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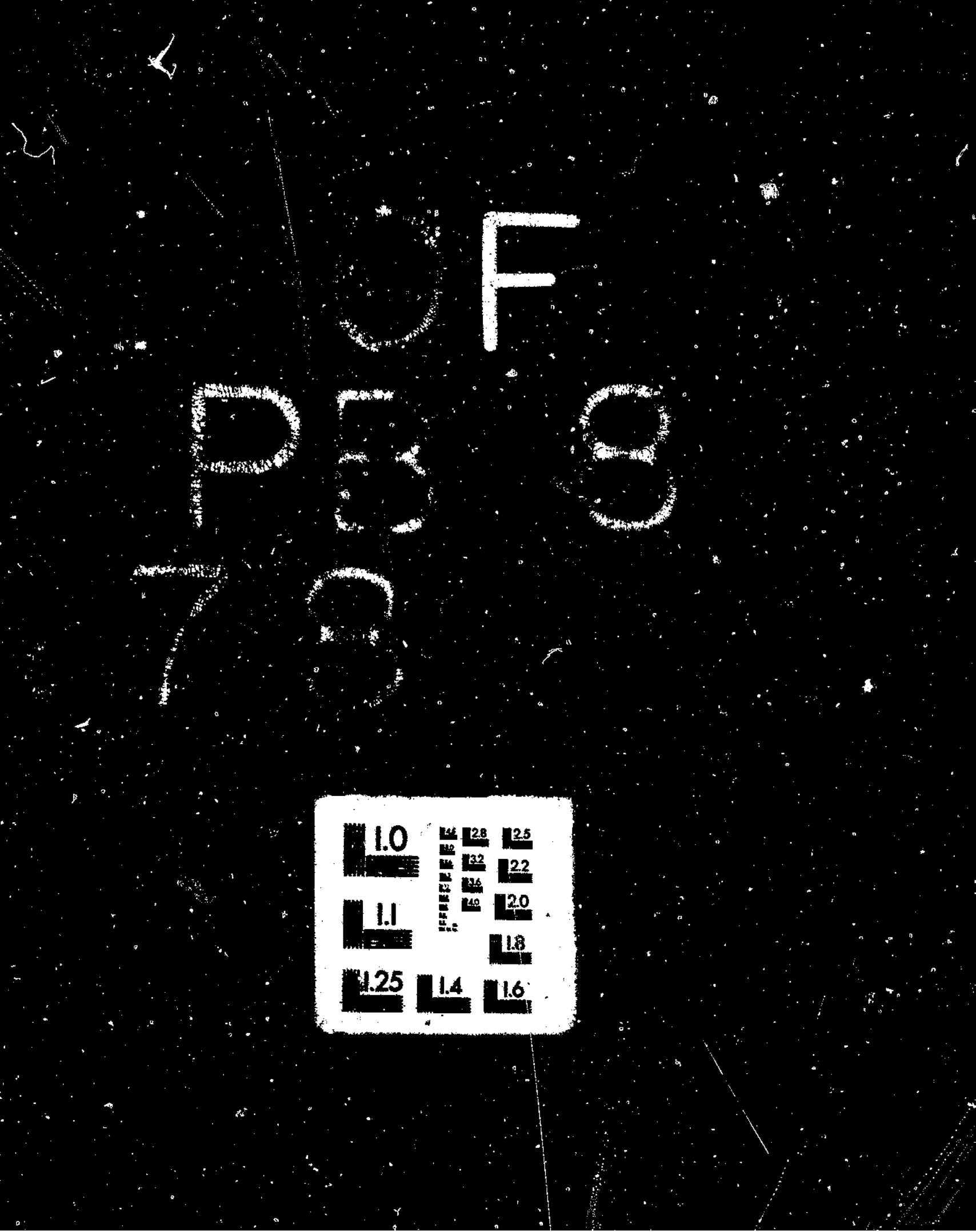
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U.S. Winter Fresh Tomato Price and Quality Projections for 1985

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U.S. WINTER FRESH TOMATO PRICE AND QUANTITY PROJECTIONS FOR 1985

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16. Abstract (Limit: 200 words)

New Caribbean-area supplies of winter fresh tomatoes exported to U.S. markets would increase total supplies, raise per capita consumption, lower gross income for both Florida and Mexican growers, and lower fresh tomato retail prices for consumers by 1985. Florida's projected share of the U.S. fresh tomato market rises from 49 percent in 1979 to 51 percent by 1985, while Mexico's share declines from 49 to 46 percent. This report projects winter fresh tomato prices, consumption, and supplies to 1985 under most likely, rapid inflation, and slower inflation situations, and estimates the effects of new imports and raising and lowering import duties on these projections.

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Forecasting	Marketing	Winter

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Exports	Markets	
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SUMMARY

New Caribbean-area supplies of winter fresh tomatoes exported to the United States would increase total supplies, raise per capita consumption, lower gross income to both Florida and Mexico growers, and lower fresh tomato retail prices. This report reviews U.S. winter fresh tomato trade, and estimates the effects of imports and of raising and lowering import duties on projected 1985 tomato prices, consumption, and supplies under three possible economic situations.

U.S. per capita consumption of fresh tomatoes during the January to May period should rise about 0.05 pounds per year, from 5.4 pounds in 1979 to about 5.7 pounds in 1985. Total U.S. consumption of winter fresh tomatoes should increase from 1,173 million pounds in 1979 to about 1,295 million pounds in 1985.

Florida's share of the winter fresh tomato market should rise from 49 percent in 1979 to 51 percent in 1985, while Mexico's share may decline from 49 percent to 46 percent.

Duty changes affect Mexican producer prices more than either Florida producer prices or U.S. retail prices. Doubling the duty raises projected U.S. retail prices about 0.3 cent per pound by 1985, while reducing Mexican growers' net prices by 1.7 cents per pound. Florida growers would receive 0.2 cent per pound more for their tomtoes under such a change.

Doubling the tomato import duty would also cause a small decline in per capita expenditures on fresh tomatoes during the January to May period because lower per capita consumption would more than offset the increase in average retail prices.

New Caribbean-area supplies equivalent to pre-1961 Cuban exports to the United States would raise total U.S. supplies about 25 million pounds, increasing per capita consumption in 1985 by 0.1 pound. Grower prices would fall 0.4 cent per pound in Florida and Mexico, and U.S. average retail prices would fall 0.7 cent per pound by 1985 below expected prices.

U.S. Winter Fresh Tomato Price and Quantity Projections for 1985

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INTRODUCTION

Florida and Mexico supply about two-thirds of all the fresh tomatoes consumed in the United States from October to July. California, Texas, South Carolina, and several minor supply areas producing late in the fall and again in the spring supply the other third. This study assesses future trends in the U.S. winter fresh tomato industry, the effects of introducing Caribbean-area tomato supplies into U.S. markets, and the effects of changes in the U.S. duty for imported tomatoes on fresh tomato supplies, consumption, and prices.

Prior to 1961, Cuba supplied fresh tomatoes to the U.S. market during the winter months, and in recent years the issue of resuming Cuban trade has arisen. 1/ Mexico has shipped fresh tomatoes to the United States for many years. Mexico's exports increased sharply in recent years, rising from 100 million pounds in 1957 to over 800 million during the 1978/79 season, and surpassing Florida as the major supplier during some seasons. These increased imports and the resulting economic pressures on U.S. producers have raised the issue of a higher duty on imported tomatoes.

Tomato Trade Issues

This study considers the economic aspects of two trade issues important to the winter fresh tomato industry: 1) should the United States change the tariff on winter fresh tomatoes imported from Mexico and 2) should the United States resume trade with Cuba in winter fresh vegetables?

Fresh fruits and vegetables imported into the United States have been subject to a tariff since 1930. The tariff on fresh tomatoes imported from Mexico has remained unchanged since 1951, when the rate was set at 1.5 cents per pound between November 15 and the last day of the following February, and 2.1 cents per pound for those entering the United States between March 1 and July 14 inclusive or during the period September 1 to

1/ The Castro government assumed power in Cuba in January 1959, but Cuban imports of fresh vegetables to the United States continued strong through the 1960 season. The winter vegetable trade had declined precipitously during the 1961 season and stopped by 1962. All U.S. imports from Cuba ceased with the February 1962 embargo on Cuban trade.

November 14 inclusive in any year. Tomatoes sold for about 9 cents per pound at the farm in Florida in 1951, and the duty added 17 to 23 percent to the costs of supplying imported tomatoes. During the 1978/79 winter season, tomatoes sold for about 22 cents per pound at the farm level, and the duty added nearly 7 to 10 percent to the cost of tomatoes from Mexico. The 1.5- to 2.1-cent duty provided less protection to domestic growers in 1978/79 than in 1951 when the present tariff structure was established. In real terms, the duty declined as other costs rose.

Should the duty be raised to provide protection to domestic producers similar to that in 1951 when the current structure was established? Would added duties cause higher tomato prices, and work contrary to current government policies to control food price inflation? Should the United States reduce duties to encourage importing of Mexican tomatoes, and thereby hold down retail price increases? Would such actions reduce the profitability of tomatoes, driving U.S. producers out of business? Should the United States reduce duties to encourage the exporting of more winter fresh vegetables to the United States as a tool for economic development in Mexico, thereby increasing jobs for Mexican farmworkers and reducing the need for Mexican nationals to migrate illegally to the United States in search of employment? This study will provide economic information useful to policymakers in deciding such questions.

Several unanswered economic questions relate to changing the duty on fresh tomatoes. How would a duty change affect the supplies entering the United States from Mexico? What effects would it have on U.S. production, grower prices, retail prices, per capita consumption, and U.S. Government revenues?

Prior to 1961, Cuba supplied fresh tomatoes to the United States during the winter months. Cuba might again ship fresh tomatoes to the U.S. market if the political climate permits. Other Caribbean-area countries, too, might become new sources of fresh tomatoes for the U.S. market with impacts on the present industry similar to those of new Cuban supplies. Economic questions similar to the duty question need answering to assess the resumption of Cuban trade.

