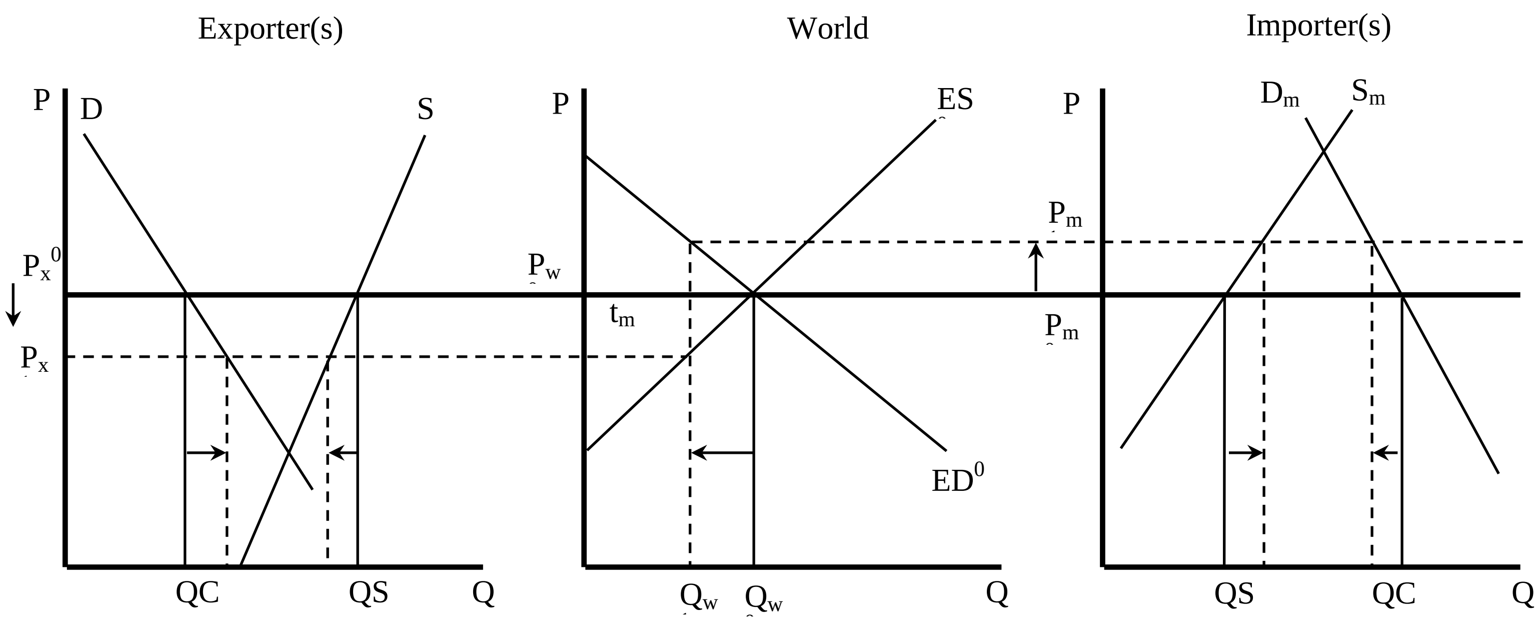


**Figure 4.3 Trade Implications of an Import Tariff**

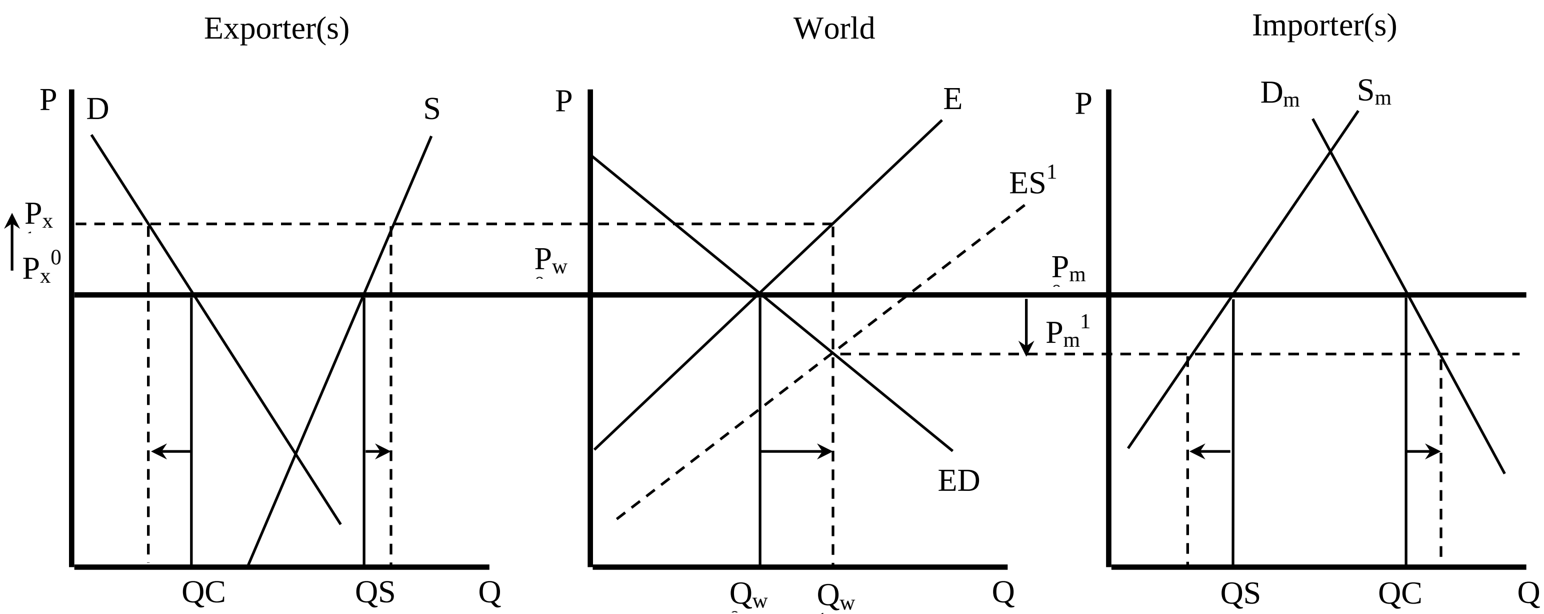


**Figure 4.4 Trade Implications of Technology Improvement in an Exporting Country**

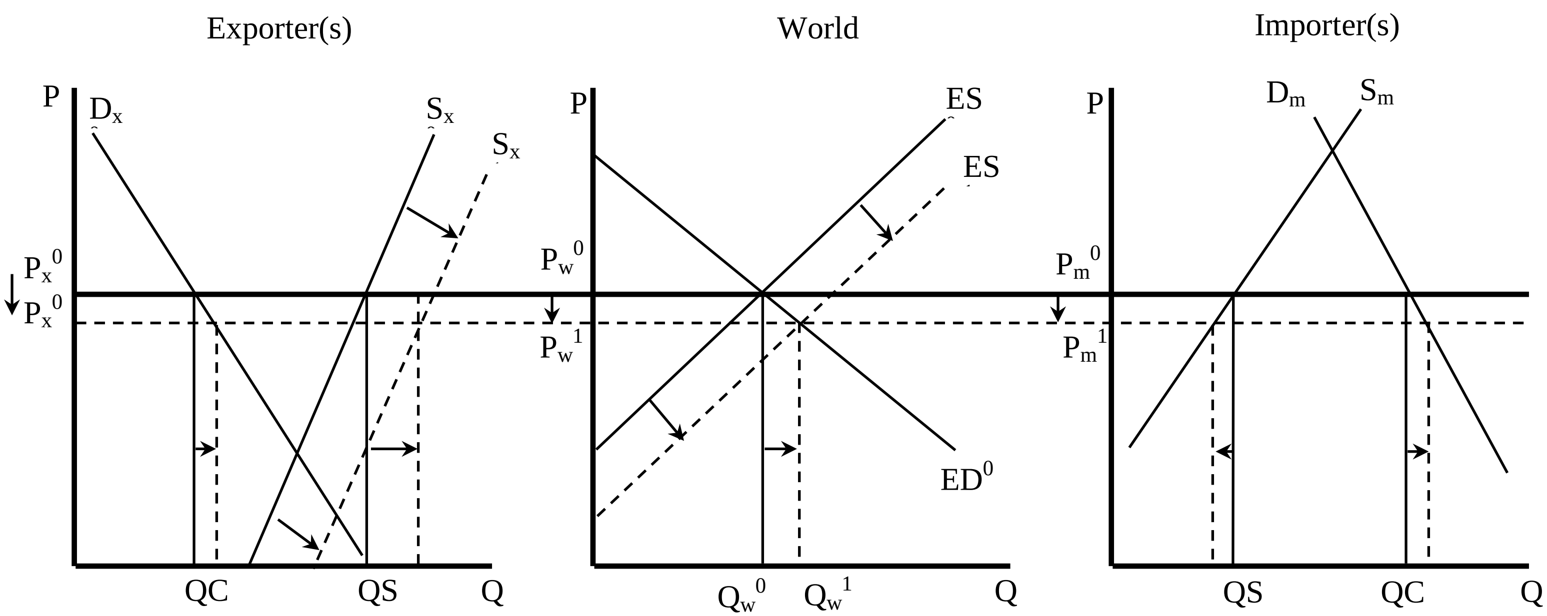


**Figure 4.5 Trade Implications of an Increase in Input Price in an Exporting Country**

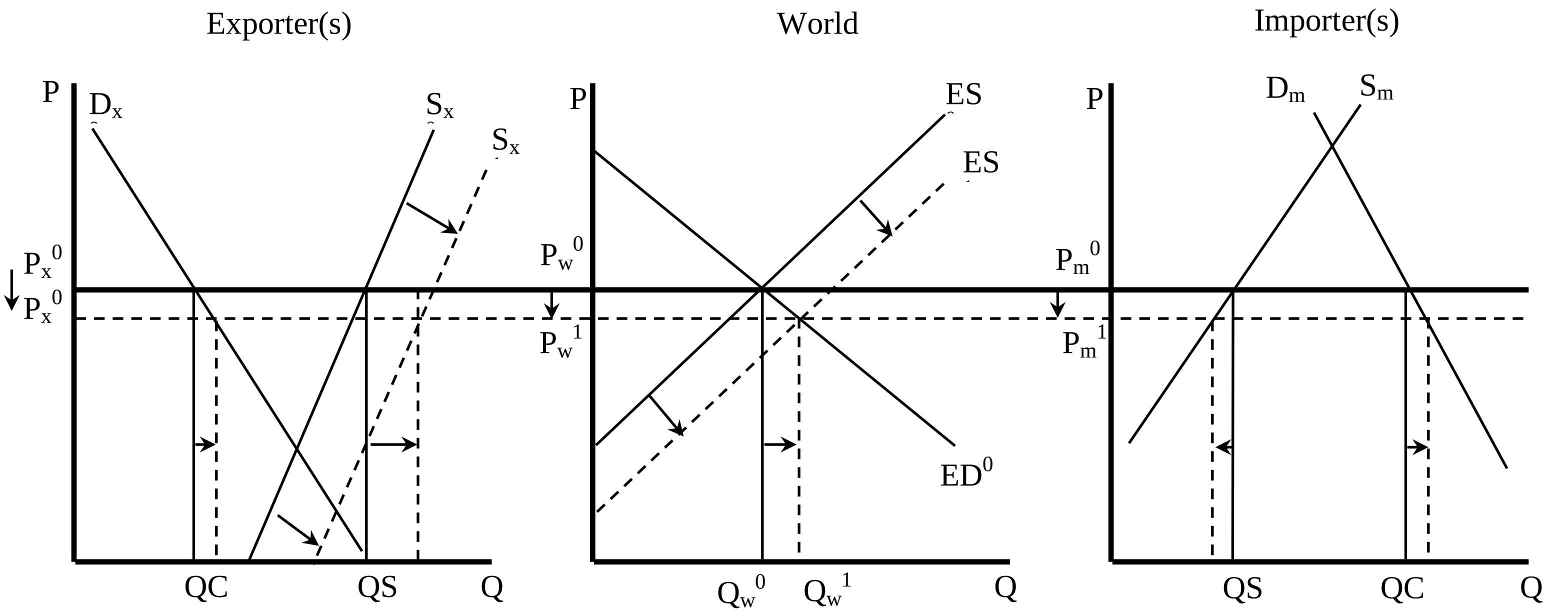
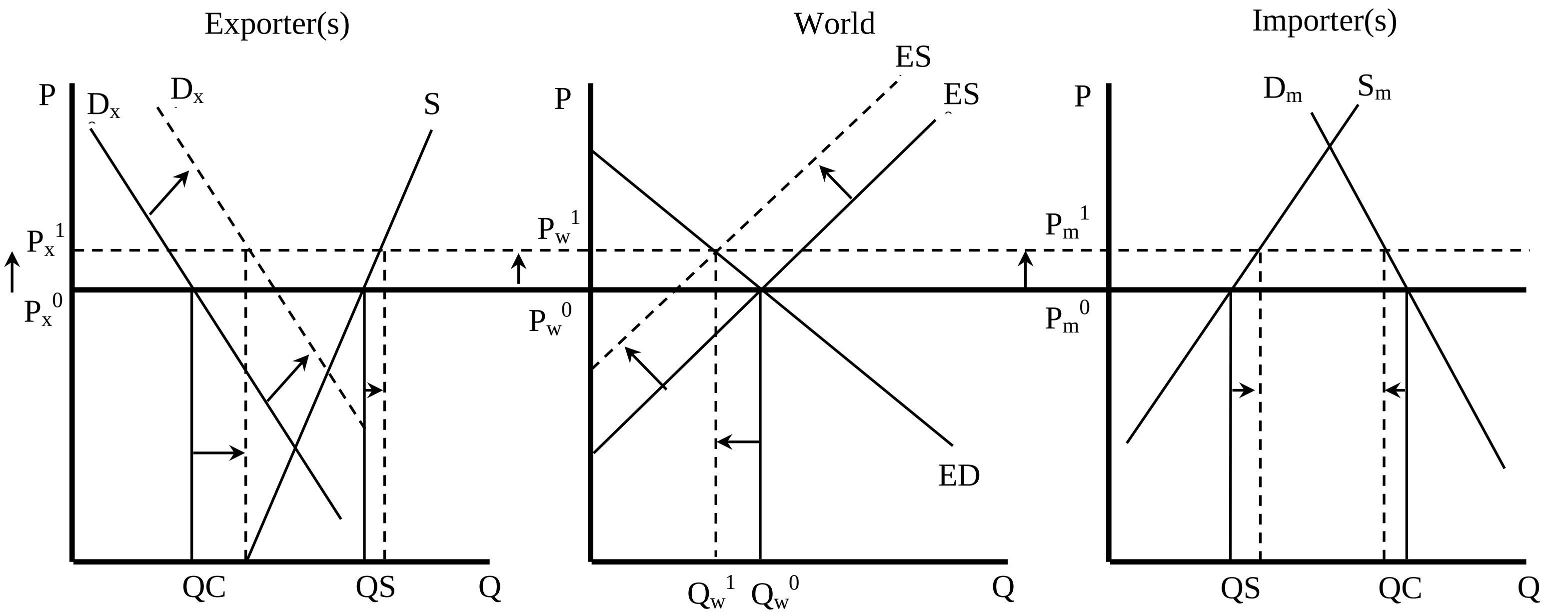


**Figure 4.6 Trade Implications of Economic Growth in an Exporting Country**



# EMPIRICAL RESULTS

This section presents the results of the empirical analysis performed using the conceptual model depicted in the previous section. First, the data sources are discussed and the estimation procedures are described. The estimation results for supply, demand, price, and trade equations for Mexico, United States, and CBI countries are presented, including a discussion of economic and statistical implications. The model is then validated through historical simulation. The model validation results and statistics are presented along with the corresponding set of dynamic multipliers. The empirical model presented in this section will be used in the following section for forecasting and simulation purposes.

