

**A GEOGRAPHIC ROTTERDAM IMPORT  
ALLOCATION MODEL TO  
INTERNATIONAL TRADE  
IN BANANAS**

**By**

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**1990**

**Submitted to the Faculty of the  
Graduate College of the  
Oklahoma State University  
in partial fulfillment of  
the requirements for  
the Degree of  
MASTER OF SCIENCE  
May, 1993**

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ALLOCATION MODEL TO  
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## PREFACE

An absolute price version of the Rotterdam model is estimated for imported bananas in the United States, the European free market, Italy and Japan. This study is divided into three papers that are being submitted for publication. The first one deals with the United States as a major banana importer worldwide. In the second paper, the model is used to explain the competitive relationship among major Latin American banana suppliers and other Latin American competitors worldwide in four selected banana markets. The third paper is in Spanish, and focuses on the competitive position of Costa Rica (a major banana exporter in Latin America) in the world banana market.

I wish to acknowledge the helpful advice of my advisor, Dr. David Henneberry, and Dr. Amy Sparks in developing the model and some of the ideas underlying this study. The author is indebted to Jorge Torres Hernández for providing access to very useful information. I would like to thank Dr. Francis Applin and Dr. Joseph Williams, members of my committee, for their helpful comments. I am also grateful to Gary Livingston for helpful suggestions. My deepest appreciation to Jenny Juárez for her participation in translating one paper to Spanish and editing this study.

## TABLE OF CONTENTS

Paper	Page
I. U.S. BANANA IMPORT DEMAND . . . . .	1
U.S. Market Structure . . . . .	3
Method . . . . .	6
Empirical Results . . . . .	10
Conclusions and Implications . . . . .	14
References . . . . .	16
II. A ROTTERDAM APPLICATION TO INTERNATIONAL TRADE IN BANANAS: FOUR MARKETS FOR LATIN AMERICAN BANANAS . . . . .	27
World Banana Imports . . . . .	29
Method . . . . .	33
Empirical Results . . . . .	37
Conclusions and Implications . . . . .	41
References . . . . .	43
III. EVALUACION DE LA COMPETENCIA Y EL POTENCIAL EXPORTADOR DE BANANOS DE COSTA RICA . . . . .	53
Importaciones mundiales de banano . . . . .	55
Método . . . . .	59
Resultados . . . . .	64
Conclusiones e implicaciones . . . . .	67
Bibliografía . . . . .	69

## LIST OF TABLES

### Paper I

Table	Page
1. Value of U.S. Imports of Major Fruits in Millions of Dollars (1961-1990) . . . . .	22
2. U.S. Banana Imports by Region in Thousands of Dollars (1962-1990) . . . . .	23
3. Growth Rates of U.S. Banana Import Values . . . . .	24
4. Rotterdam Model Parameter Estimates for U.S. Banana Imports (1964-1989) . . . . .	25
5. Expenditure and Price Elasticities of U.S. Import Demand for Bananas by Source Estimated at Sample Means, 1964-1989 . . . . .	26

### Paper II

Table	Page
1. World Imports of Three Major Fruits: Bananas, Oranges and Apples (Thousands of Metric Tons) 1962-1989 . . . . .	44
2. World Banana Import Values by Origin, Thousands of Dollars (1962-1989) . . . . .	45
3. Latin American Banana Production by Region, in Thousands of Metric Tons (1961-1990). . . . .	46
4. Selected Rotterdam Model Statistics for Four Banana Import Markets . . . . .	47
5. Conditional Income and Own-Price Elasticities of Demand for Bananas in the United States, the European Free Market, Japan and Italy, 1962-1989 . . . . .	48

Paper III

Table	Page
1. Importaciones mundiales de tres principales frutas: bananos, naranjas y manzanas (miles de toneladas métricas) 1962-1989. . . .	70
2. Banano: producción de Costa Rica, América Latina y el mundo, en miles de toneladas (1962-1989) . . . . .	71
3. Exportaciones totales de banano y café y su participación en las exportaciones totales y agrícolas, 1962-1989 . . . . .	72
4. Costa Rica: importaciones de banano desde tres mercados de importancia internacional en millones de dólares y porcentajes (1962-1989) . . . . .	73
5. La elasticidad ingreso y la elasticidad precio de las importaciones de banano desde Costa Rica en tres mercados.(promedios) . . .	74

## LIST OF FIGURES

### Paper I

Figure	Page
1. U.S. Banana Consumption, per Capita (1961-1990) . . . . .	17
2. Volume, Total Value and Unit Value (Current and Real) of U.S. Banana Imports (1961 - 1990) . . . . .	18
3. U.S. Banana Import Market Shares (1962-1990) . . . . .	19
4. Index of U.S Banana Import Value by Major Exporters, 1980=100 (1962-1990) . . . . .	20
5. U.S. Banana Import Unit Values by Main Regions of Origin, Cents per Pound (1964-1990) . . .	21

### Paper II

Figure	Page
1. U.S. Banana Import Market Shares (1962-1990) .	50
2. Banana Market Shares for the European Free Market 1962-1989 . . . . .	51
3. Japanese Banana Market Shares, 1962-1989 . . .	52
4. Italian Banana Market Shares (1962-1989) . . .	53

### Paper III

Figura	Page
1. Exportaciones de banano y café en millones de dólares, 1962-1989 . . . . .	75
2: Costa Rica Importaciones de banano desde tres mercados principales . . . . .	76

## PAPER I

### U.S. BANANA IMPORT DEMAND

Banana consumption in the United States has been growing rapidly. The United States now consumes more bananas than apples and imports more bananas than any other fruit (table 1). Per capita banana consumption has increased over the period 1961-1990 (figure 1). Between 1982 and 1987, banana consumption increased 13% (from 5.7 billion pounds to more than 6.4 billion pounds) (McClure, B., 1988). U.S. imports have steadily increased over 1961-1990 with an average annual growth rate of 9.4 per cent (see table 1). Banana imports have increased despite the irregular behavior of banana import prices (figure 2). The United States ranked first among major world banana importers, accounting for 27% of world banana imports in 1990. More than 95% of U.S. banana imports come from Latin America.

Although bananas account for a large percentage of fruit consumption in the U.S., there is little research available regarding the economics of import demand for this commodity. Recently, several empirical studies have focused on the demand for fresh fruit for which the United States is an important exporter (Seale, 1992; Sparks, 1992; and Thompson and Conklin, 1990). None has dealt with the demand



for bananas, perhaps because U.S. banana production is very small (less than 1% of total consumption).

For some countries, banana exports comprise a significant proportion of the country's total exports, so economic information on the behavior of the banana market are important for the planning process. Examples of such countries are Honduras, Costa Rica, the Caribbean, and Ecuador, for which banana exports account respectively for 37, 23, 22, and 17 per cent of total exports in 1990 (Inter-American Institute for Cooperation on Agriculture, 1992). In response to the increasing import demand for bananas, many countries are expanding their banana production. There is need to know what the competitive relationship among major banana exporters in the U.S. import market for bananas is. Economic information on the behavior of this commodity is useful to producers since a banana plantation begins to produce fruit continuously thirteen months after planting, and production can last from 10 to 20 years.

The purpose of this study is to determine the changes in market share of major Latin American banana exporters as total expenditures for imported bananas expands or contracts in the United States. The price responsiveness of exports from major banana exporters to the U.S. banana market, and the cross-price relationships between major exporters to the U.S. banana market are also estimated. The absolute price version of the Rotterdam model is estimated for U.S. banana imports. The exporting countries analyzed are Ecuador, Colombia, Costa Rica, Honduras, Panama and rest of the World

(ROW). Conditional income and price elasticities as well as graphs of prices and quantities are used to analyze the U.S. import market for bananas. This study may provide useful insights regarding past import behavior that are valuable in the decision making process.

### **U.S. Market Structure**

Table 1 lists all fruits imported by the United States over the period 1961-1990, in descending order of U.S. import value. Bananas ranked first, accounting for 58% of total fruit imports in 1990. The data show a long term increase in import growth rates of all fruits. Of the fruits listed in table 1, eight displayed an annual growth rate higher than 10%. Imports of bananas, coconuts, oranges, dates and other fruits experienced, however, a lower growth rate.

### **Value of Banana Imports**

The value of U.S. banana imports by country of origin is reported in table 2. There are 4 exporters of bananas to the U.S. market that exported more than \$150 million dollars in 1990. Ecuador with \$391 million is the largest U.S. supplier, followed by Costa Rica, Honduras, and Colombia. These countries' exports to the United States made up 82 per cent of total banana imports in 1990. Honduras was the second supplier until 1988 when Costa Rica took its place. Compared to other Caribbean countries, imports from the Dominican Republic were the largest. Central America appeared to be the region's leading exporter

of bananas up to 1989 when South America moved to first place. This is explained by the significant increase in exports by Ecuador (42%) and a decrease in exports from Honduras (19%) and Costa Rica (9%) from 1989 to 1990. In 1989, severe thunderstorms significantly reduced banana production in Central America.

### U.S. Market Shares

Figure 3 illustrates the trend in import shares of bananas in the United States. Panamanian market share declined from an average of 19 percent during the 1960's to only 1.6 per cent in 1990. This was compensated by an uptrend in the share of exports by Colombia between 1962 and 1987, moving from less than one per cent to 18.4 per cent. From that year forward, Colombian market share declined to 14.4% in 1990. Ecuador's market share fell from 41.8% in 1962 to 33.5 per cent in 1990. Ecuador had the most instability in market share among major exporters over the period (figure 3). The data on Costa Rican market share reveals more stability over time than any other major exporter of bananas to the United States. Costa Rican market share was, on average, 21% over the entire period, varying from 15.5% during 1962-1965 to 25.9 during 1971-75. On the contrary, Honduras market share displayed more variability over the period, showing the highest market share in 1976 (29.4) and the lowest in 1990 (15.8%).

## Growth Import Rates

The index of the value of U.S. banana imports and growth import rates are shown in figure 4 and table 3, respectively. Overall growth of U.S. imports was more rapid after 1976. This may reflect relative inflation rates more than real growth. The average annual growth rate of total imports was 10%. The highest growth rate of U.S. total imports of bananas for the time period of analysis was during 1976-1980 when imports increased an average of 20% annually. An exception to the rule is Colombia, which increased exports of bananas to the United States at an annual growth rate of 40 per cent. Colombia moved from exporting an average of \$17 thousand during 1962-1965 to \$168 million in 1990 (table 2). Ecuadorian banana exports to the United States decreased significantly during the second part of the 1960's, but have rebounded with an average growth rate of 11% per year. A significant increase happened after 1987, from \$218 million to \$391 million in 1990 (table 2). While total imports had steadily increased, the value of imports from Honduras showed negative growth in the period 1986-1990. Imports from Ecuador, however, increased significantly during the same period. Costa Rica, the second largest exporter of bananas to the United States after 1989, increased its exports following total growth closely.

## Import Unit Values

Import unit values of bananas purchased by the United States by region are displayed in figure 5. Import prices of bananas from the two major regions, South and Central America, gradually increased with total imports. More volatility of banana prices occurs among small suppliers, i.e. the Caribbean and North America. Bananas coming from Central America are more expensive than those from South America. This occurred despite the fact that the shipping cost of Central American bananas should be cheaper than the transportation cost of South American bananas. Bananas from the Caribbean were more expensive than bananas from any other region throughout the study period. Perhaps, this is the reason why banana import demand from the Caribbean is so low (table 2). The area of the units of production and yield per hectare in the Caribbean are smaller than in other countries in Latin America (Inter-American Institute for Cooperation on Agriculture, 1992).

### **Method**

Recent demand studies are based on a concept in which products can be distinguished by kind and place of production. Products are assumed to be imperfect substitutes. Goods are distinguished only by kind, and products are distinguished by both kind and place of production (Armington, 1969). Bananas from different suppliers are, therefore, treated as products.

The Absolute Version of the Rotterdam Model, under the assumption that preferences are blockwise dependent, was chosen to fit the data. The underlying theory of the Rotterdam Model has been explained in detail by Theil (1980) and Deaton and Muellbauer (1980). The theory is not repeated here. It is assumed that the process occurs in two stages. The first is the allocation of total expenditure on bananas and the second is the allocation of expenditure among different suppliers.

The absolute version of the Rotterdam model is specified as follows:

$$m_i = \alpha_i + \beta_i M_t + \sum \theta_{ij} p_{jt}^* + \mu_{it}$$

where:

- $i, j$  - supply regions (countries),
- $t$  - time (in years),
- $m_i$  -  $w_{it}^* q_{it}^*$
- $q_{it}$  - quantity of bananas imported from country  $i$  during time  $t$ ,
- $q_{it}^*$  -  $\log(q_{it}/q_{i,t-1})$
- $w_{it}$  - value share of bananas imported from country  $i$  during time  $t$ ,
- $w_{it}^*$  -  $(w_{it} + w_{i,t-1})/2$  = 2-year value share average of bananas imported from country  $i$ ,
- $M_t$  -  $\sum_i m_i$  = an index representing the proportional change in real total banana expenditure,
- $p_{it}$  - import price of bananas from supplier  $i$ ,
- $p_{it}^*$  -  $\log(p_{it}/p_{i,t-1})$
- $\alpha_i$  - constant term = annual change in the budget share in the absence of any change in real total banana expenditure or in relative prices
- $\beta_i$  - the conditional marginal budget share of country  $i$ 's banana imports.

$\theta_{ij}$  - the conditional Slutsky price coefficient between the  $i$ th and  $j$ th supply regions,

$\mu_i$  - disturbance term

The elasticities can be obtained as follows,

$e_{ij}^*$  -  $\theta_{ij}/\text{avg}(w_{it}^*)$  = Compensated price elasticities,

$e_{ij}$  -  $\theta_{ij}/\text{avg}(w_{it}^*) - \beta_i \cdot \text{avg}(w_{jt}^*)/\text{avg}(w_{it}^*)$  = Conditional Cournot price elasticities,

$n_i$  -  $\beta_i/\text{avg}(w_{it}^*)$  = conditional income elasticity

Since a two stage-budgeting process is assumed, the income elasticities ( $n_i$ ) obtained from this model are called conditional. The estimated demand relationships in the second stage depend on the level of expenditures allocated to total banana imports in the U.S. market.

A constant term is usually not included when estimating the Rotterdam model (Seale, Sparks and Buxton, 1992; Sparks, 1992; Deaton and Muellbauer, 1980; Mayes, 1981). This means that when expenditures and prices do not change from  $t-1$  to  $t$ , changes in demand will be equal to the disturbance term ( $\mu_{it}$ ) (Theil, 1978). In this study, a constant term ( $\alpha_i$ ) is included to measure the systematic effect of factors other than income and prices on banana imports.

The parameters in the Rotterdam model can be related to the restrictions of economic theory. The adding up condition is built into the model (Deaton and Muellbauer, 1980), implying that for all  $j$

$$\sum_i \beta_i = 1; \quad \sum_j \theta_{ij} = 0$$

Symmetry implies that for all  $i$  and  $j$

$$\theta_{ij} = \theta_{ji}$$

Finally, homogeneity holds if for all  $i$

$$\sum_j \theta_{ij} = 0$$

The data analyzed are United Nations trade data, which provide quantity and value of banana imports by origin for the U.S. market over

the period 1964-1989. From these data, the most important suppliers for the U.S. market were identified. The remaining imports were grouped into the category "rest of world" (ROW). For this model, Ecuador, Colombia, Costa Rica, Honduras, Panama and the Caribbean are the main suppliers, and they account for 89% of the total U.S. banana imports on average (table 2).

Iterative Seemingly Unrelated Regressions (ISUR) are used to estimate the Rotterdam model parameters. When the ISUR procedure is used, and if random errors follow a multivariate normal distribution, the estimator will be the maximum likelihood estimator (Judge, Hill, Griffiths, Lutkepohl and Lee, 1982). By leaving out an equation from the system (i.e., a supplier), model overspecification is avoided. If two equations are deleted, one at a time, the results should be identical. This holds because of the adding up condition. The parameters for the equation deleted can be recouped as follows (Seale et al., 1992),

$\beta_n = 1 - \sum_i \beta_i$  for  $i=1, 2, \dots, n-1$ , the adding up condition, and

$\theta_{in} = -\sum_j \theta_{ij}$  for  $i=1, 2, \dots, n-1$ , the homogeneity condition

### Hypothesis Testing

A  $X^2$  statistic is calculated and used to test the null hypothesis that all slope coefficients in the model are zero (White, Wong, Whistler and Haun, 1990):

$$X^2 = -T(\text{LOG}(1-R^2))$$

where T is the number of observations and  $R^2$  is the coefficient of multiple determination<sup>1</sup>.

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<sup>1</sup> This  $X_2$  is equivalent to the statistic obtained when performing a likelihood ratio test.