Methodology

The analysis consists of projecting future production, consumption, and prices for winter fresh tomatoes with a set of six equations. The equations, estimated from historical price, quantity, income, and other data, represent Florida supply, Mexican export supply, U.S. average grower prices, Florida grower prices, Mexican grower prices, and U.S. average retail prices. Projecting year by year, the equations simulated Florida and Mexican production and grower and retail prices for

1985 under several different economic scenarios with respect to input price inflation and U.S. per capita income growth. One scenario, defined as the "most likely," represented median estimates of input price inflation and income growth. A second, the "rapid inflation" scenario, represented much higher rates of growth in input costs and per capita income. The "slower inflation" scenario represented a more moderate rate of growth in input prices and per capita income over the next 5 years.

This study defines the winter season as the January to May period. Although the Florida season typically extends from November through June and the Mexican season from December through May, the most intense competition between these two areas occurs during January to May. In addition, price data needed for the analysis were more complete for the January through May months than for other months.

Additional 1985 quantity and price projections were developed with the most likely scenario assumptions, assuming 1) elimination of the duty on tomatoes imported from Mexico and 2) doubling of the duty. Differences between these new 1985 projections and the most likely scenario projections represented the effects of duty changes on producers and consumers.

A similar analysis provided estimates of the effect of new Caribbean area tomato imports on the U.S. market. Most likely scenario projections for 1985 were developed, first assuming that new fresh tomato supplies equal to normal pre-1961 Cuban tomato exports entered the U.S. marketing channel each year from 1980-85, and then assuming that double this amount of new supplies entered the U.S. market. 2/ Differences between the 1985 projections of new supplies and the most likely scenario projections represented the potential effect of resuming trade with Cuba. In all cases, the analysis included making estimates of the effects of policy changes on per capita consumption, retail and grower prices, and total supplies from the two major production areas.

Related Studies

A series of studies have examined Florida's and Mexico's cost competitive positions in winter fresh vegetable production, the first during the 1967/68 and 1970/71 seasons, the second during the 1973/74 season, and the most recent during the 1978/79

2/ The analysis pertains equally to new supplies from the reestablishment of commercial trade with Cuba, or from the introduction of similar supplies from other Caribbean or Latin American production areas.

season (14, 20, 24). 3/ All three studies indicate the importance of tomato duties in determining the cost competitive position of Florida producers. During the 1967/68 season, the duty on Mexican tomatoes amounted to about 20 percent of total costs; that percentage also held during the 1970/71 season. Mexico held a cost advantage over Florida vine-ripe production during both seasons, but not over Florida mature green production. Although Florida's mature green tomato production had a cost advantage over Florida vine-ripe production during both seasons, the duty on Mexican tomatoes provided the cost advantage during the 1970/71 season, and its removal would have about equalized costs in the two areas.

In the 1973/74 study, costs had risen in both Florida and Mexico, and the duty accounted for only 12 percent of total costs for supplying Mexican-produced vine-ripe tomatoes to the United States. Mexican producers, however, held a total cost advantage over Florida producers in both vine-ripe and mature green production, even with the duty included in their costs.

By the 1978/79 season, relative costs in Florida and Mexico had begun to change. The duty now accounted for only 10 percent of the costs for supplying Mexican-produced vine-ripe tomatoes; Florida's mid-winter mature green tomato production and Mexico's vine-ripe tomato production costs about the same, Florida having only a slight advantage. The duty on Mexico's imports, however, provided the small margin of advantage enjoyed by Florida producers. Elimination of the duty would have resulted in the cost advantage shifting to Mexico's favor.

A 1971 study (8) on the impacts of changing the U.S. duty on Mexican winter fresh tomatoes concluded that Mexico held a competitive advantage in vine-ripe tomatoes and that Florida vine-ripe production would decline while Mexican vine-ripe production would expand. Duty changes would affect Mexican producers more than U.S. consumers, the study concluded. For example, two-thirds of any duty reduction would go to Mexican producers in the form of higher prices, and one-third would go to U.S. consumers in the form of lower retail prices. The author estimated that elimination of duties would result in a net increase in consumption by U.S. consumers of about 12.1 million cartons (242 million pounds).

A 1979 study (23) on the effects of new Caribbean-area tomato and cucumber supplies on the U.S. industry concluded that additional tomato supplies equivalent to pre-1961 Cuban shipments

3/ Underscored numbers in parentheses refer to literature listed in the references section at the end of this report.

would represent a relatively small increase, about 2 percent, to the present tomato market. The additional supplies would benefit U.S. consumers and be detrimental to present producers both in Florida and Mexico, with estimated equilibrium wholesale prices falling by a maximum of 27 cents per hundredweight during some winter months.

THE FRESH TOMATO SECTOR

Both Florida and Mexico supply winter fresh tomatoes to the U.S. market, providing about 5 pounds per capita during the January to May period. Cuba, too, had been a supplier prior to 1961. The import duty on fresh tomatoes is becoming less important as a cost in importing tomatoes as the ad valorem equivalent duty declines with the rising general price level.

Production and Grower Prices

Florida and Mexico supplied most of the winter fresh tomatoes, accounting for nearly three-fourths of reported movements from October to July (table 1). During the 1978/79 season, Mexico shipped the largest volume during February and March, and Florida supplied the largest volumes early in the winter seasons and again during April and May (table 2). Both areas shipped about the same volumes during January and April.

Florida and Mexico almost exclusively supply the U.S. market from January to May, providing between 95 and 98 percent of the total volume (table 3). Florida had made substantial gains in its share of the total U.S. market since the early seventies. From 302 million pounds (33 percent of the total January to May supply) in 1970, Florida's production increased to 628 million pounds in 1976 (53 percent of total supply). Florida's production fell during 1977 to 398 million pounds (37 percent of the January to May supply) due to a disastrous freeze that year which killed almost all tomato plants in the State, and relegated Florida to a minor supplier status for 3 months during the middle of the season. However, by 1978, Florida again produced at its pre-1977 level, and its share returned to 46 percent of the total January to May supply. Mexico, too, increased its production during 1977 and 1978, apparently due to a devaluation of the Mexican peso and its record 1977 season. 4/ By 1979, both Florida and Mexico shipped about 600 million

4/ Devaluation of a country's currency raises the price it receives for its exports relative to the cost of domestically produced inputs, and should therefore aid that country's cost competitive advantage in exporting its products. The Mexican peso was permitted to seek a market-determined rate of exchange in August 1976, being released from a 12.5:1 fixed exchange rate with the U.S. dollar. It soon established a new level of about 22 to 23 pesos per dollar, an effective devaluation of about 85 percent.

Table 1--Total recorded movement of winter fresh tomatoes from Florida and Mexico

Season	Volume 1/			Percentage of total		
	Florida	Other United States	Mexico	Florida	Other United States	Mexico
	Million pounds			Percent		
1967/68	663	514	402	42	33	25
1968/69	552	584	548	33	35	32
1969/70	417	638	710	24	36	40
1970/71	533	552	645	31	32	37
1971/72	589	625	641	32	34	34
1972/73	598	513	819	31	27	42
1973/74	599	650	664	31	34	35
1974/75	704	484	620	39	27	34
1975/76	758	634	671	37	31	32
1976/77	622	570	828	31	28	41
1977/78	722	698	855	32	31	37
1978/79	875	589	739	40	27	33

1/ Total for October through July.

Source: (16).

Table 2--Total recorded movement of tomatoes from Florida, California, other U.S. areas, and Mexico by month, 1978/79 season

Month	Florida	California	Other United States	Mexico	Total
	Million pounds				
October	8.6	154.4	4.7	11.7	179.4
November	92.9	60.4	1.8	12.4	167.5
December	165.0	14.4	8.2	23.2	210.8
January	94.5	1.0	1.0	93.2	189.7
February	55.5	N.R.	.5	161.5	217.5
March	77.1	.4	.2	185.6	263.3
April	108.9	N.R.	.2	126.3	235.4
May	184.6	.9	3.0	88.7	277.2
June	85.8	81.5	113.6	29.8	310.7
July	3.9	118.4	68.7	4.2	195.2

N.R. = None reported.

Sources: (3, 15, 16).

Table 3--Fresh tomatoes: Production by major sources of supply, January to May, 1970-79

Year	Florida	Other United States	Imports, Mexico 1/	Total	Percentage total supply	
					Florida	Mexico
	Million pounds				Percent	
1970	302	67	559	928	33	60
1971	352	46	499	897	39	56
1972	433	55	514	1,002	43	51
1973	417	31	614	1,062	39	58
1974	479	37	514	1,030	47	50
1975	492	38	422	952	52	44
1976	628	34	520	1,182	53	44
1977	398	39	650	1,087	37	60
1978	623	28	702	1,353	46	52
1979	603	22	600	1,225	49	49

1/ Mostly exports from Mexico, but includes small amounts of tomatoes from Caribbean countries.

Sources: (1, 3, 10, 12).

pounds of tomatoes during January to May and accounted for 49 percent each of total supplies. Shipments data for the 1979/80 season indicate that Florida shipments exceeded those for a year earlier, while Mexico's shipments fell short of the year earlier levels (3).

Prices which growers received for fresh tomatoes in Florida and Mexico rose during 1970-79 along with the rising general price level. The Florida price rose from 19.5 cents to 32.9 cents per pound, and the Mexican price rose from 16.6 cents to 27.6 cents per pound (table 4). Deflating the current dollar price by the Consumer Price Index to constant 1970 dollars removes the effects of price level increases on tomato prices and shows that in real terms, grower prices actually fell during 1970-79--the Florida price from 19.5 cents to 17.6 cents per pound, and the Mexican price from 16.6 cents to 14.7 cents per pound.

