Apple Import Demand
Four Markets for U.S. Fresh Apples

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Abstract

This report presents the results of an econometric analysis of four U.S. overseas apple markets and explores competition in Canada, Hong Kong, Singapore, and the United Kingdom. The results indicate that the United States will increase its apple exports to these markets as they grow. However, U.S. import share will increase only slightly in Hong Kong and in the United Kingdom, while the share in the other two markets--Canada and Singapore--will either not quite, or just barely, be maintained. The results also show that the growth of Chile as a major world supplier of apples has not changed the U.S. competitive position in these markets. In Hong Kong, the U.S. competitive position has improved more because of the exit of China as a major apple supplier than it has declined because of the entry of Chile.

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Contents

Summary

This report presents the results of an econometric analysis that explores
competition in four major U.S. overseas apple markets (Canada, Hong Kong,
Singapore, and the United Kingdom). The results indicate that the United
States will increase its apple exports to these markets as they grow.
However, U.S. import share will increase only slightly in Hong Kong and in the
United Kingdom while the share in the other two markets--Canada and Singapore
--will either not quite, or just barely, be maintained. The results also show
that the growth of Chile as a major world supplier of apples has not changed
the U.S. competitive position in each of the major markets. In Hong Kong, the
U.S. competitive position has improved more because of the exit of China as a
major apple supplier than it has declined because of the entry of Chile.

Rising production of U.S. apples and stable domestic consumption are reducing
the prices that U.S. apple producers are paid. Unless domestic demand or
exports increase, U.S. apple producers may face lower prices which could cause
many of them to leave the business. To expand apple sales, the United States
must increase apple exports. However, production of apples is expanding
dramatically in other major producing countries, and the United States will
face strong competition for international markets. For example, Chile began
exporting significant quantities of apples in the mid- to late 1970's.
Although its role in the four international markets considered in this study
is still relatively small, Chile's importance is expected to increase. Future
trade in all four of the major U.S. markets will be determined to a major
degree by how Chilean apples fare in these markets.

This study uses an econometric model to examine the competitive relationship
between the United States and other exporting countries in four major foreign
markets. The report evaluates probable changes in the U.S. market share as
demand for imported apples expands or contracts in Canada, Hong Kong,
Singapore, and the United Kingdom; measures the price responsiveness of
exports from the United States and its major competitors to these four foreign
U.S. markets; and measures the cross-price relationships between U.S. and
foreign apple exports to these markets. The study also examines the effects
of Chile's entry and growth as a major world supplier of apples on the U.S.
competitive position in the four major U.S. markets.

Glossary

Two-stage budgeting: A method of budgeting in which a country first allocates the total expense of imports among all imported products and then allocates this expense, within each group of products, among the competing supply countries.

Conditional demand equations: Product demand relationships which arise from the two-stage budgeting process. These relationships continue only as long as the funds to be spent for that type of product remain constant.

Rotterdam model: A specific functional form for a demand equation. It is functionally related both to the budget share for the type of product being demanded and to the prices of the competing products within this product type.

Conditional income elasticity: The gain in quantity (expressed as a percentage) from a specific supplier with a 1-percent increase of imports of a product into a region. This elasticity depends on the funds remaining constant which have been allocated to import that type of product. This measure is also referred to as the Conditional Divisia elasticity (Theil, 1980).

Slutsky price elasticity: A number which indicates the percentage response in quantity supplied to a percentage change in price holding real expenditure on apples constant.

Cournot price elasticity: Same as Slutsky except nominal expenditures on apples are held constant.

Frisch price elasticity: Same as Slutsky except that the utility of expenditures on apples is held constant.

Apple Import Demand

Four Markets for U.S. Fresh Apples

Amy L. Sparks
James L. Seale, Jr.
Boyd M. Buxton*

Introduction

The farm value of U.S. apple production was over $1 billion in 1989. Apples were the third most valuable fruit crop in the United States (after grapes and oranges). Apples are widely produced across the country; however, 10 States accounted for 89 percent of the 1989 crop. The top three States (Washington, New York, and Michigan) produced 69 percent of the 1989 apple crop. The remaining seven States, in the order of level of production, were California, Virginia, Pennsylvania, North Carolina, Oregon, Idaho, and Ohio.

Due to heavy plantings in the late 1970's and early 1980's, U.S. apple production has increased in recent years and is expected to continue to increase for at least a few more years. The increased domestic production has outstripped demand, putting downward pressure on prices. In the 1988/89 marketing year, 6 percent of domestic production was exported (Sparks, Mar. 1989). At the same time, production of apples also expanded dramatically in other major producing countries (table 1). Unless domestic demand or exports increase, U.S. apple producers may face lower prices which might cause many producers to leave the business. Because of the emerging world supply and demand situation, the United States will face strong competition for international markets (Sparks, Mar. 1989 and May 1989).