## Data Sources and Considerations

As discussed in the Melon Industry section, two clearly different melon production seasons exist in the U.S., Mexico and CBI countries, i.e., the Fall-Winter and the Spring-Summer production seasons. Seasonal divisions were defined following Mexican production statistics. The Fall-Winter season covers melon production that correspond to the months of December through May while the Spring-Summer season covers the months of June through November. Monthly data were converted into seasonal data using these seasonal definitions. As stated in previous sections this study focuses on the Fall-Winter season because of Mexico's international involvement and the relative importance of exports during this production season.

The data to estimate the model consists of twenty-five annual observations covering the period 1970-1994. Mexican state-level data regarding harvested area, production, yields, and farm price were obtained from *Anuario Estadistico de la Produccion Agricola de los Estados Unidos Mexicanos* published by the Secretaria de Agricultura y Recursos Hidraulicos (SARH) now known as Secretaria de Agricultura, Ganaderia y Desarrollo Rural (SAGAR). This publication contains information at the state and season level for most crops produced in Mexico. Mexican harvested cantaloupe area and cantaloupe production intended for export were obtained by summing these data for the states of Michoacan, Sinaloa, Colima, Guerrero, Tamaulipas, Nayarit, and Jalisco. Mexican harvested watermelon area and watermelon production intended for export were estimated by aggregating these data for the states of Sinaloa, Jalisco, Sonora, Veracruz, Tabasco, and Tamaulipas. As mentioned in the Melon Industry Characteristics section, these states are the major suppliers to Mexican cantaloupe and watermelon export markets. Mexican melon yields and farm prices were obtained through production-weighted averages of information at the state level.

Cantaloupe and watermelon production intended for the domestic market were also obtained from the above source and were computed as the difference between the Fall-Winter production and the production intended for exports. As discussed in the Melon Industry Characteristics section, production intended for the domestic market is small in the Fall-Winter season and is included in the model as an exogenous variable.

Mexican data on harvested area and production for honeydew were not available for the period under study. Consequently, it was necessary to model honeydew differently than presented in the Conceptual Model of Melon Trade section. A Mexican honeydew export supply (excess supply) equation was estimated instead of Mexican supply and demand equations. As discussed in the theoretical section in the Conceptual Model of Melon Trade secton, a country's excess supply results from substracting the domestic demand and the domestic supply schedules. This means that a country's export level is affected by variables included in both the supply and demand schedules. As a consequence, a specified export supply (excess supply) function may include variables from both sides of the market. Directly specified excess supply functions have been used in previous studies (Malaga, 1997 and Garcia-Vega, 1995). Mexico's export supply of honeydew was represented by the quantity of honeydew melon imported by the United States from Mexico during the December-May period as reported by the Bureau of the Census, U.S. Department of Commerce. A U.S.-Mexico border price for honeydew was derived by dividing the imported value by the quantity imported. The resulting price was converted to pesos using the nominal Mexican peso/U.S. dollar exchange rate and then used as a proxy of Mexican farm price for honeydew.

Labor and fertilizer are considered major inputs in melon production. The cost of these inputs were used as regressors in supply equations as a proxy for production costs. Labor cost was represented by the official Mexican minimum wage as reported by the Comision Nacional de los Salarios Minimos (CNSM) and deflated by the wholesale price index of the Banco de Mexico. The fertilizer cost was represented by the price of the fertilizer known commercially as "urea" (46-00-00). Information regarding fertilizer cost was obtained from the following sources: Fertlilizantes Mexicanos (FERTIMEX), 1970-1984; and *Boletin Mensual de Informacion Basica del Sector Agropecuario y Forestal*, Agosto, 1995 for 1985 to 1994.

Mexican consumption of cantaloupe and watermelon were calculated as the difference between the Fall-Winter season production and exports. No imports were registered in Mexico during this season. Mexican exports of cantaloupe and watermelon were represented by United States imports from Mexico during the December-May period as reported by the Bureau of the Census, U.S. Department of Commerce.

Retail prices in Mexico for cantaloupe and watermelon were calculated using the monthly retail price indexes published by the Banco de Mexico in the monthly publication *Indice de Precios*. Those indexes were transformed into a series of absolute prices using the Banco de Mexico actual price for January 1989 which was then converted into a seasonal average price. Mexican per capita income was obtained by dividing the Gross Domestic Product (GDP) in 1990 prices as reported by *International Financial Statistics*, Yearbook 1996, International Monetary Fund (IMF), by the Mexican population as reported by the same source.

The real Mexican peso/U.S. dollar exchange rate was computed using the nominal December-May average exchange rate and the U.S. and Mexican consumer price indexes. Nominal monthly exchange rates were obtained from *Indicadores Economicos* published by the Banco de Mexico and U.S. and Mexico consumer price indexes were taken from *International Financial Statistics*, Yearbook 1996, IMF.

The U.S. consumption of cantaloupe, honeydew and watermelon during the December-May period was calculated as the sum of the U.S. imports and domestic shipments (U.S. production) minus U.S. exports for the December-May period. The U.S. imports and exports were obtained from the Bureau of the Census, U.S. Department of Commerce. Domestic shipment data were obtained from various issues of *Fresh Fruit and Vegetable Shipments by Commodities, States, and Months*, USDA, AMS. The U.S. imports from countries other than Mexico and CBI countries were also obtained from the Bureau of the Census and includes imports primarily from Spain, Chile, and Ecuador.

The U.S. wholesale melon prices at the New York terminal market were used as proxies of retail melon prices. Seasonal, shipment-weighted average prices were calculated for the December-May period for cantaloupe, honeydew and watermelon. Wholesale prices were obtained from *Fresh Fruit and Vegetable Prices, Wholesale Chicago and New York Prices*, USDA, AMS.

Information regarding U.S. population and consumer price index (CPI) were obtained from *International Financial Statistics*, Yearbook 1996, IMF. The U.S. income was represented by the U.S. disposable personal income and was obtained from *Business Statistics*, U.S. Department of Commerce. The U.S. income was deflated by the U.S. Consumer Price Index (CPI).

Quantities of cantaloupe, honeydew and watermelon supplied by the U.S. producers in the December-May period came from the USDA's shipment data. As discussed in the Melon Industry Characteristics section, during the December-May period only domestic U.S. shipments of watermelon compete with imports. Domestic cantaloupe and honeydew shipments complement imports in this period. Honeydew shipment data includes the sum of the category "honeydew" and the category "mixed and miscellaneous melons" which are primarily honeydew melons.

The harvested area for U.S. watermelon was derived by dividing U.S. shipments by Florida watermelon yields in the spring season. As mentioned in the Melon Industry Characteristics section, Florida is the major domestic supplier of watermelon in the U.S., particularly during early portions of the Fall-Winter period. Florida farm price for watermelon in the spring season served as a proxy for U.S. watermelon farm price. Florida yields and farm price were obtained from *Vegetable Summary*, Florida Agricultural Statistics, Florida Department of Agriculture and Consumer Prices.

U.S. labor and fertilizer costs were represented by indexes of prices paid by U.S. farmers for these inputs. These indexes were converted to real indexes by deflating with the index of prices paid by farmers for all production items. These three indexes were obtained from *Economic Report of the President*, February, 1995. U.S. tariff rates charged to Mexican melons were obtained from the U.S. International Trade Commission.

Data from CBI countries were difficult to obtain since many countries are involved and consistent official agricultural data does not exist for many of these countries. Consequently, CBI countries were modeled differently than proposed in the previous chapter. CBI countries export supply equations (excess supplies) were estimated instead of the CBI countries supply and demand equations.

The CBI countries cantaloupe, honeydew, and watermelon export supplies (excess supplies) were represented by U.S. imports from CBI countries in the December-May period. Because the CBI countries' share of the U.S. watermelon market is small, as discussed in the Melon Industry Characteristics section, CBI watermelon exports were modeled as an exogenous variable. Farm prices were represented as export-weighted averages of border prices (value/quantity imported). Both quantity and value of imports were obtained from the Bureau of the Census, U.S. Department of Commerce.

Cantaloupe and honeydew yields in CBI countries were represented by export-weighted averages of yields in Costa Rica, Guatemala, and Honduras. CBI countries yield data were obtained from *Production Yearbook*, FAO, Rome. A complete series of labor wages for the 1970-1994 period were only available for Costa Rica. Thus, Costa Rica labor cost was used as a proxy for CBI countries labor cost and was obtained from the *Yearbook of Labor Statistics*, International Labor Office, Geneva, Switzerland.

CBI countries income data were obtained from *International Financial Statistics*, Yearbook 1996, IMF. Because income from different countries was expressed in different currencies, every country's income was initially converted to an index. Then, an export-weighted average index based on the melon exports of Costa Rica, Guatemala and Honduras was calculated and used as a proxy of CBI countries income.

The nominal exchange rate of Costa Rica, Guatemala, and Honduras currencies with respect to the U.S. dollar were converted to real exchange rates using the countries consumer price indexes. Then, the real exchange rates were export-weighted to obtain a proxy variable for CBI countries real exchange rate. Nominal exchange rates and consumer price indexes of CBI countries were obtained from *International Financial Statistics*, Yearbook 1996, IMF.

### Estimation Procedures

Since the developed model consists of a system of simultaneous equations, the OLS technique will not be utilized because it would yield inconsistent estimators (coefficients). This is because some (or at least one) of the independent variables are very likely correlated with the regression disturbance term. The two-stage least squares (2SLS) technique could be used to estimate parameters of the system since this technique eliminates that part of the independent variable which is correlated with the error term (thus, 2SLS generates asymptotically normal and consistent estimators). Unfortunately, 2SLS ignores the correlation of errors across equations. However, the 3SLS method of estimation takes into account the correlation of errors across equations and restrictions in all equations of the system to generate consistent and asymptotically normal and efficient estimators (Kmenta). Therefore, the 3SLS method was selected to estimate parameters of the model.

As mentioned above, the available data consisted of twenty-five annual observations covering the period 1970-1994. To estimate parameters of the complete model would require at least thirty-five annual observations. Unfortunately, data regarding melon consumer prices and Mexican production data at the seasonal level does not exist for years prior 1970, thus the impossibility of successfully estimating the complete model. An alternative involved reducing the size of the model by dropping a component of the model such as one trading partner with its associated supply and demand relationships. However, as discussed in the Melon Industry Characteristics section, melon markets of the U.S., Mexico and CBI countries are closely interrelated. The analysis of the U.S. market without consideration of Mexico or CBI countries would be nonsensical. Thus, to estimate model parameters the complete model was divided into five economic blocks and parameters estimated for equations making up each block. The blocks included: (1) Mexican supply, (2) Mexican demand, (3) U.S. supply, (4) U.S. demand, and (5) CBI countries excess supply. The separation into blocks was only for purposes of estimating model parameters. For simulation and forecast purposes, the estimated blocks were reassembled into the complete model. Model parameters estimated in blocks proved to be useful for simulation purposes since the model was able to successfully track historical data and generate acceptable validation statistics as presented later in this chapter. A similar procedure has been used by Malaga (1997), Garcia-Vega (1995), and Tsai (1994) to estimate model parameters. The parameters will be estimated using the SYSNLIN procedure in the SAS econometric package. The SIMNLIN procedure in SAS will be used for simulation.

To measure the goodness-of-fit of the estimated equations making up the model, the adjusted (for degrees of freedom) $R^2$ will be used as a measure of performance. The individual significance of an estimator will be judged by the "t"-ratio or "t-test". Adjusted $R^2$ and t-ratios are reported for each equation and all estimated parameters, respectively. In time series data there are often problems with autocorrelation. If autocorrelation exists, the significance of the statistical tests (t-test) are doubtful. The Durbin-Watson (DW) test is used to test for the presence of autocorrelation. However, the DW test is not appropriate if there are lagged dependent variables in the model. Durbin suggested an alternative test known as the Durbin's h-test when lagged dependent variables exist. DW and Durbin's h-test are reported as part of the empirical results.

**Estimated Structural Equations**

Table 5.1 presents the estimated structural equations of the Fall-Winter U.S.-Mexico-CBI countries melon trade model. Numbers in parentheses are t-values and those in brackets represent elasticities, *ceteris paribus*. The term "elasticity" in this section will define the gross effect between two variables multiplied by the ratio of their means. The demand elasticities correspond to Marshallian or uncompensated elasticities at the means. The results of the Mexican supply and demand equations are presented first, followed by the U.S. supply and demand and CBI excess supply and trade equations. The trade clearing equations are specified as identities. An identity in economic terms is a relation with no unknown parameters and no error terms (Griffiths, *et al.*). Table 5.2 presents the definition and units of measure of variables included in the structural model and classifies them as endogenous and exogenous. Table 5.3 presents a set of descriptive statistics including the mean, standard deviation, minimum and maximum values of every variable.

*Mexican Supply*

Equations [5.1] to [5.4] represent the Mexican supply of cantaloupe and watermelon intended for export. Because of inadequate Mexican data, Mexican honeydew was modeled differently than proposed in the previous section. Cantaloupe and watermelon harvested area for the export market ($MXAHXCN_t$ and $MXAHXWT_t$) are explained by their own lagged price ($MXFPCN_{t-1}$, $MXFPWT_{t-1}$) lagged labor cost ($MXL_{t-1}$) and dummy variables ($MXSDCN_t$, $MXSDWT_t$). Dummy variables were incorporated to account for years when there was a considerable divergence between mean values and specific observations. These divergences may result from unusual conditions that are related to weather, severe pest damage (white fly, virus), or temporal agricultural policies such as export promotion programs or short-run shortages of credit. Specific details for every dummy variable included in the model are shown in table 5.3. All estimated parameters have the expected signs and are statistically significant at the .05 significance level, except cantaloupe own price ($MXFPCN_{t-1}$). The three explanatory variables together explain a substantial portion of annual variation in melon planted area (74 percent for cantaloupe and 60 percent for watermelon). Honeydew export supply was modeled as an excess supply equation. Mexican honeydew exports ($MXESHD_t$), equation [5.5], were explained by own lagged price ($MXFPHD_{t-1}$) and lagged labor cost ($MXL_{t-1}$). These two variables yielded an adjusted $R^2$= 0.81. The significance of labor cost in supply equations for melons suggests labor is a major component of melon production costs.

Alternative specifications were considered for supply equations of cantaloupe, honeydew, and watermelon that included cross-price effects. However, the cross-price variables did not add further explanation to changes in supply, indicating that one melon can not substitute for another in production. There are possibly several reasons for this outcome. First, the data used to estimate Mexican melon supply was representative of the various states throughout Mexico where the melons are produced. Because the supply data represented regions where the cross-price effects differ, the measured influence of the cross-price variables in the estimated supply relationships was negligible. Further, a melon packer/shipper serving a production area may be equipped to handle only one type of melon, thus producers in a particular region may be limited to producing a particular type of melon, thus no cross-price impacts.

In general, the own-price and labor wage elasticities are inelastic (with the exception of labor wage elasticity for honeydew). A 10% increase in the farm price of cantaloupe, *ceteris paribus*, will cause a 6.9% increase in harvested area of cantaloupe the subsequent year. A 10% increase in the labor wage, *ceteris paribus*, will decrease cantaloupe harvested area by 3.8% the subsequent year, and watermelon and honeydew harvested area by 5.6% and 14.1%, respectively.

