THE IMPACT OF THE U. S. CHANGING ITS TARIFF ON MEXICAN WINTER TOMATOES: 1967 AND 1977

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ABSTRACT

THE IMPACT OF THE U.S. CHANGING ITS TARIFF ON MEXICAN WINTER TOMATOES: 1967 AND 1977

By

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Out of the United Nations Conference on Trade and Development came a demand that the developed countries grant tariff relief to the products of developing nations. Many products could have been investigated, but because of the importance of Mexican imports during the winter season and the conflict between official United States trade policy and Florida tomato growers demands, tomatoes were chosen.

In order to investigate the impacts on consumers, producers, and government revenues of both increases and decreases in the level of tariffs, two techniques, linear programming and partial equilibrium analysis, are employed. The partial equilibrium approach provides the gross changes but does not supply the more detailed information desired. Therefore, linear programming is employed.

Three alternative formulations of the basic production and transportation linear program are used to simulate 1967 and to measure the impacts on various societal groups of different tariff structures. Inputs for all the models include the policy variable of tariff changes as well as the technical production relationships and transfer costs.

After the simulation of the base year (1967) and estimation of the situation under different tariff structures, projections are made. This involves estimating growth of demand in both countries, changes in production costs, and differences in various restraints by 1977.

The findings of the study indicated that if the tariff had been 50% lower in 1967 that Florida producers profits would have been about $440,000 lower, while Mexican production factors would have gained over $3 million dollars.

In general, the study estimated that for tariffs 50 per cent on either side of the status quo that changes in production, trade, and resource use are found primarily in Mexico. However, reduction of the tariff to zero would cause a large reduction in Florida production, trade, and resource use.

The results of the projections made for the study indicate that regardless of the level of tariff in 1977 between 0% and 200% of the 1967 level that Mexico will ship more produce than it did in the base year. Florida's shipments by contrast are projected to be less than actual 1967 shipments for every investigated tariff level.

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CHAPTER I: INTRODUCTION

Background

In the immediate period after World War II many nations of the free world attempted to re-establish means of increasing the volume of international trade. Among the organizations created to improve trading relationships was the General Agreement on Tariffs and Trade (GATT). The organization was an outgrowth of the ill fated International Trade Organization (ITO). The GATT through time developed into an institution which was primarily interested in the industrial trade problems of the more developed nations, MDC's). The increasing concentration of GATT discussions on industrial trade problems led in part to complaints from the less developed countries, (LDC's).

The discontent of the LDC's came to the surface at the United Nations Conference on Trade and Development held in Geneva in 1964. With 75 LDC's presenting a united front on the issues, it became clear that the MDC's would be outvoted on those issues where the interests of the two groups diverged. The LDC's put forth a series of proposals which they felt would remedy the trade problems which they faced. These proposals included increased levels of aid, tariff concessions, and finally tariff relief. These three issues were at the heart of the demands of the less developed world.

The Meaning of Tariff Relief

The LDC's contend that MDC's by the use of tariffs and domestic policies discriminate against their products. It is maintained that for certain tropical and specialty crops that tariffs restrict the exploitation of areas of comparative advantage for developing nations. Therefore, tariff relief in the context used by the LDC's means more than just reduction of nominal tariff levels. It includes lowering the effective level of tariffs through changes in tariff structures as they apply to raw materials and semi-manufactures or semi-processed products. Studies have shown that the effective rate of protection on most products is higher than the nominal rate. The reason for this is that the nominal tariff is higher if the product enters the country in a finished or semi-finished state.

Definition of the Thesis Problem

The issue to be investigated in this thesis is the effects on producers, consumers, and government revenues when a developed nation changes its tariff on the product of a developing nation. The United States was chosen for the developed nation and Mexico was chosen for the developing country. The United States has been the major trading partner for Mexico, taking 62.6% of its exports in 1965. Also, in numerous agricultural commodities it appears that Mexico has lower costs. Especially in those enterprises which are labor intensive and capital extensive, Mexico with its abundant labor force can compete very effectively.