During most years, Florida's grower price averages 2 to 3 cents per pound higher than the Mexican price, 1977 being an exception. During that season, Florida had very few tomatoes to market during the high-price period following the killing

Table 4--Fresh tomatoes: Grower average prices in Florida and Mexico, January to May, 1970-79

Year	Current value 1/		Constant 1970 value	
	Florida	Mexico	Florida	Mexico
	Cents per pound			
1970	19.5	16.6	19.5	16.6
1971	21.6	21.2	20.7	20.3
1972	20.0	17.6	18.6	16.3
1973	21.6	15.1	18.9	13.2
1974	27.0	22.9	21.3	18.0
1975	27.1	21.9	19.6	15.8
1976	24.3	23.3	16.6	15.9
1977	29.5	31.1	18.9	19.9
1978	29.1	25.3	17.3	15.1
1979	32.9	27.6	17.6	14.7

1/ Florida price is for large size mature greens - 85 percent or more U.S. No. 1 quality in 30-pound cartons f.o.b. south Florida shipping points. The Mexican price is for extra large vine-ripe--generally good quality and condition, in two-layer flats f.o.b. Nogales, Ariz., duty and crossing charges paid.

Source: (16).

freeze, while its large volume supplies later in the season coincided with low prices. Mexico shipped large volumes during high-price periods that year and smaller volumes during low-price periods.

Consumption and Retail Prices

Fresh tomatoes account for a large and growing share of all fresh vegetables consumed in the United States. Annual per capita consumption remained relatively constant at 12 to 14 pounds over the past 30 years. While consumption of other fresh vegetables declined, fresh tomatoes' share of all fresh vegetables rose (table 5). During 1947-49, tomatoes accounted for 11.5 percent of all fresh vegetable consumption, while by the 1977-79 period, the share for tomatoes had increased to 12.7 percent. Retail prices and consumer expenditures for fresh tomatoes, too, had risen along with the general price level over the 30-year period. During 1977-79, annual per capita expenditures for fresh tomatoes amounted to $9.38.

U.S. consumers are eating more fresh tomatoes during the January to May period. Consumers used an average of 4.5 pounds of fresh

Table 5--Fresh vegetables and tomatoes: U.S. civilian per capita consumption, retail prices, and expenditures

Period	U.S. civilian per capita consumption				
	All fresh vegetables	Fresh tomatoes	Fresh tomatoes as percentage of all vegetables	Average retail price of fresh tomatoes	Annual per capita expenditure for fresh tomatoes 1/
	----Pounds----		Percent	Cents/lb.	Dollars
1947-49	120.5	13.8	11.5	N.A.	N.A.
1957-59	104.1	12.4	11.9	30.4	3.77
1967-69	99.1	12.1	12.2	39.2	4.74
1977-79	101.1	12.9	12.7	72.7	9.38

N.A. = Not available.

1/ Estimated as average retail price times per capita consumption.

Sources: (10, 13).

tomatoes per capita during January to May 1970, while by 1979 that figure rose to 5.4 pounds (table 6). This increased consumption probably reflects in part the rising popularity of salad bars in many restaurants.

Retail prices for tomatoes almost doubled during the 10 years 1970-79, from 45 cents per pound to 81 cents. Deflating retail prices by the Consumer Price Index to remove the effects of inflation indicates the retail price in 1979 had changed very little since 1970, from 43.5 cents per pound in the latter year versus 45 cents in the former. Consumer expenditures for fresh tomatoes rose over the 10 years, both in current dollar and constant dollar terms. Real expenditures measured in constant 1970 dollars rose from $2.03 per person to $2.35, due mainly to the rise in per capita consumption.

Import Duties

All fresh tomatoes imported to the United States from Mexico are subject to an import duty. For those imported between March 1 and July 14, inclusive, and between September 1 and November 14 inclusive, the duty is 2.1 cents per pounds, while a 1.5-cent duty is charged on tomatoes entering the United States between July 15 and August 31, and November 15 to the last day of the following February, inclusive (17). Both levels apply at one time or another to tomatoes imported during the study period. Those entering during January and February are assessed at 1.5 cents per pound, while those entering during March, April, and May incur the 2.1-cent rate.

Table 6--U.S. fresh tomato consumption and expenditures, January to May, 1970-79

Year	Per capita consumption	Average retail prices		Expenditures on fresh tomatoes	
		Current dollars	Constant 1970 dollars 1/	Current dollars	Constant 1970 dollars 1/
	Pounds	--Cents per pound--		----Dollars----	
1970	4.5	45.1	45.1	2.03	2.03
1971	4.2	48.6	46.6	2.04	1.96
1972	4.7	46.8	43.4	2.20	2.04
1973	4.9	50.1	43.8	2.46	2.15
1974	4.7	57.5	45.3	2.70	2.13
1975	4.7	59.2	42.7	2.78	2.01
1976	5.3	58.5	39.9	3.10	2.11
1977	4.9	76.6	49.1	3.75	2.40
1978	5.5	70.4	41.9	3.87	2.30
1979	5.4	81.3	43.5	4.39	2.35

1/ Deflated by the Consumer Price Index to 1970 price levels.

Sources: (1, 3, 10, 11).

Examining the ad valorem equivalent (or percentage of the value of tomatoes represented by the duty) provides a means of assessing the importance of a duty in protecting the domestic industry. Data for selected years (table 7) indicate that the ad valorem equivalent of the fresh tomato duty declined in recent years, thereby making it less important in protecting the domestic industry. During 1969 and 1973, the ad valorem equivalent of the fresh tomato duty (most of which was for tomatoes from Mexico) amounted to about 12 percent. This percentage rose during 1974 and 1976 due to lower prices received those years. Following 1976, the ad valorem equivalent declined, ranging between 8 and 10 percent, as the value of fresh tomatoes rose along with the rise in the general price level.

Trade With Cuba

Cuba and the United States were natural trading partners, and for nearly 60 years (1902-61) Cuba traded mostly with the United States under a system of mutually low tariffs. Although sugar was Cuba's principal export, it also exported other farm products such as tobacco, cocoa, and fresh fruits and vegetables to the United States.

Table 7--Ad valorem equivalent duty on imported fresh tomatoes, selected calendar years

Year	Duty as a percentage of value of imports
	Percent
1969	12.1
1973	12.2
1974	17.0
1976	16.4
1977	9.9
1978	9.5
1979	8.5

Source: (9, and unpublished Commerce Department Data).

Location and climate made Cuba particularly well suited to trade in certain winter fresh vegetables. Lying 90 miles south of Florida and surrounded by warm ocean waters, Cuba's winter weather presented none of the threat to tender vegetables as in Florida. Further, Cuba's closeness to the eastern U.S. market made it particularly easy to enter fresh vegetables into marketing channels.

Tomatoes and cucumbers made up the bulk of Cuban fresh vegetable exports to the United States (table 8). Cuba's exports to this country for the five seasons prior to 1961 included an annual average of 28.7 million pounds of tomatoes and 38.7 million pounds of cucumbers. Other fresh vegetable exports included eggplant, peppers, and okra. Most of Cuba's exported tomatoes arrived in the United States from late December through mid-March. Eighty-five percent of the Cuban tomato imports to the United States from 1952-56 arrived during January, February, and March. Although Cuban tomato imports amounted to 46.6 million pounds during the 1959-60 season, they accounted for substantially less than Florida's 155.2 million pounds shipped during that winter quarter.

Following the takeover by the Castro government in 1959, relations between the United States and Cuba began to deteriorate. Trade in fresh vegetables continued strong through the 1959/60 season, but by the winter of 1961, the volume of tomato exports fell far below previous years. All trade with Cuba stopped in February 1962.

Table 8--Exports of Cuban tomatoes and cucumbers to the United States and Florida, winter quarter production, 1951-1961

Season	Cuban exports to the United States		Florida production, winter quarter only	
	Tomatoes	Cucumbers	Tomatoes	Cucumbers
	Million pounds			
1950-51	26.9	16.4	117.0	2.4
1951-52	17.3	16.4	158.8	11.8
1952-53	16.6	22.7	138.0	13.3
1953-54	15.3	31.1	193.1	15.4
1954-55	11.3	41.0	270.5	17.5
1955-56	24.3	42.2	212.8	10.0
1956-57	16.9	38.4	267.6	23.9
1957-58	36.7	40.5	63.4	N.R.
1958-59	19.3	27.9	185.2	4.9
1959-60	46.6	44.4	155.2	N.R.
1960-61	3.2	12.0	190.0	N.R.

N.R. = None reported.

Sources: (7, 19, 21).

The potential impacts of resuming fresh tomato trade with Cuba would depend on the extent that Cuba would again export to the United States. This is a difficult question to assess. U.S. growers financed and managed most export production prior to 1961. Similar arrangements seem unlikely under the present government; hence, new financing and management would be needed. Further, a centrally-controlled economy such as the present one in Cuba makes it difficult to estimate the likely volume of Cuban tomato exports because costs may have become less important in determining supply. Costs play a different role in a socialist economic system, and may be meaningless in estimating export production. Considerations other than costs, such as the need to earn foreign exchange, can override costs in the decision to export. It seems likely that if Cuba again supplied fresh tomatoes to the United States, the shipping pattern would follow that existing prior to 1961, as Cuba's climate provides it with its greatest advantage during Florida's cold weather months.

PRICE-QUANTITY PROJECTIONS

This study compares price and quantity projections for 1985 developed under different assumptions with respect to income and cost growth rates, duty levels, and new Caribbean-area supplies.

A simplified price-quantity model of the U.S. winter fresh tomato sector provided the basis for these projections (see appendix).