Previous estimates of own-price and labor cost elasticities for Mexico melon supply exists only for cantaloupe and were also found to be inelastic (Espinoza, 1987). Espinoza reported a labor cost elasticity of -0.40 and a lower own-price supply elasticity of 0.37. Differences in elasticity estimates may be attributable to the different period of analysis. Equations [5.3] and [5.4] represent cantaloupe and watermelon production intended for export ($MXQSXCN_t$ and $MXQSXWT_t$), and are obtained by multiplying the estimated harvested area ($MXAHXCN_t$ and $MXAHXWT_t$) with historical yields ($MXYIXCN_t$ and $MXYIXWT_t$) as presented in the conceptual model in chapter IV. Equations [5.6], [5.7], and [5.8] are price linkage equations which are discussed in a subsequent section.

*Mexican Demand*

Equations [5.9] to [5.12] represent the Mexican demands for cantaloupe and watermelon. A domestic demand equation for Mexican honeydew was not estimated because of unavailable Mexican data. Equations [5.9] and [5.10] represent the Mexican per capita consumption of cantaloupe and watermelon ($MXCOCN_t$ and $MXCOWT_t$). Per capita demand was modeled as a function of own retail price ($MXCPCN_t$, $MXCPWT_t$), income ($MXI_t$) and a dummy variable ($MXDDCN_t$, $MXDDWT_t$). All signs are as expected: negative own-price parameters indicate an increase in price, *ceteris paribus*, causes a decline in per capita consumption while the positive per capita income parameter indicates that an increase in income causes per capita consumption to increase. With the exception of cantaloupe's own price ($MXCPCN_t$), all variables are statistically significant at the .05 level. The estimated Mexican cantaloupe and watermelon demand equations explained 73% and 69%, respectively, of these melons annual per capita consumption.

The estimated own-price elasticities of demand for cantaloupe and watermelon during the Fall-Winter season are –0.61 and –0.78, respectively. A 10% increase in cantaloupe's own-price ($MXCPCN_t$) yields a 6.1% decline in per capita consumption ($MXCOCN_t$) while a 10% increase in watermelon's own price ($MXCPWT_t$) causes a 7.8% decrease in per capita consumption ($MXCOWT_t$). Unfortunately, no previous studies are available for purposes of comparing estimated own-price or income elasticities. Income elasticities are estimated to be 1.02 for cantaloupe and 0.69 for watermelon during the Fall-Winter season. The relatively small income elasticity for watermelon is not surprising since per capita consumption trends suggest a diminished preference for watermelon. Although there are no previously estimated income elasticities for Mexican melons, Haag and Soto (1979) indicate expected income elasticities of about zero for basic products in the Mexican diet, such as beans, corn, and wheat, and elasticities of about one for non-basic products such as fruits and vegetables. In this context, income elasticities for both cantaloupe and watermelon are in the expected range. Alternative specifications of demand were considered. Watermelon price was included in the cantaloupe equation and vice versa, but they did not add further explanation to changes in per capita consumption; this indicates that melon demand depends largely on own-price and income. Total Mexican demand for cantaloupe and watermelon ($MXQDCN_t$ and $MXQDWT_t$) are represented by identities [5.11] and [5.12]; total demand is the product of estimated per capita consumption ($MXCOCN_t$, $MXCOWT_t$) and population ($MXPOP_t$).

*U.S. Supply*

As discussed in the Melon Industry Characteristics section, U.S. watermelon compete with imports from Mexico. As a consequence, equations [5.21] and [5.22] are specified and estimated to endogenize watermelon supply behavior. Equation [5.21] represents the U.S. harvested watermelon area ($USAHWT_t$), which was modeled as a function of lagged own-farm price ($USFPWT_{t-1}$), labor cost ($USL_{t-1}$) and a dummy variable ($USSDWT_t$). Cross price effects of cantaloupe and honeydew were not included in this estimated equation since Florida, a major producer of watermelon during this season, does not produce cantaloupe and honeydew, thus no competition for production resources was expected.

The dummy variable was significant at the .05 level and although own-price and labor cost have the expected signs, neither were statistically significant. Possible explanations are: (1) the manner watermelon harvested area was derived (shipments/ Florida Spring yields) in view of unavailable harvested acreage data and (2) the substantial variability in watermelon production in April and May that may result from adverse weather conditions in Florida and Texas that cause considerable damage to early plantings. Problems often occur when estimating winter supply equations for perishables produced in the United States. Malaga (1997) found own-price and labor costs to be statistically insignificant explainers of harvested acreage when estimating supply equations for tomatoes, cucumbers, squash, and bell pepper.

The estimated own-price elasticity of watermelon supply is 0.39, indicating that a 10% increase in expected price generates a 3.9% increase in harvested acreage. This elasticity is consistent with previous estimates. Buxton (1992) estimated a watermelon own-price elasticity of 0.34, which is almost identical to that estimated in this study. The estimated labor cost elasticity is –0.50. Because of the unavailability of previous estimates it was impossible to compare the estimated labor cost elasticity with results of earlier studies. However, the U.S. watermelon labor cost elasticity is low compared to the Mexican estimate. Buxton observes that costs of major inputs in the U.S. usually do not fluctuate as widely as fruit and vegetable prices received by growers, thus modest variability in supply is explained by input costs.

*U.S. Demand*

Equations [5.15] to [5.20] represent U.S. cantaloupe, honeydew, and watermelon demands. Equations [5.15] to [5.17] are the structural equations representing per capita consumption ($USCOCN_t$, $USCOHD_t$, and $USCOWT_t$) and [5.18] to [5.20] are identities representing aggregate consumption ($USQDCN_t$, $USQDHD_t$, and $USQDWT_t$). With the exception of the income variable ($USI_t$) in the watermelon equation, all the estimated parameters are statistically significant at the .05 level. The estimated cantaloupe and honeydew demand equations yield relatively high levels of fit as reflected by the adjusted $R^2$ indicators (0.80 and 0.81, respectively). The goodness-of-fit for the estimated watermelon equation was 0.45.

Per capita demand equations [5.15] to [5.17] were specified as a function of own-price ($USCPCN_t$, $USCPHD_t$ or $USCPWT_t$), price of related commodities (other melons) and income ($USI_t$). Own-price coefficients are all negative as expected and statistically significant. Cross-price coefficients showed a consistent complementarity among melons (negative sign). Typically own-price coefficients tended to be statistically significant while cross-price influence were not. The exception was cantaloupe price which explained changes in honeydew consumption. Signs for the income variables are positive for the three types of melons.

The estimated own-price elasticities of demand for melons are relatively large. However, as observed in the Melon Industry Characteristics section, melon imports have increased over time as real prices declined and consumption of melons increased. It appears that the observed decline in price may have been one factor stimulating melon consumption in the Fall-Winter period. Estimated income elasticities for cantaloupe and honeydew are high at 2.01 and 1.36, respectively. Conversely, the estimated income elasticity for watermelon is low at 0.12. This may reflect the decline in per capita watermelon consumption reported by Allred and Lucier (1990) and the declining watermelon consumption trend observed in chapter II.

*CBI Countries Export Supply Equations*

As mentioned above, because of limited data on CBI countries melon industries it was necessary to model this region different than the model proposed in the previous section. In particular, export supply equations (excess supplies) were estimated instead of supply and demand equations.

Equations [5.24] and [5.25] represent the CBI countries estimated export supply equations for cantaloupe and honeydew, respectively. The quantity of melons supplied for export ($CBIESCN_t$, $CBIESHD_t$) are a function of lagged farm price ($CBIFPCN_{t-1}$, $CBIFPHD_{t-1}$), yields ($CBIYICN_t$, $CBIYIHD_t$), lagged exports (lagged dependent variable) ($CBIESCN_{t-1}$, $CBIESHD_{t-1}$) and a dummy variable ($CBIDUMCN_t$, $CBIDUMHD_t$). Dummies are included in these equations to represent the CBI trade agreement covering the period 1984-1994. The lagged dependent variable was designed to capture trade inertia associated with exports in the previous period. Because of the inclusion of a lagged dependent variable, the Durbin h-test was used to test for the presence of autocorrelation. As in previous equations, no autocorrelation problems were present.

Signs on all estimated coefficients are positive as expected. Only the lagged dependent and dummy variables are statistically significant. Estimated own-price elasticities are low for both cantaloupe and honeydew at 0.10 and 0.17, respectively. No previous estimates are available for comparison. As noted in the previous section, CBI countries share of the U.S. watermelon market is small thus a "small country" assumption was made by including CBI watermelon exports as an exogenous variable.

*Price Linkage and Trade Equations*

Typically price linkage equations link commodity prices in countries that trade, while price spread equations relate prices at different market levels within a country. As mentioned in the Conceptual Model of Melon Trade section, it is generally assumed that prices are determined at the retail level and changes in retail level prices are transmitted to the farm level. However, in the case of Mexico and CBI countries melon exports to the U.S. in the Fall-Winter season, an exception was made. In these countries, during the Fall-Winter season, we assume prices are determined in U.S. terminal markets with price changes transmitted to Mexico and CBI countries farm and domestic consumer price levels. That is, prices in U.S. terminal markets determine Mexico and CBI countries farm price and these in turn determine domestic Mexico and CBI countries retail price. This appeared to be a reasonable assumption since the U.S. import market dominates all melon markets during the Fall-Winter season in Mexico and the CBI countries.

Equations [5.6] to [5.8] are the estimated U.S.-Mexico price linkage equations. As specified in the previous section, changes in Mexican farm price ($MXFPCN_t$, $MXFPHD_t$, and $MXFPWT_t$) are determined by changes in U.S. retail prices ($USCPCN_t$, $USCPHD_t$, and $USCPWT_t$), Mexican real exchange rate ($MXRER_t$), and real tariffs ($USRTHD_t$ and $USRTWT_t$). The cantaloupe price linkage equation does not include a tariff variable because, as discussed in the Melon Industry Characteristics section, the U.S. tariff on Mexican cantaloupe is zero during the Fall-Winter season. Dummy variables are included for cantaloupe and watermelon ($MXLDCN_t$ and $MXLDWT_t$) to account for years when weather generated considerable departure from the mean values.

In general, the estimated coefficients in equations [5.6], [5.7], and [5.8] have the expected signs. In particular, as U.S. consumer prices increase ($USCPCN_t$, $USCPHD_t$, and $USCPWT_t$), higher prices are expected in Mexico ($MXFPCN_t$, $MXFPHD_t$, and $MXFPWT_t$) and as the peso is devaluated relative to the U.S. dollar ($MXRER_t$) Mexican farmers perceive a higher price or more pesos for their production. As expected, the negative sign on the U.S. tariff variable ($USRTHD_t$, $USRTWT_t$) indicates that reductions in the real U.S. tariff will increase melon prices in Mexico. U.S. melon price variables ($USCPCN_t$, $USCPHD_t$, and $USCPWT_t$) are statistically significant indicating the close relationship between U.S. and Mexico melon markets in the Fall-Winter season. The exchange rate variable in the honeydew equation is statistically significant at the .05 level as are the dummy variables in the cantaloupe and watermelon equations.

Equations [5.26] and [5.27] represent melon price linkage equations between U.S. and CBI countries. Specifications are similar to the U.S.-Mexico case but, in the case of CBI countries, no tariffs are included because these melons enter the U.S. duty free. The estimated coefficients on the U.S. consumer price variables ($USCPCN_t$, $USCPHD_t$) are significant at the .10 level, while the real exchange rate is significant for both cantaloupe and honeydew at the .05 level. Signs on estimated coefficients are as indicated by trade theory. A watermelon price linkage equation is not specified for CBI countries because of few exports to the United States, thus the "small country" assumption discussed above.

Equations [5.13] and [5.14] are the Mexican price spread equations for cantaloupe and watermelon, respectively. An equation for honeydew was not specified since retail price information for honeydew was not available. Mexican melon price at the consumer level ($MXCPCN_t$, $MXCPWT_t$) was specified as a function of Mexican farm price ($MXFPCN_t$, $MXFPWT_t$) and a dummy variable ($MXPDCN_t$, $MXPDWT_t$). Dummy variables were incorporated to account for years when there was considerable divergence between prices that result from weather related problems. Signs of estimated coefficients are as indicated by economic theory. With the exception of farm price in the cantaloupe equation, all estimated coefficients are statistically significant at the .05 level.

Equation [5.23] is the watermelon price spread equation for the U.S. market. The estimated coefficient on the U.S. melon price variable at the consumer level ($USCPWT_t$) is positive, as expected, and statistically significant. The watermelon consumer price variable explains 42 percent of the annual variation in farm-level watermelon price ($USFPWT_t$).

The trade clearing identities are represented by equations [5.28] to [5.35]. These formulations are similar to those proposed in the previous section; however, because of data limitations it was necessary to make several changes. They include: (1) the specification and estimation of a Mexican excess supply equation for honeydew ($MXESHD_t$) (equation [5.5]), and (2) the specification and estimation of excess supply equations for CBI countries cantaloupe and honeydew ($CBIESCN_t$, $CBIESHD_t$) (equations [5.24] and [5.25]). All other estimated equations follow the theoretically-supported specifications proposed in the Conceptual Model of Melon Trade section.

## Model Validation

The estimated U.S.-Mexico-CBI countries melon trade model was validated through historical (i.e., within sample) simulation. Several validation statistics, including the root mean square error percentage (RMS% error), Theil forecast error statistics, MSE decomposition proportions, and sensitivity analysis (dynamic multipliers) were used to evaluate the performance and stability of the model. The validation results are presented in tables 5.4 and 5.5.

The RMS% error percentage measures the deviation of a simulated variable from its actual time path in percentage terms (Pindyck and Rubinfeld). A low RMS% is an indicator of good simulation fit. Another useful statistic to evaluate historical *ex post* simulation performance is the Theil's inequality coefficient (U). This statistic scales the RMS simulation error so that the calculated U will vary between zero and one. When U=0, the simulation model has a perfect fit while the performance of the model is as poor as it could possibly be when U=1.

The Theil inequality coefficient can be decomposed into three proportions ($U^m$, $U^s$, and $U^c$) corresponding to the characteristic sources of the simulation error. The $U^m$ or bias proportion is an indication of systematic error, measuring the extent to which the average values of the simulated and actual series deviate from each other. The $U^s$ or variance proportion indicates the ability of the model to replicate the degree of variability in the variable of interest. Finally, the $U^c$ or covariance proportion measures the unsystematic error which is the remaining error after accounting for deviations from average values. The ideal distribution of the U inequality coefficient over the three proportions is $U^m= U^s=0$, and $U^c=1$ (Pindyck and Rubinfeld).

Table 5.4 presents the simulation statistics for the Mexico-U.S.-CBI countries melon trade model. In general, the RMS% appears to be relatively small except for selected excess supply and demand variables that have values above 40%. Variations in excess supply and demand variables in the model are the result of variations over a number of supply and demand variables; therefore, they tend to reflect the accumulated simulation error in the model. The Theil U coefficients are close to zero with none over 0.241. The Theil decomposition proportions follow a desirable distribution with $U^c$ values close to one and $U^m$ and $U^s$ close to zero.

The Mexico-U.S.-CBI countries melon trade model was used to calculate dynamic multipliers that result from a 10% increase in the Mexican real exchange rate value in year one. The multipliers for selected variables are presented in table 5.4. The dynamic multipliers indicate that the model is stable because all variables return to equilibrium with time and the direction of the changes are as expected. The multipliers for Mexican exports to the U.S. (MXESCN, MXESHD, MXESWT) are expressed in metric tons while those for Mexican farm prices (MXFPCN, MXFPHD, MXFPWT) are expressed in Mexican pesos/metric ton. Mexican exports increase the first year as a result of Mexico's peso devaluation with the effect declining in the second year. The 10% increase in the Mexican real exchange rate causes Mexican farm prices to rise during the first year with little change persisting after the third year (table 5.5). The sensitivity analysis provides additional confidence in the performance and stability of the estimated melon trade model.