The approach used to find the appropriate specification of the model was to estimate the model without restrictions, then estimate the system imposing symmetry and homogeneity. To test the null hypothesis that symmetry and homogeneity hold, the Likelihood ratio test (LR) is used. LR is computed as the ratio of the constrained (imposing symmetry and homogeneity) to the unconstrained maximum likelihood (Kennedy, 1985). If the null hypothesis is true, twice the difference of the log likelihood functions (unconstrained and constrained) is asymptotically distributed as  $X^2$  with degrees of freedom equal to the number of restrictions imposed (Judge et al., 1982).

Standard errors for the Cournot price elasticities were estimated as the square root of:

$$\text{var}(e_{ij}) = \text{var}(\theta_{ij}) / (s_{it})^2 + \text{var}(\beta_1) * (-s_{jt} / s_{it})^2 + \text{cov}(\theta_{ij}, \beta_1) * (-s_{jt}) / (s_{it})^2,$$

where  $s_{it} = \text{avg}(w_{it}^*)$  and  $s_{jt} = \text{avg}(w_{jt}^*)$ , which were defined above.

Standard errors for the conditional income elasticities are the square root of:  $\text{var}(n_i) = \text{Var}(\beta_1) / (s_{it})^2$ .

A t-statistic is calculated to test the null hypothesis that a parameter estimate ( $\beta$ ) is equal to  $\beta_0$  against the alternative that  $\beta$  is different from  $\beta_0$ :  $t = (\beta - \beta_0) / \text{se}(\beta)$ , which has a  $t$  distribution with degrees of freedom equal to the number of observations minus the number of parameters estimated.  $\beta$  is the parameter estimate,  $\beta_0$  is any number and  $\text{se}(\beta)$  is the standard error of  $\beta$ . If the value of the statistic is greater than the critical value, one rejects the null hypothesis.

### Empirical Results

The null hypothesis of homogeneity and symmetry cannot be rejected at the 5% level, with a Likelihood ratio of 28.65 with 21 degrees of freedom. The null hypothesis that all parameters are equal to zero is

rejected at  $\alpha=0.01$  ( $X^2_{(27)}=82.44$ ).

### Conditional Income and Price Parameters

The conditional Slutsky parameter estimates ( $\beta_i, \theta_{ij}$ ) of the Rotterdam model are presented in table 4. Due to symmetry the top half is not shown. Along the diagonal are the own price parameters which are expected to be negative. As the price of banana imports from a supplying country increases, the amount of banana imports demanded from that country declines. The sign of the off diagonal Slutsky coefficients indicate substitution ( $\theta_{ij}$  greater than zero) or complementarity ( $\theta_{ij}$  less than zero) between bananas from different sources. Table 4 also shows the conditional marginal shares and their asymptotic standard errors. These estimates indicate the share of an additional dollar allocated among imported bananas suppliers when that dollar is added to expenditures on all banana imports.

All conditional marginal shares are positive except for those of Costa Rica and Colombia. Costa Rica has a negative and significant marginal share. Colombia, on the other hand, has a negative, but insignificant marginal share. If a good has a negative income elasticity (and hence negative marginal share), it is inferior. Inferior goods can occur under blockwise dependence, the assumption made in this study (Theil, 1980). Honduras, Ecuador and Panama have the largest estimated marginal import shares. Compared to the other suppliers, Honduras is closer to the U.S. banana market and has the largest estimated marginal import share. This reflects the importance of proximity of the supplier to the U.S. banana market. The Caribbean and ROW have insignificant marginal import shares.

All Slutsky own-price estimates (along the diagonal) are negative

except for Panama and ROW. Slutsky own-price for Costa Rica is significant at the 10% level and that of the Caribbean is significant at the 1% level. Results from the Absolute Price Version of the Rotterdam model indicate pairwise Hicksian substitution or complementarity between bananas from the exporting countries to the U.S. market. Ecuadorian bananas are net substitutes for Colombian and Costa Rican bananas. Bananas from Honduras and ROW are net substitutes for bananas from Costa Rica and the Caribbean, respectively. Colombian bananas are net complements to Costa Rican bananas and Caribbean Bananas. There is a complementary relationship between banana imports from Ecuador and banana imports from the Caribbean. All other parameter estimates are statistically insignificant at the 5 percent level.

A statistically significant constant term would imply that banana import demand changes even when total banana expenditure and prices do not change. Intercepts are significant for Colombia and Costa Rica. During the period of analysis there were respectively a 1.1 percent and 2 percent changes in the banana market share for these countries that were not explained by variations in expenditures and prices. Other nonmarket forces are needed to explain the variation of Colombian and Costa Rican banana market shares.

#### Conditional Income and Price Elasticities

Cournot price and conditional income elasticities are set forth in table 5. These estimates explain the competitiveness among exporting countries to the U.S. banana market. The conditional income elasticities indicate the percentage change of banana imports from different banana suppliers due to a 1 percent change in total U.S. banana imports.

Conditional Cournot (uncompensated) price elasticities reflect both substitution and income effects from prices changes, holding nominal income constant. The diagonal elements of table 5 are own price elasticities, while the off diagonal elements are cross-price elasticities. Cournot own price elasticities indicate the percentage change of banana imports for each of the banana suppliers when there is a 1 percent change in prices.

Conditional income elasticities for Ecuador, Costa Rica, Honduras and Panama are significant at  $\alpha=0.01$ . This means that as U.S. banana imports grow by one percent, banana imports from Ecuador, Honduras, and Panama would increase by 1.8%, 2.5%, and 3.1%, respectively. However, standard errors for these elasticities are quite large such that the null hypothesis that they are equal to one cannot be rejected at  $\alpha=0.05$ . This indicates that as U.S. banana imports grow, banana market shares for Ecuador, Honduras, and Panama might remain unchanged. The income elasticity for Costa Rica is negative, showing that if U.S. banana imports increase by 1 percent, Costa Rican banana exports might decrease by 1.7 percent, decreasing its market share. This could mean that the United States is shifting its import demand for bananas to other suppliers (i.e, Ecuador, Honduras, Panama). Conditional uncompensated income elasticities for Colombia, the Caribbean and ROW are statistically insignificant. As the U.S. banana market grows, these countries would probably decrease their market shares.

There is little change of U.S. import demand for bananas as banana import prices change. This is manifested by the insignificant own-price elasticities for Colombia, Costa Rica, Panama and ROW, meaning that the null hypothesis that the demand for these countries' bananas is perfectly price inelastic cannot be rejected. Also, Ecuadorian and

Honduran bananas are unitary own-price elastic, 0.83 and 1.2 respectively. Therefore, a change in Honduran and Ecuadorian banana import prices might lead to a proportional change in the amount of banana exported to the United States. An exception to this is the Caribbean. The own-price elasticity for the Caribbean indicates that the percentage response in quantity would almost be three times (2.66) more than that of price. All Cournot own-price elasticities are negative except for those of Colombia and ROW, which are statistically insignificant ( $\alpha=0.05$ ).

Cournot cross-price elasticities indicate Ecuadorian bananas are substitutes for Colombian and Costa Rican bananas. Bananas from Colombia, Honduras, and the Caribbean are gross substitutes for bananas from the Caribbean, Costa Rica and Colombia respectively. All these estimates are significant at the 1 percent level. Negative uncompensated cross-price elasticities indicate that Ecuadorian bananas are gross complements to Honduran and Caribbean bananas. Costa Rican bananas are gross complements to bananas from Colombia and Panama. Honduran bananas are gross complements to Ecuadorian and Caribbean bananas. Finally, bananas imported from Panama and the Caribbean are gross complements to bananas imported from Ecuador. All negative cross-price elasticities just mentioned are statistically significant at the 5 percent level or less.

### Conclusions and Implications

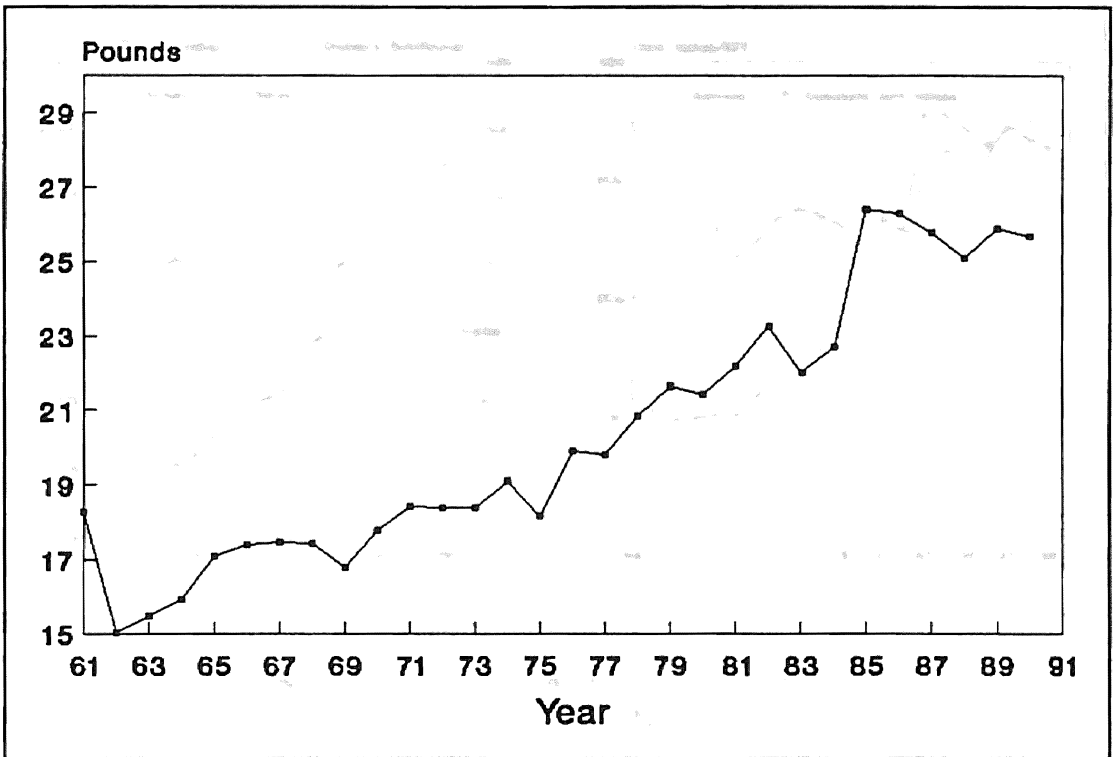
A Rotterdam import allocation model was used to fit data for banana imports in the United States. Nested tests could not reject homogeneity and symmetry among imported banana suppliers. The null hypothesis that all slope coefficients are equal to zero was rejected by

means of the Chi-square statistic.

Results indicate that Ecuador, Honduras and Panama would increase banana exports and their market shares if expenditures for banana imports in the United States increases. A 1 percent increase in U.S. banana imports would increase demand for Ecuadorian, Honduran and Panamanian bananas by 1.8%, 2.5%, 3.1%, respectively, so that the market share for these countries would increase. On the other hand, U.S. banana imports from Colombia, the Caribbean and ROW might not change as the U.S. banana market grows, leading to a decrease of market shares for these countries. Finally, Costa Rican banana exports would decrease by 1.7 percent as the U.S. banana imports increase by 1 percent, meaning that there would probably be a reduction on banana market share for Costa Rica. U.S. demand for bananas is not very responsive to changes in banana prices. A clear exception is the demand for Caribbean bananas with own price elasticity equal to  $-2.66$ . The null hypothesis of unitary own prices elasticity for Ecuador ( $-0.83$ ) and for Honduras ( $-1.2$ ) cannot be rejected. Honduran and Ecuadorian banana export earnings might not be affected by an increase or decrease in banana export prices. The own price elasticities for bananas imported from Colombia, Costa Rica, Panama and ROW are insignificant. Imposing taxes or subsidies to increase or decrease banana export prices would not change the volume of bananas imported by U.S. from these countries. The Caribbean would gain by reducing its banana export prices. As discussed in the section about the structure of the U.S. banana market, banana unit values for the Caribbean are higher than those for other countries in Latin America. This reflects the fact that this region has small units of production and low yields per hectare.

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**Figure 1. U.S. Banana Consumption, per Capita (1961-1990).**

**Source: FAO yearbooks**



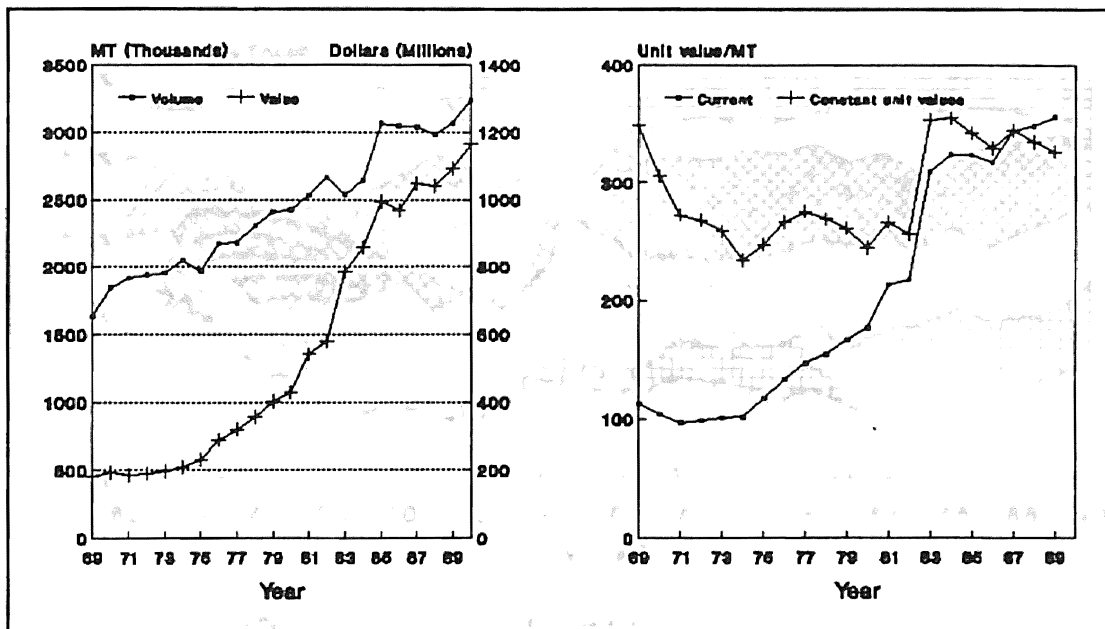


Figure 2: Volume, Total Value and Unit Value (Current and Real) of U.S. Banana Imports (1961 - 1990)

Source: FAO yearbooks

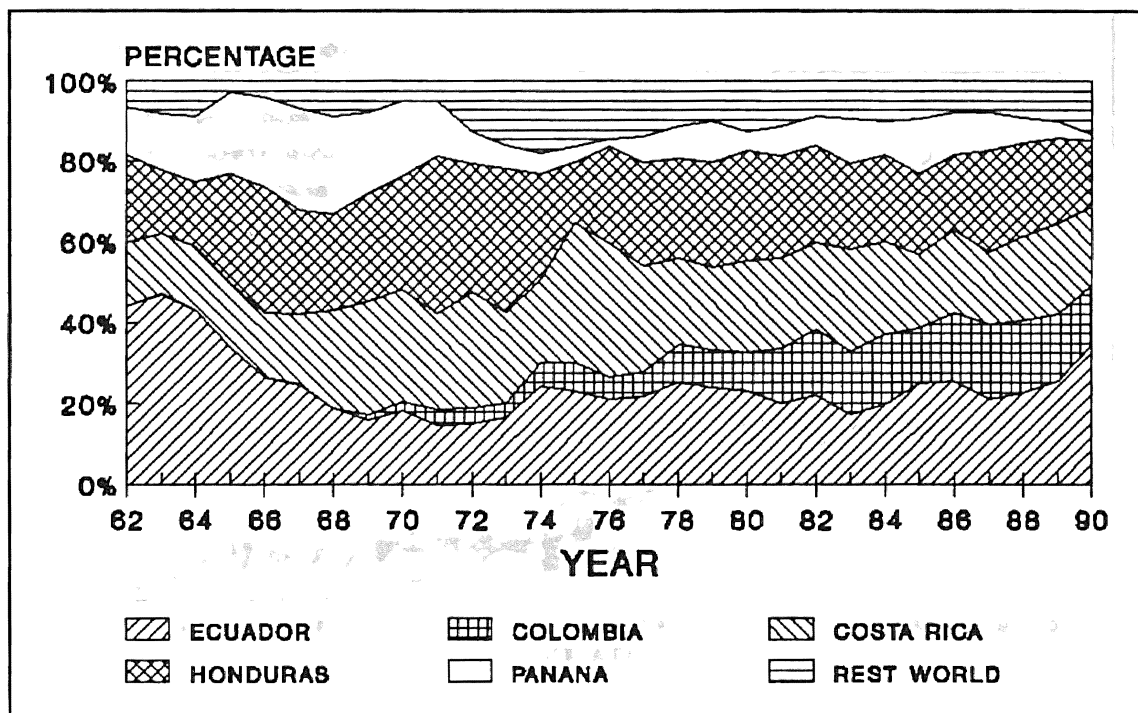


Figure 3. U.S. Banana Import Market Shares (1962-1990)

Source: United Nations trade data tape SITC .