Although apples are an important fruit crop in both domestic and international trade, there is little research available regarding the economics of import demand for this commodity. Two studies, one by Roberts and Cuthbertson and the other by Atkin and Blandford, concerned themselves with the United Kingdom market, although neither dealt with the United States as a supplier.[1]

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[1]The article by Roberts and Cuthbertson, using data from 1959 through 1969, maintained that Australia was declining in importance as a supplier to the United Kingdom and that this trend would likely continue and intensify. As we did not consider Australia to be a major supplier to the United Kingdom from 1962 through 1987 and did not even use it in our estimations, we would agree with these authors. In the other study, Atkin and Blandford identified an increase in the importance of France as a supplier to the United Kingdom using data from 1973 to 1979. Our data, which covered from 1962 to 1987, also identified a major increase in the importance of France as a supplier to the United Kingdom.

Table 1--Supply and utilization of apples in selected countries, marketing years 1976/77 and 1988/89

Country/ marketing year	Total production	Domestic consumption	Imports	Exports	Processing
		Metric tons			
Australia:					
1976/77	301,551	171,871	0	44,900	84,780
1988/89	344,000	179,000	0	23,000	142,000
Chile:					
1976/77	132,500	111,397	0	29,203	5,000
1988/89	650,000	141,000	0	330,000	179,000
China:					
1976/77	1,730,000	1,647,300	0	82,700	0
1988/89	--	--	0	--	--
France:					
1976/77	1,597,970	1,072,800	119,700	569,900	75,000
1988/89[1]	1,925,600	1,037,700	107,300	623,200	160,000
New Zealand:					
1976/77	145,546	55,476	908	66,632	24,346
1988/89	352,000	53,000	1,734	174,280	126,454
South Africa:					
1976/77	288,561	84,926	0	119,107	84,528
1988/89	490,000	170,000	0	200,000	120,000
United States:					
1976/77	2,985,725	1,706,266	47,775	120,063	1,157,171
1988/89	4,153,800	2,276,815	116,135	249,238	1,743,882

-- = Not available.
[1]In 1988/89, France withdrew 212,000 metric tons of apples from the market.
 Source: U.S. Department of Agriculture, Foreign Agricultural Service, Horticultural Products Review, Aug. 1987 and Nov. 1989.

This report examines the competitive relationship between the United States and other exporting countries in four major foreign markets for fresh apples. The objectives are:

(1)   To evaluate the probable changes in the U.S. market share as total expenditures (demand) for imported apples expand or contract in the major markets of Canada, Hong Kong, Singapore, and the United Kingdom.

(2)   To measure the price responsiveness of exports from the United States and its major competitors to these four historically important foreign U.S. markets.

(3)   To measure the cross-price relationships between U.S. and foreign apple exports to these markets.

World Apple Situation

A short consideration of U.S. exports of apples and of major U.S. competitors will be followed by a closer look at the four selected major markets.

2

U.S. Exports of Fresh Apples

Although they represented only a quarter of total world apple imports, these four markets (Canada, United Kingdom, Hong Kong, and Singapore) accounted for 56 percent of U.S. apple exports in 1987. In 1987, 36.8 percent of U.S. apple exports went to Canada, 10.9 percent to Hong Kong, 4.6 percent to the United Kingdom, and 3.2 percent to Singapore (fig 1). Taiwan is another major U.S. export market, capturing 16.1 percent of U.S. apple exports in 1987. However, because Taiwan restricts imports of non-U.S. apples, this market was not included in the study. This study focuses on Canada, the United Kingdom, Hong Kong, and Singapore because of their relative importance to the United States.
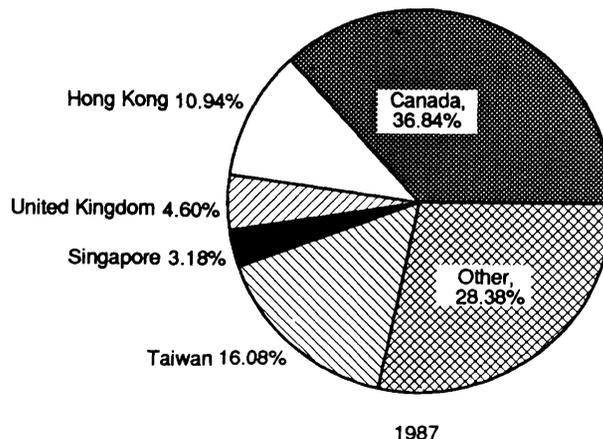
U.S. Competition in Major Fresh Apple Markets

The relative importance among suppliers to Canada, the United Kingdom, Hong Kong, and Singapore has changed many times since 1963. The following section reviews some of these changes. The observed changes reflect the competitive position among alternative suppliers, including the United States, and also reflect trade restrictions that alter trade flows and prices.