## Summary

In this section important data issues were discussed, followed by a discussion of model estimation techniques, estimation results, and model validation analysis.

The estimated model is similar to the specified model presented in the Conceptual Model of Melon Trade section. However, because of no price, consumption and production data for Mexican honeydew and no melon consumption or price data for CBI countries, several changes in specification were required. In particular, export supply (excess supply) equations were specified and estimated instead of supply and demand equations for Mexican honeydew and for cantaloupe and honeydew in CBI countries.

Alternative techniques to estimate the model parameters were discussed. OLS, 2SLS, and 3SLS were considered. However, because of the simultaneity and possible correlation among error terms across equations, 3SLS technique was selected and used. Under these conditions, 3SLS generates consistent and asymptotically normal and efficient estimators.

In general, regression results indicated good fit for most equations. Forty-four of the seventy estimated parameters were statistically significant at the 0.05 level as indicated by their t-ratios and the adjusted $R^2$ ranged from 0.35 to 0.94. The signs of the estimated coefficients were consistent with expectations. Estimated elasticities were also included in the empirical results. Elasticities were, in general, in the expected range and in agreement with previous study results. No evidence of autocorrelation was found.

Finally, the model was validated through historical simulation. Simulation statistics, including the RMS% error, the Theil U statistic, and MSE decomposition of the Theil statistic showed an overall good performance of the model in tracking the historical data. Dynamic multipliers calculated for a 10% change in the Mexican real exchange rate were also presented. These indicators confirmed the stability of the model since all endogenous variables moved in the expected direction and the model returned to equilibrium within a reasonable length of time following the shock. The estimated model will be used in the Simulation Analysis section for purposes of forecasting and sensitivity analysis.

**Table 5.1. Estimated Structural Equations of the U.S.-Mexico-CBI Countries Melon Trade Model***

Mexican Supply

[5.1] $MXAHXCN_t = 17482 + 4812\ MXFPCN_{t-1} - 392\ MXL_{t-1} + 4910\ MXSDCN_t$
(4.85) (1.22) (-3.73) (5.40) Adj. $R^2$=0.74
[0.69] [-0.38] DW=1.21

[5.2] $MXAHXWT_t = 12731 + 22323\ MXFPWT_{t-1} - 528\ MXL_{t-1} + 5310\ MXSDWT_t$
(2.38) (2.85) (-3.39) (3.53) Adj. $R^2$=0.60
[0.74] [-0.56] DW=1.52

[5.3] $MXQSXCN_t = MXAHXCN_t{*}MXYIXCN_t$

[5.4] $MXQSXWT_t = MXAHXWT_t{*}MXYIXWT_t$

[5.5] $MXESHD_t = 83581056 + 194248982\ MXFPHD_{t-1} - 5159483\ MXL_{t-1}$
(1.30) (1.52) (-2.75) Adj. $R^2$=0.81
[0.99] [-1.41] DW=1.63

[5.6] $MXFPCN_t = 0.259 + 0.556\ USCPCN_t + 0.049\ MXRER_t + 0.135\ MXLDCN_t$
(1.75) (3.62) (0.80) (2.47) Adj. $R^2$=0.50
DW=1.26

[5.7] $MXFPHD_t = -0.039 + 0.497\ USCPHD_t + 0.100\ MXRER_t - 0.059\ USRTHD_t$
(-0.50) (3.67) (5.31) (-1.67) Adj. $R^2$=0.86
DW=1.22

[5.8] $MXFPWT_t = 0.275 + 0.461\ USCPWT_t + 0.069\ MXRER_t - 0.053\ USRTWT_t$
(2.26) (3.09) (1.89) (-1.33)
$+0.083\ MXLDWT$ Adj. $R^2$=0.60
(2.52) DW=1.28

Mexican Demand

[5.9] $MXCOCN_t = 0.921 - 0.951\ MXCPCN_t + 0.0002\ MXI_t + 0.941\ MXDDCN_t$
(1.74) (-1.61) (3.35) (7.36) Adj. $R^2$=0.73
[-0.61] [1.02] DW=1.64

[5.10] $MXCOWT_t = 2.961 - 1.905\ MXCPWT_t + 0.0002\ MXI_t + 1.520\ MXDDWT_t$
(4.02) (-7.05) (2.78) (4.69) Adj. $R^2$=0.69
[-0.78] [0.69] DW=1.95

[5.11] $MXQDCN_t = MXCOCN_t{*}MXPOP_t$

[5.12] $MXQDWT_t = MXCOWT_t{*}MXPOP_t$

[5.13] $MXCPCN_t = 1.030 + 0.319\ MXFPCN_t - 0.185\ MXPDCN_t$ Adj. $R^2$=0.35
(6.48) (1.33) (-2.40) DW=1.46

[5.14] $MXCPWT_t = 0.357 + 1.440\ MXFPWT_t + 0.615\ MXPDWT_t$ Adj. $R^2$=0.77
(1.72) (3.28) (6.83) DW=1.51

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**Table 5.1. Continued**

U.S. Demand

[5.15] $USCOCN_t = -2.091 - 2.454\ USCPCN_t + 0.0003\ USI_t$ Adj. $R^2$=0.80
(-1.36) (-2.41) (5.12) DW=1.46
[-0.93] [2.01]

[5.16] $USCOHD_t = 1.687 - 3.234\ USCPHD_t - 0.602\ USCPCN_t + 0.00005\ USI_t$
(2.96) (-8.59) (-2.14) (2.04) Adj. $R^2$=0.81
[-2.65] [-0.66] [1.36] DW=2.19

[5.17] $USCOWT_t = 7.136 - 8.462\ USCPWT_t + 0.00001\ USI_t$ Adj. $R^2$=0.45
(9.79) (-9.35) (0.52) DW=1.91
[-2.32] [0.12]

[5.18] $USQDCN_t = USCOCN_t * USPOP_t$

[5.19] $USQDHD_t = USCOHD_t * USPOP_t$

[5.20] $USQDWT_t = USCOWT_t * USPOP_t$

U.S. Supply

[5.21] $USAHWT_t = 20496 + 826.856\ USFPWT_{t-1} - 52.571\ USL_{t-1} + 13644\ USSDWT_t$
(1.40) (1.43) (-0.54) (3.05) Adj. $R^2$=0.37
[0.39] [-0.50] DW=2.00

[5.22] $USQSWT_t = USAHWT_t * USYIWT_t$

[5.23] $USFPWT_t = 4.662 + 0.218\ USCPWT_t$ Adj. $R^2$=0.42
(3.99) (3.92) DW=1.61

CBI Excess Supply

[5.24] $CBIESCN_t = -12165416 + 11616865\ CBIFPCN_{t-1} + 1835665\ CBIYICN_t$
(-0.75) (0.55) (1.13)
[0.10]
$+ 0.912\ CBIESCN_{t-1} + 40130444\ CBIDUMCN_t$ Adj. $R^2$=0.94
(9.07) (3.85) Dh=1.26

[5.25] $CBIESHD_t = -4639207 + 2541342\ CBIFPHD_{t-1} + 3096550\ CBIYIHD_t$
(-0.43) (0.22) (1.69)
[0.17]
$+ 0.587\ CBIESHD_{t-1} + 20719283\ CBIDUMHD_t$ Adj. $R^2$=0.92
(3.12) (2.56) Dh=1.42

[5.26] $CBIFPCN_t = 0.120 + 0.387\ USCPCN_t + 0.470\ CBIRER_t$ Adj. $R^2$=0.49
(0.86) (1.56) (2.70) DW=1.22

[5.27] $CBIFPHD_t = -0.660 + 1.184\ USCPHD_t + 1.588\ CBIRER_t$ Adj. $R^2$=0.75
(-2.86) (1.86) (5.70) DW=1.52

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**Table 5.1. Continued**

Trade Equations

[5.28] $USEDCN_t = USQDCN_t - USQSCN_t + USEXCN_t$
[5.29] $USEDHD_t = USQDHD_t - USQSHD_t + USEXHD_t$
[5.30] $USEDWT_t = USQDWT_t - USQSWT_t + USEXWT_t$

[5.31] $MXESCN_t = MXQSXCN_t + MXQSDCN_t - MXQDCN_t$
[5.32] $MXESWT_t = MXQSXWT_t + MXQSDWT_t - MXQDWT_t$

[5.33] $USEDCN_t = MXESCN_t + CBIESCN_t + OTESCN_t$
[5.34] $USEDHD_t = MXESHD_t + CBIESHD_t + OTESHD_t$
[5.35] $USEDWT_t = MXESWT_t + CBIESWT_t + OTESWT_t$

*t values are in parentheses and gross effect elasticities are in brackets

**Table 5.2 Estimated Fall-Winter Melon Trade Model: Definition of Variables and Units**

Endogenous Variables

| | |
|---|---|
| MXAHXCN = | Cantaloupe Harvested Area Intended for Export in Mexico (ha) |
| MXAHXWT = | Watermelon Harvested Area Intended for Export in Mexico (ha) |
| MXQSXCN = | Cantaloupe Production Intended for Export in Mexico (ton) |
| MXQSXWT = | Watermelon Production Intended for Export in Mexico (ton) |
| MXFPCN = | Mexican Cantaloupe Farm Price (pesos/kg) |
| MXFPHD = | Mexican Honeydew Farm Price (pesos/lb) |
| MXFPWT = | Mexican Watermelon Farm Price (pesos/kg) |
| MXCOCN = | Cantaloupe Per-capita Consumption in Mexico (kg) |
| MXCOWT = | Watermelon Per-capita Consumption in Mexico (kg) |
| MXQDCN = | Cantaloupe Aggregate Consumption in Mexico (ton) |
| MXQDWT = | Watermelon Aggregate Consumption in Mexico (ton) |
| MXCPCN = | Mexican Cantaloupe Consumer Price (pesos/kg) |
| MXCPWT = | Mexican Watermelon Consumer Price (pesos/kg) |
| MXESCN = | Mexican Cantaloupe Excess Supply (Export) (ton) |
| MXESHD = | Mexican Honeydew Excess Supply (Export) (lb) |
| MXESWT = | Mexican Watermelon Excess Supply (Export) (ton) |
| USCOCN = | Cantaloupe Per-capita Consumption in United States (lb) |
| USCOHD = | Honeydew Per-capita Consumption in United States (lb) |
| USCOWT = | Watermelon Per-capita Consumption in United States (lb) |
| USQDCN = | Cantaloupe Aggregate Consumption in United States (lb) |
| USQDHD = | Honeydew Aggregate Consumption in United States (lb) |
| USQDWT = | Watermelon Aggregate Consumption in United States (lb) |
| USCPCN = | U.S. Cantaloupe Consumer Price (dol/lb) |
| USCPHD = | U.S. Honeydew Consumer Price (dol/lb) |
| USCPWT = | U.S. Watermelon Consumer Price (dol/lb) |
| USAHWT = | U.S. Watermelon Harvested Area (acres) |
| USQSWT = | U.S. Watermelon Production (cwt) |
| USFPWT = | U.S. Watermelon Farm Price (dol/cwt) |
| USEDCN = | U.S. Cantaloupe Excess Demand (Imports) (lb) |
| USEDHD = | U.S. Honeydew Excess Demand (Imports) (lb) |
| USEDWT = | U.S. Watermelon Excess Demand (Imports) (lb) |
| CBIESCN = | CBI Countries Cantaloupe Excess Supply (Export) (lb) |
| CBIESHD = | CBI Countries Honeydew Excess Supply (Export) (lb) |
| CBIFPCN = | CBI Countries Cantaloupe Farm Price (index) |
| CBIFPHD = | CBI Countries Honeydew Farm Price (index) |

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**Table 5.2. Continued**

Exogenous Variables

| | |
|---|---|
| MXL = | Mexican Labor Cost (pesos/day) |
| MXSDCN = | Mexican Cantaloupe Harvested Area Eqn. Dummy Variable (0,1) |
| MXSDWT = | Mexican Watermelon Harvested Area Eqn. Dummy Variable (0,1) |
| MXYIXCN = | Mexican Cantaloupe Yields of Area Intended for Exports (ton/ha) |
| MXYIXWT = | Mexican Watermelon Yields of Area Intended for Exports (ton/ha) |
| MXRER = | Mexico-U.S. Real Exchange Rate (pesos/U.S. dol.) |
| USRTHD = | U.S. Real Tariff Charged to Honeydew Imports from Mexico (index) |
| USRTWT = | U.S. Real Tariff Charged to Watermelon Imports from Mexico (index) |
| MXLDCN = | U.S.-Mexico Cantaloupe Price Linkage Eqn. Dummy Variable (0,1) |
| MXLDWT = | U.S.-Mexico Watermelon Price Linkage Eqn. Dummy Variable (0,1) |
| MXI = | Mexican Per-capita Income (pesos) |
| MXDDCN = | Cantaloupe Per-capita Cons. in Mexico Eqn. Dummy Variable (0,1) |
| MXDDWT = | Watermelon Per-capita Cons. in Mexico Eqn. Dummy Variable (0,1) |
| MXPOP = | Mexican Population (1000) |
| MXPDCN = | Mexican Cantaloupe Price Spread Eqn. Dummy Variable (0,1) |
| MXPDWT = | Mexican Watermelon Price Spread Eqn. Dummy Variable (0,1) |
| USI = | U.S. Per-capita Income (dol) |
| USPOP = | U.S. Population (1000) |
| USL = | U.S. Labor Cost (index) |
| USYIWT = | U.S. Watermelon Yields (cwt/acre) |
| USSDWT = | U.S. Watermelon Harvested Area Eqn. Dummy Variable (0,1) |
| CBIYICN = | CBI Countries Cantaloupe Yields (ton/ha) |
| CBIYIHD = | CBI Countries Honeydew Yields (ton/ha) |
| CBIESWT = | CBI Countries Watermelon Excess Supply (Excess Supply) (lb) |
| CBIDUMCN = | CBI Countries Cantaloupe Excess Supply Eqn. Dummy Variable (0,1) |
| CBIDUMHD = | CBI Countries Honeydew Excess Supply Eqn. Dummy Variable (0,1) |
| CBIRER = | CBI Countries -U.S. Real Exchange Rate (index) |
| USEXCN = | U.S. Cantaloupe Exports (lb) |
| USEXHD = | U.S. Honeydew Exports (lb) |
| USEXWT = | U.S. Watermelon Exports (lb) |
| MXQSDCN = | Cantaloupe Prod. Intended for Domestic Market in Mexico (ton) |
| MXQSDWT = | Watermelon Prod. Intended for Domestic Market in Mexico (ton) |
| OTESCN = | Other Countries Cantaloupe Excess Supply (Exports to U.S. (lb) |
| OTESHD = | Other Countries Honeydew Excess Supply (Exports to U.S.) (lb) |
| OTESWT = | Other Countries Watermelon Excess Supply (Exports to U.S.) (lb) |

[*]Values of commodity prices, inputs, exchange rate, and income are all at their 1990 value.