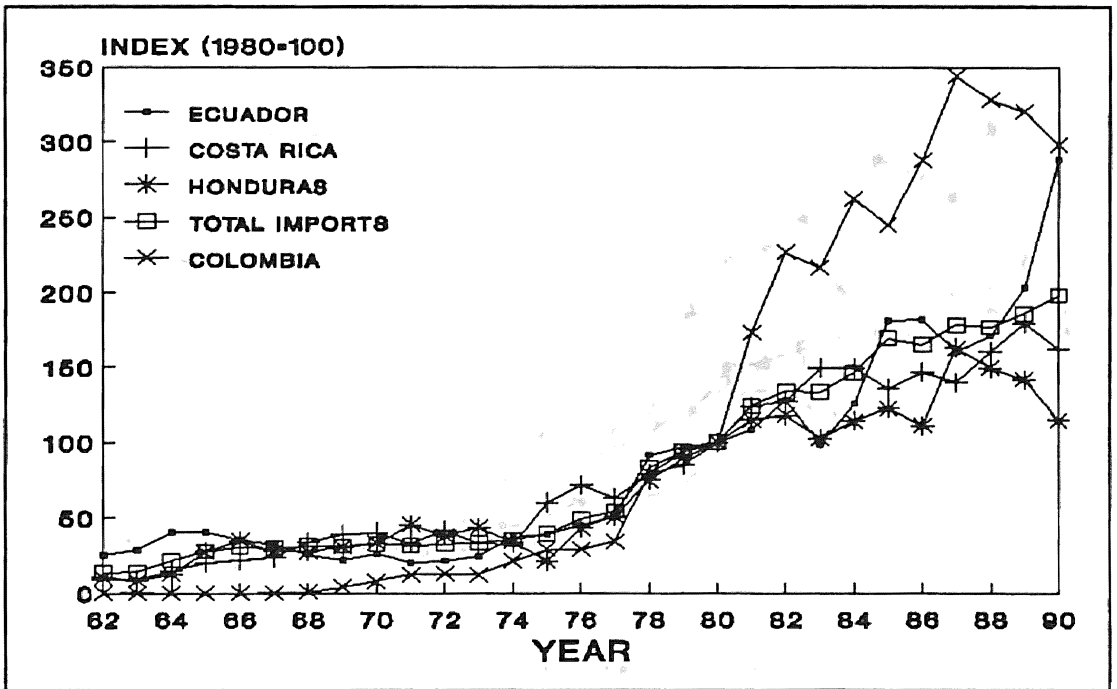
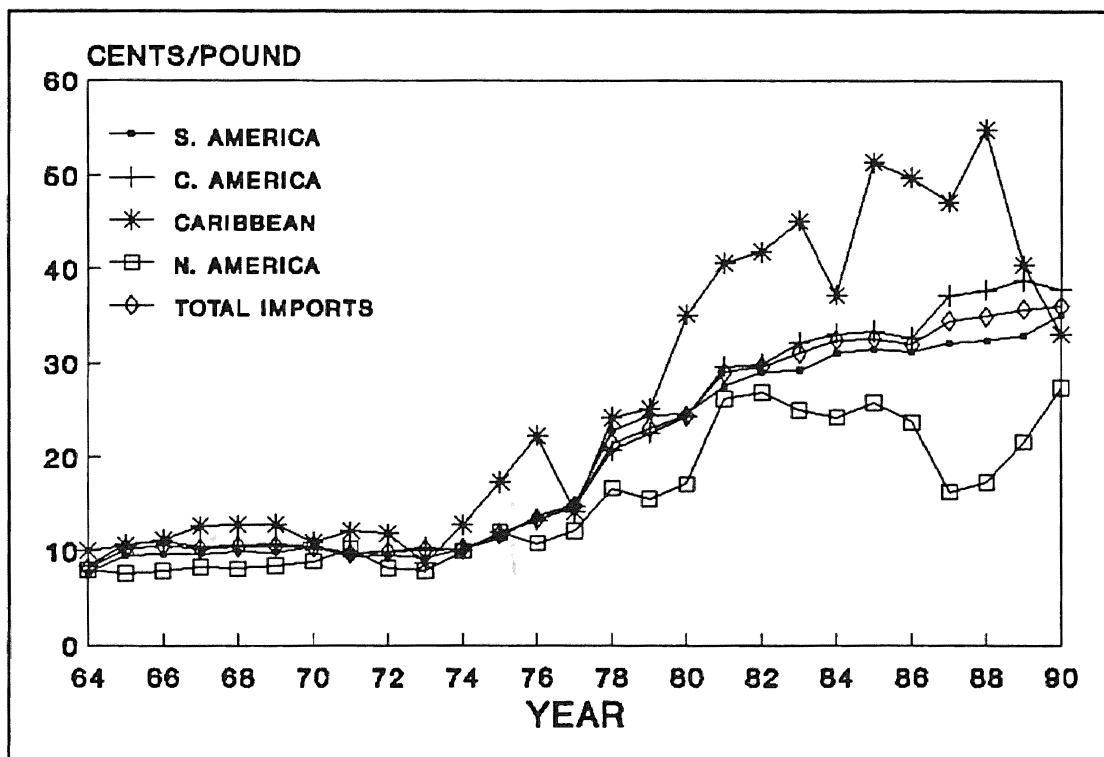


Figure 4. Index of U.S. Banana Import Value by Major Exporters, 1980=100 (1962-1990).

Source: United Nations trade data tape SITC .



**Figure 5.** U.S. Banana Import Unit Values by Main Regions of Origin, Cents per Pound (1964-1990)

**Source:** United Nations trade data tape SITC .

Table 1. Value of U.S. Imports of Major Fruits in Millions of Dollars (1961-1990)

FRUIT	61-65	66-70	71-75	76-80	81-85	86	87	88	89	90	Annual Growth rate *
BANANAS	106.03	184.12	202.73	360.01	752.30	968.62	1048.00	1039.81	1093.51	1165.91	9.42
GRAPES	2.99	3.73	5.30	22.81	130.86	210.99	259.78	327.41	305.51	397.24	20.14
PINEAPPLES, CANNED	14.63	24.88	37.43	93.88	143.31	186.40	184.24	184.58	195.05	174.61	10.78
PINEAPPLES, FRESH	0.79	0.46	1.94	7.67	12.72	24.65	30.20	36.68	50.75	54.87	31.09
APPLES	4.37	7.48	10.78	23.37	55.32	88.40	83.74	75.83	70.18	53.27	12.00
PEACHES	0.54	0.86	0.40	2.15	12.90	28.69	34.70	40.89	43.68	50.14	17.77
COCONUTS	15.43	17.00	21.58	40.41	54.48	38.55	51.76	49.60	35.35	36.36	5.35
PEARS	1.15	2.09	3.21	3.11	10.37	26.18	33.34	33.02	33.16	32.76	12.39
ORANGES, ETC.	3.25	6.00	7.47	9.23	11.83	18.99	19.92	10.97	13.42	20.69	6.86
LEMONS & LIME	0.36	0.33	0.65	3.42	6.73	7.90	9.77	9.41	7.80	12.13	15.45
RAISINS	0.08	0.20	1.74	9.37	2.06	2.75	5.76	8.09	10.56	9.46	18.26
DATES	3.33	2.35	4.34	9.80	12.89	3.98	5.17	7.59	11.48	7.07	5.31
Other citr	0.13	0.69	2.28	1.70	0.90	1.38	1.33	2.38	1.24	1.89	9.69

\* Growth rates were calculated with the formula:  $Y = a e^{rt}$ , where  $Y$  is value of imports,  $r$  is the growth rate for the period of study ( $t$ ), and  $a$  is a constant.

Source: FAO yearbooks

Table 2: U.S. Banana Imports by Region in Thousands of Dollars (1962-1990)

REGION	PERIOD (AVERAGE)									
	62-65	66-70	71-75	76-80	81-85	86	87	88	89	90
SOUTH AMERICA	46977	41639	49978	142844	305931	416358	419289	422002	463260	574030
Ecuador	45999	38239	38611	104363	174322	246572	217835	232256	275474	391147
Colombia	17	1438	9908	37945	126703	162056	193948	184735	180464	168037
Venezuela	662	1838	1426	141	2954	7018	6621	4789	6940	14647
Rest	300	124	32	396	1952	712	885	222	382	199
CENTRAL AMERICA	63508	140908	151706	301542	512843	530724	616639	602545	605284	546158
Costa Rica	17803	42002	53113	105793	181732	194696	185673	213424	238413	215886
Honduras	23657	49511	58323	114815	183230	178130	260877	239428	227353	184129
Guatemala	1842	5615	16644	27279	43188	57592	70390	83355	92945	127233
Panama	18887	40697	14659	30079	81380	99926	99692	66321	46560	18905
Rest	1320	3083	8967	23577	23312	380	7	17	13	5
CARIBBEAN	2638	1059	456	1991	5239	1036	800	1263	1924	1859
Dominican Republic	719	371	358	1939	4567	932	700	1184	1920	1750
Rest	1919	688	98	53	672	104	100	79	4	109
NORTH AMERICA	559	588	415	2565	6692	17608	13507	14251	20400	41490
REST OF THE WORLD	62	183	538	787	4323	8920	1152	2934	5364	4780
TOTAL IMPORTS	113744	184377	203094	449730	835028	974646	1051387	1042995	1096232	1168317

Source: United Nations data tape, SITC 0513

Table 3. Growth Rates of U.S. Banana Import Values  
(1962-1990).\*

REGION	62-65	66-70	71-75	76-80	81-85	86-90	Overall
<b>SOUTH AMERICA</b>	0.89	-0.70	0.19	0.26	0.10	0.07	0.11
Ecuador	-0.18	-0.10	0.19	0.22	0.10	0.12	0.09
Colombia	-0.81	1.96	0.22	0.35	0.08	0.00	0.40
Venezuela	-0.47	0.02	-0.13	-0.05	0.75	0.15	0.06
Rest	0.81	-0.27	1.01	0.60	0.30	-0.34	0.13
<b>CENTRAL AMERICA</b>	0.33	0.05	0.01	0.17	0.05	0.00	0.09
Costa Rica	0.28	0.17	0.10	0.10	0.03	0.04	0.10
Honduras	0.33	-0.00	-0.16	0.23	0.01	-0.01	0.09
Guatemala	-0.38	0.32	0.27	0.13	-0.04	0.19	0.15
Panama	0.44	-0.04	-0.24	0.40	0.20	-0.41	0.05
Rest	0.23	-0.26	0.70	0.12	0.11	-0.80	-0.08
<b>CARIBBEAN</b>	-0.01	-0.24	-0.12	0.45	-0.40	0.20	0.02
Dominican Republic	-0.96	0.26	-0.19	0.43	-0.49	0.23	0.08
Rest	0.50	-1.57	-0.35	1.11	0.65	-0.31	-0.10
<b>NORTH AMERICA</b>	0.23	-0.11	0.05	0.25	0.40	0.21	0.16
<b>REST OF THE WORLD</b>	1.76	-0.97	0.02	0.84	0.87	0.03	0.25
<b>TOTAL IMPORTS</b>	0.26	0.02	0.05	0.20	0.07	0.04	0.10

\* Growth rates were calculated with the formula:  $Y = a e^{rt}$ , where  $Y$  is value of imports,  $r$  is the growth rate for the period of study ( $t$ ), and  $a$  is a constant.

Source: Calculated from table 2

Table 4: Rotterdam Model Parameter Estimates for U.S. Banana Imports (1964-1989)

	MARGINAL SHARES	ECUADOR						
ECUADOR	0.389** (0.141)	-0.094 (0.083)	COLOMBIA					
COLOMBIA	-0.086 (0.070)	0.075** (0.026)	-0.005 (0.018)	COSTA RICA				
COSTA RICA	-0.384** (0.161)	0.232** (0.090)	-0.093** (0.034)	-0.241* (0.132)	HONDURAS			
HONDURAS	0.633** (0.238)	-0.090** (0.059)	-0.010 (0.029)	0.132* (0.072)	-0.143 (0.105)	PANAMA		
PANAMA	0.353** (0.151)	-0.081 (0.049)	0.019 (0.024)	0.057 (0.062)	0.094 (0.062)	0.036 (0.065)	CARIBBEAN	
CARIBBEAN	0.045 (0.033)	-0.028** (0.013)	0.021** (0.006)	0.026 (0.017)	-0.020 (0.013)	-0.004 (0.012)	-0.013** (0.004)	ROW
ROW	0.040 (0.120)	-0.015 (0.043)	-0.026 (0.021)	-0.000 (0.053)	0.016 (0.052)	-0.006 (0.041)	0.018* (0.009)	0.012 0.046
CONSTANT		-0.010 0.007	-0.011** 0.004	0.020** 0.008	0.010 0.012	-0.012 0.008	-0.003 0.002	0.005 0.006
VALUE SHARES		0.221	0.082	0.228	0.252	0.114	0.005	0.099

Numbers in parenthesis are standard errors

\*\* = significantly different from zero at the 5% level or less with 18 degrees of freedom

\* = significantly different from zero at the 10% level or less with 18 degrees of freedom

ROW = Rest of the World



Table 5: Expenditure and Price Elasticities of U.S. Import Demand for Bananas by Source  
 Estimated at Sample Means, 1964-1989

	EXPENDITURE ELASTICITY	Cournot price elasticities						
		ECUADOR	COLOMBIA	COSTA RICA	HONDURAS	PANAMA	CARIBBEAN	ROW
ECUADOR	1.807** (0.639)	-0.825* (0.452)	0.191 (0.134)	0.639 (0.389)	-0.861** (0.284)	-0.573** (0.238)	-0.134** (0.059)	-0.246 (0.191)
COLOMBIA	-1.054 (0.850)	1.147** (0.414)	0.025 (0.231)	-0.889** (0.426)	0.388 (0.378)	0.346 (0.310)	0.255** (0.070)	-0.218 (0.252)
COSTA RICA	-1.686** (0.706)	1.391** (0.478)	-0.268 (0.163)	-0.671 (0.549)	1.004** (0.345)	-0.060 (0.295)	0.124 (0.076)	0.166 (0.233)
HONDURAS	2.513** (0.846)	-0.911** (0.345)	-0.166 (0.144)	-0.049 (0.354)	-1.202** (0.437)	0.088 (0.278)	-0.092 (0.053)	-0.183 (0.221)
PANAMA	3.107** (1.327)	-1.401** (0.572)	-0.091 (0.241)	-1.213** (0.585)	0.049 (0.583)	-0.039 (0.604)	-0.055 (0.104)	-0.355 (0.364)
CARIBBEAN	8.821 (6.321)	-7.291** (3.197)	3.253** (1.241)	3.120 (3.350)	-6.081** (2.763)	-1.862 (2.434)	-2.660** (0.820)	2.785 (1.805)
ROW	0.405 (1.220)	-0.239 (0.564)	-0.301 (0.242)	-0.094 (0.582)	0.063 (0.580)	-0.104 (0.455)	0.185* (0.096)	0.082 (0.456)
CONSTANT		-0.010 (0.007)	0.011** (0.004)	0.020** (0.008)	0.010 (0.012)	-0.012 (0.008)	-0.003 (0.002)	0.005 (0.006)
VALUE SHARES		0.221	0.082	0.228	0.252	0.114	0.005	0.099

\*\* = significantly different from zero at the 5% level or less with 17 degrees of freedom  
 \* = significantly different from zero at the 10% level or less with 17 degrees of freedom  
 ROW = Rest of the World

## PAPER II

### A ROTTERDAM APPLICATION TO INTERNATIONAL TRADE IN BANANAS: FOUR MARKETS FOR LATIN AMERICAN BANANAS

By volume, bananas are the number two food product for direct consumption worldwide, surpassed only by milk consumption (Inter-American Institute for Cooperation on Agriculture (IICA), 1992). More bananas are traded internationally than any other fruit, with oranges and apples a distant second and third (table 1). Banana import demand on the international banana market grew from \$0.4 billion in 1962 to \$3.6 billion in 1989 (table 2). World banana imports grew on average eight percent annually over the period 1962-1989. Major world banana importers are the United States, the European free market<sup>2</sup> (EFM), Japan, France, United Kingdom, and Italy, accounting for 26, 23, 12, 9, 8, and 6 percent respectively. Costa Rica, Panama, Ecuador, Honduras and Colombia showed up as major banana exporters to these markets over the period 1962-1989 (Table 2).

In response to the increasing banana import demand worldwide, many countries have been expanding their banana production. World banana production in 1990, 45.8 million metric tons, was more than double the production in 1961-1965, an annual average of 23.3 million metric tons

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<sup>2</sup> European free market is made up of Germany, Austria, Belgium, Denmark, Finland, Ireland, Norway, the Netherlands, Sweden and Switzerland (IICA, 1992).