<u>Canada</u>

Canadian apple imports trended upward over the 1962-87 period, with the United States as the dominant supplier (fig 2). However, U.S. exports to Canada dropped sharply from 1981 to 1985. This decline reflected both a decline in total Canadian imports and an increase in imports from New Zealand, South Africa, and Chile. Canadian imports of U.S. apples rose sharply from 1986 to 1987 following the record large apple crop in North America in 1987, with consequent low prices both in the United States and in Canada. Under the Canadian Special Imports Measures Act, SIMA, the Canadian Government constructed a normal value for U.S. apples and, in 1988, imposed anti-dumping restrictions on apple imports from the United States. The normal value is a constructed cost of production plus a reasonable profit which, in SIMA, was defined as 8 percent. Canada claimed that during part of the 1987 marketing

Figure 1
Destination of U.S. apple exports

Hong Kong 10.94%
Canada, 36.84%
United Kingdom 4.60%
Singapore 3.18%
Other, 28.38%
Taiwan 16.08%

1987

season some U.S. apples were sold below that normal value, constituting dumping. The restrictions consist of minimum price requirements rather than quantity restrictions.
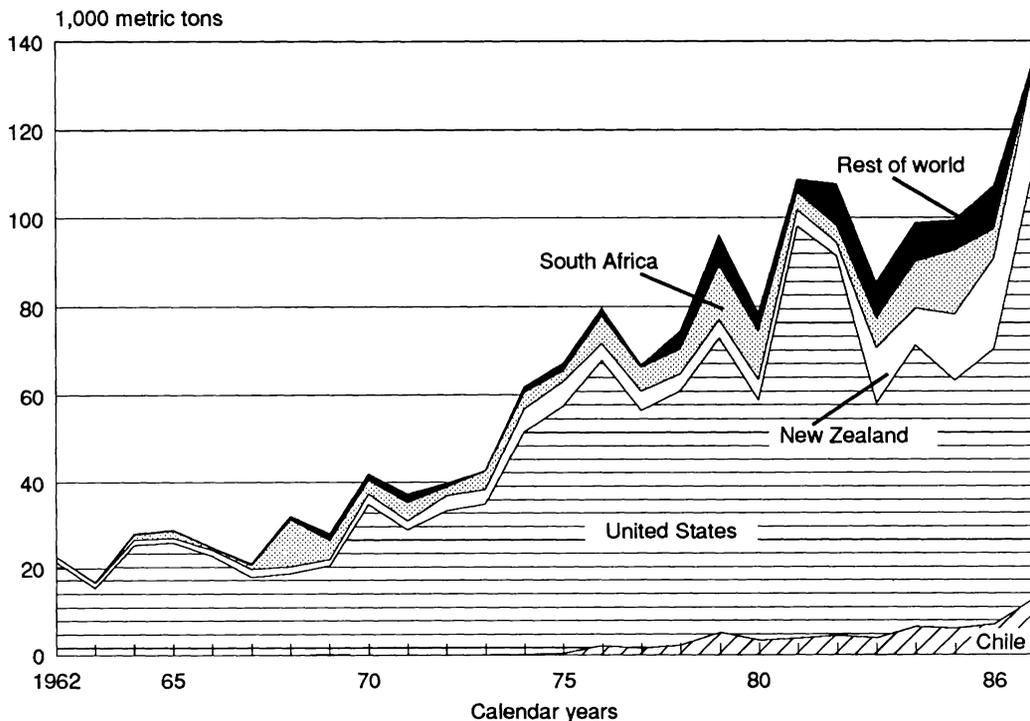
Hong Kong

Total world imports of fresh apples into Hong Kong rose sharply in the 1960's before leveling off during the 1970's and declining in the early 1980's (fig. 3). Imports rebounded in 1987. The major changes in the Hong Kong apple market were brought about by the decline of imports from China and the increase in imports from the United States. By 1980, the United States had replaced China as the major supplier. In recent years, Chile has become the second leading supplier. Minimal trade restrictions exist for apple imports in Hong Kong.
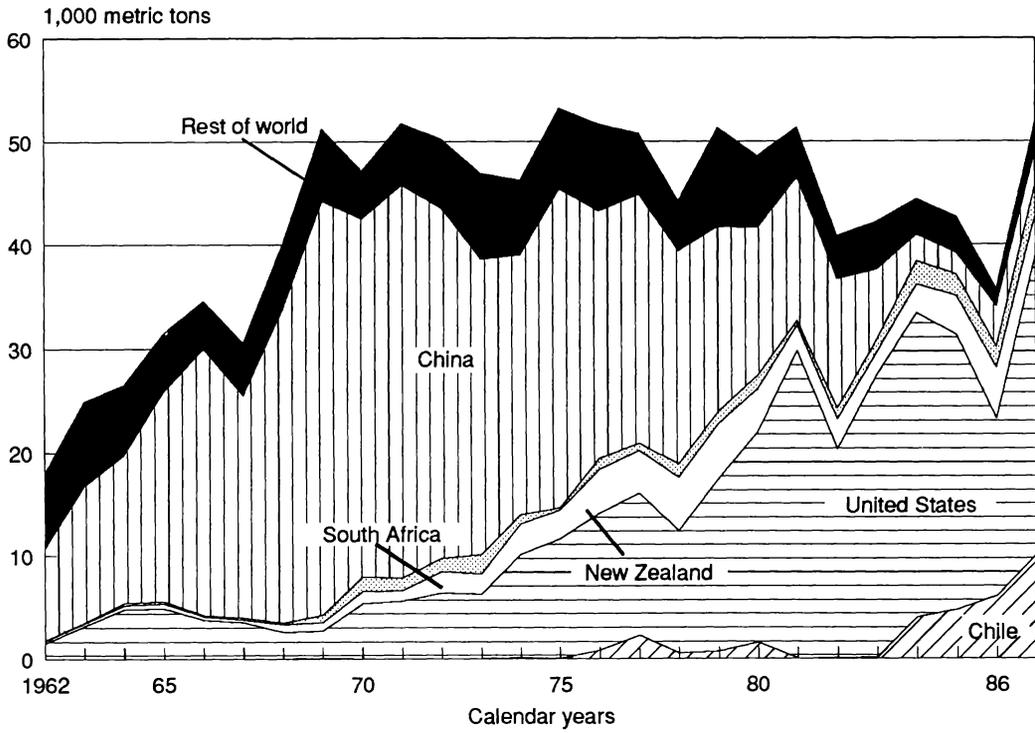
Singapore