**Table 5.3. Descriptive Statistics**

| Variable Identification | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|
| MXAHXCN | 15,628 | 4,336 | 8,691 | 23,446 |
| MXAHXWT | 14,299 | 4,799 | 6,217 | 25,002 |
| MXQSXCN | 192,255 | 52,925 | 108,048 | 304,566 |
| MXQSXWT | 187,684 | 66,320 | 64,158 | 298,119 |
| MXFPCN | 0.627 | 0.120 | 0.431 | 0.995 |
| MXFPHD | 0.287 | 0.075 | 0.193 | 0.410 |
| MXFPWT | 0.478 | 0.083 | 0.340 | 0.760 |
| MXCOCN | 1.856 | 0.535 | 0.869 | 3.056 |
| MXCOWT | 2.820 | 0.832 | 1.845 | 5.495 |
| MXQDCN | 136,405 | 51,106 | 52,286 | 254,531 |
| MXQDWT | 199,982 | 57,405 | 105,616 | 371,022 |
| MXCPCN | 1.20 | 0.15 | 0.88 | 1.44 |
| MXCPWT | 1.17 | 0.36 | 0.73 | 1.86 |
| MXESCN | 89,422 | 27,799 | 61,556 | 163,644 |
| MXESHD | 56,288,339 | 44,167,444 | 9,393,920 | 163,418,769 |
| MXESWT | 90,124 | 24,821 | 50,582 | 156,567 |
| USCOCN | 1.632 | 0.787 | 0.856 | 3.036 |
| USCOHD | 0.568 | 0.376 | 0.168 | 1.305 |
| USCOWT | 2.222 | 0.553 | 1.257 | 3.390 |
| USQDCN | 393,385,676 | 209,041,516 | 190,021,510 | 758,335,806 |
| USQDHD | 137,130,492 | 98,939,083 | 35,932,440 | 329,067,267 |
| USQDWT | 518,765,258 | 155,496,005 | 294,814,000 | 847,151,309 |
| USCPCN | 0.623 | 0.104 | 0.431 | 0.765 |
| USCPHD | 0.466 | 0.091 | 0.301 | 0.633 |
| USCPWT | 0.280 | 0.034 | 0.214 | 0.339 |
| USAHWT | 18,630 | 6,357 | 7,230 | 31,655 |
| USQSWT | 3,252,520 | 1,276,742 | 1,193,000 | 6,331,000 |
| USFPWT | 8.95 | 2.52 | 3.63 | 14.69 |
| USEDCN | 278,601,596 | 144,605,959 | 148,003,000 | 602,482,804 |
| USEDHD | 107,472,572 | 88,921,393 | 23,924,440 | 286,061,267 |
| USEDWT | 208,092,058 | 58,825,217 | 113,186,344 | 359,918,695 |
| CBIESCN | 81,013,999 | 109,669,922 | 11,576,837 | 376,495,484 |
| CBIESHD | 39,833,101 | 48,803,089 | 1,034,823 | 150,819,569 |
| CBIFPCN | 0.73 | 0.17 | 0.45 | 1.00 |
| CBIFPHD | 1.21 | 0.40 | 0.65 | 2.04 |
| MXL | 15.39 | 5.21 | 8.59 | 21.93 |
| MXYIXCN | 12.36 | 1.19 | 10.18 | 14.44 |
| MXYIXWT | 13.13 | 2.00 | 8.97 | 17.15 |
| MXRER | 2.49 | 0.35 | 1.87 | 3.11 |
| USRTHD | 1.255 | 0.280 | 0.842 | 1.721 |
| USRTWT | 1.103 | 0.286 | 0.646 | 1.626 |
| MXI | 6,626 | 917 | 5,497 | 8,875 |
| MXPOP | 72,095 | 13,406 | 48,996 | 93,010 |
| USI | 14,438 | 1,431 | 11,865 | 16,776 |
| USPOP | 231,144 | 17,497 | 204,880 | 260,710 |
| USL | 177.60 | 16.08 | 157.37 | 207.25 |
| USYIWT | 130 | 30 | 70 | 183 |
| CBIESWT | 7,416,120 | 10,822,523 | 158 | 35,521,870 |
| CBIYICN | 7.11 | 4.44 | 4.02 | 18.95 |
| CBIYICN | 7.11 | 4.44 | 4.02 | 18.95 |

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**Table 5.3. Continued**

| Variable Identification | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|
| CBIYIHD | 4.04 | 4.36 | 1.02 | 15.95 |
| CBIRER | 0.95 | 0.18 | 0.80 | 1.40 |
| USEXCN | 5,259,920 | 1,727,759 | 3,007,000 | 8,316,000 |
| USEXHD | 2,098,080 | 948,320 | 700,000 | 3,950,000 |
| USEXWT | 14,578,800 | 7,921,073 | 6,240,000 | 33,230,000 |
| MXQSDCN | 33,572 | 27,152 | 2,696 | 113,609 |
| MXQSDWT | 102,421 | 49,323 | 12,500 | 230,684 |
| OTESCN | 391,037 | 466,820 | 0 | 1,674,653 |
| OTESHD | 10,767,059 | 5,003,471 | 4,037,453 | 23,118,086 |
| OTESWT | 193,252 | 201,814 | 0 | 781,566 |

Dummy Variables

| | |
|---|---|
| MXSDCN | 1978-1980=1; 0 otherwise |
| MXSDWT | 1978-1979, 1992=1; 0 otherwise |
| MXLDCN | 1976,1983=1; 0 otherwise |
| MXLDWT | 1976,1983=1; 0 otherwise |
| MXDDCN | 1978-1979, 1991=1; 0 otherwise |
| MXDDWT | 1978-1979=1; 0 otherwise |
| MXPDCN | 1970-1973=1; 0 otherwise |
| MXPDWT | 1970-1971=1; 0 otherwise |
| USSDWT | 1983,1990=1; 0 otherwise |
| CBIDUMCN | 1984-1994=1; 0 otherwise |
| CBIDUMHD | 1984-1994=1; 0 otherwise |

**Table 5.4. Melon Trade Model: Simulation Validation Statistics**

| | | MSE Decomposition Proportions | | | |
|---|---|---|---|---|---|
| Variable | Theils U | $U^M$ | $U^S$ | $U^C$ | RMS % Error |
| MXAHCN | 0.067 | 0.000 | 0.130 | 0.870 | 16.425 |
| MXAHWT | 0.097 | 0.000 | 0.127 | 0.873 | 21.910 |
| MXQSCN | 0.069 | 0.001 | 0.037 | 0.962 | 16.416 |
| MXQSWT | 0.097 | 0.000 | 0.055 | 0.945 | 21.918 |
| MXESHD | 0.138 | 0.000 | 0.062 | 0.937 | 45.205 |
| MXFPCN | 0.067 | 0.001 | 0.226 | 0.773 | 12.151 |
| MXFPHD | 0.049 | 0.003 | 0.019 | 0.978 | 12.005 |
| MXFPWT | 0.050 | 0.000 | 0.122 | 0.878 | 10.599 |
| USCPCN | 0.038 | 0.011 | 0.016 | 0.972 | 7.658 |
| USCPHD | 0.051 | 0.000 | 0.138 | 0.862 | 10.273 |
| USCPWT | 0.069 | 0.000 | 0.003 | 0.997 | 14.244 |
| MXCOCN | 0.082 | 0.003 | 0.102 | 0.895 | 19.520 |
| MXCOWT | 0.086 | 0.002 | 0.070 | 0.928 | 17.201 |
| MXQDCN | 0.079 | 0.008 | 0.104 | 0.888 | 19.521 |
| MXQDWT | 0.088 | 0.001 | 0.019 | 0.980 | 17.194 |
| MXCPCN | 0.052 | 0.000 | 0.285 | 0.715 | 11.334 |
| MXCPWT | 0.064 | 0.000 | 0.157 | 0.843 | 15.599 |
| USCOCN | 0.098 | 0.009 | 0.103 | 0.888 | 25.503 |
| USCOHD | 0.073 | 0.005 | 0.135 | 0.860 | 21.178 |
| USCOWT | 0.114 | 0.001 | 0.005 | 0.994 | 24.465 |
| USQDCN | 0.092 | 0.001 | 0.077 | 0.923 | 23.829 |
| USQDHD | 0.071 | 0.002 | 0.128 | 0.870 | 21.102 |
| USQDWT | 0.116 | 0.000 | 0.004 | 0.996 | 24.462 |
| MXESCN | 0.173 | 0.007 | 0.211 | 0.781 | 41.455 |
| CBIESCN | 0.038 | 0.075 | 0.091 | 0.834 | 53.318 |
| CBIESHD | 0.096 | 0.000 | 0.041 | 0.959 | 39.487 |
| MXESWT | 0.241 | 0.001 | 0.335 | 0.664 | 54.627 |
| USQSWT | 0.126 | 0.000 | 0.128 | 0.872 | 35.672 |
| USAHWT | 0.133 | 0.000 | 0.215 | 0.785 | 35.672 |

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**Table 5.4. Continued**

| | | | | | |
|---|---|---|---|---|---|
| USFPWT | 0.111 | 0.000 | 0.235 | 0.764 | 28.421 |
| CBIFPCN | 0.082 | 0.000 | 0.176 | 0.824 | 20.552 |
| CBIFPHD | 0.070 | 0.001 | 0.051 | 0.949 | 17.069 |
| USEDCN | 0.110 | 0.016 | 0.225 | 0.759 | 25.073 |
| USEDHD | 0.100 | 0.000 | 0.024 | 0.976 | 30.795 |
| USEDWT | 0.225 | 0.000 | 0.327 | 0.673 | 48.790 |

See Table 5.2 for definition of variables.

**Table 5.5. Dynamic Multipliers for Selected Variables Following a 10% Increase in the Mexican Real Exchange Rate**

| | Variables | | | | | |
|---|---|---|---|---|---|---|
| Period | MXESCN (ton) | MXESHD (ton) | MXESWT (ton) | MXFPCN (pesos/ton) | MXFPHD (pesos/ton) | MXFPWT (pesos/ton) |
| 1 | 982 | 2,662 | 3,177 | 0.01139 | 0.02621 | 0.01706 |
| 2 | 105 | -82 | 1,817 | -0.00006 | -0.00081 | -0.00021 |
| 3 | -5 | 3 | -29 | 0 | 0.00003 | 0.00001 |
| 4 | 0 | 0 | 2 | 0 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | 0 | 0 | 0 | 0 | 0 | 0 |

## SIMULATION ANALYSIS

This section presents the results of using the estimated Mexico-U.S.-CBI countries melon trade model to forecast and simulate scenarios that are designed to give better understanding of forces affecting melon trade over the 1996-2004 period. In particular, the analysis centers on making projections regarding quantities consumed, produced and traded, and the distribution of market share among different supplier nations. Alternative scenarios are analyzed to identify factors that have the most significant effect on melon trade. This section is particularly important because the results provide input for policy recommendations that will be designed to enhance Mexico's role in export melon markets.

Initially a ten-year baseline forecast of endogenous variables in the melon trade model is presented that is conditioned or based on a forecast of exogenous variables in the model. The baseline forecast includes the scheduled NAFTA tariff phase-out that commenced in 1994 and the 1994-1995 Mexican peso devaluation. The baseline forecast is contrasted with additional simulation results that reflect varying assumptions regarding the exogenous variables. The factors (scenarios) analyzed through the simulation analysis are: (1) peso/dollar exchange rates, (2) tariff phase out (NAFTA), (3) Mexican economic growth, (4) Mexican melon yields, and (5) Mexican agricultural labor costs. Comparing baseline results with those of the various scenarios will provide insight as to the relative importance of these five factors on Mexico-U.S.-CBI countries melon markets and trade.

### Baseline Forecast

The baseline forecast presented in this section provides a projection of specific endogenous variables over the 1996 through 2004 period given the phase-out of tariffs under NAFTA (commenced in 1994) and the devaluation of the peso that occurred in 1994/1995[*]. Before presenting the baseline forecast, however, the assumptions regarding the values of the exogenous variables included in the model are presented.

*Baseline Forecast Assumptions*

Possibly the most critical assumptions are those relating to the forecasted growth in the U.S. and Mexican macroeconomic variables, including real per capita GDP, population, consumer price indexes, real wages, and exchange rates. The projections for these exogenous variables for both the U.S. and Mexico came from the Food and Agricultural Policy Research Institute (FAPRI) as provided by the Wharton Econometrics Group (WEFA). Projections for other exogenous variables (e.g. yields) were based on the average annual growth rates for years prior to 1995.

Baseline forecast assumptions are presented in table 6.1. The U.S. real per capita GDP is expected to exhibit an average annual growth rate of between 1.2% and 1.4%. This projection is the result of the rather stable growth expected for the U.S. economy for the period 1996-2004. Mexican real per capita GDP is projected to grow at an annual average rate of 2.0% which was the growth observed during 1988-1994. The consumer price index (CPI) was assumed to grow at annual rates between 2.6% and 2.9% in the U.S. and to decline slowly in Mexico from 26.5% in 1996 to 16.8% by the end of the forecast period. The U.S. population forecast exhibits a slowly declining annual growth rate; the growth rate is projected to decline from 1.01% in 1996 to 0.84% in 2004. Mexican population growth projections also show declining rates, although their rates are twice those of the United States. The U.S. agricultural wages were forecast to increase at annual rates between 2.6% and 3.2% during the 1996-2002 period but to decline during 2003-2004 to 2.6%. The real Mexican wage rate is projected to grow at an annual rate of 1.5%, which is similar to its recent rate of growth.

[*] The Mexico-U.S. nominal exchange rate in early December 1994 (before devaluation) was 3.3 pesos/dollar. Starting in late December and continuing in 1995 a devaluation of Mexican peso change the nominal exchange rate to 6.5 pesos/dollar, a 100% currency devaluation.

The nominal peso/U.S. dollar exchange rate is projected to increase by 8.2% to 20.1% over the forecast period. This implies a decline in the real exchange rate over the period given the CPI forecast for Mexico and the United States. The U.S. watermelon production yield forecast is based on the average growth rates observed for the years 1970-1994. U.S. watermelon production yields are projected to grow twice the rate of Mexican watermelon yields (1.5%). Mexico and CBI countries production yield forecast for cantaloupe, honeydew, and watermelon are based on observed annual rates of growth for the 1990-1994 period.

Projections for other exogenous variables, such as U.S. imports from other countries, and U.S. exports were based on the average annual growth rates of the last ten years. The baseline forecast scenario also assumes that the scheduled tariff phase-out required under NAFTA continues unimpeded. Watermelon and honeydew tariffs are totally eliminated by the year 2004 as per the NAFTA schedule. The baseline forecast of endogenous variables represent normal weather, that is, no extreme weather events are included.

*Baseline Forecast Results*

Results of the baseline forecast for selected endogenous variables are presented in tables 6.2 to 6.5. Additional endogenous variables are presented in table A.1 (Appendix). Following historic trends, Mexican cantaloupe, honeydew, and watermelon exports to the United States decrease over the forecast period (table 6.2). In particular, Mexican exports of cantaloupe and watermelon decline 48% and 62%, respectively. Mexican harvested area for cantaloupe and watermelon are also projected to decrease over the forecast period. The reduction in Mexico's harvested area is not as significant as the reduction in exports because Mexican domestic consumption is projected to increase, absorbing a portion of those melons previously intended for export. Cantaloupe harvested area is projected to decrease about 1000 ha (6%), while that of watermelon is projected to decrease about 900 ha (4%) over the forecast period. Mexican per capita consumption of cantaloupe and watermelon are projected to expand. The projected expansion of Mexican cantaloupe consumption is greater than that of watermelon. This is expected since consumption trends analyzed in the Melon Industry Characteristics section and the estimated higher income elasticities shown in the Empirical Results section were more favorable for increased cantaloupe consumption than watermelon consumption.

The U.S. per capita consumption of cantaloupe and honeydew are projected to grow 31% and 14%, respectively, over the next decade. However, watermelon consumption, as reflected by historical trends, and a very low consumer preference (as reflected by the estimated low income elasticity) is projected to decrease about 8% over the forecast period. Additional explanation for the projected decrease in watermelon consumption is that the real own-price is projected to increase slightly (Appendix) as imports from Mexico significantly decrease. The U.S.'s cantaloupe and honeydew imports are projected to continue increasing. In particular, the U.S. cantaloupe imports are projected to increase 16% while that of honeydew increase by 5% over the next decade. In contrast, U.S. imports of watermelon are projected to decrease about 53%. This significant reduction in U.S. imports of watermelon is explained by the reduction in per capita consumption and the increase in U.S. domestic production which competes with imports in the U.S. domestic market.