While a wide variety of agricultural crops could have been chosen, the study is limited to tomatoes. The theoretical and empirical models used for this study should be directly transferrable to other crops. Tomatoes are chosen because of the large percentage of the crop which is exported (33%) and the increasing importance of the crop in the total value of Mexican exports. Tomato exports rose from 2.3% of total value in 1940 to 4.6% in 1965. Since Mexico does not ship processed tomatoes to the United States, the effective tariff problem is not of interest for this study and tariff relief is used to mean only a reduction in the nominal level of tariff.

A variety of U.S. tariff policies are evaluated. The potential effect of five tariff levels is investigated. The first assumes that there is no change in tariff, i.e., the tariff remains at 100%. The second assumes that tariffs are cut by 50%. A third policy assumes that the entire tariff is eliminated. Since tariffs can be raised as well as lowered and because of a rising tide of protectionism in the United States, two additional levels are investigated. Therefore, a fourth level is 150% of the present rate and the fifth is a tariff of 200%.

This study has the following objectives:

(1) To simulate with LP the winter tomato industry in the United States and Mexico in 1967.

(2) To postdict for 1967 production levels, trade patterns and resource use levels in each country under the different tariff levels.

(3) To project for 1977 trade patterns, levels of resource use and production levels.

(4) To analyze the effect of changes in the U.S. tariff level on American and Mexican producers, the United States government revenue and American consumers.

(5) To formulate tariff and other policy recommendations based on information obtained from the models.

CHAPTER II: REGIONAL PRODUCTION, CONSUMPTION, AND TRADE PATTERNS

Historical Production Patterns

Domestic Production

Over the past 10 years location of production of winter tomatoes utilized in the United States has changed dramatically. The most important domestic shift has been the decline in importance of Texas and California. In 1956 these two states marketed 26.0 percent of the total domestic winter tomatoes marketed and 22.5% of all tomatoes marketed during the winter season. Florida accounted for the remaining 74.0 percent of domestic winter tomatoes marketed. By 1967 Texas and California produced 6.2 percent of domestic winter tomatoes, and only 4.0 percent of all winter tomatoes marketed in the United States. Florida was the recipient of the domestic production shift marketing 93.8 percent of domestic tomatoes in 1967.(22-p. 54)

The shift of production occurred fairly gradually from 1956 to 1962 but accelerated after 1962. A major reason for the change was the variability of the weather in the lower Rio Grande Valley and the Imperial Valley. Both these areas have a higher probability of freezing temperatures and damaging rains during the growing season than either South Florida or Mexico.

Associated with the weather problem was the problem of finding buyers for California and Texas products. Buyers desired a reliable source of supply which was large enough to justify the investment needed to operate in a given area. As Mexico, in particular, proved to be a reliable source of supply, fewer and fewer buyers were willing to depend on areas with higher levels of uncertainty (i.e., Texas and California).(22-p. 4)

Historical Consumption

Non-Domestic Production--Mexico

Mexican output grew at a compound rate of 1.5 percent from 1950 to 1960.(20-p. 52) From 1960 to 1965 the rate rose to 3.9 percent. The growth in the first period was due primarily to acreage increases which amounted to 16.7 percent for the period. In the second period acreage actually dropped slightly, but yields increased rapidly to overcome the acreage drop.

There are several explanations for the rapid increase in output from 1960 to 1965. The first was the end of the "bracero" program. When it became apparent that this program would eventually be phased out, American capital holders started to supply capital to Mexican enterprises. This was accomplished through wholesalers at the border in Nogales.

With the infusion of capital, the wholesalers also supplied technical information. This was a second reason for increased yields. The wholesalers supplied both technical experts, who made trips to the West Coast area, and experiment station bulletins from American universities. This increased assistance is considered to be an important reason for the increased yields.(22, p. 24)

The capital and technical assistance was extended primarily to the large growers. This fact combined with the adoption of the use of export permits encouraged consolidations of tomato acreage.(22, p. 24) This was a third reason for the increase in output reported in the 1960 to 1965 period.