Although Singapore is a growth market for U.S. apples, it accounted for less than 5 percent of total U.S. apple exports in 1988. Total imports into Singapore of fresh apples from all sources reached a peak in 1981 but have declined sharply since (fig. 4). China was an important supplier until about 1970, when its exports to Singapore dropped significantly. The United States and Australia were the largest suppliers in 1987. U.S. exports rose from almost nothing in 1970 to more than 12,000 metric tons in 1984 and 1985. From 1985 to 1987, U.S. exports declined and exports from Australia rose. The major competitors for the United States are now New Zealand and Australia. Chile has not been a significant supplier. Singapore, like Hong Kong, places minimal trade restrictions on apple imports.

Figure 2
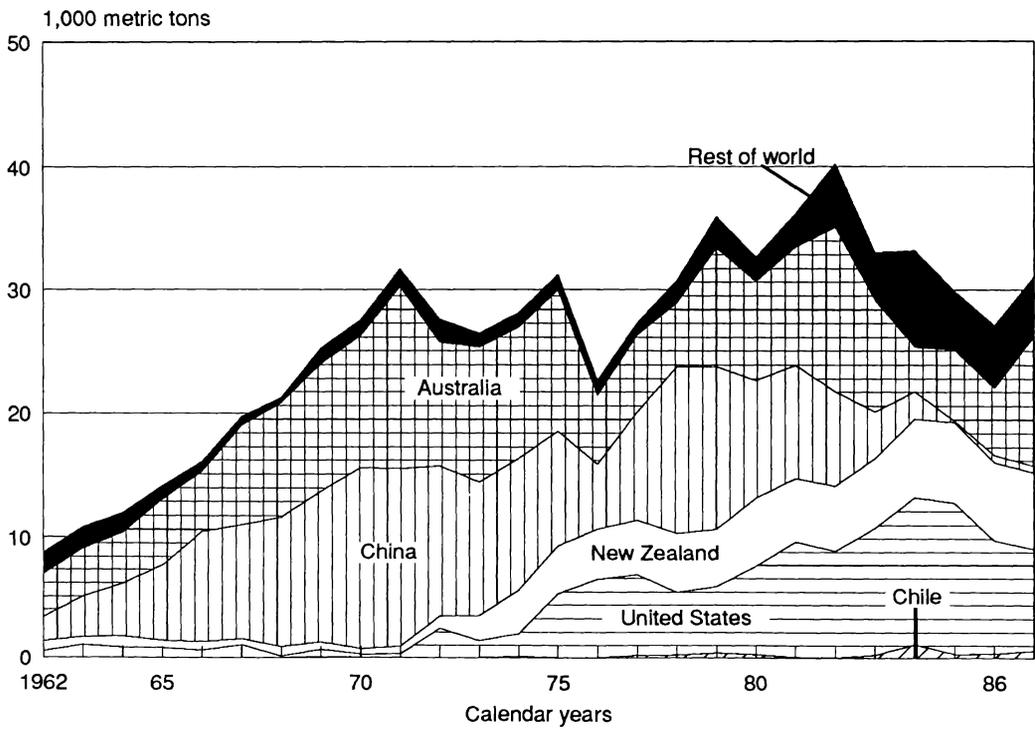Canadian apple imports

Source: United Nations trade data.

4

Figure 3
Hong Kong apple imports

1,000 metric tons

Source: United Nations trade data.