(table 3). Latin America has been part of this trend. A decided uptrend in banana production by Latin America is also exhibited, moving from an average of 11 million metric tons during 1961-1965 to 17.8 million metric tons in 1990. This poses an interesting question: what is the competitive relationship among major Latin American banana suppliers and other Latin American competitors worldwide in the four selected banana markets (the U.S., the EFM, Japan and Italy)?

Having economic information on the behavior of the banana market is very important for many countries in Latin America. Banana exports are a significant percentage of total national exports in many of the major banana exporting countries. For example, total banana exports for Honduras, Costa Rica, and Ecuador account for 37%, 23% and 17% of total exports respectively. Recent studies have shown that bananas are substitutes for other fruits (Thompson, Conkling, and Dono, 1990; Deaton and Muellbauer, 1980). Growth in banana consumption is, therefore, a concern for those who grow other fruits for which bananas are substitutes.

The purpose of this study is to estimate a geographic import demand system for imported bananas to the U.S., the EFM, Japan and Italy. The objectives are:

- (1) To determine the changes in market share of major banana exporters as total expenditures for imported bananas expand or contract in these four major markets.
- (2) To determine the price responsiveness of exports from major banana exporters to these four markets.
- (3) To determine the cross-price relationships among major exporters to these banana markets.

The absolute price version of the Rotterdam model is estimated for imported bananas in the U.S., the EFM, Japan, and Italy. Conditional income and price elasticities are used to analyze the competitive relationship among major Latin American banana exporters (Ecuador, Panama, Colombia, Costa Rica, Honduras) and other exporting countries to these foreign markets. This study may provide useful insights regarding past import behavior that are valuable in the decision making process.

### World Banana Imports

Due to their relative importance to Latin American major banana suppliers, four markets are the focus of this study. In 1989, banana imports to these four markets— the U.S, the EFM, Japan and Italy— accounted for 70 percent of the total marketed worldwide. Of this, 73 percent came from five major banana exporters in Latin America (Ecuador, Colombia, Costa Rica, Honduras, and Panama), 17 percent came from the Philippines, Thailand and Somalia, and 10 percent came from other suppliers. Other major banana importers are France and the United Kingdom, both accounting for 16 percent of world banana imports in 1989. None of the major selected Latin American banana exporters have a significant market share in these markets because they are protected markets. France, the United Kingdom and Italy provide protection for the trade of bananas from former colonies and overseas provinces (IICA, 1992).

#### The United States Market

The United States is considered a free market with no quotas and other non-tariff restrictions on banana imports. The United States ranked first among major banana importers worldwide with a total import

value of 1.1 billion dollars, comprising 30 percent of total world trade in 1989 (table 2). The banana-producing countries of Latin America supplied about 89 percent of total imported by the U.S. (table 2). Figure 1 illustrates the trend in import shares of bananas in the United States. Panamanian market share declined from an average of 19 percent during the 1960's to only 1.6 percent in 1990. This was compensated by an uptrend in the share of exports by Colombia between 1962 and 1987, moving from less than 1 percent to 18.4 percent. From that year forward, Colombian market share declined to 14.4 percent in 1990. Ecuadorian market share fell from 41.8 percent in 1962 to 33.5 percent in 1990. Ecuador had the most instability in market share among major exporters over the period in this market (figure 1). The data on Costa Rican market share reveals more stability over time than any other major exporter of bananas to the United States. Costa Rican market share was, on average, 21 percent over the entire period, varying from 15.5 percent during 1962-1965 to 25.9 during 1971-75. Honduran market share displayed more variability over the period, showing the highest market share in 1976 (29.4) and the lowest in 1990 (15.8 percent).

#### The European Free Market (EFM)

The EFM is made up of 10 countries: Germany, Austria, Belgium, Denmark, Finland, Ireland, Norway, the Netherlands, Sweden and Switzerland. The outstanding feature of this market is the absence of quotas and other non-tariff restrictions on banana imports.

This market purchased a total of \$822 million, or 23 percent of the total value of bananas purchased worldwide (table 2). Four countries -Panama, Costa Rica, Colombia, and Ecuador- provided 81

percent of banana imports to this region in 1989. Panama, the leading supplier, provided 32 percent followed by Costa Rica and Colombia with market shares of 23 percent and 13 percent respectively. The relative importance among banana suppliers to the free European banana market changed significantly during the sixties (figure 2). During that decade, the participation of Panama and Costa Rica was almost zero, compared to a 55 percent market share by these suppliers in 1989. It is only after 1972 that the relative importance among suppliers to this market showed more stability (figure 2).

### The Japanese Market

The Japanese market is also considered a free market with no quotas or non-tariff restrictions on banana imports. Japanese Banana import value in 1989 was 444 million dollars, accounting for 12 percent of the value traded worldwide during that year (table 2). Of the total imported, 99 percent was supplied by only three countries: the Philippines (77 percent), Thailand (11 percent), and Ecuador (11 percent). The Philippines showed a marked upward trend in market share over the 1969-1989 period (Figure 3). The Philippine market share rose sharply from 2.7 percent in 1969 to 77 percent in 1989. On the other hand, Thailand went from a market share of 60 percent in 1962 to only 11 percent in 1989. Ecuador's market share also fell sharply, from 39 percent in 1962 to 11 percent in 1989.

### Italian Market

Italy is one of the three countries in Europe (France and the United Kingdom are the others) that provide protection for the trade of bananas from former colonies and overseas countries. The principal

characteristic of these markets is the type of protection granted by the ECC, under Article 115 of the Treaty of Rome and the Lomé convention, to preferential suppliers such as the African, Asian, and Pacific countries (IICA, 1992). France and the United Kingdom are not included in this analysis since these markets are not important for the major selected Latin American banana suppliers.

Italy imported bananas worth \$200 million in 1989, which represented 5.5 percent of total trade. Of the total, Costa Rica provided 27 percent, Ecuador 12 percent, Panama 11 percent, Somalia 8 percent and other suppliers 42 percent. More than in any other market analyzed here, the relative importance among suppliers to the Italian banana market changed significantly over the 1962-1989 period (figure 4). The leading supplier, Costa Rica, entered the market in 1969 with a market share of 14 percent, reached a peak in 1973 (43 percent), and supplied 27 percent to this market in 1989. Overall, Ecuadorian market share decreased over the 1966-1989 period. Ecuador entered the Italian market in 1966 with a 22 percent market share. Their share has gone up and down over the period and was 12 percent in 1989. Panama has had a great deal of instability in its market share over the 1962-1989 period. It was not until 1968 that Panama began to participate significantly in the Italian market with a market share of 10 percent that year. Panama reached its market share peak in 1975 (38 percent), went down to 3 percent in 1987 and increased again up to 11 percent in 1989. For its part, Somalia has the longest tradition of banana trade with Italy. However, its market share dropped sharply over the 1962-1989 period, moving from a 62 percent market share in 1962 to only 8 percent in 1989 (figure 4).

## Method

Recent import demand studies are based on a concept in which products can be distinguished by kind and place of production. Products are assumed to be imperfect substitutes. Goods are distinguished only by kind, and products are distinguished by both kind and place of production (Armington, 1969). Bananas from different suppliers are, therefore, treated as products.

The Absolute Version of the Rotterdam Model, under the assumption of weak separability, was chosen to fit the data. The underlying theory of the Rotterdam Model has been explained in detail by Theil (1980) and Deaton and Muellbauer (1980). The theory is not repeated here. It is assumed that the process occurs in two stages. The first is the allocation of total expenditure on bananas, and the second is the allocation of expenditure among different suppliers.

The absolute version of the Rotterdam model is specified as follows:

$$m_i = \alpha_i + \beta_i M_t + \sum \theta_{ij} p_{jt}^* + \mu_{it} \quad (3.1)$$

where:

$i, j$  - supply regions (countries),

$t$  = time (in years),

$m_i$  =  $w_{it}^* q_{it}^*$

$q_{it}$  - quantity of bananas imported from country  $i$  during time  $t$ ,

$q_{it}^*$  -  $\log(q_{it}/q_{i,t-1})$

$w_{it}$  - value share of bananas imported from country  $i$  during time  $t$ ,

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



- $M_t$  -  $\Sigma_i m_i$  = an index representing the proportional change in real total banana expenditure,  
 $P_{it}$  - import price of bananas from supplier  $i$ ,  
 $P^*_{it}$  -  $\log(P_{it}/P_{i,t-1})$   
 $\alpha_1$  - constant term = annual change in the budget share in the absence of any change in real total banana expenditure or in relative prices  
 $\beta_1$  - the conditional marginal budget share of country  $i$ 's banana imports.  
 $\theta_{ij}$  - the conditional Slutsky price coefficient between the  $i$ th and  $j$ th supply regions,  
 $\mu_1$  - disturbance term

The elasticities can be obtained as follows,

- $e^*_{ij}$  -  $\theta_{ij}/\text{avg}(w^*_{it})$  = Compensated price elasticities,  
 $e_{ij}$  -  $\theta_{ij}/\text{avg}(w^*_{it}) - \beta_1 * \text{avg}(w^*_{jt})/\text{avg}(w^*_{it})$  = Conditional Cournot price elasticities,  
 $n_i$  -  $\beta_1/\text{avg}(w^*_{it})$  = conditional income elasticity

Since a two stage-budgeting process is assumed, the income elasticities ( $n_i$ ) obtained from this model are called conditional. The estimated demand relationships in the second stage depend on the level of expenditures allocated to total banana imports in each of the selected markets.

A constant term is usually not included when estimating the Rotterdam model (Seale, Sparks and Buxton, 1992; Sparks, 1992; Deaton and Muellbauer, 1980; Mayes, 1981). This means that when expenditures and prices do not change from  $t-1$  to  $t$ , changes in demand will equal the disturbance term ( $\mu_{it}$ ) (Theil, 1978). In this study, a constant term ( $\alpha_1$ ) is included to measure the systematic effect of factors other than income and prices on banana imports.

The parameters in the Rotterdam model can be related to the restrictions of economic theory. The adding up condition is built into

the model (Deaton and Muellbauer, 1980), implying that for all  $j$   $\sum_i \beta_{ij} = 1$ ;  $\sum_j \theta_{ij} = 0$ . Symmetry implies that for all  $i$  and  $j$   $\theta_{ij} = \theta_{ji}$ . Finally, homogeneity holds if for all  $i$   $\sum_j \theta_{ij} = 0$ .

The data analyzed are United Nations trade data, which provide quantity and value of banana imports by origin for each of the selected markets over the period 1962-1989. From these data, the most important suppliers for each market were identified. The remaining imports were aggregated into the category "rest of world" (ROW). For the U.S. and the EFM, Ecuador, Colombia, Costa Rica, Honduras, and Panama were the main suppliers. These countries provided 89 percent and 81 percent of the bananas imported by the U.S. and the EFM respectively. Regarding the Japanese market, the Philippines, Thailand, and Ecuador were chosen to estimate the model; these countries' exports accounted for 99 percent of Japanese banana imports in 1989. For the Italian market, Costa Rica, Ecuador, Panama, and Somalia were included. These countries accounted for 58 percent of the total imported to Italy in 1989, 42 percent was aggregated into the category "rest of the world."

The sample period is different for each market. The data available on banana imports by source for the U.S. permits estimation for the period 1964-1989. However, the data for the European market is for the period 1972-1989. As previously discussed, it is only after 1972 that the relative importance among suppliers to the European market began to show some stability (figure 2). For the Japanese market, the period of analysis is 1968-1989 since the leading supplier, the Philippines, entered the market in 1968. Finally, the period of analysis for the Italian market is 1969-1989 because the leading supplier, Costa Rica, entered the market in 1969.

Iterative Seemingly Unrelated Regressions (ISUR) are used to

estimate the Rotterdam model parameters. When the ISUR procedure is used, and if random errors follow a multivariate normal distribution, the estimator will be the maximum likelihood estimator (Judge, Hill, Griffiths, Lutkepohl and Lee, 1982).

### Hypothesis Testing

A  $X^2$  statistic is calculated and used to test the null hypothesis that all slope coefficients in the model are zero (White, Wong, Whistler and Haun, 1990):  $X^2 = -T(\text{LOG}(1-R^2))$ . Where T is the number of observations and  $R^2$  is the coefficient of multiple determination<sup>3</sup>.

The approach used to find the appropriate specification of the model was to estimate the model without restrictions, then estimate the system imposing symmetry and homogeneity. To test the null hypothesis that symmetry and homogeneity hold, the Likelihood ratio test (LR) is used. LR is computed as the ratio of the constrained (imposing symmetry and homogeneity) to the unconstrained maximum likelihood (Kennedy, 1985). If the null hypothesis is true, twice the difference of the log likelihood functions (unconstrained and constrained) is asymptotically distributed as  $X^2$  with degrees of freedom equal to the number of restrictions imposed (Judge et al., 1982).

Standard errors for the Cournot price elasticities were estimated as the square root of:

$$\text{var}(e_{ij}) = \text{var}(\theta_{ij}) / (s_{it})^2 + \text{var}(\beta_1) * (-s_{jt} / s_{it})^2 + \text{cov}(\theta_{ij}, \beta_1) * (-s_{jt}) / (s_{it})^2,$$

where  $s_{it} = \text{avg}(w^*_{it})$  and  $s_{jt} = \text{avg}(w^*_{jt})$ , which were defined above.

Standard errors for the conditional income elasticities are the square root of:  $\text{var}(n_i) = \text{Var}(\beta_1) / (s_{it})^2$ .

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<sup>3</sup> It is equivalent to the statistic obtained when performing a likelihood ratio test.

## Empirical Results

The null hypothesis of homogeneity and symmetry could not be rejected at the 5 percent level in all selected markets, except for the Italian market (table 4). The likelihood ratio (LR) equals (degrees of freedom in parenthesis) 28.65(21), 8.48(6), 8.5(10) for the U.S., Japan and EFM respectively. Regarding the Italian market, the LR equals 9.48(4) and 22.46(46) for homogeneity and symmetry respectively. Still larger is the LR when imposing both homogeneity and symmetry (30.16(10) (table 4). It is likely that this is because of the tariffs and other internal barriers applied to banana imports from the "dollar area"<sup>4</sup> to Italy. Bananas coming from the "dollar area" are restricted by imposing a tariff of 20 percent, a value added tax of 9 percent, and an excise tax of 17.6 percent (IICA, 1992). It is worth noting that these restrictions are not applied to imports from Somalia and to banana imports from some other countries aggregated into ROW. Clearly, the Italian banana market cannot be considered a free market. Therefore economic assumptions such as symmetry and homogeneity would not hold. Yet results on this market are reported in this study without imposing these restrictions. The null hypothesis that all parameters are statistically insignificant in each of the markets is rejected at  $\alpha=0.05$  or less (table 4).

### Conditional Income and Price Elasticities

In this section, conditional income and Cournot price elasticities are reported for each of the major Latin American banana suppliers.

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<sup>4</sup> The "dollar area" consists of: Bolivia, Canada, Colombia, Costa Rica, Cuba, Ecuador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Philippines, United States and Venezuela.

Rotterdam parameter estimates are available upon request from the author. Cournot price and conditional income elasticities are set forth in table 5. These estimates explain the competitiveness among exporting countries to each of the major banana markets. The conditional income elasticities indicate the percentage change of banana imports from different banana suppliers due to a 1 percent change in total expenditure on banana imports. Conditional Cournot (uncompensated) price elasticities reflect both substitution and income effects from prices changes, holding nominal income constant. Cournot own price elasticities indicate the percentage change of banana imports from each of the banana suppliers when there is a 1 percent change in prices.

Ecuador. Conditional income elasticities for Ecuador are significant in all selected markets at  $\alpha=0.05$  (table 5, column 1). As total expenditure on banana imports increases by 1 percent in the United States, the EFM, Japan and Italy, imports from Ecuador increase by 1.8 percent, 0.7 percent, 4.8 percent and 1.2 percent respectively. However, standard errors are large so that as import demand increases in these markets, imports from Ecuador may increase almost proportionally (unitary elasticity), leading to no change in market share for Ecuador. An exception to this is banana imports to Japan that may increase more than proportionally (4.8 percent). As indicated by the its large income elasticity, Ecuador has the strongest competitive position in the Japanese market.

There is very little price responsiveness of banana exports from Ecuador. Due to large standard errors, the null hypothesis of unitary own price elasticities cannot be rejected in both the Japanese market (-1.88 percent) and the U.S. market (-0.82 percent). As import price

changes, quantity imported from Ecuador to these markets may change proportionally. The own price elasticity in the EFM (-0.27 percent) is statistically insignificant. In the Italian market, the own price elasticity is positive and significant (1.96 percent) at  $\alpha=0.05$ . For a restricted market, one should not expect results to agree with economic theory based upon the assumption of a free market.