The price-quantity model implies a recursive structure for the tomato industry. With such a structure, current year production depends on prices received by growers during previous seasons and some exogenous variables, while current season prices depend on the quantity of tomatoes produced this year along with certain exogenous variables. 5/ This current price, in turn, determines next season's production, which determines next season's price. Projecting future price and quantities involves a series of steps where 1) current production is estimated from last year's prices, 2) current prices are estimated from current production, 3) next year's production is estimated from this year's prices, and so on. In this study, retail prices represent a markup over grower prices. In order to project 1985 tomato prices and quantities, values had to be assigned variables determined outside the model such as the producer price index (PPI), population, the Florida cost of production variable (FLCP), and the Mexican cost of production variable (MXCP) over the projection period.

Economic Scenarios

The values assigned to the exogeneous variables reflect assumptions about future economic conditions in the United States and Mexico. Rises in the general price level seem likely over the next few years. Rising prices affect price and quantity projections in several ways. Values for the cost of production variable in the supply equations rise, tending to suppress production. Rising prices also affect the retail price through the rising PPI, the proxy variable for cost of marketing services. A rising PPI leads to a larger farm-retail marketing spread and therefore higher retail prices.

Per capita disposable income appears likely to change too, affecting the tomato price and quantity projections. Disposable income affects projections through the U.S. average grower price equation, where higher income pushes the U.S. average grower price equation higher, therefore raising the estimates of Florida and Mexico grower prices. These higher prices, in turn, stimulate supply, thereby partially offsetting the output depressing effects of rising production costs.

Five different economic scenarios represented different assumptions about the exogenous economic variable in this

5/ Exogeneous variables are ones whose values are determined outside the model, as opposed to endogenous variables whose values are generated by the model.

study (table 9). One, identified as the most likely scenario, represented values for the exogeneous variables selected as the most likely to prevail over the projection period. The other scenarios were selected as the most likely to prevail over the projection period. The other scenarios were selected to bound the range of economic outcomes likely to occur. One, identified as the rapid inflation scenario, represented higher rates of price inflation and no real income growth, while a second, the slower inflation scenario, represented a lower rate of inflation and a 2-percent real income growth. The most likely scenario portrayed a growth rate of 9 percent annually in per capita disposable income, Florida production costs, and the producer price index over the 1980-85 period. In the rapid inflation scenario, Florida production costs, per capita income, and the PPI grew at a 15-percent annual rate. In the slower inflation scenario, disposable income grew 8 percent annually, while Florida production costs and the PPI increased only 6

Table 9--Economic scenarios used to project tomato prices and quantities to 1985

Scenario	U.S. per capita disposable income	U.S. index of prices paid by farmers for production items 1/	U.S. producer price index, all items	Mexican agricultural wages	U.S. population
	Annual percentage growth				
Most likely	9	9	9	15	.75
Rapid inflation	15	15	15	15	.75
Slower inflation	8	6	6	15	.75
Most likely with:					
Higher Mexican wage growth	9	9	9	25	.75
Slower Mexican wage growth	9	9	9	9	.75

1/ Excludes prices paid for feed and feeder livestock.

percent per year. Two additional situations were identified as the most likely scenario with higher Mexican wage growth, representing a 25-percent annual growth in Mexico's agricultural wage, and the most likely scenario with slower Mexican wage growth representing a 9-percent annual growth in the Mexican agricultural wage. The U.S. population grew at a 0.75-percent annual rate in all scenarios.

Most Likely Scenario Projections

Tomato supplies from all production areas for 1985 under the most likely scenario totaled 1,360.5 million pounds, 11 percent above 1979 supply (table 10). Florida provided the largest part of the increase, its production rising 15 percent from 602.8 million pounds in 1979 to 694.1 million in 1985. Projected imports from Mexico would increase only about 4 percent during the same period. One reason for the greater increase in Florida production than in imports from Mexico may be that the projected Mexican production costs grew 15 percent annually versus 9 percent for Florida. The 43.4 million pounds of other U.S. production, determined outside the model, represented the average for other supply areas during 1970-79.

Projected per capita consumption of tomatoes rose nearly 6 percent from the 1979 level--5.4 pounds in 1979 to 5.7 pounds in 1985. Although 5.7 pounds per person represented more tomatoes than U.S. consumers purchased during any January to May season in the 1970-79 period, the trend in per capita consumption during the 1970-79 period if extended, indicates 1985 consumption of 5.9 pounds per person. 6/

Projected grower prices increase to 54.9 cents per pound by 1985 for Florida tomatoes and 49.6 cents per pound for imported tomatoes from Mexico. Rises in the general price level largely offset these higher prices. Discounting grower prices at a 9-percent annual rate removed the effect of price inflation, and resulted in prices of 32.7 cents per pound for Florida tomatoes and 29.6 cents per pound for those imported from Mexico--very nearly the same as the 1979 prices received by growers in the two areas.

The projected retail price for 1985 came to 132.9 cents per pound, up 62 percent from the 82 cents per pound average for 1979. General price level growth offset most of this increase. Discounting projected prices at a 9-percent annual rate to remove the effect of inflation on the value of the dollar

6/ The trend line fit to 1970-79 data gave an equation for per capita consumption = 4.43 + .0946T, where T = 1 in 1970. Projecting 1985 consumption with this equation gives 5.94 pounds per person.

Table 10--Projected 1985 winter fresh tomato supply, per capita consumption, and prices, three economic scenarios, January to May

Production, consumption prices	1979 actual	Most likely scenario	Rapid inflation scenario	Slower inflation scenario	Most likely scenario with--Rapid Mexican agricultural wage growth	Most likely scenario with--Slower Mexican agricultural wage growth
			Million pounds			
Supply:[1]						
Florida	602.8	694.1	708.2	725.5	710.8	685.8
U.S. imports from Mexico	599.9	623.0	700.6	608.5	514.2	672.2
Other U.S.[2]	22.4	43.4	43.4	43.4	43.4	
Total	1,225.1	1,360.5	1,452.2	1,377.4	1,268.4	1,401.40
			Pounds per capita			
U.S. consumption	5.4	5.7	6.1	5.8	5.3	5.9
			Cents per pound			
Grower prices:						
Florida (f.o.b. packing houses):						
1985 dollars	N.A.	54.9	70.4	51.9	56.7	54.1
1979 dollars[3]	32.9	32.7	30.4	36.6	33.8	32.3
Mexico (f.o.b. Nogales, Ariz.)						
1985 dollars	N.A.	49.6	63.7	47.1	51.4	48.9
1979 dollars	27.6	29.6	27.5	33.2	30.6	29.2
Retail prices:						
U.S. average, 1985 dollars	N.A.	132.9	171.2	121.2	135.2	131.9
U.S. average, 1979 dollars[2]	82.0	79.2	74.0	85.4	80.6	78.6

N.A. = Not applicable.

1/ Florida quantity was estimated by multiplying the simulated per capita production by the projected 1985 total population for the United States and Canada. Mexican and other U.S. production was estimated by multiplying the simulated values for per capita production by the projected 1985 total U.S. population.

2/ Projected other U.S. production was set equal to the average for the 1970-79 period.

3/ Obtained by deflating the 1985 projections to 1979 using a discount rate equivalent to the rate of change in the PPI for that scenario.

transforms the 1985 retail price into 79.2 cents per pound in 1979 dollars, a 3-percent decline from 1979 prices.

Rapid Inflation Scenario Projections

Total supplies for the rapid inflation scenario exceeded both the 1979 actual supply and the most likely scenario projection of total supply. Several reasons account for the larger supply under the rapid inflation scenario. In the case of Florida, the reason lies in the magnitude of the price effect and cost of production effect in the Florida supply equations. Rising production costs depress supply, while rising disposable income enhance supply--though indirectly through higher production prices. The positive indirect income effect on supply overpowered the negative direct effect of higher production costs. As both production costs and disposable income changed from 9 percent annual growth to 15 percent, the net effect on Florida production rose by a projected 14.1 million pounds.

Mexico's exports to the United States rose under the rapid inflation scenario for reasons similar to those for Florida's higher production. The larger disposable income with the rapid inflation scenario enhanced Mexico's projected supply. Unlike Florida's production costs, however, Mexico's costs remained the same for both scenarios, and only the production increasing effects of higher disposable income affects Mexico's U.S. imports between the two scenarios. As a result, Mexico's projected exports to the United States increased by an estimated 77.6 million pounds between the most likely and the rapid inflation scenarios.

Increased per capita consumption reflects the increased total supplies, rising from 5.7 pounds for the most likely scenario to 6.1 pounds for the rapid inflation scenario. Projected per capita consumption for the rapid inflation scenario represented about a 7-percent increase over the most likely scenario projection for 1985.

Projected grower prices for the rapid inflation scenario are substantially above either the 1979 actual price or the 1985 most likely scenario projected price. Inflation, however, more than offsets the higher prices, since the 1979 dollar value of these prices is only 30.4 cents per pound for Florida (8 percent less than Florida's 1979 actual price) and 27.5 cents per pound for Mexico (almost the same as the 1979 actual price received by Mexican growers).

The same pattern exists for the retail price. The nominal value of projected retail price in 1985 of 171.2 cents per pound amounted to only 74 cents in 1979 dollars, 8 cents per pound less than the 1979 actual price. This lower real price in 1985 accounts for the high per capita consumption observed for the rapid inflation scenario.

Slower Inflation Scenario Projections

Projected total supply under the slower inflation scenario rose slightly above the most likely scenario projection of total supply. Florida's production, however, showed a substantial increase over the most likely and rapid inflation scenario projections, while Mexico's projected imports rose just slightly over 1979 actual imports.

Per capita consumption under the slower inflation scenario rose 0.1 pound to 5.8 pounds--just slightly larger than the most likely scenario projection, and almost equal to the trend line projection to 1985.

Grower prices in 1979 dollars increase the most under the slower inflation scenario. The nominal values of 51.9 cents and 47.1 cents per pound, respectively, for Florida and Mexico, amounted to 36.6 cents and 33.2 cents in 1979 dollar terms, substantially higher than either the 1979 actual prices or the 1979 dollar value estimates for the other two scenarios.