Domestic Consumption

Consumption of fresh tomatoes reached a peak in 1955 at 13.4 pounds per capita and has declined since that time. The average yearly per capita consumption now runs about 12.4 pounds(25) with fluctuations of between 12.0 and 12.8 pounds. In contrast to falling total consumption, recent data indicates that per capita marketings during the winter season are rising.(22, p. 16) A limited series of data indicate that marketings rose from 5.16 pounds in 1963 to 5.6 pounds in 1967. There is some question whether this rise is in fact a true trend which will continue in the future or whether it is merely a temporary fluctuation.

Mexican Consumption

Around 95 percent of all tomatoes consumed in Mexico are fresh. Data as to exact per capita consumption is very unreliable for noncensus years prior to 1960. Studies however indicate that tomatoes have a positive income elasticity and that per capita consumption has been rising. In 1960 consumption was set at 15.05 pounds per capita. By 1965 consumption had risen to about 16 pounds per person. (20-p. 40)

The same study showed that consumption in urban areas is twice as high as in rural areas. Increasing urbanization has contributed to rising demand for tomatoes as well as other vegetable products.

Trade Patterns

Prior to 1950 the United States was close to self-sufficiency in winter tomatoes, having re-established its vegetable production after World War II. With the reduction of tariffs and improvement in transportation, imports began to flow in again. Imports of winter tomatoes came from primarily two sources: Cuba and Mexico.

Prior to 1961 the United States extended preferential treatment to tomatoes from Cuba. However, imports from this source were never tremendously important in the total. At its peak in 1960, Cuba provided only 7.5 percent total tomatoes marketed. Political developments in 1961 caused the United States to revoke the preferences granted Cuba and further to embargo products from this country.

With the demise of Cuba, the only major foreign producer in the United States winter market was Mexico. In 1956 Mexico supplied 72.7 percent of all winter tomato imports. By 1967 imports from Mexico were 99 percent of nondomestic tomatoes. At the same time, Mexico was becoming increasingly important in the total U.S. market, In 1956 Mexican exports provided 9.5 percent of total marketings or 690,000 cwt.; by 1967 23.4 percent of total marketings or 3,624,000 cwt. were of Mexican origin.

In summary, the United States has historically required imports of tomatoes during the winter season. Because of low costs production and an adequate resource base, Mexico has always potentially been the most likely supplier. With the development of better transportation within Mexico, imports of Mexican tomatoes increased rapidly.

Current Production Patterns

Mexico

Production Areas

Production of tomatoes is spread throughout most of Mexico. However, the majority of tomatoes are grown in the Northern Pacific Region principally in the states of Sinaloa and Sonora, often referred to as the West Coast. In 1967 over 89% of all Mexican tomatoes produced were grown in Sinaloa.(22-p. 5) Over the past 20 years production has moved to Sinaloa near the city of Culiacan from areas both to the north and south due to superior growing conditions. Climatically, the Coastal Plain of Culiacan is superior to the other regions. Tomatoes are still grown to the north near the city of Los Mochis, in Sinaloa, and the city of Guaymos in Sonora and to the south near the city of Mazatlan. But all these areas have cooler weather than Culiacan which in the 5 to 20 years of records had no temperature below 32° F.(22-p. 16)

Varieties

Mexico produces two types of tomatoes, vine ripened and mature green. Mature green tomatoes are, as the name implies, picked while still green, the product ripening during transit to the consumption center. Vine ripened tomatoes are a different variety with thinner skins. These tomatoes must be staked whereas the mature green are allowed to grow on the ground. The majority of tomatoes grown in the past were of the mature green variety due to absence of an adequate transportation system. As will be seen later, the composition of production has changed drastically over the last 10 years as transportation and handling systems have improved.

Yields

The yields recorded also vary greatly between the average for the country as a whole and for the export areas and growers. According to a United States Department of Agriculture publication the yield per acre for 1965 was 7,531 kilograms/hectare (or 6,702 pounds per acre.)(21-p. 52) This figure is, by the admission of the report, very rough. The yields for the West Coast are much higher, around 36,000 pounds per acre for vine ripened. The difference in yield results from the more scientific methods employed in the West Coast and the shift from mature green to vine ripened. Gerhing gives an example of the yield differences.(22-p. 84) For the 1965-1966 season the yield for staked vine ripened tomatoes was 24,712 kilograms per hectare while the yield for ground tomatoes was only 6.537 kilograms per hectare. (11, p. 45) Yields in Sinaloa are higher than the rest of the country because of greater amounts of capitalization and a larger scale of operation.