The following addresses how market shares in the U.S. Fall-Winter melon market are projected to change over the next decade. The share of the U.S. cantaloupe, honeydew, and watermelon import market supplied by different sources is presented in tables 6.3 to 6.5. Table 6.3 shows the share of U.S. cantaloupe imports supplied by Mexico, CBI countries, and other countries over the forecast period. As noted in the Melon Industry Characteristics section, during the 1970s and early 1980s, Mexico was the dominant source of cantaloupe imports by the United States: during this period, Mexico supplied more than 90% of total U.S. imports. However, after the early 1980s, the Mexican share commenced to decline and by 1993-1994, Mexico supplied about 30% of the U.S. market in the Fall-Winter. Over the forecast period, the Mexican share of the U.S. cantaloupe market follows a declining trend and by 2004, Mexico's share is projected to be only 16%. In contrast, CBI countries' share, in particular, the share supplied by Honduras, Costa Rica, and Guatemala is projected to increase from 64% in 1996 to 83% in 2004 (table 6.3).

For honeydew, as discussed in the Melon Industry Characteristics section, Mexico's share of the U.S. market declined from about 60% in early 1970s to 37% in 1994. For the forecast period, Mexico's projected share continues to decline from 40% in 1996 to 33% in 2004. On the other hand, CBI countries' share is projected to increase from 56% in 1996 to 63% in 2004 (table 6.4). For watermelon, as shown in the Melon Industry Characteristics section, the U.S. Fall-Winter market is shared between U.S. suppliers and imports from Mexico. Mexico's share of the U.S.

watermelon market declined from an average of 40% in early 1970s to 25% in 1994 (chapter II). Over the forecasting period, Mexico's market share declined from 30% in 1996 to 13% in 2004 (table 6.5). In general, important declines are observed in Mexico's share of the U.S. Fall-Winter melon markets. To better understand the factors responsible for the decline in Mexico's role in the U.S. melon markets a simulation analysis that focuses on key variables affecting Mexico-U.S.-CBI countries melon trade is performed in the next section.

**Baseline Forecast Results Versus Scenarios**

Initially an analysis is performed to simulate the likely effects of five key factors on the level of Mexican cantaloupe, honeydew, and watermelon exports to the U.S. over the 1996-2004 period. These outcomes are compared with baseline estimates to isolate their influence on trade. The factors (scenarios) included in the analysis are: (1) changes in the Mexican peso/U.S. dollar exchange rate, (2) the phase-out of the U.S. import tariff schedule under NAFTA, (3) growth in Mexican per capita income, (4) growth in Mexican cantaloupe and watermelon yields, and (5) growth in Mexican wage rates. A theoretical discussion of expected effects of these factors on melon trade was presented in the Conceptual Model of Melon Trade section.

The first scenario examines the effects of the 1994/95 devaluation of the peso on Mexican melon exports. The model is simulated over the forecast period assuming that the real value of the Mexican peso is held constant at its 1993 level (referred as the No-Devaluation scenario); this implies that the nominal peso devaluation of 1994/95 was immediately offset by the inflation differentials between the U.S. and Mexico. In essence, the simulation considers what Mexican melon exports might have been over the 1996-2004 period if no real devaluation of the peso had occurred in 1994/95. The difference between the baseline solution values and their values in the No-devaluation scenario represent the effects of the Mexican peso devaluation on the Mexican melon exports.

The second scenario considers what the pattern and level of Mexican melon exports might be if tariffs were not phased out as required under NAFTA (referred to as the No-NAFTA scenario). This scenario is analyzed only for honeydew and watermelon since the cantaloupe tariff for the January-May period was zero before NAFTA was implemented. Contrasting baseline solution values with solution values in the No-NAFTA scenario serve to isolate the effects of the NAFTA tariff phase-out on Mexican melon exports.

The national objective of the economic reforms undertaken by the Mexican government over the past decade has been to generate economic growth and development. Mexican economic growth will generate growth in real per capita income and demand in Mexico and limit the growth in Mexican exports over the next decade. To examine the effect of increased per capita income in Mexico on its melon exports, a third scenario is included. Under this scenario, real Mexican per capita income is projected to grow for the 1996-2004 period at the following annual rates: 2.3%, 2.8%, 3.5%, 3.1%, 3.0%, 3.0%, 4.1%, 4.6%, and 4.9%, respectively (FAPRI, 1997 World Agricultural Outlook, staff report #2-97, p.17). The differences between the baseline solution values that assume a 2% growth in per capita income and those that result from the accelerated economic growth scenario will measure the effect of higher Mexican per capita income growth on Mexican exports of cantaloupe, honeydew, and watermelon.

As discussed in the Melon Industry Characteristics section, the Mexican melon industry is characterized by low productivity or yields. Changes in Mexican melon production through time are explained by changes in harvested area. Yields have made a very low contribution to changes in Mexican melon production. A fourth scenario (referred to as Mexican melon yields) was included to measure the effect of increased Mexican cantaloupe and watermelon yields on Mexican melon exports. Under this scenario, the growth in Mexican melon yields are assumed to be that of its competitors: a 3% annual growth rate for watermelon yields (U.S. yields) and a 1.8% growth rate for cantaloupe yields (CBI countries yields). The assumed rates of growth for Mexican melon yields are double those in the baseline forecast. The model will again be used to simulate over the forecast period after incorporating the new "high yields" into the model. The difference between exports of Mexican melons under the baseline assumptions and those under the high yield scenario will represent the effect of higher Mexican melon yields on Mexican melon exports.

The relatively low cost of agricultural labor in Mexico is generally believed to be a key component of Mexico's competitive advantage in the production and export of melons. To measure the effect of changes in real Mexican wage rates on Mexican melon exports, one additional scenario (increase in Mexican labor cost scenario) is simulated with the melon trade model. Under this scenario, Mexican agricultural wages are projected to grow at rates similar to the projected growth in Mexican real per capita income. Again, the difference between the value of Mexican exports under the baseline assumption and those under the higher Mexican labor cost scenario will offer a measure of the effects of higher Mexican labor cost on Mexican melon exports.

The projected change in Mexican cantaloupe, honeydew, and watermelon exports under the different scenarios are presented in tables 6.6 to 6.8. The analysis is designed to determine the relative importance of each factor on Mexican melon exports to the U.S. and then to make policy recommendations to the Mexican melon industry based on the analysis.

*Effects of Scenarios on Mexican Cantaloupe Exports*

The change in Mexican cantaloupe exports under various scenarios is presented in table 6.6. The expected direction (signs) of the impacts are analyzed first and then an analysis of short and long run effects are performed.

The direction of the impact for each analyzed factor is as expected by trade theory discussed in the Conceptual Model of Melon Trade section. An increase in Mexican per capita income increases Mexican domestic consumption, thus reducing the quantity of melons exported (negative sign). An increase in the cost of Mexican agricultural labor reduces domestic production, thus decreasing the supply for export (negative sign). An increase in Mexican cantaloupe yield, increases domestic supply, thus increasing the supply for export (positive sign). No devaluation of the overvalued Mexican peso (1993 level) decreases Mexican competitiveness in the U.S. market, thus reducing cantaloupe exports (negative sign).

An examination of absolute and relative changes in export levels that result from various analyzed factors show an increase in Mexican yields to have the largest effect on Mexican cantaloupe exports to the United States. Compared to the baseline projections, the assumed increase in Mexican cantaloupe yield from 0.92% to 1.84% will boost Mexican exports by 22% in 1996 and by 79% in 2004. Accelerated growth in per capita income has a small effect on exports in the short-run, but the second-largest effect in the long run, decreasing Mexican cantaloupe exports by 60% in 2004. An increase in the cost of Mexican agricultural labor has a small impact in the short-run but, in the long run, (year 2004), causes a 15% reduction in Mexican cantaloupe exports. The 1994/95 peso devaluation has the second largest impact in the short run but, in the long run, the effect is almost negligible. In summary, the yields scenario has the greatest impact on Mexican cantaloupe exports in the short and long run. The No-devaluation scenario is important in the short run, while accelerated growth in Mexican per capita income and an increase in the cost of agricultural labor has significant impacts in the long-run.

*Effects of Scenarios on Mexican Honeydew Exports*

The effect of higher agricultural labor cost, the 1994/95 devaluation of the peso and NAFTA on Mexico honeydew exports to the United States are shown in table 6.7. The impact of increased honeydew yield and accelerated growth in per capita income could not be analyzed because of inadequate data to estimate Mexican demand and supply relationships.

Simulation results show the three analyzed factors to have a negative effect on Mexican honeydew exports. In particular, if the NAFTA tariff phase-out failed to occur, Mexico honeydew exports are projected to be lowered 197,000 pounds in 1996 and 847,000 pounds in 2004 (table 6.7); that is, the tariff-lowering provisions of NAFTA are projected to increase Mexican honeydew exports to the United States 197,000 pounds in 1996 and 847,000 pounds in 2004. The analysis shows the 1994-1995 devaluation to have the greatest effect on Mexican honeydew exports to the United States in the short run. However, by 2004, this effect decreases substantially as the higher inflation rates in Mexico neutralize the positive effects of the 1994-1995 Mexican peso devaluation. The no-devaluation simulation results suggest that the Mexican devaluation led to a substantial increase in Mexican honeydew exports in 1996.

As in the case of cantaloupe, the agricultural labor cost scenario has a small impact in the short-run but a significant impact in the long run. The No-NAFTA scenario suggests that the tariff-reducing provisions of NAFTA will have a small impact on Mexican honeydew exports in the short and long-run. This result is not surprising given the relatively low U.S. tariffs (8.5% *ad valorem*) for Mexican honeydew prior to NAFTA. In summary, for honeydew exports, the No-devaluation scenario has the greatest impact in the short-run, while Mexican labor cost has the greatest impact in the long run. Because of the limited effects of the No-NAFTA scenario, any substantial increase in Mexican honeydew exports over the next decade will likely be the result of factors other than NAFTA.

*Effects of Scenarios on Mexican Watermelon Exports*

The effects of the five analyzed forces on watermelon exports are presented in table 6.8. The projected changes in exports are those suggested by trade theory as discussed in the Conceptual Model of Melon Trade section. The No-devaluation scenario shows that an overvalued Mexican peso (1993 level) decreases Mexican competitiveness in the U.S. market, thus reducing watermelon exports (negative sign). Projected Mexican watermelon exports under No-NAFTA would have been lower (negative sign) compared to the U.S. tariff phase out included in the baseline projections. An increase in Mexican watermelon yield increases domestic production, thus increasing the supply for exports (positive sign). An increase in Mexican per capita income increases Mexican domestic consumption, thus reducing the quantity of watermelon exports (negative sign). An increase in the cost of Mexican agricultural labor reduces domestic production, thus decreasing the supply for export (negative sign).

The analysis shows the no-devaluation scenario has the largest impact on Mexican watermelon exports in the short-run (a 36% reduction in 1996 compared to the baseline level). In the long-run, however, the simulation analysis indicates the greatest impact on Mexican watermelon exports is caused by the assumed increase in Mexican watermelon yield (a 120% increase compared to the baseline level). Accelerated grow in Mexican per capita income and Mexican agricultural labor costs have important effects on Mexican watermelon exports in the long-run. The No-NAFTA scenario has the smallest impact in the long run on Mexican watermelon exports. Interestingly, the decline in the U.S. watermelon tariff (20% *ad valorem*) is about equal to the projected increase in Mexican watermelon exports (17.48%) by 2004.

In general, the simulation analysis with the melon trade model shows the largest impact on Mexican melon exports in the short-run is caused by the Mexican currency devaluation, whereas in the long-run the greatest impact is the result of improvements in Mexican melon yields. Factors like Mexican labor cost and Mexican economic growth have important impacts on Mexican melon exports but a more modest influence than higher yields. The U.S. watermelon tariff phase-out was found to have less impact on exports than other analyzed factors.

## Summary

This section presented the results of the simulation analysis with the melon trade model which was estimated and validated in the Empirical Results section. A ten-year baseline forecast of endogenous variables was first presented. Then, through simulation analysis, five factors were analyzed to determine those that have the most significant effect on melon trade. These factors were: (1) Mexican peso/U.S. dollar exchange rate, (2) melon tariffs (NAFTA), (3) Mexican economic growth, (4) Mexican melon yields, and (5) Mexican agricultural labor costs.

Baseline results show Mexican melon exports to the U.S. are expected to continue their decline during the Fall-Winter season over the 1996-2004 period. Mexican producers share of the U.S. melon markets is expected to decrease while that of U.S. and CBI countries is expected to significantly increase. Cantaloupe and honeydew consumption in the U.S. during the Fall-Winter is expected to grow as a result of increasing imports. However, U.S. per capita consumption of watermelon is projected to decrease; this finding is supported by historical trends. The analysis shows the 1994-1995 devaluation of the peso had the greatest short-run influence on Mexico’s ability to export while the largest long-run impact was associated with improvements in Mexican melon yields. Mexican agricultural labor cost and accelerated growth in Mexican per capita income have important impacts on melon exports but are of less importance than yields. In general, the tariff-reducing provisions of NAFTA have a comparatively modest influence on Mexican melon exports.

**Table 6.1. Baseline Forecast Assumptions: Projected Annual Growth of Exogenous Variables, 1996-2004**

| Year | U.S. Per Capita Real GDP[1] | U.S. Population[2] | U.S. CPI[1] | U.S. Wages[1] | U.S. Yields Watermelon[4] | CBI Yields Cantaloupe[5] | CBI Yields Honeydew[5] |
|---|---|---|---|---|---|---|---|
| | (Percentage Change from Previous Year) | | | | | | |
| 1996 | 1.2 | 1.01 | 2.9 | 2.6 | 3.0 | 1.84 | 1.84 |
| 1997 | 1.2 | 0.98 | 2.6 | 2.7 | 3.0 | 1.84 | 1.84 |
| 1998 | 1.4 | 0.95 | 2.8 | 2.5 | 3.0 | 1.84 | 1.84 |
| 1999 | 1.4 | 0.92 | 2.8 | 2.6 | 3.0 | 1.84 | 1.84 |
| 2000 | 1.3 | 0.90 | 2.8 | 3.1 | 3.0 | 1.84 | 1.84 |
| 2001 | 1.3 | 0.88 | 2.8 | 3.6 | 2.0 | 1.84 | 1.84 |
| 2002 | 1.3 | 0.87 | 2.8 | 3.2 | 2.0 | 1.84 | 1.84 |
| 2003 | 1.3 | 0.85 | 2.7 | 2.8 | 2.0 | 1.84 | 1.84 |
| 2004 | 1.4 | 0.84 | 2.7 | 2.6 | 2.0 | 1.84 | 1.84 |

| Year | Mexican Per Capita Real GDP[6] | Mexican Population[2] | Mexican CPI[1] | Mexican Exchange Rate[1] | Mexican Real Wages[3] | Mexican Yields Cantaloupe[5] | Mexican Yields Watermelon[5] |
|---|---|---|---|---|---|---|---|
| | (Percentage Change from Previous Year) | | | | | | |
| 1996 | 2.0 | 1.90 | 26.5 | 20.1 | 1.5 | 0.92 | 1.50 |
| 1997 | 2.0 | 1.87 | 21.3 | 14.2 | 1.5 | 0.92 | 1.50 |
| 1998 | 2.0 | 1.83 | 18.8 | 13.6 | 1.5 | 0.92 | 1.50 |
| 1999 | 2.0 | 1.80 | 18.5 | 13.3 | 1.5 | 0.92 | 1.50 |
| 2000 | 2.0 | 1.75 | 18.6 | 12.2 | 1.5 | 0.92 | 1.50 |
| 2001 | 2.0 | 1.72 | 17.2 | 11.2 | 1.5 | 0.92 | 1.50 |
| 2002 | 2.0 | 1.68 | 17.0 | 10.2 | 1.5 | 0.92 | 1.50 |
| 2003 | 2.0 | 1.65 | 16.9 | 9.2 | 1.5 | 0.92 | 1.50 |
| 2004 | 2.0 | 1.61 | 16.8 | 8.2 | 1.5 | 0.92 | 1.50 |

[1] Source: The WEFA Group, November 1996.
[2] Source: U.S. Bureau of the Census, August 1994.
[3] Source: Based on recent growth in Mexican wages
[4] Source: Average long-term growth before 1995.
[5] Source: Average growth 1990-94.
[6] Source: Average growth 1988-94.