Figure 4
Singapore apple imports

1,000 metric tons
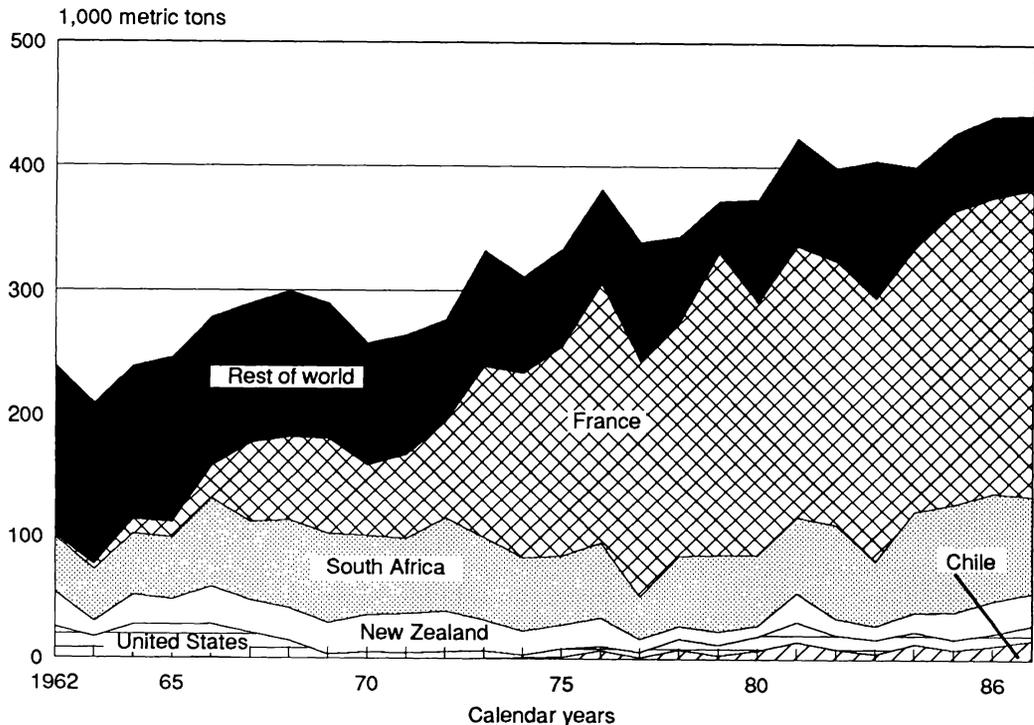

Source: United Nations trade data.

United Kingdom

Fresh apple imports to the United Kingdom have shown a marked upward trend for the entire 1962-87 period (fig. 5). In 1987, the United Kingdom accounted for 6.8 percent of total U.S. fresh apple exports. However, the United States is a relatively small supplier of this country's total imports. Imports to the United Kingdom from France grew from almost nothing to 56 percent of total United Kingdom imports in 1987. Imports from South Africa, the second leading supplier to the United Kingdom, have remained quite stable over the 1962-87 period.

The United Kingdom, a member of the European Community (EC), follows the Common Agricultural Policy (CAP) for agricultural imports. When agricultural commodities are imported, they must be priced at or above a reference price determined by the CAP. If they are not, the products are assessed a levy or tariff equal to the difference between the import and reference prices. U.S. apples generally do not conflict with this trade barrier. They are usually priced higher than the reference price because of their high quality.

In 1988, the EC instituted a quota on apple imports. While the quota was aimed at Southern Hemisphere suppliers, who had been among the major suppliers to the EC, the quota also had a detrimental effect on U.S. apple exports. The U.S. Government took the issue to the General Agreement on Tariffs and Trade (GATT). A ruling was passed against the quota. Since then, the quota has not been reapplied. The EC has negotiated bilateral voluntary restraint agreements with the Southern Hemisphere suppliers, Chile, South Africa,

Figure 5
United Kingdom apple imports

Source: United Nations trade data.

6

Australia, and Argentina. No voluntary restraint agreement has been made with the United States, the residual supplier in the EC.

Exports from Chile Expand

Apple production in Chile grew from 132,500 metric tons in 1976/77 to 650,000 in 1988/89. Most of this production was for export; consumption in Chile had increased only to 141,000 metric tons in 1988/89. Chile began exporting significant quantities of apples in the mid- to late 1970's. Although its role in the international markets is still relatively small, Chile's importance is expected to increase when recently planted trees come into bearing age and as production levels continue to rise. Future trade in all four of the major U.S. export markets will be determined to a major degree by how Chilean apples fare in these markets.

Theoretical Background

World trade in fresh apples is determined by a complex set of factors. Trade restrictions can distort prices and quantities that would result from a purely competitive trade environment. However, it is assumed that competitive forces dominate apple trade and that changes in trade patterns are largely determined in competitive world markets. On these assumptions, an econometric model has been developed here to help evaluate the competitive position of the United States in regard to other suppliers and to measure the potential growth of U.S. apple exports to major U.S. foreign markets. This model uses three primary factors to explain market shares of competing suppliers: (1) the import price for U.S. apples, (2) the import price for apples from competing countries, and (3) the total expenditures for apples in the market.

Methodology

Recent research concerning demand as it is distinguished by place of production has proved a catalyst for empirical studies on trade that are based on demand theory (Armington; Figueroa; Sarris; Sparks, 1987). Armington used a two-stage budgeting process in which a country first allocates total expenditures among competing goods, and second allocates the given expenditure for a specific product among the competing supply countries. Products, in this framework, are distinguished by their place of production. Fresh apples from different supply countries, for example, are treated as different products.