Colombia. It appears that there is no change in banana imports from Colombia to the United States and the EFM as total banana imports and import prices change in those markets. Colombian income elasticities are statistically insignificant at  $\alpha=0.05$  (Table 5, column 2). If banana expenditure on imports increases in each of the importing markets, imports from Colombia may not change. Also, Cournot own-price elasticities are insignificant in the four markets. However, imports from Colombia to the U.S. may change due to factors other than changes in expenditure and import prices. This is because the intercept for Colombia in the U.S. is statistically significant. During the period of analysis there was 1.1 percent change in the banana market share for Colombia that was not explained by variations in expenditures and prices. Other nonmarket forces are needed to explain the variation of Colombian banana market shares.

Costa Rica. Costa Rica is a major exporter to the U.S., to Italy and to the EFM countries. As imports for bananas expands in these markets, imports from Costa Rica increase in the EFM and Italy by 1.6 percent and 1.7 percent, respectively (table 5, column 3). Costa Rica has the strongest competitive position in the EFM as indicated by its larger conditional income elasticity (1.6 percent) as compared to the

other competitors. In the U.S., a 1 percent increase in banana imports would lead to a decrease in imports from Costa Rica by 1.7 percent. If a good has a negative income elasticity (and hence negative marginal share), it is inferior. Inferior goods can occur under weak separability, the assumption made in this study (Theil, 1980). This could mean that the United States shifts its import demand for bananas to other suppliers (i.e, Ecuador, Honduras, Panama).

The own price elasticity for Costa Rica in the EFM is significant, but insignificant in the U.S. (table 5, column (3)). A change in quantity imported from Costa Rica to the EFM would be almost four times more than the change in price (-3.66 percent). Again, contrary to what is expected from economic theory, the own price elasticity for Costa Rica in the Italian market is positive and significant.

Honduras. Honduran banana exports are more responsive to changes in total banana expenditure on imports in the U.S. than they are to changes in import banana prices. As U.S. imports increase by 1 percent, banana imports from Honduras would increase by 2.5 percent (table 5, column (4)). Honduras has a strong competitive position so that its market share is expected to increase as U.S. imports expand. With respect to price changes, as price decreases by 1 percent Honduran banana sales to the U.S. would increase almost proportionally (-1.2 percent).

Panama. Panama is listed as a major banana exporter in all selected markets, except the Japanese market (table 5, column 5). As imports expand in the U.S., imports from Panama would increase about three times more than proportionally (3.1 percent). This makes Panama

the strongest competitor among major suppliers in the U.S. Less responsive are Panamanian exports to Italy and the EFM as imports change in these markets. An increase in Italian imports would lead to a proportional increase in imports from Panama (1.3 percent). If EFM imports expand by 1 percent, imports from Panama to this market would increase by 0.6 percent.

Regarding price changes, only the own price elasticity for Panama in the EFM is significant at the 5 percent level. The own-price elasticity for Panama indicates that the percentage response in quantity is twice (2.1 percent) that of price.

Cournot cross-price elasticities, available upon request, indicate that Bananas from Somalia are Complements to bananas from Costa Rica and Panama in the Italian Market. Philippine bananas are complement to Ecuadorian bananas in the Japanese market.

### Conclusions and Implications

A geographic Rotterdam allocation model was used to fit data for banana imports in four major markets. Nested tests could not reject homogeneity and symmetry in all selected markets, except for the Italian market. The Italian market cannot be considered a free market so economic assumptions such as symmetry and homogeneity are not expected to hold.

Results indicate that major Latin American banana producers would increase banana exports if expenditure for imported bananas in the U.S., the EFM, Italy and Japan increases. As expenditure for imported bananas expands in these markets, imports from Ecuador to all selected markets would increase. Imports from Costa Rica to the EFM and Italy would also increase. Similarly, imports from Honduras to the U.S., and imports



from Panama to the U.S., the EFM, and Italy would increase as expenditure for imported bananas increases in these markets. On the other hand, imports from Costa Rica to the U.S. would decrease as imports increase in this market, and Colombian exports may not change as imports increase in all selected markets. This suggests that there would be a decrease in market share for Costa Rica and Colombia if banana imports expand in those markets. As indicated by the large income elasticity, Ecuador is the strongest competitor in Japan, Costa Rica in the EFM, and Panama in the U.S. Income elasticity for Ecuador (in the U.S. and Japan), Costa Rica (in the EFM and Italy), Honduras (in the U.S.) and Panama (in the U.S.) are elastic. Policies by these countries to increase demand for bananas in those markets would result in proportionally larger increases for these countries' bananas.

There is very little price responsiveness of banana exports for the major Latin American banana producers. Own price elasticities are statistically insignificant for Ecuador (in the EFM), Colombia (in all selected markets), Costa Rica (in the U.S.) and Panama (in the U.S.). As price changes, there is a proportional change in quantity exported by Ecuador (in the U.S. and Japan) and Honduras (in the U.S.). The situation in the EFM is different for Costa Rica and Panama. As price decreases by 1%, Costa Rican and Panamanian banana exports would increase by 3.6% and 2.1% respectively. It is worth noting that Costa Rica and Panama charge the banana tax established in 1974 when the Union of Banana Exporting Countries was founded (IICA, 1992). Efforts to lower costs accrued as a result of trade barriers, would result in increases in demand for bananas for these countries. The change in demand would be proportionally higher than the change in price in these market.

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Table 1. World Imports of Three Major Fruits:  
Bananas, Oranges and Apples  
(Thousands of Metric Tons) 1962-1989.

YEAR	BANANAS	ORANGES	APPLES
1962	3706	3074	1534
1965	4673	3442	1824
1970	5595	4071	1846
1975	6277	4637	2352
1980	6684	4857	2714
1981	6729	4649	3087
1982	6722	4818	2792
1983	6100	4760	3127
1984	6574	4912	2996
1985	7074	4585	2877
1986	7290	4967	2864
1987	7513	5125	3213
1988	7800	5294	3274
1989	8208	5235	3281

Source: FAO yearbooks

Table 2: World Banana Import Values by Origin, Millions of Dollars (1962-1989)

year	1962	1965	1970	1975	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
<b>UNITED STATES</b>	<b>78.6</b>	<b>164.6</b>	<b>192.8</b>	<b>230.9</b>	<b>589.3</b>	<b>733.0</b>	<b>788.8</b>	<b>787.2</b>	<b>860.1</b>	<b>996.2</b>	<b>970.6</b>	<b>1050.8</b>	<b>1041.5</b>	<b>1093.5</b>
Honduras	17.0	44.1	53.4	34.3	160.1	184.0	188.7	164.3	182.9	196.3	178.1	260.9	239.4	227.4
Ecuador	34.5	55.3	35.2	53.0	135.7	147.2	174.1	133.7	170.8	245.8	246.6	217.8	232.3	275.5
Costa Rica	12.3	26.5	53.5	79.5	132.7	164.2	168.3	198.0	198.3	179.9	194.7	185.7	213.4	238.4
Colombia	0.0	0.0	4.4	16.4	56.4	97.6	127.8	122.2	148.0	138.0	162.1	193.9	184.7	180.5
Panama	9.3	33.5	36.5	9.3	27.5	55.4	58.4	86.4	70.3	136.4	99.9	99.7	66.3	46.6
The Caribbean	1.8	1.3	0.7	0.3	3.6	9.0	8.1	2.6	5.1	1.5	1.3	0.8	1.3	1.9
row	3.7	3.9	9.3	38.1	73.2	75.7	63.4	80.1	84.7	98.2	88.0	92.0	104.1	123.4
% WORLD IMPORTS	19.3	25.2	24.9	17.0	27.9	32.7	36.3	34.2	35.3	37.3	31.7	30.3	27.8	30.0
<b>EFM<sup>1</sup></b>	<b>0.0</b>	<b>166.8</b>	<b>150.6</b>	<b>160.1</b>	<b>314.8</b>	<b>543.1</b>	<b>509.7</b>	<b>467.5</b>	<b>457.1</b>	<b>479.9</b>	<b>516.0</b>	<b>674.1</b>	<b>868.4</b>	<b>804.2</b>
PANAMA	1.2	6.8	35.8	78.0	156.2	161.3	163.7	181.8	158.2	164.0	215.3	262.4	247.5	260.3
COSTA RICA	0.0	2.3	18.3	74.0	110.3	127.8	106.3	107.0	105.0	104.2	130.4	179.1	152.0	191.2
COLOMBIA	21.2	35.4	23.1	53.5	77.5	60.5	43.8	51.8	89.4	61.8	107.2	118.8	120.0	109.1
ECUADOR	32.6	65.4	43.8	75.8	70.5	67.9	66.0	57.5	55.2	84.4	122.2	132.7	135.6	106.2
ROW	111.7	40.7	39.1	33.4	128.6	92.2	87.8	58.9	72.2	101.6	99.1	175.4	148.9	154.8
% WORLD IMPORTS	40.9	23.1	20.7	23.1	25.7	22.7	21.5	19.8	19.7	19.3	22.0	25.0	21.5	22.6
<b>JAPAN</b>	<b>12.5</b>	<b>60.6</b>	<b>144.1</b>	<b>163.4</b>	<b>190.2</b>	<b>223.6</b>	<b>243.2</b>	<b>231.4</b>	<b>259.6</b>	<b>297.2</b>	<b>378.1</b>	<b>368.0</b>	<b>434.8</b>	<b>443.7</b>
PHILIPPINES	0.0	0.0	8.1	131.8	158.2	193.0	197.8	183.8	214.5	247.4	308.1	263.5	340.1	341.6
THAILAND	7.6	54.6	36.3	24.7	31.3	28.3	43.7	43.4	43.6	42.5	44.4	62.1	56.6	48.3
ECUADOR	4.8	5.0	80.9	6.4	0.6	2.2	1.7	2.4	1.5	7.3	24.0	35.5	36.1	50.9
ROW	0.1	1.1	18.8	0.4	0.0	0.1	0.0	1.8	0.0	0.0	1.7	7.0	2.1	2.9
% WORLD IMPORTS	3.1	9.3	18.6	12.0	9.0	10.0	11.2	10.0	10.7	11.1	12.3	10.6	11.6	12.2
<b>ITALY</b>	<b>24.5</b>	<b>59.7</b>	<b>45.2</b>	<b>91.5</b>	<b>130.1</b>	<b>115.0</b>	<b>128.4</b>	<b>136.6</b>	<b>122.9</b>	<b>150.0</b>	<b>170.5</b>	<b>211.1</b>	<b>309.4</b>	<b>199.9</b>
COSTA RICA	0.0	0.4	7.7	20.2	36.1	31.9	21.9	29.6	27.6	15.1	38.6	33.7	67.5	54.3
ECUADOR	0.0	4.3	5.3	25.7	17.9	14.0	20.3	14.5	17.3	23.7	19.7	21.0	45.6	23.0
SOMALIA	15.3	23.8	11.9	7.7	12.6	5.9	11.4	17.7	4.3	13.6	13.9	26.7	26.6	16.2
PANAMA	0.0	0.0	0.2	34.8	9.9	20.4	14.5	18.7	13.5	5.9	6.6	5.8	24.2	22.6
ROW	9.2	31.2	20.2	3.1	53.6	42.8	60.4	56.1	60.1	91.6	91.7	123.9	145.4	83.9
% WORLD IMPORTS	6.0	9.2	5.8	6.7	6.2	5.1	5.9	5.9	5.0	5.6	5.6	6.1	8.3	5.5
<b>REST OF WORLD</b>	<b>125.6</b>	<b>216.6</b>	<b>230.8</b>	<b>560.5</b>	<b>657.6</b>	<b>659.6</b>	<b>546.7</b>	<b>692.1</b>	<b>711.7</b>	<b>713.1</b>	<b>869.3</b>	<b>974.3</b>	<b>1154.9</b>	<b>1081.2</b>
% WORLD IMPORTS	30.8	33.2	29.9	41.2	31.2	29.4	25.1	30.0	29.2	26.7	28.4	28.1	30.8	29.7
<b>TOTAL WORLD IMP.</b>	<b>408.0</b>	<b>652.2</b>	<b>773.1</b>	<b>1361.0</b>	<b>2110.2</b>	<b>2241.0</b>	<b>2174.6</b>	<b>2304.4</b>	<b>2434.1</b>	<b>2672.5</b>	<b>3062.6</b>	<b>3472.7</b>	<b>3744.8</b>	<b>3640.0</b>

<sup>1</sup> European free market is made up of Germany, Austria, Belgium, Denmark, Finland, Ireland, Norway, the Netherlands, Sweden, Switzerland

Source: United Nations trade data tape SITC 0513.

**Table 3. Latin American Banana Production by Region, in Thousands of Metric Tons (1961-1990).**

REGION	Period									
	61-65	66-70	71-75	76-80	81-85	86	87	88	89	90
<b>SOUTH AMERICA</b>	7674	9297	9593	9157	9258	10542	10932	11225	11652	11933
Brazil	3144	4274	4275	4272	4584	5052	5131	5118	5502	5488
Ecuador	2832	2757	2608	2295	1860	2316	2387	2576	2576	2817
Colombia	577	763	907	1046	1216	1300	1300	1300	1350	1340
<b>CENTRAL AMERICA</b>	2141	3427	4143	4155	4022	3702	4196	3935	4327	4529
Costa Rica	462	814	1232	1151	1125	1096	1143	1162	1400	1530
Panama	561	827	986	1036	1049	907	1251	1081	1254	1250
Honduras	696	1266	1339	1285	1210	1032	1166	1180	1092	1100
<b>CARIBBEAN</b>	1163	1180	1205	1293	1398	1578	1516	1629	1495	1340
<b>LATIN AMERICA</b>	10978	13904	14940	14604	14679	15822	16644	16789	17474	17802
<b>WORLD PRODUCTION</b>	23317	28858	31773	34865	38461	42434	44678	44856	44965	45845

Source: FAO yearbooks

Table 4: Selected Rotterdam Model Statistics for Four Banana Import Markets

IMPORT MARKET	UNRESTRICTED		RESTRICTED	
		HOMOGENEITY	SYMMETRY	SYMMETRY/ HOMOGENEITY
<b>THE U.S.</b>				
Maximum likelihood	407.265	404.157	396.63	392.942
LR\ a		6.22(6)	21.27(15)	28.65(21)
X <sup>2</sup> \ b	111.09(48)*	104.87(42)*	89.82(33)*	82.44(27)*
<b>THE EMF</b>				
Maximum likelihood	165.66	162.18	165.19	161.41
LR\ a		6.96(4)	0.94(6)	8.5(10)
X <sup>2</sup> \ b	56.40(24)*	49.43(20)*	55.44(18)*	47.89(14)*
<b>JAPAN</b>				
Maximum likelihood	114.77	111.54	111.77	110.53
LR\ a		6.46(3)	6.00(3)	8.48(6)
X <sup>2</sup> \ b	93.76(15)*	87.30(12)*	87.74(12)*	85.27(9)*
<b>ITALY</b>				
Maximum likelihood	161.17	156.18	149.94	146.09
LR\ a		9.98(4)*	22.46*	30.16(10)*
X <sup>2</sup> \ b	64.28(24)*	54.32(20)*	41.84(18)*	34.14(14)*

\|a Likelihood ratio, which is distributed as a Chi-square with degrees of freedom equal to the number of restrictions

\|b Distributed as Chi-square under the null hypothesis that all the slopes are equal to zero

\*= Statistically significant at 5% level or less

Numbers in parenthesis are degrees of freedom

The EMF= European free market

Table 5: Conditional Income and Own-Price Elasticities of Demand for Bananas in the United States, the European Free Market, Japan and Italy, 1962-1989

Importing country	Ecuador (1)	Colombia (2)	Costa Rica (3)	Honduras (4)	Panama (5)	Somalia (6)	Thailand (7)	Philippines (8)	ROW (9)
<b>INCOME ELASTICITIES</b>									
The United states	1.807** (0.639)	-1.054 (0.850)	-1.686** (0.706)	2.513** (0.946)	3.107** (1.327)	-	-	-	0.405 (1.220)
The EMF\1	0.708** (0.330)	0.615 (0.799)	1.631** (0.513)	-	0.652** (0.298)	-	-	-	1.300** (0.594)
Japan	4.815** (1.033)	-	-	-	-	-	0.060 (0.505)	0.264 (0.247)	5.224** (1.880)
Italy	1.208** (0.503)	-	1.656** (0.449)	-	1.357* (0.718)	1.770** (0.434)	-	-	0.582 (0.438)
<b>OWN-PRICE ELASTICITIES</b>									
The United states	-0.825* (0.452)	0.025 (0.231)	-0.671 (0.549)	-1.202** (0.437)	-0.039 (0.604)	-	-	-	0.082 (0.456)
The EMF\1	-0.257 (0.812)	2.158 (1.282)	-3.664** (1.213)	-	-2.134** (0.863)	-	-	-	0.544 (1.015)
Japan	-1.884** (0.593)	-	-	-	-	-	-1.516** (0.641)	-0.618** (0.166)	-0.224 (0.548)
Italy	1.961** (0.948)	-	3.208** (0.815)	-	-1.565 (1.528)	0.189 (0.361)	-	-	1.517 (1.513)
<b>INTERCEPTS</b>									
The United states	-0.010 (0.007)	0.011** (0.004)	0.020** (0.008)	0.010 (0.012)	-0.012 (0.008)	-0.003 (0.002)	-	-	0.005 (0.006)
The EMF\1	-0.007 (0.004)	0.006 (0.008)	-0.004 (0.010)	-	0.008 (0.007)	-	-	-	-0.003 (0.009)
Japan	-0.007 (0.018)	-	-	-	-	-	-0.018 0.013	0.024 0.018	0.000 0.005
Italy	-0.012 (0.010)	-	0.035** (0.013)	-	-0.006 (0.015)	-0.007 (0.007)	-	-	-0.010 (0.020)