The projected average retail price amounted to 121.2 cents per pound in nominal value or 85.4 cents in 1979 dollars. This represented a substantial increase over the 1979 price of 82 cents due in part to higher real disposable income shifting consumer demand for winter fresh tomatoes.

Changing Mexican Agricultural Wages

A 25-percent annual growth rate in Mexican agricultural wages results in a 108.8-million pound decline in 1985 projected imports of tomatoes from Mexico. Due to higher prices, Florida's projected production grows about 16.7 million pounds, and the projected total supply falls about 7 percent to 1,268.4 million pounds. Projected per capita consumption would fall about 0.4 pound to 5.3, while projected retail prices increase to 135.2 cents per pound. Projected Florida and Mexican grower prices rise about 1.8 cents per pound to 56.7 cents and 51.4 cents, respectively.

A decline in the rate of growth of Mexican agricultural wages to 9 percent annually from 15 percent results in increased Mexican imports, reduced Florida production, increased total supply, and lower tomato price projections for 1985. Mexico's projected tomato imports to the United States rise by 49 million pounds. Projected Florida production falls 9.1 million pounds, and total supply rises by 43.9 million pounds. Projected U.S. per capita consumption for 1985 would be 5.9 pounds. Grower prices fall about 0.7 cents and retail prices fall about 1 cent per pound under this scenario.

Changing Competitive Position

The above analysis indicates Florida tomato growers will expand their market share relative to Mexican growers during the January to May period, especially under conditions defined by

the most likely scenario, and the scenario where Mexican agricultural wages grow 25 percent annually. Disposable income gains tend to shift the demand for fresh tomatoes and drive prices higher, while lower rates of growth in production costs tend to maintain the real value of price gains more than in the scenarios where inflation increases at a faster rate. Florida's projected total production increases under such a scenario, and its share of the total market grows from 49 percent in 1979 to 53 percent in 1985.

As costs increase proportionately in Florida and Mexico (the rapid inflation scenario case and in the situation with the slower Mexican agricultural wage rate growth), competitive positions for Florida and Mexico remain about the same. Florida's share of the January to May market remains at 49 percent from 1979-85, while Mexico's share falls from 49 percent to 48 percent during the same period.

TOMATO IMPORT DUTY

Importers pay a duty of 1.5 cents per pound on tomatoes entering the United States from Mexico during January and February and 2.1 cents per pound on those entering during March, April, and May. Comparing 1985 projections for prices and quantity developed under the assumption of 1) no duty on tomatoes and 2) with the duty doubled to 3.0 cents per pound during January and February and 4.2 cents per pound during March, April, and May, with most likely scenario projections, permitted estimating the effects of duty changes on the tomato industry and U.S. consumers. A change in the duty was represented by adjusting the grower price variable in the Mexican supply equation. For example, in the situation depicting elimination of the duty, the net price received by Mexican growers with a given f.o.b. Nogales price was raised 1.5 to 2.1 cents per pound above the price they would receive under the present duty arrangement. In the projections portraying a doubling of the duty, the net price to Mexican growers was lowered 1.5 to 2.1 cents per pound below the level it would have been in the absence of a change. The analysis reflected the same price, income, and population growth assumptions defined for the most likely scenario (table 9).

Effects of Lower Duty

Eliminating the U.S. duty on tomatoes from Mexico results in higher gross income to Mexican growers and lower gross income to Florida growers than with the duty at its present level. In addition, U.S. consumers would eat slightly more winter fresh tomatoes, paying slightly less per pound at the retail level, and U.S. Treasury receipts would fall by the amount of the present duty on imported tomatoes. However, projected total supplies and the share of the total supplied by Florida and Mexico change very little.

Eliminating the U.S. duty on Mexican tomatoes would result in a 9.2-million pound increase in total supplies to the United States (table 11). Mexico would export an additional 12.8 million pounds beyond that projected under the most likely scenario by 1985. A 3.6-million pound reduction in Florida production offsets some of the increase in Mexican imports giving the 9.2-million pound net gain in total supplies. Per capita consumption would increase less than 0.1 pound.

Mexican producers would realize a net price benefit from a reduction in the U.S. import duty. Although the projected 1985 f.o.b. price of tomatoes at Nogales, Ariz., fell 0.1 cent per pound in the absence of the duty, the net price to Mexican growers would rise about 1.7 cents per pound because they no longer would have to subtract the duty from the f.o.b. Nogales price to arrive at their net price. Eliminating the U.S. duty on Mexican tomatoes would reduce prices received by Florida growers by about 0.2 cent per pound in 1985.

The U.S. average retail price on tomatoes would fall about 0.2 cent per pound from 132.9 cents to 132.7 cents. However, because of slightly higher per capita consumption, total expenditures on tomatoes during January to May would rise 4 cents per person following elimination of the duty.

U.S. Treasury receipts from the tomato import duty would change from a projected $11.7 million under the most likely scenario to zero with the duty eliminated.

Effects of Higher Duty

Increasing the duty on imported tomatoes results in slightly higher gross income to Florida growers, lower gross income to Mexican growers, a small increase in retail prices, and a small decline in per capita consumption. Total U.S. Treasury receipts from tomato import duties would increase but less than in direct proportion to the increase in the rate.

Total supplies would fall 9.3 million pounds by 1985 from the most likely scenario projection for that year (table 11). The greatest decrease occurs in imports from Mexico, which are 12.8 million pounds less than the 1985 most likely projections. Florida's production, on the other hand, would rise to a projected 697.6 million pounds--3.5 million pounds more than the 1985 most likely scenario projection and 94.8 million more than 1979 actual production. Per capita consumption falls about 0.1 pound by 1985 from 5.7 to 5.6 pounds.

The effects of doubling the duty affects Mexican growers the most. Although the f.o.b. price at Nogales increases 0.2 cent per pound over the price under the most likely scenario, the average net price received by Mexican growers would fall about

Table 11--Projected 1985 U.S. winter fresh tomato production and prices with the most likely economic scenario and with two selected duty levels on imported tomatoes, January to May

Production and prices	1979 actual	Most likely scenario	Duty eliminated	Duty doubled
		Million pounds		
Production 1/				
Florida	602.8	694.1	690.5	697.6
Mexico (exports to United States)	599.9	623.0	635.8	610.2
Other United States 2/	22.4	43.4	43.4	43.4
Total	1,225.1	1,360.5	1,369.7	1,351.2
		Pounds per capita		
U.S. consumption	5.4	5.7	5.7	5.6
		Cents per pound		
Grower prices				
Florida 3/	32.9	54.9	54.7	55.1
Mexico 4/	27.6	49.6	49.5	49.8
Retail prices, U.S. average	82.0	132.9	132.7	133.2
		Million dollars per year		
U.S. Treasury receipts from duty 5/	11.3	11.7	0	21.0

1/ Florida quantity was estimated by multiplying per capita production by the projected 1985 total population for United States and Canada. Mexican and other U.S. production was estimated by multiplying per capita production by the projected 1985 total U.S. population.

2/ Other U.S. production was set equal to the average for the 1970-79 period.

3/ Average price per pound for large size mature green tomatoes f.o.b. the south Florida shipping point.

4/ Average price per pound for extra large size vine-ripe tomatoes f.o.b. Nogales, Ariz.

5/ Estimated by multiplying monthly imports by appropriate duty for that month.

1.7 cents after subtracting the extra duty. The Florida grower price would rise about 0.2 cent per pound above the 1985 most likely scenario projection.

The U.S. retail price for winter fresh tomatoes rises with the doubled duty, up 0.3 cent per pound by 1985 from 132.9 cents to 133.2 cents. However, because of lower per capita consumption, total expenditures for fresh tomatoes during January to May fall about 4 cents per person.

U.S. Treasury receipts would increase as a result of doubling the duty—9.3 million more than the most likely scenario projection of 1985 U.S. Treasury receipts.

Comparison With 1971 Study

In 1971, Dickinson (8) concluded that eliminating the duty on Mexican tomatoes would increase U.S. tomato consumption by 242 million pounds, whereas the present study indicates only a 9-million pound increase. Further, Dickinson indicated that two-thirds of any duty reduction would go to Mexican producers while the remaining one-third would go to U.S. consumers. The present study indicates that almost all of a duty reduction (90 to 95 percent) would go to Mexican producers.

Several reasons may partially explain such a wide range in the expected production impacts from eliminating the tomato duty. One reason may be the declining importance of duty as a cost item for importing tomatoes to the United States. Although the nominal value of the duty has remained constant between 1970 and 1980, the ad valorem equivalent duty has declined. During 1969 and 1973 the ad valorem equivalent duty was about 12 percent, while by 1978 and 1979 it had fallen to only about 9 percent (table 7). Since the duty accounts for a smaller share of costs than previously, its elimination would probably have a smaller impact on production.

Differences in the time periods may account for a part of the difference in projected effects of eliminating the duty. The production period for the present study was January through May, while the earlier study covered the entire fall-winter-spring period.

Changes in the competitive position of the two areas could contribute to differences in results of the two studies. During the late sixties and early seventies, Mexico was making substantial inroads into the U.S. market while Florida was supplying a declining share. Mexico's production costs were low relative to Florida's, and elimination of the duty would have enhanced Mexico's cost advantage. Florida made substantial cost-reducing technological advances in tomato production during the seventies and improved its cost competitive position relative to the

earlier years. Eliminating the current duty may not result in as great a relative improvement in Mexico's cost competitive position as before, and therefore would not have as great an impact on additional supplies coming into the country from Mexico.

A further factor that may account for some of the difference between the 1971 study and the present estimate is the type of analytical model used. The 1971 study used a linear programming model as the basis for its analysis. Linear programming sometimes tends to overestimate response to changes in economic variables. The present study used an econometric model as the basis for the analysis, and may underestimate the effects of heretofore unobserved policy variable changes such as elimination of the tomato duty.