This report uses a systemwide approach to import allocation to estimate a country's demand for apples under the assumption that preferences are block independent (Theil and others, 1989). In particular, a two-stage budgeting process is assumed where a country allocates total import expenditures among different imported products including fresh apples and then allocates total apple import expenditures among the competing supply countries. These estimated demand relationships in the second step are called "conditional" because they depend on the level of expenditures allocated to total apple imports in each market.

The absolute version of the Rotterdam model is chosen to fit the data for each of the four import markets. The data are United Nations trade data which give the quantity and value of fresh apple imports by origin of each of the four

markets over the 1962-87 period.[2] From these data, the most important suppliers in 1987, including the United States, are identified so as to account for at least 80 percent of the total imports to each market. Imports from all remaining countries have been aggregated here into a "rest of world" category. (See the Glossary for a more detailed definition of these terms.)

The model for a specific market is shown in the following system of equations:

$$(W^*_{it} * Dq_{it}) = \phi_i * DQ_{gt} + \Sigma_j \pi^*_{ij} * Dp_{jt} + e^*_{it,}$$

where:

g = import market,

i,j = supply regions (countries),

t = time (in years),

q_{it} = quantity of apples imported from country i during time t,

Dq_{it} = log $(q_{it}/q_{i,t-1})$,

W_{it} = value share of apples imported from country i during time t,

W^*_{it} = $(W_{i,t-1} + W_{it})/2$ = 2-year value share average of apples imported from country i,

DQ_{gt} = $\Sigma_i(W^*_{it} * Dq_{it})$,

W^*_{gt} = $\Sigma_i W^*_{it}$ = total value of apples imported by region g in time periods t and t-1,

P_{it} = import price of apples from supplier i,

Dp_{it} = log $(P_{it}/P_{i,t-1})$,

π^*_{ij} = the conditional Slutsky price coefficient between the ith and jth supply regions,

e^*_{it} = disturbance term,

ϕ_i = conditional marginal budget share of country i's apple imports.

Restrictions resulting from demand theory imply that $\Sigma_i \phi_i = 1$ (budget shares for the g market's supply regions sum to one) and $\Sigma_j \pi^*_{ij} = 0$. Symmetry requires that $\pi^*_{ij} = \pi^*_{ji}$ (the estimated price parameters between the ith and jth supply regions are symmetric). For example, in a given market, the coefficient on the U.S. price in the New Zealand equation is symmetric to the coefficient on the New Zealand price in the U.S. equation (Lee and others, 1990; Theil, 1976).

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[2]Canada is an exception. Due to missing data, only the years 1963-86 were used in the market's demand estimations.

Three measures of price elasticities are possible using the Rotterdam model: Cournot, Slutsky, and Frisch (see Glossary). The relationships among these three measures can be explained with the standard indifference curves used in demand theory. The Cournot price elasticity reflects both the substitution and income effects; nominal expenditures on apples are held constant. The Slutsky price elasticity reflects an income compensation to allow consumers to achieve the same bundle of goods after (as before) the rise in price; real expenditures on apples are held constant. The Frisch price elasticities reflect only the substitution effect. All three measures are calculated from the estimated price coefficients in the Rotterdam model, usually referred to as Slutsky price coefficients. The Cournot price elasticities are reported in this study because they are the most consistent with the assumption of holding total expenditures constant in the two-stage budgeting procedure used.

Also calculated from the estimated Slutsky price coefficients and the coefficients on expenditures is a measure of how the quantity of apples from each alternative supplier would be expected to change in response to a change in imports of apples into a market. This measure is called the "conditional income elasticity."

Estimation Results

The following sections review the estimation results. First to be considered are those for the demanding regions of Canada, Hong Kong, Singapore, and the United Kingdom. Implications of the Cournot price and conditional income elasticities are discussed with respect to U.S. competitiveness in these markets. The concluding section deals with the implications of the estimated coefficients when a dummy variable is used to represent Chile's entrance into world apple markets.

Canada

The conditional income elasticities indicate that for a 1-percent increase in imports, those from South Africa and the rest of the world (ROW) will increase by 1.4 and 0.6 percent, respectively (table 2). As the Canadian market grows, South Africa will increase its import share, while ROW will decline. However, in 1987 Canada ceased its imports from South Africa for political reasons. As the data used in this study cover the 1963-86 period, the 1987 data do not reflect these new conditions. The conditional income elasticity for the United States, at 1.04, indicates that the United States will basically maintain its share of the Canadian market as that market grows. All income elasticities are statistically significant at least at the 90-percent confidence level.

The own-price elasticities for each of the suppliers into the Canadian market are negative and statistically significant at the 99-percent confidence level except that of the ROW, which is significant at approximately the 80-percent confidence level. This indicates that as the prices of U.S., South African, and ROW apples increase, the quantities demanded of these apples in the Canadian market will decline. All of these elasticities are inelastic, indicating that the percentage response in quantity will be less than that in price.