\1 The European free market is made up of Germany, Austria, Belgium, Denmark, Finland, Ireland, Norway, The Netherlands Sweden, Switzerland

\*\* = significantly different from zero at the 5% level or less

\* = significantly different from zero at the 10% level or less

ROW= Rest of the World

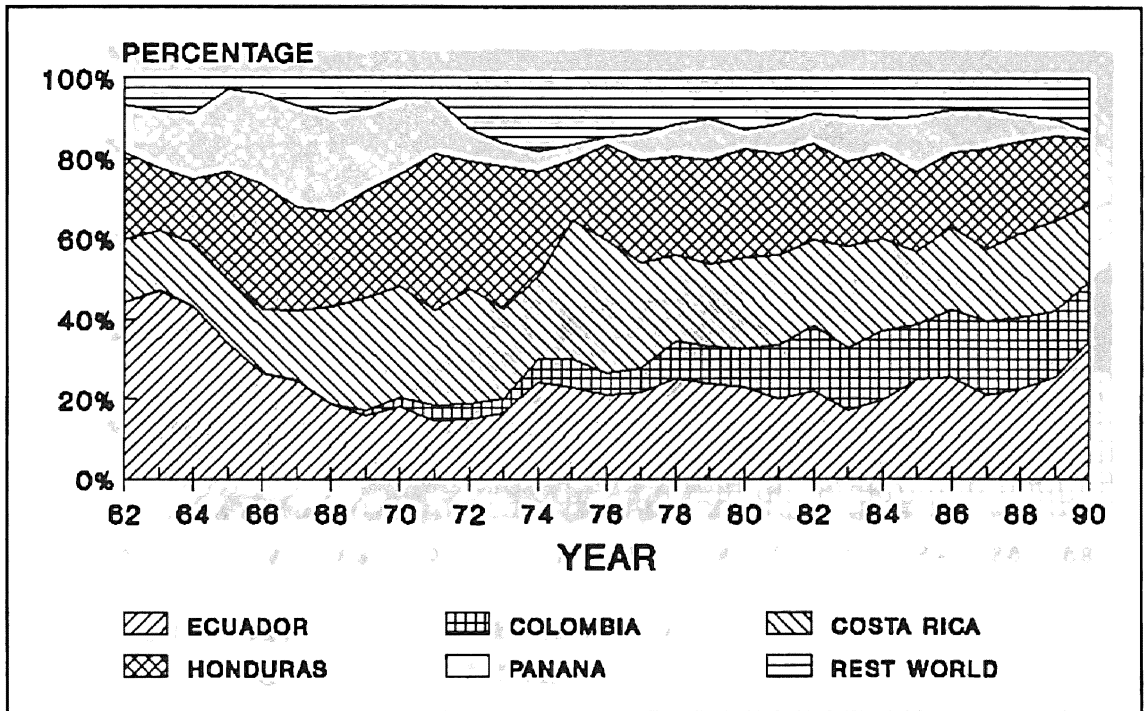


Figure 1. US Banana Import Market Shares (1962-1990)

Source: United Nations trade data tape SITC 0513.



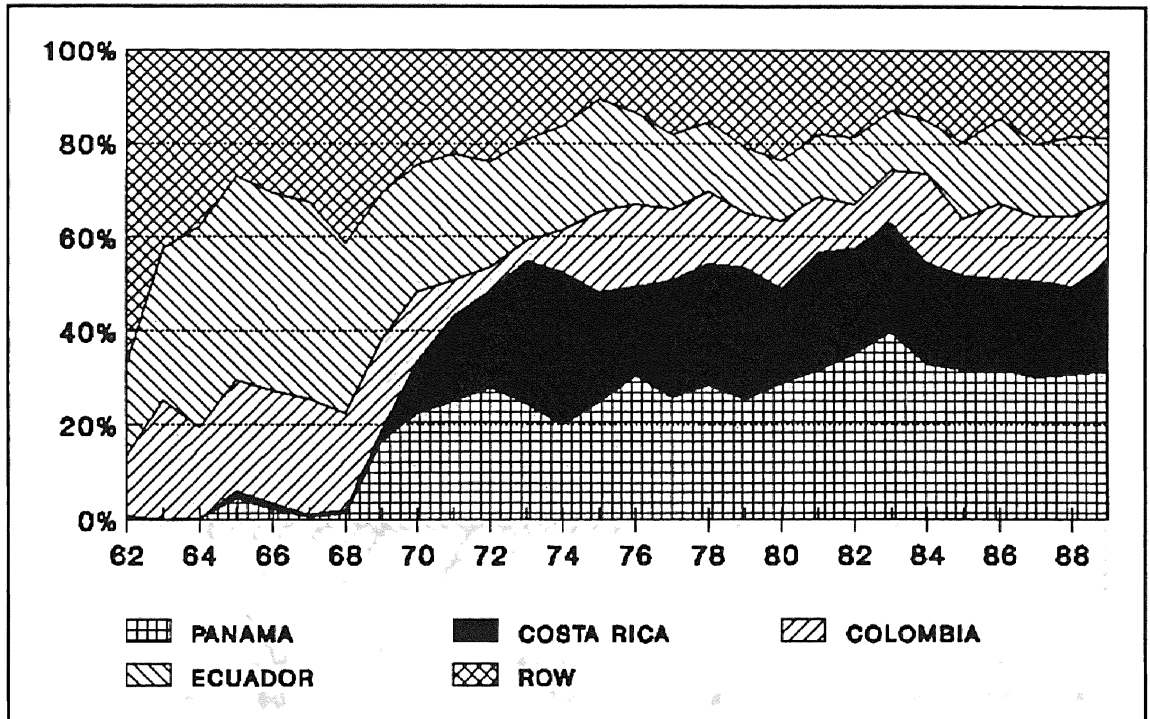


Figure 2. Banana Market Shares for the European Free Market 1962-1989.

Source: United Nations trade data tape SITC 0513.

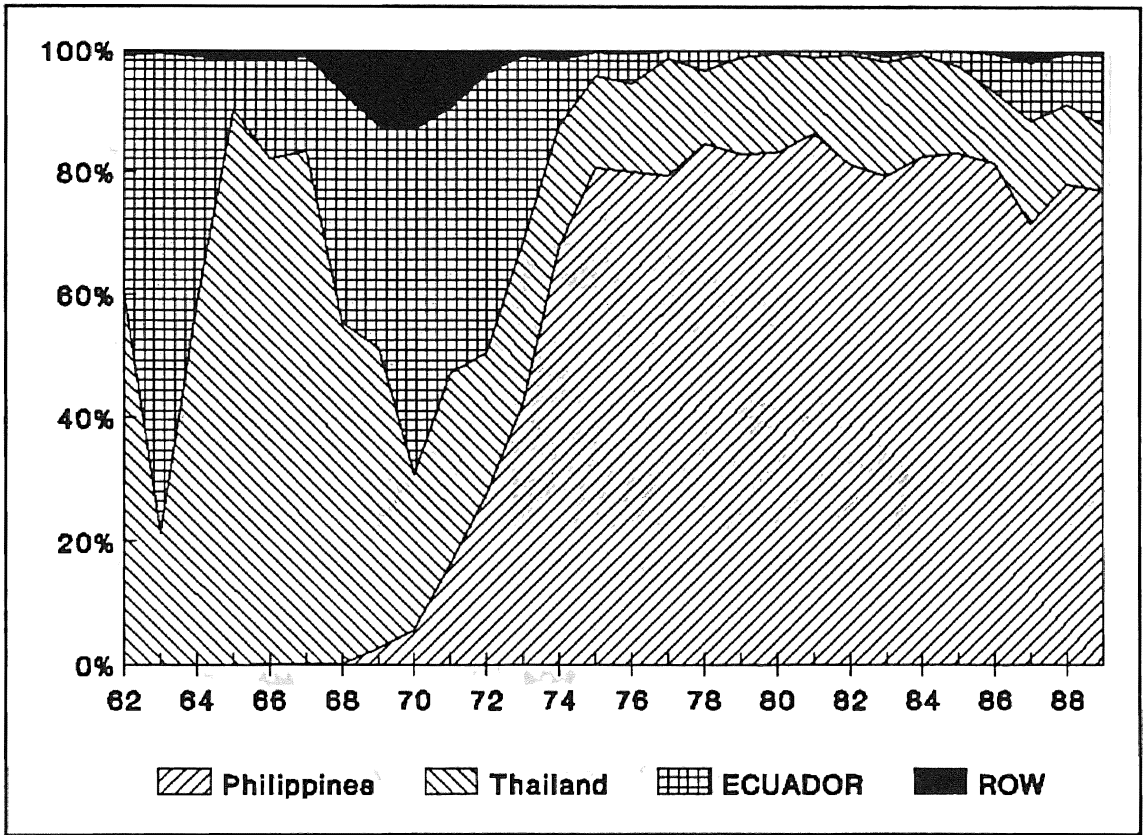


Figure 3. Japanese Banana Market Shares, 1962-1989

Source: United Nations trade data tape SITC 0513.

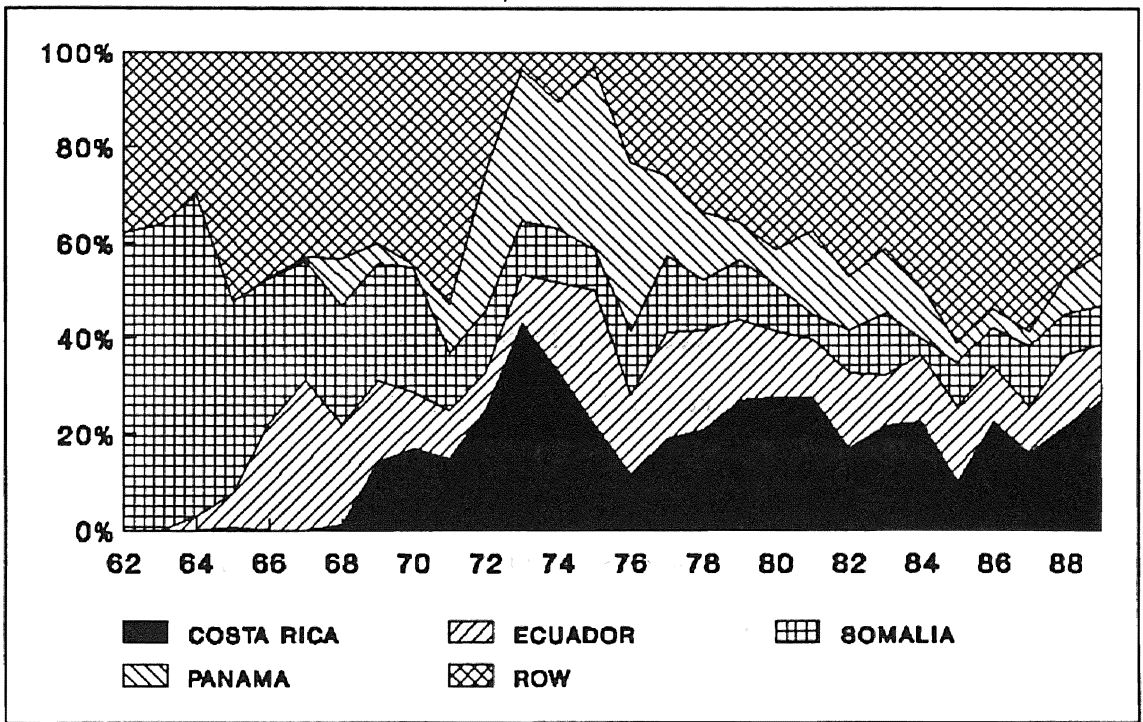


Figure 4. Italian Banana Market Shares (1962-1989)

Source: United Nations trade data tape SITC 0513.

### PAPER III

#### EVALUACION DE LA COMPETENCIA Y EL POTENCIAL EXPORTADOR DE BANANOS DE COSTA RICA

El consumo de banano a nivel mundial ha aumentado significativamente en los últimos años. Actualmente, el Banano es la fruta que más se comercia a nivel internacional; sólo el comercio de naranjas y manzanas se le acercan en importancia (Cuadro 1). Las importaciones de banano a nivel mundial aumentaron de 0.4 billones de dólares en 1962 a 3.6 billones de dólares en 1989, con una tasa de crecimiento anual del 8% (FAO Trade Yearbooks).

Como respuesta al aumento en las importaciones mundiales de banano, muchos países en América Latina, incluido Costa Rica, han aumentado la producción de banano (Cuadro 2). La producción de banano en Latinoamérica aumentó de un promedio de 11 millones de toneladas durante 1962-1965 a 17.5 millones de toneladas métricas in 1989. Por su parte Costa Rica aumentó su producción bananera de un promedio de 462 mil toneladas durante 1962-1965 a 1.4 millones toneladas en 1989.

Costa Rica, como objeto de estudio esta investigación, tiene establecido como los mercados de importación de mayor importancia a los Estados Unidos, el mercado libre Europeo

(MLE)<sup>5</sup> e Italia. Estos países importaron más del 92% del volumen exportado por Costa Rica en 1989. Dado lo anterior, es de interés para Costa Rica determinar su competencia con otros exportadores de banano para satisfacer la creciente demanda internacional de esta fruta.

La importancia de este estudio se justifica en el siguiente contexto: Por mucho tiempo, las dos fuentes de ingreso más importantes para Costa Rica han sido las exportaciones de banano y café. Ambos productos representaron un 42% del total de exportaciones en 1989 (Cuadro 3). Las exportaciones de banano crecieron considerablemente (10% anual) durante el período 1962-1989 hasta convertirse en el primer producto de exportación en 1989. Las exportaciones de banano han crecido a una tasa relativamente constante, no siendo el caso para las exportaciones de café las cuales variaron considerablemente durante el mismo período debido a la variabilidad de los precios internacionales del café (figura 1). Como consecuencia de lo anterior, una reducción de las exportaciones de cualquiera de estos productos afectan considerablemente la economía costarricense.

El propósito de este estudio es determinar el potencial de las exportaciones de banano de Costa Rica y la competencia en el mercado de exportación bananera que se ha establecido entre Costa Rica y otros países hacia tres de

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<sup>5</sup> MLE está conformado por Alemania, Australia, Bélgica, Dinamarca, Finlandia, Irlanda, Noruega, Países Bajos, Suecia and Suiza (Instituto Inter-Americano de Cooperación para la Agricultura (IICA), 1992).

los principales países importadores de esta fruta. Los objetivos específicos son:

- (1) Determinar el cambio en la participación de Costa Rica ante un cambio en el valor de las importaciones de sus principales importadores de banano.
- (2) Establecer el cambio en las exportaciones de banano de Costa Rica ante cambios en el precio internacional del banano.
- (3) Determinar la interdependencia entre Costa Rica y sus principales competidores en el mercado mundial del banano.

En este estudio, el modelo de "Rotterdam" en su versión absoluta es estimado para cada uno de los tres principales países de destino de las exportaciones de banano de Costa Rica. La elasticidad condicional de ingreso y la elasticidad precio de la demanda es utilizada para analizar la competencia entre Costa Rica y sus principales competidores (Ecuador, Panama, Colombia, Honduras y El Caribe). Este estudio puede proveer de información útil en el proceso de toma de decisiones.

### **Importaciones mundiales de banano**

Este análisis es enfocado hacia tres principales mercados (Estados Unidos (EUA), el mercado libre Europeo (MLE), e Italia) dada su importancia como mercados de destino de las exportaciones de banano de Costa Rica. En

1989, el total de exportaciones de banano a estos mercados fue de 1.2 millones de toneladas las cuales representaron 92% del total exportado ese año por Costa Rica (1.3 millones de toneladas) (United Nations trade data tape SITC 0513).

Los Estados Unidos. Estados Unidos se considera como mercado libre sin cuotas y otras restricciones no arancelarias. Los Estados Unidos figura como primer importador de bananos en el mundo con un total importado de 1.1 billones de dólares, lo cual representó un 30% del total comercializado en 1989 (table 3). El mercado de mayor importancia para Costa Rica durante la mayor parte del período 1962-1989 fue los Estados Unidos (figura 2), supliendo Costa Rica un 22% del total importado por este país en 1989 (table 3). Las exportaciones de Costa Rica hacia los Estados Unidos aumentaron de 12 millones de dólares en 1962 a 238 millones de dólares en 1989, con una tasa de crecimiento anual del 9.7%.