Acreage

At present only about 53% of the total acreage devoted to vegetables is planted in tomatoes. This means that of the 18,188 hectares in vegetables in Sinaloa for the 1965-66 season about 9,640 hectares were for tomatoes. By the 1966-67 season acreage for all vegetables rose to 22,518 hectares.(22, p. 5) Acreage in tomatoes has been expanding in this area over time and the trend can continue.

Technology

The increasing yields and acreage are in part due to changes in available technology. Since the exports are by large scale firms (around 200-250 acres according to Ariza) (1, p. 61) they can and do use a good deal of machinery. Most growers use modern labor-replacing machinery, although some firms still use mule cultivators and hand dusters because of low labor costs. The U.S.D.A. report says, "Modern crawler-type machinery, some of narrow gauge for between-row work, is found on nearly every farm in the Culiacan area. Wheel tractors of latest design are also widely used." (22, p. 26)

Because of the shortage of well trained machinery operators, it is usual for some of the operations that may be mechanized in the United States to be performed manually in Mexico. Also, since the production of vine ripened tomatoes is labor intensive, Mexico finds that its comparative advantage lies in the production of this form of the product.

Production Costs

The costs of producing a 20 lb. crate of vine ripened tomatoes in Sinaloa is $0.31;(22-p. 26) this assumes a yield of 36,000 lbs/acre. The costs used in this study were taken from the aforementioned publication, Supplying U.S. Markets with Fresh Winter Produce. The components of the total cost can be divided into the traditional categories of land, labor, and capital. The production cost is allocated as follows: 1.4¢ per 20 pound crate for land, 6.4¢ per 20 pound crate for labor, and 22.7¢ per crate for capital.[1]

The above figure includes only pre-harvest costs. The harvesting and packing costs are divided into capital and labor costs by the USDA. Capital costs in Mexico are 39.3 cents per lug of which 35.1 cents is for packing and the remaining 4.2 cents is allocated to harvesting. Labor costs are allocated with $0.135 for harvesting and 8.7 cents for packing. The total production, harvesting, and packing cost amounts to 92 cents. On a percentage basis labor accounts for 30.9 percent of the total cost, capital for 67.4 percent, and land for 1.7 percent.

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[1]See appendix Table 1 for complete exposition of costs.

Labor

In the production of most row crops the limiting factor is labor. For crops such as vine ripened tomatoes which have defied successful mechanization in harvesting, labor becomes even more important. According to the USDA survey, Mexico averages 391 hours of labor used per acre, which is about 25 hours less than is used for growing vine ripes in Florida. Of several possible explanations for this, the first is that Mexico uses 50 less hours of pruning labor, which might imply that labor is simply more efficient in Mexico. A second cause might be that Mexican operations are larger in scale and can use labor more efficiently.

In terms of availability of labor, there appears to be an unlimited supply for the West Coast area. Field hands are usually peasants who live in the highlands surrounding the fertile valleys. Usually an entire family unit is recruited. Men and boys work in the fields while women and children above 12 years old work in the packing sheds. Those persons working are able in the 6-7 month production season to accumulate a substantial amount of income, though most of the workers are unskilles, some are able to work with mules. Machinery operators are usually former "braceros" who received some training while working in the U.S. under Public Law 78.

Labor costs have continued to rise in Mexico just as they have in the U.S. In 1956 the minimum wage in Culiacan was $.08 per hours; by 1966 it was $0.215; and by 1968 it was \$0.289.(22-p. 21) This rise is a 16 percent compound rate, but only 3.7¢ per year. Historically, the minimum wage has been raised every two years and farmers hire labor at this wage.