NEW CARIBBEAN-AREA SUPPLIES

New Caribbean-area supplies were presumed to enter the U.S. market channel following a pattern similar to that of Cuban tomatoes prior to 1961. Differences between 1985 projections with these new supplies and the most likely scenario projection represented the effects of resuming trade with Cuba or introducing new supplies into the U.S. market channel from other sources. The normal pre-1961 tomato shipments from Cuba were deflated by U.S. population for 1979 and added to the residual quantity in projecting to 1985 (table 12). A second 1985 projection was made using double the pre-1961 normal Cuban shipments as new Caribbean-area supplies.

Effects of New Supplies

New Caribbean-area supplies of fresh winter tomatoes to the U.S. market would result in larger total supplies, higher per capita consumption, lower gross incomes for both Florida and Mexican growers, and lower fresh tomato retail prices for U.S. consumers.

New supplies equivalent to normal pre-1961 Cuban exports to the United States would raise projected 1985 total supplies from 1,360.5 million to 1,386.0 million pounds (table 13). Production from Florida would fall 9.7 million pounds, while Mexican imports would decline only 3.6 million. Per capita consumption would rise from 5.7 to 5.8 pounds.

Florida grower prices would decrease by about 4.0 cents per pound in 1985 from 54.9 cents to 54.5 cents. Mexican grower prices, too, would fall by 0.4 cent from 49.6 cents per pound for the most likely scenario to 49.2 cents with the additional Caribbean-area supplies.

Retail prices would decline by about 0.7 cent per pound, while consumer expenditures per person would rise about 11 cents as the larger quantity of tomato purchases would more than offset the lower price.

Table 12--Pre-1961 Cuban exports of fresh tomatoes to the United States

Level of supplies	January	February	March	April	May
Normal pre-1961 shipments:					
Million pounds	12.46	16.9	7.43	0.27	0.0
Pounds per capita 1/	.05737	.07781	.03421	.00124	.0
Double pre-1961					
Million pounds	24.82	33.8	14.86	.54	.0
Pounds per capita 1/	.11474	.15562	.06842	.00248	.0

1/ Estimated by dividing monthly totals by 1977 U.S. population of 217.2 million.

Sources: (7, 19).

The effects of new Caribbean-area supplies on tomato prices and quantities are almost proportional to the amount of new supplies. For example, doubling the amount of new tomatoes doubles the impacts on supplies, consumption, and prices.

Comparison With 1977 Study

A 1977 study also considered the effects of new Caribbean-area supplies on Florida and Mexico tomato producers (23). Although that study was conducted for a different time period and used a different methodology, the results are similar to those obtained in the present study. In both cases, new Caribbean-area supplies reduced grower receipts in Florida and Mexico and resulted in small increases in total supplies and consumption. The present study indicates the impacts may be greater for Florida growers than was indicated in the earlier study. Although the earlier study found that Florida producers would reduce production about 4.2 million pounds (0.8 percent of expected production) as a result of added supplies equivalent to normal pre-1961 Cuban shipments, the present study indicates a 9.7-million-pound reduction (1.4 percent of the expected Florida production).

The two studies indicated similar impacts on grower prices, too. In the earlier study, the predicted effect on grower prices was 0.2 cent per pound, a 0.5-percent reduction in 1976 expected grower prices. In the present study, grower prices fell by 0.4 cent, or 0.7 percent lower than 1985 projected prices with no new Caribbean-area supplies.

Table 13—Projected 1985 U.S. winter tomato production and prices, most likely economic scenario, and two levels of new Caribbean-area supplies, January to May

Production and prices	1979 actual	Most likely scenario	Normal pre-1961 Cuban exports	Double pre-1961 Cuban exports
		Million pounds		
Production: 1/				
Florida	602.8	694.1	684.4	674.7
Mexico (exports to United States)	599.9	623.0	619.4	615.8
Other United States	22.4	43.4	43.4	43.4
Caribbean (new production)	N.A.	N.A.	38.8	77.7
Total	1225.1	1360.5	1386.0	1411.6
		Pounds per capita		
U.S. consumption	5.4	5.7	5.8	5.9
		Cents per pound		
Grower prices:				
Florida (f.o.b. packinghouse)	32.9	54.9	54.5	54.2
Mexico (f.o.b. Nogales, Ariz.)	27.6	49.6	49.2	48.7
Retail prices, U.S. average	82.0	132.9	132.2	131.5

N.A. = Not applicable.

1/ Florida quantity was estimated by multiplying per capita production by the projected 1985 total population for the United States and Canada. Mexican and other U.S. producti was estimated by multiplying per capita production by the projected 1985 total population for the United States.

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APPENDIX--WINTER FRESH TOMATO PRICE-QUANTITY PROJECTION MODEL

The price-quantity model was developed under the assumption that the winter fresh tomato sector could be represented by a recursive structure. 1/

Supply Equations

The model included three sources of supply: Florida, imported supplies (mostly Mexican tomatoes, called Mexican supply), and residual supply (small quantities of tomatoes from California, Texas, Midwest production, and production from other minor producing States). The residual supply was treated as an exogenous variable.

The amount of fresh tomatoes supplied by Florida and Mexico was assumed to be a function of the expected prices of tomatoes and expected costs of production, and month of the season. In the case of Florida, this function also includes fixed investment in production assets such as machinery, packinghouses, trained labor, and other items used in tomato production that have a wear-out life of several seasons. Prices received by growers for the same month during the previous year (FLFOB, the Florida grower prices, and MXFOB, the Mexican grower prices) were used as the expected price variables, and cost indices (FLCP and MXCP) were used as proxy variables for the cost of production. 2/

1/ There may be simultaneity between price and quantity at extremely high and extremely low prices. When prices are unusually high, growers may pick an extra time to recover smaller and lower grade tomatoes, while they may abandon part of their crop when prices are too low to cover variable picking and packing costs. There is more adjustment potential on the down-side from crop abandonment than on the up-side during any point in the season because maximum production is largely fixed by the predetermined planted acreage. However, crop abandonment appears to be a minor factor in determining fresh tomato supply.

2/ It would have been desirable to explicitly include the effect of the peso:dollar exchange rate in the price quantity model. The exchange rate problem has been handled in several ways in other studies involving international trade questions (5). A number of variations of the present price-quantity model were estimated with the exchange rate explicitly included as a variable, or with the Mexican rural wage and Mexican grower prices expressed in peso terms. In all such cases, the parameter estimates on Mexican grower prices (MXFOB) and/or Mexican rural wage (MXCP) were inconsistent with the economic theory. Hence, to maintain theoretical consistency in the Mexican costs and price parameters, the exchange rate variables were dropped from the Mexican supply equation and the values for MXFOB and MXCP were expressed in dollar terms.

Increases in expected grower prices would increase profitability and therefore be positively related to quantity of production, while increases in the cost of production variables would reduce expected profits and therefore be inversely related to quantity supplied. The proxy variable for fixed investment was lagged production. Larger production would result in greater fixed investment carried over to the next season and thus a cost structure with lower variable costs in the following season than if production were smaller. Lagged production was expected to be positively related to current quantity produced.

Monthly intercept shifters were included in the supply equations to enable the model to predict seasonal change in production. Florida's climate tends to be least favorable for tomato production during January and February, and its production is typically lower during the January to March period than during April and May. Mexico, on the other hand, has a climate favorable to tomato production during the midwinter, and ships its largest volumes during January through April, with shipments declining rapidly during May.

Equations (1) and (2) define the specific supply functions for Florida and Mexico, respectively, and equation (3) defines total supply. The variables are defined in appendix table 1.

$$(1)\quad FLQTPC^{m}_{t} = \alpha_1 + \beta_{11}FLFOB^{m}_{t-1} + \beta_{12}FLCP_{t-1} + \beta_{13}FLQTPC^{m}_{t-1} + \beta_{14}FEBA + \beta_{15}MARA + \beta_{16}APRA + \beta_{17}MAYA,$$

$$(2)\quad MXQTPC^{m}_{t} = \alpha_2 + \beta_{21}MXFOB^{m}_{t-1} + \beta_{22}MXCP_{t} + \beta_{23}FEBA + \beta_{24}MARA + \beta_{25}APRA + \beta_{26}MAYA,$$

$$(3)\quad QTOMPC^{m}_{t} = FLQTPC^{m}_{t} + MXQTPC^{m}_{t} + RESQTPC^{m}_{t}.$$

Quantity variables in these supply equations were converted to a per capita basis. Florida's production included tomatoes exported to Canada, so it was deflated by the total population for the United States and Canada. Mexico's quantity variable included all fresh tomatoes imported into the United States for consumption from January to May, most of which were from Mexico. Residual production included largely greenhouse production and spring production from South Carolina, Texas, California, and some minor supply areas, and was assumed to be consumed entirely in the United States. Both the Mexican import and residual quantities were deflated by U.S population to arrive at per capita figures.

Appendix table 1--Definition of variables

Variable name	Abbreviation	Definition
Florida production	$FLQTPC_t^m$	Quantity of fresh tomatoes in 1,000 cwt. per million population supplied by Florida during month m of season t. 1/
Imports	$MXQTPC_t^m$	Quantity of fresh tomatoes imported for consumption in 1,000 cwt. per million population during month m of season t.
Florida grower price	$FLFOB_t^m$	Monthly average price per cwt. for large size mature green tomatoes in 30-pound cartons (85 percent or more U.S. No. 1 quality received by Florida growers, f.o.b. south Florida shipping points during month m of season t. 2/
Mexican grower price	$MXFOB_t^m$	Monthly average price per cwt. (in dollars) for extra large size vine-ripe tomatoes in 22-pound, 2-layer flats received by Mexican growers, f.o.b. Nogales, Ariz., duty and crossing charges paid--generally good quality and condition during month m of season t. 3/
U.S. retail price	$RETLP_t^m$	U.S. monthly average retail price for fresh tomatoes during month m of season t.
Florida cost of production	$FLCP_t$	Index of prices paid for items used in production exclusive of feed and livestock costs for the year during which season t begins. 4/

See footnotes at end of table.