En comparación con los otros países competidores, la participación de Costa Rica en este mercado reveló mayor estabilidad con un promedio de un 21% durante 1962-1989, la cual varió de un 15.5% durante 1962-1965 a un 21.8% en 1989. Los principales competidores para Costa Rica en el mercado estadounidense son Panamá, Colombia, Ecuador y Honduras, con una participación porcentual en 1989 de 1.6%, 14.4%, 33.5% y 15.8%, respectivamente. Aun cuando en 1989 la participación de Panamá en el mercado fue muy pequeña, este país se incluye en este análisis porque su participación durante los

primeros años del período de análisis fue relativamente importante (19% durante los años 60's).

El mercado libre Europeo (MLE). Siguiendo la segmentación del mercado mundial del banano elaborado por el IICA (1992), el MLE se compone de 10 países: Alemania, Australia, Bélgica, Dinamarca, Finlandia, Irlanda, Noruega, Países bajos, Suecia y Suiza. La característica más importante de este mercado es la ausencia de cuotas y otras restricciones no arancelarias a la importación de banano. Este mercado importó un total de 822 millones de dólares, 23% del total comercializado en el mundo (cuadro 3). Las importaciones de banano de este mercado desde Costa Rica también crecieron significativamente de 18 millones de dólares en 1970 a 191 millones de dólares en 1989, con una tasa de crecimiento anual del 8.2% durante 1970-1989 (figura 2). Tres países -Panamá, Colombia, y Ecuador- son los principales competidores de Costa Rica. Las exportaciones de estos países, incluyendo Costa Rica, representaron un 81% de las importaciones de este mercado en 1989. Panamá, el exportador líder, suministró un 32%, seguido por Costa Rica y Colombia con participaciones del 23% y 13% respectivamente. La importancia relativa entre los suplidores del MLE cambió significativamente durante los 60's. Durante esta década, la participación de Panamá y Costa Rica fue nula comparado con un 55% en la participación de estos mismos países en 1989. Solamente después de 1972 la importancia relativa entre los suplidores de banano hacia



este mercado mostró mayor estabilidad.

Mercado de Italia. Italia es uno de los tres mercados en Europa (Francia y El Reino Unido son los otros) que brindan protección al comercio de la fruta proveniente de sus ex-colonias y provincias de ultramar. La principal característica de estos mercados es el tipo protección garantizada por la Comunidad Europea -bajo el artículo 115 del tratado de Roma y la convención de Lomé- a supplidores preferenciales como es el caso de los países de Africa, Asia, y el Pacífico (IICA, 1992).

Italia importó un total de 200 millones de dólares in 1989, lo cual significó un 5.5% del total comercializado a nivel mundial en ese año. Del total, Costa Rica suministró un 27%, Ecuador 12%, Panamá 11%, Somalia 8% y otros supplidores un 42%. Las exportaciones de Costa Rica a este mercado aumentaron más del doble, de 20 millones de dólares en 1970 a 54 millones de dólares en 1989, con una tasa de crecimiento anual del 8.4% (figura 2). Más que en ninguno de los mercados analizados en este estudio, la importancia relativa entre los exportadores al mercado Italiano cambió significativamente durange el período 1962-1989. El supplidor de bananos líder en este mercado, Costa Rica, penetró el mercado Italiano en 1969 con una particiapiación del 14%, alcanzando un pico de 43% en 1973, y suppliando un 27% en 1989.

### Método

Estudios recientes sobre la demanda de importación se basan en la teoría del consumidor. Bajo este contexto, es importante distinguir la diferencia entre un bien y un producto. Cada producto se puede distinguir por su tipo y su origen, y se asume que cada producto es sustituto imperfecto de otros productos. Los bienes se distinguen por su tipo (por ejemplo bananos) y los productos se distinguen por su tipo y su origen o lugar de producción (Armington, 1969). Por ejemplo, los bananos provenientes de diferentes países se definen como productos.

El modelo escogido para ajustar los datos es el modelo de "Rotterdam" bajo el supuesto de "separabilidad" (separability). El supuesto de separabilidad permite dividir los bienes de consumo en grupos, lo cual a su vez permite explicar la preferencia del consumidor por un grupo de bienes en particular independientemente de los otros grupos. Dicho de otra forma, existe una función de utilidad para cada grupo de bienes que es independiente de las funciones de utilidad para otros grupos. El supuesto de separabilidad permite estimar el sistema de demanda de importaciones de banano sin considerar la demanda de importación por otros bienes. La teoría que justifica este modelo ha sido explicada en detalle por Theil (1980) y Deaton y Muellbauer (1980) y no es detallada en este estudio. Se asume que el proceso de importación ocurre en dos etapas. La primera etapa es la distribución por parte

de cada país del gasto total en importaciones en la importación de cada bien, y la segunda etapa es decidir los países desde dónde importar. Muchos factores determinan la variación de las importaciones desde un determinado país exportador. En este estudio se asume, basado en la teoría de maximización de la utilidad del consumidor, que tres factores principales explican dicha variación: 1) el gasto total en importaciones de banano por el país importador, 2) el precio de importación desde el país exportador y 3) el precio de importación desde los países competidores en dicho mercado. La inclusión de una constante en el modelo permite cuantificar la variación en las importaciones de un país que no se explica por variaciones en el ingreso o en los precios.

El modelo de "Rotterdam", estimado para cada mercado, se define como el siguiente sistema de ecuaciones:

$$m_i = \alpha_i + \beta_i M_t + \sum \theta_{ij} p_{jt}^* + \mu_{it} \quad (3.1)$$

donde:

- $i, j$  - regiones o países exportadores de banano,
- $t$  - tiempo en años,
- $m_i$  -  $w_{it}^* q_{it}^*$ ,
- $q_{it}$  - cantidad de las importaciones de banano desde el país  $i$  en año  $t$ ,
- $q_{it}^*$  -  $\log(q_{it}/q_{i,t-1})$ ,
- $w_{it}$  - participación de las exportaciones de bananos del país  $i$  en el año  $t$ ,
- $w_{it}^*$  -  $(w_{it} + w_{i,t-1})/2$  = promedio de dos años de la participación de las exportaciones del país  $i$  en el mercado,
- $M_t$  -  $\sum_i m_i$  = índice que representa el cambio proporcional en

términos reales del total de importaciones en dólares,

$$P_{it}^* = \log(P_{it}/P_{i,t-1})$$

$P_{it}$  = precio de importación de banano desde el país exportador  $i$ ,

$\alpha_i$  = constante que representa el cambio anual en la participación de las exportaciones del país  $i$  en ausencia de cambios en el total de importaciones o precios relativos,

$\beta_i$  = cambio en las demanda de importación de bananos desde el país  $i$  ante un cambio (de un dólar) en el gasto total de importación de bananos en dicho mercado,

$\theta_{ij}$  = este parámetro estima el cambio en la demanda de importación ante un cambio en el precio de importación desde  $i$  o  $j$ . También se entiende como el efecto de sustitución de un cambio relativo en los precios,

$\mu_i$  = error.

La elasticidad precio de la demanda de importación de bananos desde un país en particular es obtenida con la siguiente fórmula (donde  $\text{pro}$  = promedio):  $e_{ij} = \theta_{ij}/\text{pro}(w_{it}^*) - \beta_i * \text{pro}(w_{jt}^*)/\text{pro}(w_{it}^*)$ . Esta elasticidad mide el efecto total (efecto ingreso y el efecto de sustitución) de un cambio en los precios de importación. La elasticidad de ingreso de la demanda de importación para cada país exportador se calculada de la siguiente forma:  $n_i = \beta_i/\text{pro}(w_{it}^*)$ . Dado que el proceso se desarrolla en dos etapas la elasticidad ingreso ( $n_i$ ) y la elasticidad precio de la demanda ( $e_{ij}$ ) son condicionales. La demanda de importaciones que se estima en la segunda etapa depende del total del gasto designado para las importaciones de banano en cada uno de los mercados de importación.

Usualmente, la constante no es incluida cuando se estima este modelo (Seale, Sparks and Buxton, 1992; Sparks, 1992; Deaton and Muellbauer, 1980; Mayes, 1981). Esto implica que cuando el total del gasto en importaciones de banano y los precios no cambian desde el año

$t-1$  al año  $t$ , los cambios en la demanda serían igual al error en cada ecuación ( $\mu_{it}$ ) (Theil, 1978). En este estudio, la constante ( $\alpha_1$ ) se incluye para cuantificar cambios sistemáticos que se dan por otros factores que no sean cambios en el gasto en importaciones o cambios en los precios.

Los parámetros que se estiman con este modelo se relacionan directamente con los supuestos de la teoría económica. El primer supuesto que está empotrado en el modelo es que la participación marginal de cada país en un mercado en particular suma uno (Deaton and Muellbauer, 1980). En términos matemáticos implica que para todo  $j$   $\sum_i \beta_i = 1$  y  $\sum_j \theta_{ij} = 0$ . El segundo supuesto es simetría e implica que para todo  $i$  y para todo  $j$   $\theta_{ij} = \theta_{ji}$ . El tercer y último supuesto es homogeneidad (para todo  $i$   $\sum_j \theta_{ij} = 0$ ). En otras palabras, no existe ilusión monetaria; o sea que si el precio de los bienes de consumo y el ingreso del consumidor cambian en la misma proporción, el consumidor se mantiene en la misma condición inicial y la demanda de dichos bienes no cambia (en este caso el consumidor es el país importador).

Los datos sobre importaciones de bananos provenientes de las Naciones Unidas permiten distinguir las importaciones de cada uno de los mercados de importancia para Costa Rica por país de origen durante el período 1962-1989. De esta información se determinaron los competidores más importantes de Costa Rica en cada mercado, así como el resto de las importaciones fueron agregadas en la categoría "Resto del mundo" (RDM). Para el mercado de E.U. y el MLE, Costa Rica, Colombia, Ecuador, Honduras y Panamá fueron incluidos en el modelo, los cuales representaron un 89% y un 81% del total de importaciones de E.U. y MLE, respectivamente. Con respecto al mercado italiano, Costa Rica, Ecuador, Panamá y Somalia se incluyeron en el modelo, representando un 58% del

total importado por Italia en 1989, con un 42% de las importaciones agregadas en la categoría RDM.

El período de análisis es diferente para cada mercado de importación. La disponibilidad de datos sobre las importaciones por cantidad por parte de los Estados Unidos sólo permite estimar el modelo para el período 1964-1989. El período de análisis para el MLE es 1972-1989. Como se comentó anteriormente, no es sino hasta 1972 que la importancia relativa entre los suplidores de banano a este mercado mostró mayor estabilidad. Finalmente, el análisis del mercado italiano abarca el período 1969-1989 cuando el suplidor líder, Costa Rica, penetra el mercado italiano en 1969.

Para la estimación del modelo de Rotterdam se usaron regresiones aparentemente no relacionadas (RANR). Este procedimiento toma en cuenta la correlación entre cada ecuación que representa cada país exportador de bananos. Cada ecuación en el sistema se relaciona entre sí a través de la imposición de restricciones, en este caso las restricciones de homogeneidad y simetría.

Prueba de hipótesis. La prueba de Chi cuadrado  $X^2$  es usada para probar la hipótesis nula de que los coeficientes del modelo son estadísticamente significativos (White, Wong, Whistler y Haun, 1990):  $X^2 = -T(\text{LOG}(1-R^2))$ , donde T es el número de observaciones y  $R^2$  es el coeficiente múltiple de determinación.

Una manera de encontrar la especificación adecuada del modelo en cuestión es estimar el modelo en primera instancia sin restricciones, y luego, imponiendo simetría y homogeneidad. Para probar si la hipótesis nula de simetría y homogeneidad se justifica o no se usa la prueba "razón de posibilidad" (RP) (the Likelihood ratio test). La prueba RP es

calculada como la razón del valor máximo de la función de posibilidades (maximum likelihood function) bajo el supuesto de simetría y homogeneidad y el valor máximo de la función de posibilidad sin ninguna restricción (Kennedy, 1985). Si la hipótesis nula es cierta, dos veces la diferencia entre el logaritmo del valor máximo de ambas funciones (restringida y sin restringir), esto se distribuye asintóticamente como la Chi-cuadrada  $X^2$  con grados de libertad igual al número de restricciones en el modelo (Judge et al., 1982).

Los errores estándares para las elasticidades precio de la demanda fueron estimados como la raíz cuadrada de la siguiente expresión:

$$\text{var}(e_{ij}) = \text{var}(\theta_{ij}) / (s_{it})^2 + \text{var}(\beta_i) * (-s_{jt} / s_{it})^2 + \text{cov}(\theta_{ij}, \beta_i) * (-s_{jt}) / (s_{it})^2,$$

donde  $s_{it} = \text{pro}(w^*_{it})$ ,  $s_{jt} = \text{pro}(w^*_{jt})$ ,  $\text{var} = \text{variancia}$  y  $\text{cov} = \text{covariancia}$ . Los errores estándares para la elasticidad ingreso se obtuvieron como la raíz cuadrada de:  $\text{var}(\eta_i) = \text{Var}(\beta_i) / (s_{it})^2$ .

### Resultados

Las hipótesis nulas de homogeneidad y simetría no pudieron ser rechazadas en los mercados de Estados Unidos y el mercado libre de Europa a un nivel de significancia del 5%. Por el contrario, estas hipótesis son rechazadas para el mercado Italiano. La razón de posibilidad (RP) es igual a (grados de libertad entre paréntesis) 28.65(21), 8.5(10) para E.U. y el MLE respectivamente. Concerniente al mercado italiano, la RP es igual a 9.48(4) y 22.46(46) para homogeneidad y simetría respectivamente; aun mayor es la RP cuando se imponen ambas restricciones, homogeneidad y simetría (30.16(10)). Probablemente esto

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<sup>6</sup> El valor máximo de la función de posibilidad es el valor obtenido como resultado de maximizar la función de posibilidad. Maximizar la función de posibilidad significa maximizar la probabilidad de obtener las observaciones en la muestra estadística.

se debe a los aranceles y otras barreras internas impuestas por el mercado italiano a las importaciones de bananos desde la zona dólar<sup>7</sup>. Las importaciones del banano provenientes de la zona dólar son restringidas a través de la imposición de un arancel de un 20%, un impuesto al valor agregado del 9% y un impuesto al consumidor de 17.6% (IICA, 1992). Es importante mencionar que estas restricciones no son impuestas a las importaciones desde Somalia y a las importaciones desde otros países agregados en la categoría RDM. Evidentemente, el mercado italiano no se puede considerar como un mercado libre, por lo tanto, los supuestos económicos de simetría y homogeneidad no se mantienen. Aun así, los resultados sobre este mercado son reportados sin la imposición de estas restricciones. La hipótesis nula de que todos los parámetros son estadísticamente insignificativos en cada uno de los mercados es rechazada a un nivel de significancia del 5%.

Elasticidad ingreso y la elasticidad precio de la demanda. La elasticidad precio y la elasticidad ingreso de la demanda de importación de bananos desde Costa Rica para cada uno de los mercados se presenta en el cuadro 4. Estos estimados explican la competencia entre Costa Rica y sus principales competidores en cada uno de los mercados. La elasticidad condicional del ingreso indica el porcentaje de cambio en las importaciones de banano desde Costa Rica ante un cambio de un 1% en el valor total de las importaciones de banano. La elasticidad condicional del precio refleja el efecto de sustitución y el efecto de ingreso ante un cambio en los precios de importación del banano, manteniéndose constante el gasto en las importaciones de banano del país

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<sup>7</sup> La zona dólar comprende los países de Bolivia, Canadá, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala, Honduras, México, Nicaragua, Panamá, Filipinas Estados Unidos y Venezuela.



importador. La elasticidad precio indica el porcentaje de cambio en las importaciones de banano desde Costa Rica cuando hay un cambio de un 1% en el precio de importación del banano.

A continuación se presenta en detalle los resultados para Costa Rica. Información general sobre la competencia para los otros países exportadores de banano puede encontrarse en Arias, Henneberry y Sparks, 1993. Si las importaciones de banano se expandieran en el MLE e Italia por un 1%, las importaciones de estos mercados desde Costa Rica aumentarían 1.6% y 1.7%, respectivamente (cuadro 4). Costa Rica tiene la posición competitiva más fuerte en el MLE, como es indicado por su alta elasticidad condicional del ingreso (1.6%) en comparación con los otros competidores. En los E.U., un aumento del 1% en las importaciones de banano tendería a disminuir las importaciones desde Costa Rica por 1.7%. Si un bien tiene una elasticidad de ingreso negativa (y por ende participación marginal negativa), este bien es inferior. Que un bien sea inferior puede darse bajo el supuesto de separabilidad, supuesto hecho en este estudio (Theil, 1980). Esto puede significar que los E.U. está cambiando su demanda de importaciones de banano hacia otros suplidores (i.e, Ecuador, Honduras, Panamá). Esto implica que a medida que pase el tiempo y los Estados Unidos aumente sus importaciones, Costa Rica perdería participación porcentual en este mercado. Sin embargo, la constante en la ecuación que representa la demanda de exportaciones de bananos de Costa Rica es estadísticamente significativa (0.02). Esto da a entender que aun cuando no hubiesen cambios en las importaciones totales de los E.U. o cambios en los precios, la participación de Costa Rica en este mercado aumentaría en un 2%. Este aumento no se explica por las fuerzas del mercado. La constante es también estadísticamente significativa para el mercado italiano; aun cuando no hubiesen cambios

en el gasto en importaciones totales de banano en los precios, la demanda de bananos de Costa Rica aumentaría en un 3.5%.