The wages of a minimum of 26.25 pesos per day in 1967 were about five to eight times as much as the worker could expect to earn working in the mountains.(22-p. 21)

Labor costs to the grower is higher than just the wage paid. Because the rate of employment is higher in the Culiacan area than in the rest of Mexico, the growers must provide transportation for the workers from their homes in the mountains to the fields for the season and back to their homes after the season is over. Added costs to the grower are incurred through restrictions imposed by the government. The growers can import only as many workers as there are jobs and must supply continued employment for all workers. Growers are also expected to provide adequate housing for workers. In addition to the required housing, the grower must supply a school, playground and hire a school teacher to provide an education for all children who migrate with the workers. As a result of these requirements, an additional 10 percent was added to wages to obtain labor costs in the USDA data(21-p. 21).

Production Season

The production season for vegetables is dictated by climate. In Culiacan planting is done from September to January with the harvest ocurring from December to early

June. For areas to the south production must start later due to the higher temperatures and end earlier because of cold weather in the higher elevations. Areas to north start about the same time but also end earlier because of frosts. While production covers about six months, the peak export season is February to April.(1, p. 16)

"The Culiacan area of Sinaloa has the production potential, at the costs found in the study, to supply the whole U.S. market with its winter requirements."(22-p. 34) This predication depends on continuation of adequate capitalization. Historically, American interests have extended credit against the crop. This practice has, however, declined over the last five years.(22-p. 24) The present system is for the grower to supply or obtain from normal banking channels his own credit. Due to the risk of vegetable crops, the government has not extended any credit and probably will not in the future.

Marketing and Transportation

The marketing system for export products from the West Coast of Mexico to the United States developed over time to be f.o.b. Nogales, Arizona. Tomatoes are shipped primarily by truck to Nogales where American buyers are located. Here the produce is checked and repacked for shipment to American consumption centers. For this reason, transportation charges listed in Appendix Table 5 are from Nogales to the consumption center. Since the study assumed f.o.b. Culiacan, an additional $1.022 per 20 pound lug is added to the transport costs to account for the costs incurred in moving the product to Nogales.(22-p. 107) A major component in this figure is the 39.3¢/per lug tariff imposed by the United States.

Florida

Production Areas

Domestic winter production of tomatoes has shifted over time to Florida from Texas and California. Adverse weather conditions is the major reason for this shift. Texas has periodically damaging winter rains and freezes which have caused shippers to look for more reliable sources of supply. California also suffers from cold temperatures during the winter season which makes vegetable production a highly risky venture. Therefore, the only domestic area left is in South Florida.

Production of tomatoes is located in three semi-distinct areas of Florida; Palm Beach East, Dade County (Miami); and Southwest Florida. Both vine ripened and mature-green tomatoes are grown in the Palm Beach East and Southwest Florida areas while Dade County grows only mature greens. Within Florida there has been a shift recently from the east coast to the southwest with its virgin lands free of weeds and tomato diseases. The shift was not too successful since yields for the 1966-67 season were lower in the southwest than those of the east coast region.

Yields

Vine ripened yields in South Florida are about the same as in Sinaloa. The USDA study used the figure of 1,800 twenty pound boxes per acre.(22-p. 82) This yield is two and a half times the yield for mature green tomatoes used in the study.(22-p. 80) The mature green yield was put at 350-40 pound lugs per acre. Historically, yields for both types of tomatoes have fluctuated yearly in conjunction with weather conditions. Good weather years such as 1966-67 show high yields while poorer yields as much as 15 percent lower are recorded when the weather conditions are adverse.(17)

Acreage

Fluctuations in acreage have accompanied the fluctuating yields in Florida. Increased competition from Mexico has put pressure on all domestic winter production areas causing Texas and California to drop out and cutting the acreage in Florida. Between the 1965-66 season and the 1968-69 season acreage of vine ripened tomatoes dropped by 23.1 percent from 8,310 acres to 6,390 acres. However, between the 1967-68 season and 1968-69 season there was an increase of 1,060 acres of vine ripened tomatoes harvested. According to government publication, this increase was a result of poor yields and poor weather which allowed more land to be harvested.(17) Acreage of mature green tomatoes also fell during the period but only 5.7 percent. While this fall in acreage is not considered significant, it is an indication of reorganization occurring in production.