Cournot elasticities indicate that the responses in the demand for U.S. apples to price increases for apples from the ROW are negative and statistically

Table 2--Conditional income and price elasticities of demand for imported fresh apples in Canada, 1963-86[1]

i/j	United States	South Africa	Rest of world
Cournot price elasticities:			
United States	-0.90 (.07)[2]	-0.03 (.03)	-0.11 (.07)
South Africa	-.52 (.55)	-.85 (.25)	-.18 (.25)
Rest of world	-.22 (.25)	-.03 (.10)	-.46 (.37)
Conditional income elasticities	1.04 (.10)	1.38 (.70)	.63 (.38)

[1]Elasticities calculated at sample means.
[2]Asymptotic standard errors in parentheses.

significant at the 90-percent confidence level. This is evidence that, in the Canadian market, U.S. apples are complements to apples from the ROW. The cross-price elasticities for South African apples are statistically insignificant.

Hong Kong

The estimation results for the Hong Kong market are set forth in table 3. The conditional income elasticities indicate the United States as the strongest competitor. At 1.16, the United States will increase its share in Hong Kong as this market grows. China has an elasticity slightly greater than one, indicating that it will slightly increase its share. The ROW's market share will decline as the Hong Kong market grows. These three elasticities are statistically significant at the 99-percent confidence level, although that for South Africa is statistically insignificant. This elasticity, therefore, cannot be interpreted as different from zero.

The Cournot own-price elasticities for all suppliers are negative and are all statistically significant at at least the 90-percent confidence level except for the ROW, which is insignificant. The Cournot own-price elasticities for the United States and South Africa are elastic. The quantity response to a change in the price of these apples will be larger as to percentage than was the original price change.

Cournot cross-price elasticities indicate that U.S. apples are substitutes for Chinese apples. This positive elasticity is significant at the 95-percent confidence level. As the price of Chinese apples increases, the demand for U.S. apples will also increase. The price of apples from the ROW and South Africa do not affect the demand for U.S. apples because these elasticities are not significantly different from zero.

Singapore

Table 4 details the estimation results for Singapore. Conditional income elasticities indicate that Australia is the strongest competitor. With an elasticity of 1.5, Australia will increase its exports to Singapore by approximately 1.5 percent for every 1-percent increase in fresh apple imports. The ROW and China follow with elasticities of 1.11 and 1, respectively. The

Table 3--Conditional income and price elasticities of demand for imported fresh apples in Hong Kong, 1963-87[1]

i/j	United States	China	South Africa	Rest of world
Cournot price elasticities:				
United States	-1.52 (.32)[2]	0.50 (.27)	-0.01 (.09)	-0.14 (.38)
China	.84 (.31)	-.71 (.44)	-.18 (.10)	-.97 (.36)
South Africa	.11 (1.03)	-1.45 (.91)	-2.15 (1.09)	2.93 (1.41)
Rest of world	-.04 (.37)	-.75 (.29)	.27 (.12)	-.31 (.55)
Conditional income elasticities	1.16 (.27)	1.02 (.37)	.55 (.79)	.82 (.29)

[1]Elasticities calculated at sample means.
[2]Asymptotic standard errors in parentheses.

United States, with a conditional income elasticity of 0.93, will not quite maintain its share in the Singapore market as that market grows. All of these elasticities are statistically significant at the 97-percent confidence level. New Zealand's conditional income elasticity in the Singapore market is statistically insignificant.

The Cournot own-price elasticities for each of the suppliers into the Singapore market are negative and statistically significant at at least the 97-percent confidence level. As is the case with Canada, if the prices of apples from the United States, New Zealand, China, Australia, and the ROW increase, the quantities demanded of these apples in Singapore will decline. The U.S. own-price elasticity is elastic; those for all other suppliers are inelastic.

Cournot cross-price elasticities indicate U.S. apples to be complements to those from New Zealand. This elasticity is significant at the 95-percent confidence level. All other cross-price elasticities with U.S. apples are statistically insignificant.

United Kingdom

Estimation results for the United Kingdom are presented in table 5. Conditional income elasticities indicate that the United States is a strong competitor in this market. At 2.8, this elasticity indicates that for a 1-percent increase in imports, the United States will increase its exports to the United Kingdom by 2.8 percent. New Zealand, with an elasticity of 2, is also a strong competitor. France and South Africa will increase their shares as the United Kingdom market grows. All of these elasticities are significant at at least the 97-percent confidence level. The elasticity for the ROW is not significantly different from zero.

All Cournot own-price elasticities of the suppliers of the United States, New Zealand, South Africa, France, and the ROW are negative. They are also statistically significant at the 90-percent confidence level except that of

11

Table 4--Conditional income and price elasticities of demand for imported fresh apples in Singapore, 1963-87[1]

i/j	United States	New Zealand	China	Australia	Rest of world
Cournot price elasticities:					
United States	-1.24 (.35)[2]	-0.31 (.17)	0.27 (.25)	0.35 (.25)	-0.00 (.16)
New Zealand	-.20 (.25)	-.73 (.25)	.60 (.27)	.03 (.23)	.62 (.19)
China	.27 (.27)	.25 (.19)	-.78 (.34)	-.49 (.21)	-.26 (.19)
Australia	.08 (.16)	-.24 (.10)	-.35 (.12)	-.96 (.16)	-.03 (.08)
Rest of world	-.05 (.36)	.69 (.27)	-.54 (.39)	.01 (.29)	-1.26 (.37)
Conditional income elasticities	.93 (.43)	-.33 (.38)	1.00 (.37)	1.50 (.26)	1.14 (.49)

[1]Elasticities calculated at sample means.
[2]Asymptotic standard errors in parentheses.