Continued--

Appendix table 1--Definition of variables--Continued

Variable name	Abbreviation	Definition
Mexican cost of production	$MXCP_t$	Mexican daily wage (in dollar terms) for agricultural workers in the Culiacan area of Mexico during season t.
Intercept shifters	FEBA MABA APRA MAYA	(1 if February, 0 otherwise) (1 if March, 0 otherwise) (1 if April, 0 otherwise) (1 if May, 0 otherwise)
Total supply	$QTOMPC_t^m$	Total quantity of fresh tomatoes in 1,000 cwt. per million population supplied by Florida, imports, and residual domestic suppliers during month m of season t.
Residual supply	$RESQTPC_t^m$	Quantity of fresh tomatoes in 1,000 cwt. per million population supplied by U.S. domestic production areas other than Florida during month m of season t.
Disposable income per capita	Y_t	Disposable per capita income in the United States for the year during which season t begins. 4/
Average grower price	$AVFOB_t^m$	Weighted average of Florida and Mexico grower prices for fresh tomatoes during month m of season t.
Producer price index	PPI_t	U.S. producer price index for the year during which season t begins. 4/

1/ Since Florida production is marketed in both the United States and Canada, it was deflated by the total population for the United States plus Canada.

2/ Prior to the 1974/75 season, the 6x6 size price was used in place of the large size price.

3/ Prior to the 1974/75 season, the 5x6 and larger size price was used in place of the extra large size price.

4/ The season for Florida begins in the fall of one year and continues through the winter and spring of the subsequent year. Hence, January 1970 falls in the 1969/70 season and the observation for that month is the value for 1969.

Grower Price Equations

The model included three grower price equations--one to estimate the U.S. average grower price, one to estimate the Florida grower price from the U.S. average grower price, and one to estimate the Mexican grower price from the U.S. average price. Three independent variables contributed to determining grower prices: the total quantity of tomatoes marketed per capita from all production areas, per capita disposable income, and month of the year.

The theory of demand indicates that total quantity supplied of a commodity changes inversely to changes in its price. As larger volumes are marketed, all else being equal, prices fall, and vice versa. Therefore, the expected mathematical sign on the regression coefficient for total quantity would be negative.

Demand theory also suggests that income affects the demand for a good, but the type of relationship depends on the way consumers view the product. In the case of fresh tomatoes, the relationship was expected to be positive. As consumers obtain higher incomes, the demand for fresh tomatoes would rise, and marketing a given supply of tomatoes would result in a higher price than if the same quantity were marketed while consumers had a lower income.

Month of the year also appears to affect the demand for fresh tomatoes. Demand appears to be greater in the warm months than during the colder midwinter.

Monthly grower prices for Florida and Mexico were estimated as functions of the U.S. average grower price and the quantity the respective areas contributed to total per capita consumption. The Florida and Mexico grower prices were expected to show a close positive relation to the U.S. average price as each was an important component of that average. Differences in the source of supply were expected to be related to month-to-month differences in the Florida and Mexico grower prices, too. During February and March, for example, a large proportion of total supply originates from Mexico, and a surplus of tomatoes exists in the western United States relative to the East, tending to depress the Mexican grower prices at Nogales, Ariz., relative to the Florida price.

Equation (4) defines the equation for the average U.S. grower price, while (5) and (6) define equations for the Florida and Mexico grower prices respectively.

$$(4)\quad AVFOB_t^m = \alpha_4 + \beta_{41}QTOMPC_t^m + \beta_{42}Y_t + \beta_{43}FEBA + \beta_{44}MARA + \beta_{45}APRA + \beta_{46}MAYA$$

$$(5)\quad FLFOB_t^m = \alpha_5 + \beta_{51} AVFOB_t^m + \beta_{52} FLQTPC_t^m$$

$$(6)\quad MXFOB_t^m = \alpha_6 + \beta_{61} AVFOB_t^m + \beta_{62} MXQTPC_t^m$$

Retail Price Equations

The price-quantity model included an equation relating the U.S. average retail price to the U.S. average grower price, and the cost of performing marketing services. The retail price was assumed to have both a short-term (less than 1 month) response and a longer term (1 month lag) response. The equation presumes that in the short run, retailers may not completely pass changes in wholesale prices on to consumers, preferring instead to absorb some of the wholesale level price changes into their margin markup. If, however, the new wholesale price persists for a month or more, the retailer would then adjust prices to maintain a "normal" margin markup. The size of the marketing margin between grower price and retail price was assumed to be related to the cost of providing marketing services. As the costs for performing marketing services increases along with the rising price level, the marketing margin increases. The producer price index in the retail price equation serves as a proxy for cost of performing the marketing function. The specific form of the retail price equation is given in equation (7).

$$(7)\quad RETLP_t^m = \alpha_7 + \beta_{71} AVFOB_t^m + \beta_{72} AVFOB_t^{m-1} + \beta_{73} PPI_t.$$

Empirical Results

Appendix table 2 presents the parameter estimates for structural equations 1, 2, 4, 5, 6, and 7. Since the model adopted the recursive structure, ordinary least squares (OLS) regression was used to estimate the structural relationship. Parameter estimation was based on monthly January through May data for the period 1970-79 (app. tables 3-5). The standard error for each parameter is reported in the parenthesis. Appropriate R^2 values and degrees of freedom are presented on the right hand side of the table. The signs on each parameter were theoretically consistent.

Model Validation

Validation involves determining how well the model reproduces historical observations. Because the model in this study is recursive, it can be used to project several years ahead. Given values for the exogeneous variables, successive monthly and annual values for the endogenous variables can be projected without including actual values as data. Then projected values can be compared with actual values to determine how well the model predicts.

Appendix table 2--Supply-price projection model of the U.S. winter fresh tomato industry, monthly data, January to May, 1970-79

Equation	Constant	Independent variables														R^2	DF
		$FLFOB^{m}_{t-1}$	$MXFOB^{m}_{t-1}$	$FLCP_{t-1}$	$MXCP_{t}$	$FLQTC^{m}_{t-1}$	$QTOMPC^{m}_{t}$	Y_{t}	$AVFOB^{m}_{t}$	$FLQTPC^{m}_{t}$	$MXQTPC^{m}_{t}$	$AVFOBL^{m-1}_{t}$	PPI_{t}	FEBA	MARA	APRA	MAYA		
1	1.0157	.0730		-.0068		.5740								-.8307	-.6734	-.3817	1.9744	.78	37
	(1.0489)	(.0373)		(.0062)		(.1755)								(.6179)	(.5998)	(.5676)	(.7523)		
2	1.9129		.0670		-.1454									3.9312	2.2935	3.5185	2.7784	.61	38
	(.8788)		(.0332)		(.1784)									(.5792)	(.5636)	(.5570)	(.5675)		
4	19.2259						-2.1578	.0048						-.0037	.0510	8.5029	11.5207	.59	38
	(4.1898)						(.5558)	(.0007)						(2.3657)	(2.1772)	(2.7430)	(4.5613)		
5	5.7739								1.0448	-.9145				5.6888	4.0667	13.1715	14.4157	.92	42
	(1.4964)								(.0504)	(.1467)				(2.5708)	(2.3660)	(2.9801)	(4.9568)		
6	.0230								.9476		-.0423			-1.2170	-0.8861	6.7068	10.3215	.94	42
	(1.1556)								(.0344)		(.1306)			(2.5574)	(2.3537)	(2.9654)	(4.9310)		
7	2.0707								.3267			.9272	.1764					.81	41
	(4.5528)								(.1702)			(.1788)	(.0361)						

Numbers in parentheses are standard errors.

Appendix table 3--Quantity of fresh market tomatoes produced and marketed by month from Florida, other U.S. regions, imports, December through May

Season	Month					
	December	January	February	March	April	May
			1,000 cwt.			
Florida:						
1969/70	775.3	684.0	424.1	259.9	500.9	1,154.3
1970/71	1,117.2	898.9	474.9	322.2	573.2	1,246.0
1971/72	1,252.8	939.6	610.7	798.7	701.5	1,282.1
1972/73	1,144.0	831.4	424.6	513.0	831.6	1,570.8
1973/74	1,144.8	880.6	476.0	1,023.4	942.5	1,466.1
1974/75	1,489.0	1,190.0	908.0	1,033.2	1,152.0	1,670.4
1975/76	1,303.7	1,070.5	873.3	873.3	1,275.0	2,185.8
1976/77	1,499.7	794.3	222.4	42.4	423.1	2,503.5
1977/78	1,488.0	1,164.8	627.2	448.0	588.8	2,315.8
1978/79	1,825.3	1,084.9	619.9	878.2	1,297.8	2,148.0
Other U.S. regions:						
1969/70	829.1	31.8	13.8	12.6	72.1	544.3
1970/71	213.7	20.3	10.2	19.4	67.6	339.8
1971/72	149.0	37.0	13.1	16.5	169.0	312.2
1972/73	220.9	45.7	6.1	12.6	32.0	215.1
1973/74	178.4	35.2	10.9	15.3	30.0	284.0
1974/75	211.9	29.3	8.4	9.8	37.7	297.1
1975/76	284.5	32.8	3.6	6.1	69.1	229.9
1976/77	168.9	39.2	11.6	6.0	40.8	294.8
1977/78	255.5	3.6	0.4	4.4	17.0	250.8
1978/79	226.4	24.0	5.0	6.0	14.0	174.0
Imports:						
1969/70	189.2	782.7	1,056.4	1,232.5	1,527.6	992.4
1970/71	306.8	588.5	1,211.0	881.8	1,220.8	1,089.7
1971/72	189.6	398.8	1,548.6	799.0	1,269.4	1,123.1
1972/73	146.5	599.9	1,312.8	1,112.8	1,956.8	1,154.0
1973/74	169.7	840.6	1,374.4	861.8	908.9	1,150.5
1974/75	104.4	250.0	856.8	868.3	989.5	1,251.7
1975/76	160.5	569.3	1,426.4	936.6	1,188.6	1,083.6
1976/77	237.8	542.0	1,692.6	1,193.7	1,769.1	1,304.4
1977/78	219.5	1,254.6	1,437.1	1,686.9	1,439.2	1,205.1
1978/79	241.4	573.9	1,596.2	1,301.1	1,444.6	1,083.8

Sources: December, April, and May estimates based on (12) distributed among months according to shipments reported in (1). January, February, and March estimates for Florida developed in the same way. January, February, amd March estimates for other U.S. areas based on monthly shipments reported in (1). Greenhouse production, included in other U.S., based on unloads reported in (2). Imports from Bureau of Census as reported in (10) and subsequent updates.