La elasticidad precio de la demanda para Costa Rica en el EFM es estadísticamente significativa, pero insignificante en los E.U. (cuadro 4). Sin embargo la hipótesis nula de que la elasticidad precio de la demanda en los Estados Unidos es igual que -1 no puede ser rechazada, lo cual sugiere que la cantidad de bananos demandada desde Costa Rica variaría en la misma proporción que varían los precios. Un cambio en la cantidad importada desde Costa Rica hacia el EFM sería casi cuatro veces más que el cambio en el precio (-3.66%). De nuevo, contrario a lo esperado según la teoría económica, la elasticidad precio de la demanda para Costa Rica en el mercado italiano es positivo y significativo.

La elasticidad cruzada de la demanda en los Estados Unidos indica que importaciones de banano provenientes de Honduras y Ecuador son sustitutos de las importaciones provenientes de Costa Rica. Debido a la relativa importancia de la participación de Honduras y Ecuador en el mercado estadounidense, variaciones en las exportaciones de estos países podrían afectar significativamente las exportaciones de Costa Rica a este mercado.

### Conclusiones e implicaciones

El modelo de distribución geográfica de Rotterdam se usó para ajustar los datos sobre importación de bananos desde Costa Rica en tres mercados. Las hipótesis nulas de homogeneidad y simetría en los E.U. y en el MLE no pudieron ser rechazadas; lo contrario es cierto para el mercado italiano. El mercado italiano no puede ser considerado como un mercado libre, por lo tanto no se espera que los supuestos económicos se mantengan.

Los resultados indican que Costa Rica incrementaría más que proporcionalmente sus exportaciones de banano si el total de importaciones de bananos en el MLE e Italia aumentan. Por el contrario las importaciones de banano por parte de los E.U. desde Costa Rica disminuirían cuando las importaciones de este mercado aumenten. Esto sugiere que la participación de Costa Rica aumentaría en el MLE e Italia pero disminuiría en los E.U. Sin embargo la tendencia creciente de las exportaciones de Costa Rica en los E.U. no se explica por variaciones en el total del gasto en importaciones pero por otros factores no de mercado. Las políticas por parte de Costa Rica o empresas exportadoras de banano en el país para incrementar la demanda de bananos en el MLE serían relativamente efectivas. Este no sería el caso para el mercado estadounidense debido a que son otros los factores que afectan la demanda de exportaciones de banano de Costa Rica en este mercado.

La respuesta de demanda de las exportaciones de banano de Costa Rica es diferente en cada uno de los mercados analizados. El mercado estadounidense las variaciones de precios no afectarían la demanda de bananos de Costa Rica. La situación es diferente en el MLE para el cual la elasticidad precio de la demanda es muy elástica. Esto implica que cualquier esfuerzo para reducir el precio del banano por parte de Costa Rica, a través de una reducción del costo de producción, costo de transporte de la fruta o una reducción en el impuesto a las exportaciones del banano, aumentaría la demanda de bananos de Costa Rica por parte de el MLE en forma significativa. La misma política tendría un efecto insignificante en el mercado estadounidense.

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Table 1. Importaciones mundiales de tres principales frutas:  
 bananos, naranjas y manzanas  
 (miles de toneladas métricas) 1962-1989.

AÑO	BANANOS	NARANJAS	MANZANAS
1962	3706	3074	1534
1965	4673	3442	1824
1970	5595	4071	1846
1975	6277	4637	2352
1980	6684	4857	2714
1981	6729	4649	3087
1982	6722	4818	2792
1983	6100	4760	3127
1984	6574	4912	2996
1985	7074	4585	2877
1986	7290	4967	2864
1987	7513	5125	3213
1988	7800	5294	3274
1989	8208	5235	3281

Fuente: FAO. Trade Yearbooks

**Cuadro 2. Banano: producción de Costa Rica, América Latina y el mundo, en miles de toneladas (1962-1989)**

Año	Costa Rica	América Latina	Mundial
62-65	462	10978	23317
66-70	814	13904	28858
71-75	1232	14940	31773
76-80	1151	14604	34865
81-85	1125	14679	38461
86	1096	15822	42434
87	1143	16644	44678
88	1162	16789	44856
89	1400	17474	44965

Fuente: FAO Production Yearbooks

Cuadro 3. Exportaciones totales de banano y café y su participación en las exportaciones totales y agrícolas, 1962-1989

Año	Banano			Café		
	Expo. \$1000	% Expo. Agríc.	% exp. Totales	Expo. \$10 000	% Expo. Agríc.	% exp. Totales
62	21171	25.5	22.8	4842	58.3	52.1
65	28475	30.8	25.5	4663	50.4	41.7
70	67619	37.1	29.2	7309	40.1	31.6
75	144985	40.1	29.4	9910	27.4	20.1
80	214501	32.5	21.4	24783	37.6	24.7
81	229128	34.4	22.7	24006	36.0	23.8
82	233054	38.7	26.8	24155	40.1	27.8
83	219908	40.6	25.1	20588	38.0	23.5
84	254754	37.2	26.8	26728	39.0	28.1
85	195452	30.2	21.1	31613	48.9	34.1
86	218795	27.8	20.2	39192	49.8	36.1
87	230372	30.2	20.8	33449	43.9	30.2
88	257110	32.5	20.6	31646	40.0	25.4
89	309180	36.6	21.9	28625	33.9	20.2

Fuente: FAO. Trade Yearbooks

Cuadro 4. Costa Rica: importaciones de banana desde tres mercados de importancia internacional en millones de dólares y porcentajes (1962-1988)

Año	EUA\1			MLE\2			Italia		
	Costa Rica totales		%	Costa Rica totales		%	Costa Rica totales		%
1962	12.3	78.6	15.7	0.0	166.8	0.0	0.0	24.5	0.0
1963	12.3	83.5	14.7	0.0	112.4	0.0	0.0	30.7	0.0
1964	20.2	128.2	15.7	0.0	119.8	0.0	0.0	19.0	0.0
1965	26.5	164.6	16.1	2.3	150.6	1.5	0.4	59.7	0.6
1966	29.0	181.4	16.0	2.0	158.0	1.3	0.0	57.1	0.0
1967	30.8	176.8	17.4	0.9	173.0	0.5	0.0	54.0	0.0
1968	44.7	185.9	24.1	1.4	154.6	0.9	0.6	51.8	1.2
1969	52.0	184.5	28.2	4.3	158.9	2.7	7.1	49.3	14.3
1970	53.5	192.8	27.7	18.3	160.1	11.4	7.7	45.2	17.0
1971	43.7	186.1	23.5	33.7	183.9	18.3	5.4	36.6	14.9
1972	54.9	191.4	28.7	43.4	209.2	20.7	14.3	56.4	25.4
1973	44.2	197.7	22.4	74.9	243.8	30.7	25.8	60.0	43.1
1974	43.2	208.1	20.8	86.5	265.8	32.6	22.7	68.4	33.2
1975	79.5	230.9	34.4	74.0	314.8	23.5	20.2	91.5	22.1
1976	94.9	290.1	32.7	56.5	297.2	19.0	9.5	81.6	11.7
1977	83.8	320.5	26.1	89.9	359.9	25.0	18.5	97.1	19.0
1978	104.7	491.3	21.3	103.4	398.9	25.9	23.7	113.6	20.8
1979	112.9	555.4	20.3	128.0	455.9	28.1	37.7	138.7	27.2
1980	132.7	589.3	22.5	110.3	543.1	20.3	36.1	130.1	27.7
1981	164.2	733.0	22.4	127.8	509.7	25.1	31.9	115.0	27.7
1982	168.3	788.8	21.3	106.3	467.5	22.7	21.9	128.4	17.0
1983	198.0	787.2	25.2	107.0	457.1	23.4	29.6	136.6	21.7
1984	198.3	860.1	23.1	105.0	479.9	21.9	27.6	122.9	22.5
1985	179.9	896.2	18.1	104.2	516.0	20.2	15.1	150.0	10.1
1986	194.7	970.6	20.1	130.4	674.1	19.3	38.6	170.5	22.6
1987	185.7	1050.8	17.7	179.1	868.4	20.6	33.7	211.1	16.0
1988	213.4	1041.5	20.5	152.0	804.2	18.9	67.5	309.4	21.8
1989	238.4	1093.5	21.8	191.2	821.6	23.3	54.3	199.9	27.1

1\ Estados Unidos

2\ Mercado Libre Europeo el cual incluye Alemania, Austria, Bélgica, Dinamarca, Finlandia, Irlanda, Noruega Países Bajos, Suecia y Suiza

Fuente: United Nations data tape SITC 0513



**Cuadro 5: La elasticidad ingreso y la elasticidad precio de las importaciones de banano desde Costa Rica en tres mercados. (promedios)\1**

	E.U.A.\2	EFM\3	Italy\4
Elasticidad ingreso	-1.686** (0.706)	1.631** (0.513)	1.656** (0.449)
Elasticidad precio	-0.671 (0.549)	-3.664** (1.213)	3.208** (0.815)
Elasticidad cruzada del precio			
Ecuador	1.391** (0.478)	0.137 (0.566)	-2.478** (0.847)
Colombia	-0.268 (0.163)	-0.241 (0.693)	-
Panama	-0.060 (0.295)	1.477 (0.892)	2.61** (0.956)
Honduras	1.004** (0.345)	-	-
El Caribe	0.124 (0.076)	-	-
Somalia	-	-	-1.089** (0.374)
RDM	0.166 (0.233)	0.659 (0.774)	-5.595** (1.551)
Constante	0.020** (0.008)	-0.004 (0.010)	0.035** (0.013)

\1 Las elasticidades precio representan el cambio total ante cambios relativos en los precios: incluyen el efecto sustitución y el efecto ingreso dado un cambio en el precio

\2 Para el período 1964-1989

\3 Mercado libre Europeo: período 1972-1989

\4 Período: 1968-1989

\*\* Estadísticamente significativo con  $\alpha=0.05$

\* Estadísticamente significativo con  $\alpha=0.1$

Errores estándares entre paréntesis

RDM: resto del mundo

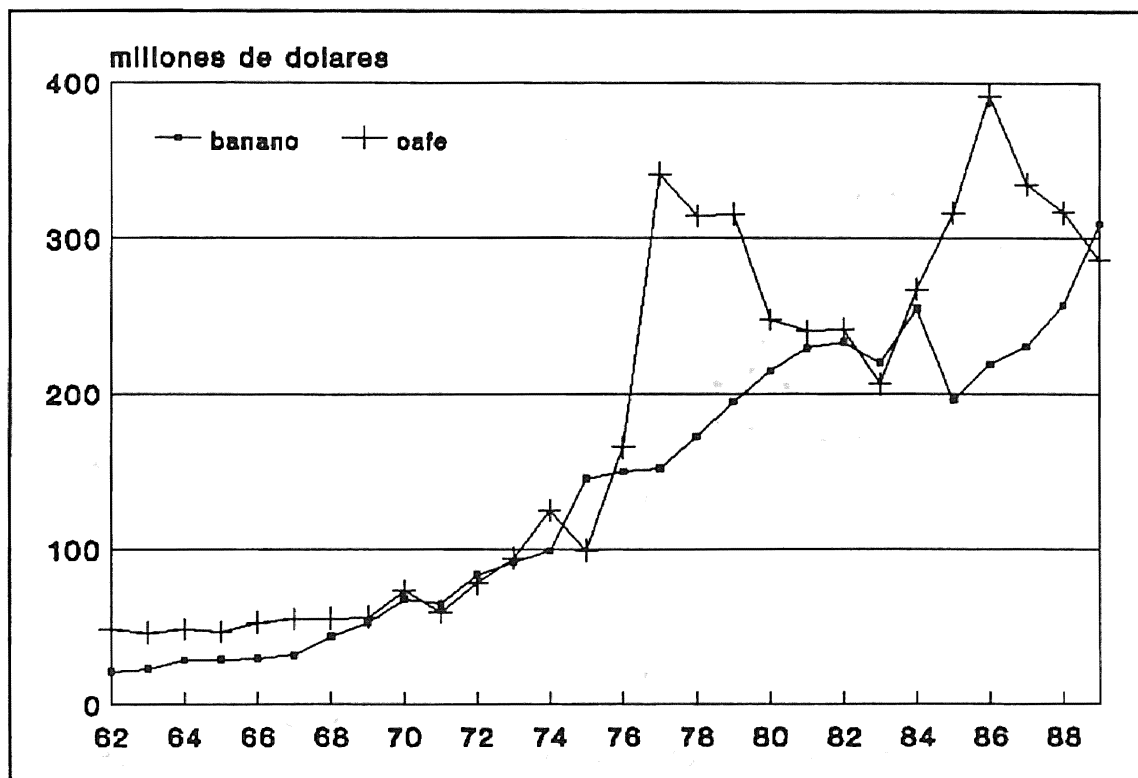
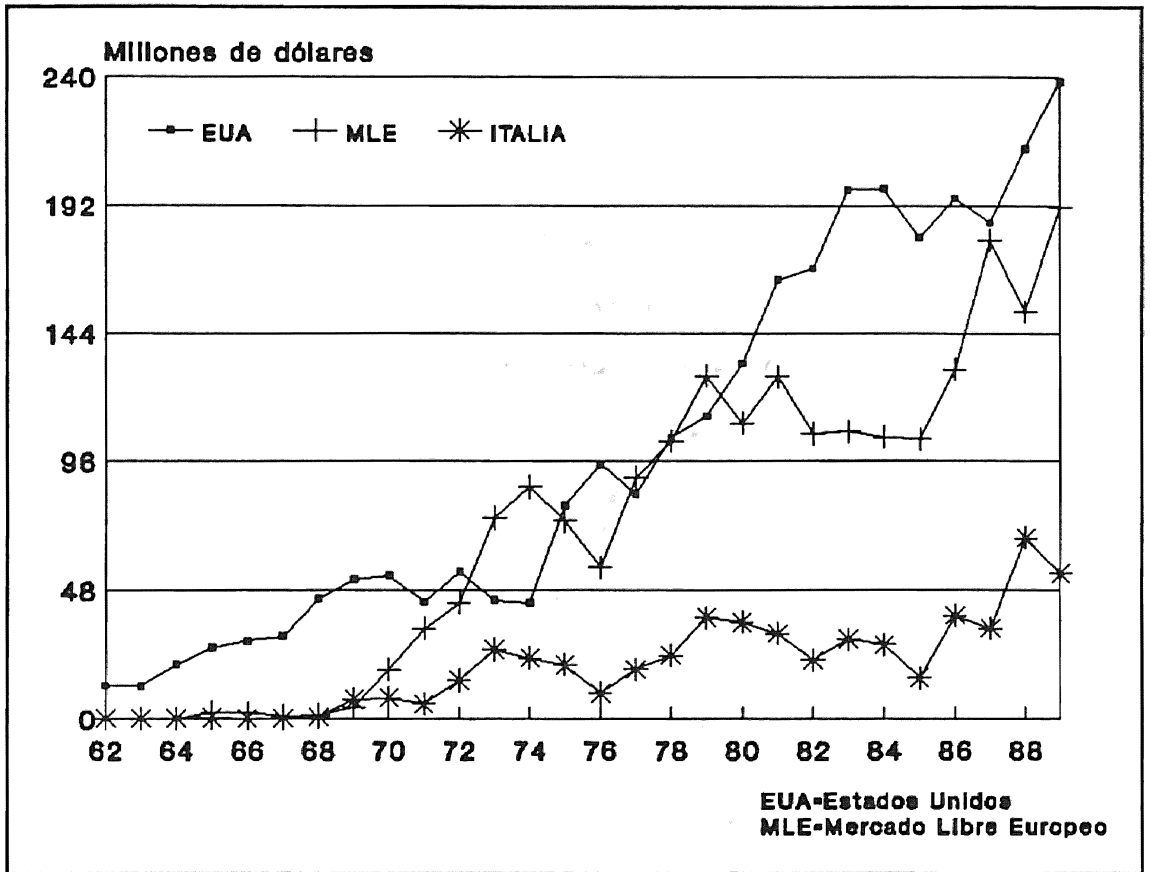


Figura 1. Exportaciones de banano y cafe en millones de dólares, 1962-1989



**Figura 2:** Costa Rica Importaciones de banano desde tres mercados principales

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