Table 5--Conditional income and price elasticities of demand for imported fresh apples in the United Kingdom, 1963-87[1]

i/j	United States	New Zealand	South Africa	France	Rest of world
Cournot price elasticities:					
United States	-1.02 (.56)[2]	0.04 (.25)	-0.80 (.85)	-0.90 (.53)	-0.17 (.85)
New Zealand	.06 (.15)	-.39 (.14)	-.12 (.37)	-.71 (.29)	-.84 (.41)
South Africa	-.08 (.14)	-.02 (.10)	-.58 (.44)	-.42 (.23)	-.11 (.39)
France	-.03 (.06)	-.07 (.06)	-.20 (.16)	-.47 (.21)	-.10 (.20)
Rest of world	.10 (.11)	-.06 (.08)	.17 (.30)	.17 (.21)	-.44 (.40)
Conditional income elasticities	2.85 (1.15)	2.00 (.67)	1.17 (.51)	1.29 (.38)	.06 (.42)

[1]Elasticities calculated at sample means.
[2]Asymptotic standard errors in parentheses.

the ROW, which is insignificant. That of the United States is unitary elastic; those of all others are inelastic.

Cournot cross-price elasticities show U.S. apples to be complements to French apples. This elasticity is significant at the 90-percent confidence level.

All other cross-price elasticities for U.S. apples are statistically insignificant.

Impact on the United States of Chile's Participation in World Apple Markets

To assess the impact of Chile's participation on U.S. competitiveness in its four primary apple markets, the four systems of equations were reestimated. A dummy variable with zero values from 1963 to 1973 (when Chile was not a supplier) and a value of one from 1974 to 1987 (when Chile was a supplier) was multiplied by the expenditure variable. The significance of the coefficient on the dummy variable was used as a test of whether the entrance of Chile as a world supplier of fresh apples affected the conditional marginal shares of the United States in each of the four markets. In all markets except Hong Kong, the coefficient on the dummy variable was insignificant at the 95-percent confidence level. This is evidence that the competitiveness of the United States in Canada, Singapore, and the United Kingdom has been as yet unchanged by the emergence of Chile as a supplier to these markets. In Hong Kong, the coefficient on the dummy variable was significant at the 95-percent confidence level. This result is due to the dramatic shifts in the relative importance of suppliers in Hong Kong; from 1974 to 1987, the United States dramatically increased its share of the Hong Kong market, primarily at the expense of China, which, by 1987, was almost excluded. These changes, rather than Chile's entrance into this market, affect the finding of statistical significance for the dummy variable for 1974-87; Chile is a rather minor exporter of fresh apples to Hong Kong.

Conclusions and Implications

In order to sell both the current production and the increasing future production of apples at a profitable price, the United States needs to strengthen demand for its product. As domestic consumption is staying relatively stable, overseas markets may be an avenue through which the United States can market its apples. Estimation results using the Rotterdam model indicate that as the United Kingdom and Hong Kong markets grow, the United States will increase its share in these markets. (In this estimation, Chile is considered with the rest of the world.) As the Canadian and Singapore markets grow, the United States will increase its exports to them but not enough to increase its market share. In another set of estimations, using a dummy variable to account for Chile's entrance into world apple markets, U.S. competitiveness was structurally unchanged in all markets except Hong Kong. In this case, the increased strength in the U.S. competitive position is probably due to the exit of China rather than the entrance of Chile. It appears that the entrance of Chile has not had a strong influence on the overseas markets for U.S. apples.

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Appendix

The following is the calculation of Slutsky, Cournot, and Frisch price elasticities as well as conditional income elasticities.

Slutsky price elasticity:

$$S_{ij} = \pi_{ij} \; / \; w_i,$$

where π_{ij} = Slutsky price parameter,

w_i = the average budget share of supplier i in market g.

Cournot price elasticity:

$$C_{ij} = S_{ij} - \phi_i \; (w_j \; / \; w_i),$$

where ϕ_i = estimated expenditure parameter for supplier i,

w_j = the average budget share of supplier j in market g.

Frisch price elasticity:

$$F_{ij} = V_{ij} \; / \; w_i,$$

where $V_{ij} = \pi_{ij} + (\; \Theta_{gg} * \phi_j * \phi_i),$

Θ_{gg} = Frisch own-price import elasticity for apples,

ϕ_j = expenditure parameter on j.

Conditional income elasticity:

$$CD_i = \phi_i \; / \; w_i,$$

where ϕ_i = expenditure parameter for supplier i,

w_i = the average budget share of supplier i in region g.

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