Appendix table 4--Monthly average grower prices for selected size and grade of fresh tomatoes in Florida and Mexico, December through May

Season	Month					
	December	January	February	March	April	May
	Dollars per cwt.					
Florida, mature green: 1/						
1969/70	25.00	19.38	17.40	23.05	20.68	18.92
1970/71	17.03	17.09	24.03	31.72	26.72	18.84
1971/72	22.72	20.73	16.76	16.39	23.11	21.52
1972/73	24.03	29.39	24.62	23.61	23.13	15.28
1973/74	22.29	22.82	36.11	21.00	32.82	26.88
1974/75	23.75	28.96	31.25	25.33	25.00	25.92
1975/76	28.54	25.67	20.83	36.25	29.38	17.17
1976/77	27.50	41.67	2/41.88	2/42.24	39.17	22.71
1977/78	25.92	26.57	25.42	31.04	45.83	26.67
1978/79	23.84	29.90	31.04	36.83	43.75	26.67
Mexico, vine-ripe: 3/						
1969/70	30.86	17.88	13.17	18.56	16.01	17.88
1970/71	18.93	18.25	19.56	25.91	22.73	18.93
1971/72	26.14	24.08	14.31	12.55	17.55	23.30
1972/73	N.R.	27.84	14.64	12.81	14.47	12.02
1973/74	N.R.	18.76	25.43	15.98	29.41	23.02
1974/75	N.R.	25.00	24.30	21.71	20.32	21.15
1975/76	22.73	25.13	18.06	32.55	24.72	19.66
1976/77	31.82	35.00	29.55	35.23	33.18	24.86
1977/78	40.91	27.84	17.20	20.17	34.55	28.69
1978/79	29.54	22.92	21.02	29.32	36.93	25.00

N.R. = None reported.

1/ Monthly average price per cwt. for large mature green tomatoes in 30-pound cartons (85 percent or more U.S. No. 1 quality) received by Florida growers, f.o.b. south Florida shipping points.

2/ Missing values were estimated from wholesale prices in New York and Chicago for large tomatoes.

3/ Monthly average price per cwt. for extra large size vine-ripe tomatoes in 22-pound cartons f.o.b. Nogales, Ariz., duty and crossing charges paid--generally good quality and condition.

Appendix table 5--Annual population, income, production cost, and price indices used in the empirical analysis for 1969-1978

Season	Population		U.S. disposable per capita income	Producer price index, U.S., all items 2/	Index of price paid for production items, U.S. adjustment 3/	Daily wage for tomato workers, Mexico 4/
	United States 1/	Canada				
	---Million---		Dollars	----1967 = 100----		Dollars
1969/70	201.7	21.03	3111	106.5	102	2.44
1970/71	203.8	21.32	3348	110.4	106	2.44
1971/72	206.0	21.60	3588	114.0	112	2.85
1972/73	207.8	21.85	3837	119.1	117	2.85
1973/74	209.3	22.13	4285	134.7	125	3.83
1974/75	210.8	22.48	4646	160.1	162	4.67
1975/76	212.4	22.83	5088	174.9	197	5.60
1976/77	214.0	23.14	5504	183.0	205	4.16
1977/78	215.6	23.32	6009	194.2	219	4.82
1978/79	217.2	23.62	6641	209.3	226	5.65

1/ Total for 48 contiguous States on July 1 for the year season began.

2/ Dept. of Labor, Bureau of Labor Statistics.

3/ The index reported in (11) includes feed and feeder livestock components. Since these items are not important in tomato production, their effects were removed from the index used in the study.

4/ Reported by (6) and summarized in (24).

Sources: (4, 18, 22, 11, 6).

Validation was performed by initiating the model with the 1974/75 season and simulating quantities and prices to the 1978/79 season. No corrections were made to the predicted endogeneous variables during the period. Simulated values for lagged explanatory variables were used for projecting successive years' prices and quantities rather than the observed values. Actual values of exogenous variables such as PPI, MXCP, and FLCP were used. Simulating for several years without correcting the endogenous variable estimates introduces the possibility of the model compounding errors, a situation where errors from current year estimates accumulate over successive years, exacerbating future errors. Projecting without correcting the lagged endogeneous variables to actual values each year provides a more rigorous test of the model's simulating ability than if corrections are made.

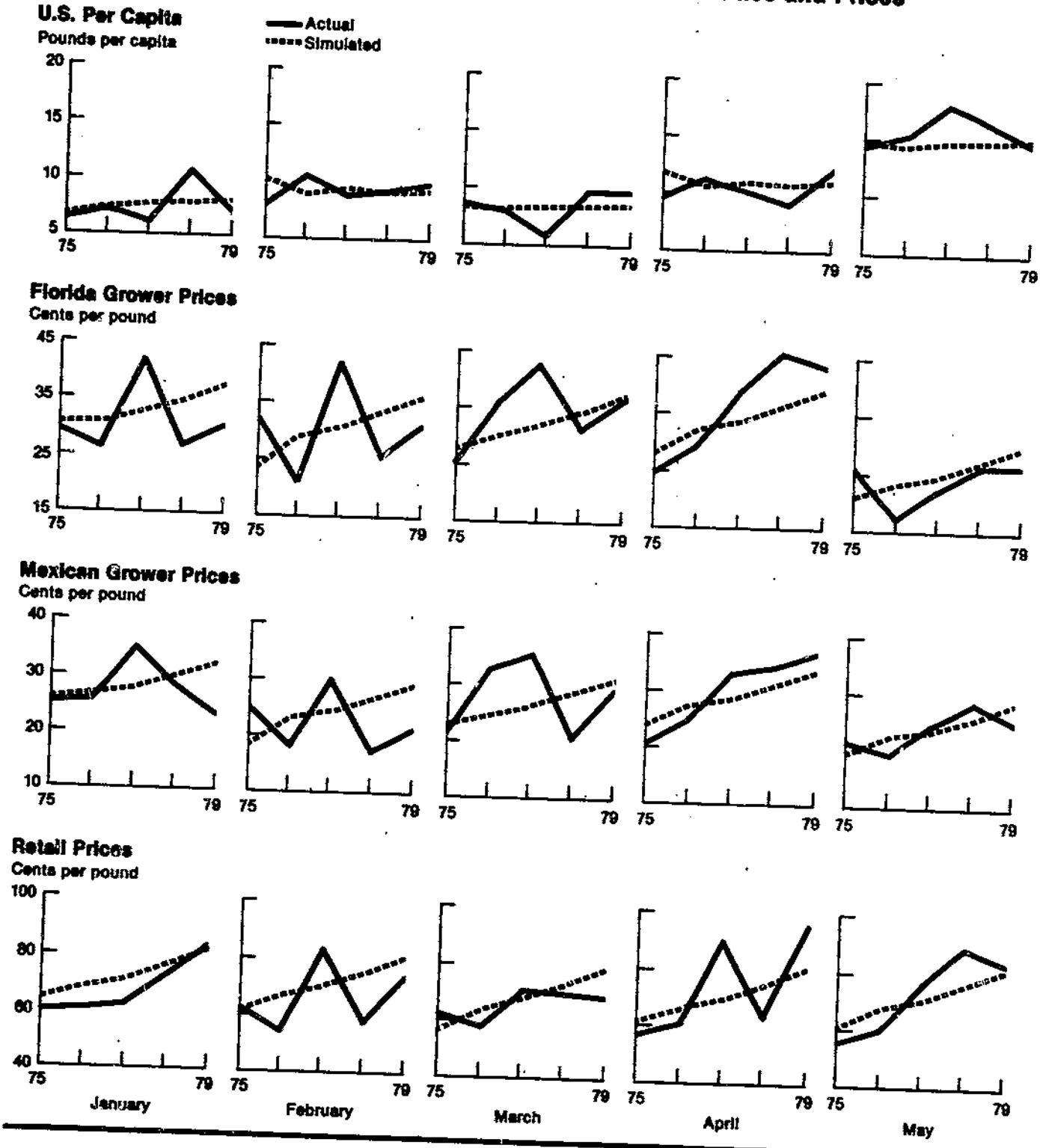
Results of the simulation are shown in figure 1. The simulated values show less variation than actual values and appear as a trend around which actual values fluctuate. The greatest difference between simulated values and actual values occurs in 1977 when a major freeze in January of that year destroyed almost all of the Florida crop. Florida shipped very few tomatoes during the 3 months following that freeze resulting in unusually high grower and retail prices. Average errors of the simulated values for the five seasons are as follows:

Item	Average absolute error	Average error, percentage of actual values
Consumption per capita	1.1	11.2
Florida grower price	5.0	17.7
Mexican grower price	4.4	17.7
Retail price	7.7	11.1

The simulated values for total consumption had an average absolute error of 1.1 pounds, or 11.2 percent of actual per capita consumption. The largest percentage errors occurred among the estimates for grower prices, averaging 17.7 percent of the actual values. In percentage terms, the average error for retail prices was smaller than those for grower level prices, perhaps because the PPI, an exogeneous variable, was such an important factor in the retail price equation.

Figure 1

Actual and Simulated Values of Winter Fresh Tomato Quantities and Prices



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