Production Costs

The long term fall in acreages of vine ripened tomatoes in Florida is the result of the weakening of Florida's competitive position. Preharvest costs of production in Florida for the 1966-67 season was 84.3 cents per twenty pound lug. These costs were prorated as follows: 1.78 percent for land, 38.66 percent for labor, and 59.34 percent for capital. When compared with the preharvest cost of 62.6 cents for a 20 pound lug of mature green Florida tomatoes, the loss of competitive position becomes apparent. In addition to the lower total preharvest cost for mature greens, the proportion of cost accounted for by labor is much smaller, being only 6.07 percent. Capital expenditures, on the other hand, comprise 85.30 percent of preharvest costs.

When total f.o.b. costs are considered the competitive position of Florida's vine ripened tomatoes appears even worse. With all costs based on 20 pound lugs, the comparative costs are $2.131 for South Florida vine ripened tomatoes, $0.92 for vine ripened tomatoes from Sinaloa (f.o.b. Culiacan, Sinaloa not Nogales) and $1.305 for mature green tomatoes from Florida. Even after adjustment is made for quality differences between vine ripened and mature green tomatoes, Florida's vine ripens are still at a competitive disadvantage.[2] The adjustment raises the cost of mature greens to $2.105 per 20 pound lug.

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[2] See Chapter 3 for the discussion of quality differentials.

Appendix Table 12 shows that labor cost in the harvest and packing of mature greens is 42 percent of the labor cost for domestic vine ripened tomatoes. This advantage in labor cost is still another indication of the poor competitive position of Florida vine ripends.

Labor

The problem of labor has been alluded to previously. Labor costs have risen rapidly during the past decade. In Dade County the piece rate rose by 50 percent in about 5 years while in the Okeechobee area the hourly rate rose from 65 cents in the early '60s to $1.00 in 1967. Increased wages have also occurred in the processing industry (this includes packers); these workers are included under the provisions of the amendment to the Fair Labor Standards article. As a result they had to be paid a minimum $1.40/ hour in 1967 and must be paid at least $1.60 by 1970.

Decreases in the number of workers available at these wage rates compounds the labor problem. One cause of the decrease in workers is the nonfarm wages. In the period January 1965 to October 1968, hourly wages for nonfarm workers in Florida rose from $2.13 to $2.58; this is a 21 percent rise.(22-p. 14) With an earnings differential of over $1, workers shift from agricultural activities to nonfarm activities when the opportunity arises.

A second cause is the restriction of entry permits allowing foreign nationals to work in vegetable production. For the years between 1966 and 1968, the Secretary of Labor certified that there were sufficient domestic workers in the U.S., and therefore would not allow the use of foreign workers on Florida vegetable farms.

A third cause is the drop in the number of interstate migrants. With increasing rates of mechanization, particularly in the north, making a living as a migrant has become even more difficult than before. If the level of mechanization continues to rise as it almost certainly will, it can be expected that the size of this component of the labor force will continue to fall.

The changing composition of the labor force portends further problems in the future. In Dade County, the composition of the labor force in 1964 was about 40 percent local, 40 percent intrastate, and 20 percent interstate U.S. workers with 3 percent being foreign workers. By 1968 the composition was about 60 percent local, 30 percent intrastate, and 10 percent interstate with no foreign laborers. (22-p. 18) This pattern was observable in all other Florida vegetable production areas. The shrinking labor force will not be a problem if wide scale mechanization becomes a reality, but at the present this does not appear to be too likely. Increasing dependence on local labor may result in hiring workers of lower productivity at higher wages, thereby further deteriorating Florida's competitive position.

Production Season

The production seasons for vine ripened and mature green tomatoes overlap. For vine ripened tomatoes in South

Florida planting begins in September and continues through January with harvesting starting in early November and finishing in early May. Mature green tomatoes are planted in two crops in the southwest region; the fall crop is planted in September with harvesting occurring during November and early December; the spring crop is planted by mid-February and harvested in April and May.(17) In Dade County, the largest producer of mature green tomatoes, the planting season is September through February. Harvesting is done continuously from early December to late April or early May. With the large number of production areas, there are Florida tomatoes throughout the entire winter season.