**Table 6.2. Baseline Forecast Results: Cantaloupe, Watermelon, and Honeydew, Selected Variables, 1996-2004**

| Year | Mexican Harvested Area (Ha) | Mexican Exports to U.S. (1,000 lb.) | Mexican Per Capita Consumption (Kg) | U.S. Imports (1,000 lb.) | U.S. Per Capita Consumption (lb.) |
|---|---|---|---|---|---|
| | | | Cantaloupe | | |
| 1996 | 17,117 | 256,993 | 1.79 | 713,334 | 3.21 |
| 1997 | 16,938 | 241,521 | 1.83 | 734,045 | 3.33 |
| 1998 | 16,798 | 227,127 | 1.88 | 753,512 | 3.47 |
| 1999 | 16,687 | 213,301 | 1.93 | 771,417 | 3.61 |
| 2000 | 16,569 | 198,738 | 1.97 | 786,697 | 3.73 |
| 2001 | 16,448 | 183,495 | 2.02 | 799,599 | 3.86 |
| 2002 | 16,321 | 168,065 | 2.07 | 810,759 | 3.99 |
| 2003 | 16,196 | 150,889 | 2.12 | 818,822 | 4.11 |
| 2004 | 16,074 | 133,737 | 2.17 | 825,689 | 4.23 |
| | | | Watermelon | | |
| 1996 | 21,416 | 214,069 | 2.82 | 244,766 | 2.78 |
| 1997 | 20,808 | 184,752 | 2.86 | 213,704 | 2.68 |
| 1998 | 20,711 | 169,418 | 2.90 | 201,042 | 2.68 |
| 1999 | 20,738 | 158,571 | 2.93 | 191,068 | 2.68 |
| 2000 | 20,718 | 145,474 | 2.98 | 178,051 | 2.68 |
| 2001 | 20,657 | 130,727 | 3.02 | 163,790 | 2.65 |
| 2002 | 20,597 | 115,873 | 3.06 | 149,430 | 2.63 |
| 2003 | 20,534 | 99,131 | 3.11 | 133,190 | 2.60 |
| 2004 | 20,476 | 80,799 | 3.17 | 115,369 | 2.57 |

(continued on next page)

**Table 6.2. Continued**

| Year | Mexican Exports to U.S. (1,000 lb.) | Mexican Farmer Price (1990=100) (Pesos/lb.) | U.S. Per Capita Consumption (lb.) | U.S. Imports (1,000 lb.) | CBI Exports to U.S. (1,000 lb.) |
|---|---|---|---|---|---|
| | | | Honeydew | | |
| 1996 | 119,398 | 0.39 | 1.32 | 296,418 | 166,478 |
| 1997 | 112,037 | 0.38 | 1.34 | 294,086 | 171,507 |
| 1998 | 110,165 | 0.39 | 1.36 | 296,367 | 175,660 |
| 1999 | 110,228 | 0.38 | 1.39 | 300,018 | 179,247 |
| 2000 | 109,544 | 0.38 | 1.41 | 302,655 | 182,569 |
| 2001 | 108,237 | 0.38 | 1.43 | 304,549 | 185,769 |
| 2002 | 106,753 | 0.37 | 1.46 | 306,196 | 188,900 |
| 2003 | 105,315 | 0.37 | 1.48 | 307,881 | 192,024 |
| 2004 | 103,746 | 0.36 | 1.50 | 309,502 | 195,214 |

**Table 6.3. Cantaloupe Baseline Results: U.S. Imports and Market Share, 1996-2004**

| | | U.S. Import Sources | | | | | |
|---|---|---|---|---|---|---|---|
| | | Imports from Mexico | | Imports from CBI | | Imports from Other Countries | |
| Year | U.S. Imports (1,000 lb.) | (1,000 lb.) | Share (%) | (1,000 lb.) | Share (%) | (1,000 lb.) | Share (%) |
| 1996 | 713,334 | 256,993 | 36.03 | 456,061 | 63.93 | 280 | .04 |
| 1997 | 734,045 | 241,521 | 32.90 | 492,245 | 67.06 | 279 | .04 |
| 1998 | 753,512 | 227,127 | 30.14 | 526,106 | 69.82 | 280 | .04 |
| 1999 | 771,417 | 213,301 | 27.65 | 559,737 | 72.31 | 278 | .04 |
| 2000 | 786,697 | 198,738 | 25.26 | 587,681 | 74.70 | 278 | .04 |
| 2001 | 799,600 | 183,495 | 22.95 | 615,825 | 77.02 | 280 | .04 |
| 2002 | 810,759 | 168,065 | 20.73 | 642,437 | 79.24 | 257 | .03 |
| 2003 | 818,822 | 150,889 | 18.43 | 867,654 | 81.54 | 279 | .03 |
| 2004 | 825,689 | 133,737 | 16.20 | 691,674 | 83.77 | 278 | .03 |

**Table 6.4. Honeydew Baseline Results: U.S. Imports and Market Share, 1996-2004**

| | | U.S. Import Sources | | | | | |
|---|---|---|---|---|---|---|---|
| | | Imports from Mexico | | Imports from CBI | | Imports from Other Countries | |
| Year | U.S. Imports (1,000 lb.) | (1,000 lb.) | Share (%) | (1,000 lb.) | Share (%) | (1,000 lb.) | Share (%) |
| 1996 | 296,418 | 119,398 | 40.28 | 166,478 | 56.16 | 10,542 | 3.56 |
| 1997 | 294,086 | 112,037 | 38.10 | 171,507 | 58.32 | 10,542 | 3.58 |
| 1998 | 296,367 | 110,165 | 37.17 | 175,660 | 59.27 | 10,542 | 3.56 |
| 1999 | 300,018 | 110,228 | 36.74 | 179,247 | 59.75 | 10,542 | 3.51 |
| 2000 | 302,655 | 109,544 | 36.19 | 182,569 | 60.32 | 10,542 | 3.48 |
| 2001 | 304,549 | 108,237 | 35.54 | 185,769 | 61.00 | 10,542 | 3.46 |
| 2002 | 306,196 | 106,753 | 34.86 | 188,900 | 61.69 | 10,542 | 3.44 |
| 2003 | 307,881 | 105,315 | 34.21 | 192,025 | 62.37 | 10,542 | 3.42 |
| 2004 | 309,502 | 103,746 | 33.52 | 195,214 | 63.07 | 10,542 | 3.41 |

**Table 6.5. Watermelon Baseline Results: Total Shipments and Market Share, 1996-2004**

| | | Shipment's Sources | | | | | |
|---|---|---|---|---|---|---|---|
| | | Imports from Mexico | | U.S. Shipments | | Imports from Other Countries | |
| Year | Total Shipments (1,000 lb.) | (1,000 lb.) | Share (%) | (1,000 lb.) | Share (%) | (1,000 lb.) | Share (%) |
| 1996 | 702,446 | 214,069 | 30.47 | 457,676 | 65.15 | 30,702 | 4.37 |
| 1997 | 675,800 | 184,752 | 27.34 | 459,887 | 68.05 | 31,161 | 4.61 |
| 1998 | 673,733 | 169,418 | 25.15 | 472,688 | 70.16 | 31,627 | 4.69 |
| 1999 | 673,974 | 158,571 | 23.59 | 482,704 | 71.64 | 32,100 | 4.76 |
| 2000 | 674,091 | 145,474 | 21.58 | 496,037 | 73.59 | 32,580 | 4.83 |
| 2001 | 665,670 | 130,727 | 19.64 | 501,329 | 75.39 | 33,067 | 4.97 |
| 2002 | 659,763 | 115,873 | 17.56 | 510,329 | 77.35 | 33,561 | 5.09 |
| 2003 | 649,710 | 99,131 | 15.26 | 516,516 | 79.50 | 34,063 | 5.24 |
| 2004 | 640,318 | 80,799 | 12.62 | 524,946 | 81.58 | 34,573 | 5.40 |

**Table 6.6. Cantaloupe Forecast Results: Baseline Versus Scenarios for Mexican Exports, 1996-2004**

| Year | Baseline | Scenarios | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | No-Devaluation | | High Mexican Econ. Growth | | Increase Mexican Yields | | Increase Mexican Labor Cost | |
| | Mexican Exports (ton) | Change (ton) | Change (%) | Change (ton) | Change (%) | Change (ton) | Change (%) | Change (ton) | Change (%) |
| 1996 | 116,571 | -4,528 | -3.88 | -1,139 | -0.98 | 25,607 | 21.97 | -368 | -0.31 |
| 1997 | 109,553 | -3,413 | -3.12 | -2,793 | -2.55 | 28,285 | 25.82 | -737 | -0.67 |
| 1998 | 103,024 | -3,034 | -2.94 | -6,016 | -5.84 | 30,969 | 30.06 | -1,379 | -1.34 |
| 1999 | 96,752 | -2,982 | -3.08 | -8,602 | -8.89 | 33,817 | 34.95 | -2,459 | -2.54 |
| 2000 | 90,146 | -2,778 | -3.08 | -11,194 | -12.42 | 36,598 | 40.60 | -3,332 | -3.69 |
| 2001 | 83,233 | -2,455 | -2.95 | -14,016 | -16.84 | 39,316 | 47.24 | -4,278 | -5.13 |
| 2002 | 76,223 | -2,053 | -2.75 | -20,067 | -26.33 | 42,130 | 55.27 | -5,182 | -6.80 |
| 2003 | 68,442 | -1,707 | -2.49 | -27,377 | -40.00 | 45,045 | 65.81 | -6,828 | -9.97 |
| 2004 | 60,662 | -1,198 | -1.97 | -36,499 | -60.17 | 48,064 | 79.23 | -8,993 | -14.82 |

**Table 6.7. Honeydew Forecast Results: Baseline Versus Scenarios for Mexican Exports, 1996-2004**

| | Baseline | Scenarios | | | | | |
|---|---|---|---|---|---|---|---|
| | | No-Devaluation | | No-NAFTA | | Increase Mexican Labor Cost | |
| Year | Mexican Exports (1000 lb.) | Change (1,000 lb.) | Change (%) | Change (1,000 lb.) | Change (%) | Change (1,000 lb.) | Change (%) |
| 1996 | 119,398 | -21,086 | -17.66 | -197 | -0.16 | -362 | -0.30 |
| 1997 | 112,037 | -13,316 | -11.89 | -374 | -0.33 | -686 | -0.61 |
| 1998 | 110,165 | -11,527 | -10.46 | -541 | -0.49 | -1,271 | -1.15 |
| 1999 | 110,228 | -11,483 | -10.42 | -707 | -0.64 | -2,239 | -2.03 |
| 2000 | 109,544 | -10,674 | -9.74 | -873 | -0.80 | -2,957 | -2.69 |
| 2001 | 108,237 | -9,363 | -8.65 | -853 | -0.79 | -3,747 | -3.46 |
| 2002 | 106,753 | -7,919 | -7.42 | -852 | -0.80 | -4,474 | -4.19 |
| 2003 | 105,315 | -6,497 | -6.17 | -850 | -0.81 | -5,875 | -5.57 |
| 2004 | 103,746 | -4,886 | -4.71 | -847 | -0.82 | -7,651 | -7.40 |

Table 6.8. Watermelon Forecast Results: Baseline Versus Scenarios for Mexican Exports, 1996-2004

| Year | Baseline | Scenarios | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No-Devaluation | | No-NAFTA | | Increase Mexican Yields | | High MX Economic Growth | | Increase MX Labor Cost | |
| | Mexican Exports (ton) | Change (ton) | Change (%) | Change (ton) | Change (%) | Change (ton) | Change (%) | Change (ton) | Change (%) | Change (ton) | Change (%) |
| 1996 | 97,100 | -34,995 | -36.04 | -2,056 | -2.12 | 8,410 | 8.66 | -1,096 | -1.13 | -493 | -0.50 |
| 1997 | 82,802 | -26,103 | -31.52 | -2,556 | -3.09 | 11,952 | 14.43 | -2,699 | -3.26 | -966 | -1.16 |
| 1998 | 76,847 | -24,166 | -31.45 | -3,099 | -4.03 | 16,259 | 21.16 | -5,777 | -7.52 | -1,813 | -2.35 |
| 1999 | 72,108 | -23,585 | -32.71 | -3,647 | -5.06 | 20,732 | 28.75 | -8,142 | -11.29 | -3,238 | -4.49 |
| 2000 | 65,986 | -21,738 | -32.94 | -4,207 | -6.38 | 25,093 | 38.03 | -10,541 | -15.97 | -4,760 | -7.21 |
| 2001 | 59,297 | -19,088 | -32.19 | -4,765 | -8.04 | 29,708 | 50.10 | -13,133 | -22.15 | -5,608 | -9.45 |
| 2002 | 52,559 | -16,188 | -30.80 | -5,302 | -10.09 | 34,205 | 65.08 | -18,830 | -35.83 | -6,792 | -12.92 |
| 2003 | 44,965 | -13,036 | -28.99 | -5,847 | -13.00 | 39,171 | 87.11 | -25,521 | -56.76 | -8,599 | -20.01 |
| 2004 | 36,650 | -8,628 | -23.54 | -6,405 | -17.48 | 43,808 | 119.53 | -33,877 | -92.43 | -11,869 | -32.38 |

# CONCLUSIONS AND RECOMMENDATIONS

Melons have been traditional export products of Mexico and an important source of foreign currency and rural employment. Mexico has been the dominant foreign source of melons for the U.S. market. However, Mexico's share of the U.S. cantaloupe, honeydew, and watermelon markets has significantly declined in recent years. Domestic and trade policies of involved governments and adoption of improved melon production technologies have been cited as forces behind Mexico's declining role in the U.S. market. However, there are no previous studies that empirically identify specific variables that determine melon trade levels between Mexico, U.S., and CBI countries. A better understanding of forces that impact melon trade is needed so the Mexican government and producer organizations can help Mexico farmers improve their economic well-being by increasing production and exports to world markets.

This study proposed a comprehensive analysis of Mexico, U.S., and Caribbean countries melon markets to better understand the effects of important economic variables on melon production, quantities traded, prices, and consumption. Specific objectives pursued in this study included: (1) describe and analyze the structure and characteristics of the melon industries in Mexico, the United States, and other competing countries; (2) specify and estimate an econometric model that incorporates Mexico's melon sector and its involvement in the domestic and international markets; (3) evaluate the effects of exchange rates, NAFTA melon provisions, melon production technology, income growth, agricultural labor cost, and other economic factors on Mexico-U.S.-CBI countries melon trade with use of the developed model; and (4) make policy recommendations based on the study results that could be used by the Mexico melon sector to increase production, exports, and market share in foreign markets.

The first objective was achieved in the Melon Industry Characteristics section by presenting and analyzing the characteristics of Mexico, U.S., and CBI countries melon industries and by providing the basis for the conceptual model subsequently defined. Among the most important conclusions of this section were:

(1) The Mexican melon industry is involved in international markets during the Fall-Winter season (December-May), thus, the need to focus the melon study on this period. During the Mexican Spring-Summer season (June-November) the melon industry focuses on the domestic market;

(2) Changes in annual melon production in Mexico are explained by changes in harvested area. The annual rates of growth in melon production are very similar to rates of growth in harvested melon area. Melon yields in Mexico have contributed little to changes in Mexican melon production since the annual growth rate in melon yields has been near zero.

(3) Melon production and export activities in Mexico face a number of problems that affect not only the profitability of melon production, but also its competitive position in international markets. Some of these problems are: (a) low growth rates for melon yields; (b) small farmers limited access to credit; (c) high incidence of insects and virus; (d) technology dependence; (e) increasing competition in international markets; and (f) international trade protectionism.

(4) The USDA's monthly and weekly cantaloupe and honeydew shipment data show Mexican imports complement U.S. shipments in the December-May period but compete with U.S. imports from CBI countries. In contrast, watermelon imports from Mexico compete with U.S. shipments for market share in the December-May period. In general, Mexico's share of the U.S. cantaloupe, honeydew and watermelon markets has significantly declined in recent years;

(5) Cantaloupe and honeydew melon consumption in the U.S. showed an upward trend during the December-May period while the growth in watermelon consumption was comparatively flat.

(6) Among the CBI countries, the primary suppliers of melons to the United States in December-May are Costa Rica, Guatemala, and Honduras. Melon industries in these countries have grown steadily in recent years because of high international demand, favorable prices, and the introduction of high levels of production technology.

The Conceptual Model of Melon Trade section and the Empirical Results section achieved the second research objective by formulating and estimating a model representing Mexico-U.S.-CBI countries melon trade. In the Conceptual Model of Melon Trade section, alternative approaches to modeling international agricultural trade were considered. The selected approach, a partial equilibrium framework, is based on neoclassical trade theory and is consistent with study objectives and commodity market characteristics. Key variables influencing melon trade such as tariffs, exchange rates, agricultural labor cost, yields, and income growth were incorporated and analyzed in the theoretical model.

The estimated model (Empirical Results section) was similar to the specified model presented in the Conceptual Model of Melon Trade section. However, because of limited melon production and consumption data for Mexican honeydew and CBI countries the appropriate demand and supply relationships could not be estimated. Thus, export supply (excess supply) equations were specified and estimated rather than supply and demand equations for Mexican honeydew and for cantaloupe and honeydew in CBI countries. Alternative techniques to estimate model parameters were discussed. OLS, 2SLS, and 3SLS were considered. However, because of simultaneity and possible correlation among error terms across equations, the 3SLS technique was selected. Regression results indicated a good fit for most equations with adjusted $R^2$ statistics ranging from 0.35 to 0.94. Forty-four out of seventy estimated coefficients were statistically significant at the 0.05 level. All signs of estimated coefficients were consistent with trade theory.

Elasticity estimates were, in general, in the expected range and in agreement with the results of previous studies. The calculated Durbin-Watson statistics showed no evidence of autocorrelation in the estimated equations. Simulation statistics, including RMS% error, U-Theil coefficient, and MSE decomposition, indicated a good performance of the model in tracking the historical data. Estimated dynamic multipliers showed the Mexico-U.S.-CBI countries trade model was stable.

The third objective was achieved in the Simulation Analysis section when the estimated and validated model was used to evaluate and forecast the effects on Mexican melon trade of: (1) the 1994-1995 peso devaluation, (2) reductions in U.S. melon tariffs (NAFTA), (3) increases in Mexican per capita income, (4) increases in Mexican melon yields, and (5) increases in the cost of Mexican agricultural labor. The baseline forecast showed Mexican melon exports to the U.S. to continue declining through 2004. Further, Mexican producers share of the U.S. melon market declines while the share supplied by producers in the U.S. and CBI countries increases. During the 1970s and early 1980s, Mexico was the dominant source of cantaloupe imports by the United States: during this period, Mexico supplied more than 90% of total U.S. imports. However, after the early 1980s, the Mexican share commenced to decline and by 1993-1994, Mexico supplied about 30% of the U.S. market in the Fall-Winter. Over the forecast period (1996-2004), the Mexican share of the U.S. cantaloupe market follows a declining trend and by 2004, Mexico's share is projected to be only 16%. In contrast, CBI countries' share, in particular, the share supplied by Honduras, Costa Rica, and Guatemala is projected to increase from 64% in 1996 to 83% in 2004. For honeydew, Mexico's share of the U.S. market declined from about 60% in early 1970s to 37% in 1994. For the forecast period (1996-2004), Mexico's projected share continues to decline from 40% in 1996 to 33% in 2004. On the other hand, CBI countries' share is projected to increase from 56% in 1996 to 63% in 2004. For watermelon, the U.S. Fall-Winter market is shared between U.S. suppliers and imports from Mexico. Mexico's share of the U.S. watermelon market declined from an average of 40% in early 1970s to 25% in 1994. Over the forecasting period (1996-2004), Mexico's market share declined from 30% in 1996 to 13% in 2004.

Analysis of the various scenarios shows, in the short run, the most favorable impact on Mexican melon exports results from the Mexican peso devaluation whereas, in the long run, the most favorable impact is caused by improvements in Mexican melon yields. Increases in the cost of Mexican agricultural labor and growth in Mexican per capita income have unfavorable long-run impacts on Mexico's melon exports but the effect is of a lower magnitude than an increase in melon yields. In general, the tariff-reducing provisions of NAFTA have a comparatively modest influence on Mexican melon exports.

Now, following study objectives, the next step is to make policy recommendations (objective 4) that might be used by the Mexican melon sector to increase market share and profitability of export sales to the U.S. and other foreign buyers. Policy recommendations should be based on study results, be plausible, and have no negative effects on other economic sectors. How can Mexico increase melon exports to foreign markets? According to study results, melon exports can be increased by one or more of the following strategies. They are: (1) eliminating U.S. tariffs, (2) devaluating the Mexican currency, (3) increasing Mexican yields, (4) reducing Mexican agricultural labor cost, and/or (5) reducing Mexican economic growth. Elimination of tariffs is now in process under the provisions of the NAFTA. Modest increases in Mexican exports are expected from the reduction in U.S. melon tariffs.

Devaluating the Mexican peso would enhance melon exports but the exchange rate is a national government policy decision and not a decision for a particular sector of the economy. Determination of a specific exchange rate is related to the economy's balance of payments and associated trade balance. So, a devaluation can not be recommended as a unilateral policy to promote melon exports, unless overvaluation of the Mexican peso were generating negative effects for the Mexican melon export sector.

Reducing real agricultural labor costs will also increase Mexican melon exports. However, this policy is not plausible since labor unions would not allow a reduction in wages. Further, this is not politically acceptable for Mexican society since agricultural workers now live at poverty levels. Additionally, a reduction in wage levels would reduce aggregate demand reducing the market for domestic output and imports. A reduction in Mexican economic growth would increase Mexican melon exports since some proportion of the melon production consumed in Mexico would be exported because of reduced domestic demand. However, this policy is unacceptable because it contradicts the Mexican economic policy which is to pursue economic growth and a higher employment rate.

To increase melon yields is another way to promote Mexican melon exports. Higher yields increase Mexican supply and reduce the per unit costs of production, thus improving the competitive position of Mexican melons in United States markets. Those countries with high yields have more opportunities to increase their export supply. As shown by this study, improvements in Mexican melon yields have the greatest long-run impact on Mexican melon exports. Based on the findings of this study, policy recommendations should focus on ways to improve melon yields and to solve melon industry problems related in the Melon Industry Characteristics section. Policy recommendations to Mexican government and producer organizations are as follows:

(1) Promote melon research in order to increase production yields and reduce per unit production costs, thus improving Mexican producers competitive position in international markets. This can be done through increased funding of research programs of the National Institute of Agricultural Research (INIFAP), a government research agency which includes more than 50 experimental stations throughout Mexico;

(2) Increase extension programs in order to communicate agricultural research results to producers that operate medium and small farms. Agricultural research results (technology package) usually include information regarding (a) optimal planting dates and methods, (b) optimal fertilization levels, (c) appropriate variety/hybrid seeds, (d) irrigation timing, (e) pest control methods and products and (f) cultural practices. Extension programs should also include farmer education regarding the importance of productivity when competing in a free trade environment and economic principles associated with optimal input usage;

(3) Make agricultural credit more accessible to small and medium-sized farm units. Usually low yields are related to a lack of credit since many farmers have no resources to purchase necessary inputs to obtain optimal yields and quality of product;

(4) Promote foreign market diversification since the Mexican melon export sector is highly dependent on trade policies and market conditions of one country, the United States;

(5) Promote increased demand for Mexican melons in foreign markets through promotional campaigns directed by Mexican embassies and consulates and exporters; and

(6) Implement information systems so that Mexican melon farmers have information regarding government programs intended to stimulate exports, and basic market information such as prices, buyers, quality standards, and other market requirements of foreign and domestic markets.

## Limitations of the Study

Modeling the Mexico-U.S.-CBI countries melon trade has not been a straightforward process. Lack of literature and unavailable data made the melon study a difficult task. Some other limitations or shortcomings of this study should be noted.

First, modest modifications were made to the conceptual model presented in the Conceptual Model of Melon Trade section because empirical estimation of selected economic relationships was not possible because of the unavailability of data. In particular, no data were available on production and consumption of Mexican honeydew and melon consumption in CBI countries. Because of this problem, some changes in model specifications were required. In particular, export supply (excess supply) equations were specified and estimated instead of supply and demand equations for Mexican honeydew and cantaloupe and honeydew in CBI countries.

Second, as noted in the Conceptual Model of Melon Trade section, it was necessary to estimate the econometric model in blocks rather than a complete model because of the unavailability of adequate historical data. Thus, some concern regarding the presence of bias in the parameter estimates. The validation effort suggested, however, that the compromise in parameter estimation was not significant since the simulation model was able to successfully track historical data and generate acceptable validation statistics.

Third, for simplicity, the developed model assumed that macroeconomic variables and production technology were exogenous. These assumptions are quite standard in agricultural trade models. However, a more extensive model that endogenized these variables would have increased the ability to analyze the relationship between these variables and levels of trade, production, consumption, and prices.

Fourth, supply specifications assumed naive expectations and did not include variables reported to be important to Mexico’s melon production, such as credit availability, production subsidies, and other agricultural policies affecting the Mexican melon sector. Unavailability of reliable data has been the major obstacle to including additional variables.

Fifth, the possible existence of market power in Mexico-U.S.-CBI countries melon trade was not addressed. Our assumption of perfect competitive markets was based on melon market characteristics discussed in the Melon Industry Characteristics section. Our assumption, that no market power is exerted in melon markets was not tested.

Sixth, recent trends in the food industry emphasize the importance of product quality. In particular, melon size is important to consumers with price premiums often paid for specific melon sizes. Although quality might be important in explaining some price variations and demand trends, appropriate data were not available to incorporate quality into our analysis.

Seventh, weather conditions such as floods, droughts, freezes and other special events like short-run shortages of credit, and partial or total crop loss from pest attacks have important effects on production, trade, and prices. These variables are very difficult to quantify and more difficult to predict. Therefore, those conditions are considered in the model by using dummy variables for years in which clear distortions in trends occur. These conditions are not considered in the forecast analysis.

Eighth, as stated in study objectives, the melon trade model was designed to determine how Mexico might increase international competitiveness in its melon sector. This study was not designed to answer the normative question as to what Mexico should produce for the export sector. To answer this question a different quantitative tool such as mathematical programming would probably have been more appropriate.

Finally, forecasting and simulation analysis have been performed using reasonable assumptions about the future trend of exogenous variables. Although well recognized forecasting sources have been used, forecast results are dependent on these assumptions. Additional scenarios and combinations of scenarios could have been evaluated for the exogenous variables in the simulation analysis; however, only those variables and scenarios that were necessary to meet study objectives were evaluated.

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## APPENDIX

**Table A.1. Baseline Forecast Results: Cantaloupe, Watermelon, and Honeydew, Additional[1] Endogenous Variables, 1996-2004**

| Year | Mexican Farm Price (1990=100) (pesos/kg) | Mexican Quantity Supplied (ton) | Mexican Consumer Price (1990=100) (pesos/kg) | U.S. Consumer Price (1990=100) (dol/lb) | U.S. Aggregate Consumption (1,000 lb.) |
|---|---|---|---|---|---|
| | | | Cantaloupe | | |
| 1996 | 0.63 | 289,449 | 1.230 | 0.330 | 852,738 |
| 1997 | 0.61 | 290,226 | 1.224 | 0.304 | 894,661 |
| 1998 | 0.60 | 291,527 | 1.220 | 0.279 | 940,289 |
| 1999 | 0.58 | 293,382 | 1.216 | 0.257 | 986,124 |
| 2000 | 0.57 | 295,148 | 1.212 | 0.236 | 1,030,131 |
| 2001 | 0.56 | 296,847 | 1.207 | 0.216 | 1,074,406 |
| 2002 | 0.54 | 298,467 | 1.203 | 0.197 | 1,118,909 |
| 2003 | 0.53 | 300,099 | 1.198 | 0.180 | 1,163,676 |
| 2004 | 0.51 | 301,777 | 1.193 | 0.164 | 1,210,933 |
| | | | Watermelon | | |
| 1996 | 0.58 | 369,437 | 1.188 | 0.253 | 738,295 |
| 1997 | 0.57 | 364,747 | 1.186 | 0.258 | 718,380 |
| 1998 | 0.58 | 367,043 | 1.193 | 0.259 | 725,571 |
| 1999 | 0.58 | 371,354 | 1.196 | 0.259 | 732,641 |
| 2000 | 0.58 | 374,980 | 1.197 | 0.260 | 739,693 |
| 2001 | 0.58 | 378,176 | 1.198 | 0.261 | 738,300 |
| 2002 | 0.58 | 381,368 | 1.199 | 0.262 | 739,168 |
| 2003 | 0.59 | 384,478 | 1.200 | 0.264 | 735,768 |
| 2004 | 0.59 | 387,871 | 1.196 | 0.266 | 732,864 |

(continued on next page)

**Table A.1. Continued**

| Year | Mexican Farm Price (1990=100) (pesos/lb) | Mexican Exports to U.S. (1,000 lb) | CBI Farm Price (1990=100) (index) | U.S. Consumer Price (1990=100) (dol/lb) | U.S. Aggregate Consumption (1,000 lb.) |
|---|---|---|---|---|---|
| | | | Honeydew | | |
| 1996 | 0.39 | 119,398 | 2.12 | 0.303 | 352,836 |
| 1997 | 0.38 | 112,037 | 2.21 | 0.305 | 358,333 |
| 1998 | 0.39 | 110,165 | 2.29 | 0.303 | 368,247 |
| 1999 | 0.38 | 110,228 | 2.38 | 0.300 | 379,403 |
| 2000 | 0.38 | 109,544 | 2.46 | 0.298 | 389,528 |
| 2001 | 0.38 | 108,237 | 2.55 | 0.296 | 399,186 |
| 2002 | 0.37 | 106,753 | 2.64 | 0.295 | 408,777 |
| 2003 | 0.37 | 105,315 | 2.75 | 0.293 | 418,535 |
| 2004 | 0.36 | 103,746 | 2.84 | 0.292 | 428,758 |

[1] This table complements table 6.2.
Note: 1 ton = 2,204 lb