Transportation Costs

Transportation costs for both types of tomatoes are shown in Appendix Table 7. Uniformly the cost to transport a 20 pound lug of vine-ripened is 5 cents more expensive than a 20 pound lug of mature green tomatoes. In fact, mature greens are transported in 40 pound lugs. Because of lower handling costs, the transportation rate is lower.

Potential Expansion

The potential in Florida for expansion of production in vine-ripened tomatoes is very bleak, because of the high labor requirement of the product in the face of increasing labor costs and decreasing labor supplies. Mechanization does not appear to be on the horizon for vine-ripened tomatoes which further dims the prospect for increased production. On the other hand, the prospect for mature green tomatoes is much brighter. Since mature greens are more capital intensive, the labor problem is not as critical. The total cost of Florida mature green tomatoes compares well with the total cost of Mexico vine ripened tomatoes. There appears to be adequate land, labor, and capital to continue expanded production of the mature green product. This discussion assumes continuation of the status quo in tariff and nontariff policy.

CHAPTER III: FORMULATION OF THE MODELS

Introduction

Given the production, consumption and trade patterns discussed in the previous chapter, this chapter will develop some techniques to analyze the impacts of changing the U.S. tariff policy on Mexican tomatoes.

Theoretical Aspects

The basic theory of economic integration is useful in evaluating the effect of tariff changes. Balassa contends that an increase in welfare is the ultimate objective of any economic activity. He further contends, "In the case of integration economic welfare will be affected by (a) a change in the quantity of commodities produced, (b) a change in the degree of discrimination between domestic and foreign goods, (c) a redistribution of income between the nationals of different countries, and (d) income redistribution within individual countries."(2, p. 21)

It is possible to evaluate changes in welfare resulting from economic integration in terms of static economic analysis either through comparative statics or in terms of dynamic effects. The static effects involve changes in resource allocation under given ceteris paribus assumptions. Static efficiency requires that the economy operate on the production possibilities frontier. Comparative statics allows for time to vary. The production frontier may shift due to marginal changes with the given state of arts. Dynamic effects as seen by Balassa consist of variables which shift the production possibilities curve out and to the right. Factors which underlie dynamic efficiency are technological change, external economies, and economies of scale.

Measurement of Welfare Impacts from Integration

Balassa discusses four effects important in analyzing economic integration's impact on welfare. These effects are the production effects, consumption effects, terms of trade, and the administrative effects. The first two are of value in the development of the models used in this study. Production effects result from the shift of consumer purchases from more expensive domestic sources to less expensive foreign sources due to tariff reductions. The opposite result occurs if the tariff is raised. Further, with a tariff reduction domestic resources move to alternative uses while foreign resources are bid away from other uses. Again, an increase in tariff would cause the opposite result. The consumption effects with lower tariffs involve the substitution of foreign goods for the higher price domestic products.

Theoretical Models

Two techniques are employed to analyze the problem, partial equilibrium analysis and linear programming. As an initial approximation an equilibrium model is constructed. This part of the analysis, however, provides only the gross potential benefit from tariff changes. It is a technique that has been used in previous studies to analyze the effect of policy changes.(14) This method has been well explained by Kindleberger in his book.(15-p. 105)

Such a partial equilibrium analysis requires the development of demand and supply for the two countries under consideration. These curves, in turn, are used to derive export supply and import demand curves, which estimate the effect of any given tariff. This analysis reveals whether the exporting or the importing country is bearing the burden of the tariff. Further this technique can estimate the production and consumption effects in each country if the tariff level is changed. A more complete discussion of this method is developed in Chapter 4.

The other technique used in this analysis is linear programming. Linear programming has been used extensively in spatial equilibrium analysis. Most studies have dealt with the optimum allocation of single products given known demand and supply relationships (6, 12, 16), and have sought primarily to estimate equilibrium prices and product flows. More recently linear programming has been extended to solve multi-product problems(3) and problems where price is one of the predetermined variables.(10) The problem posed by this study is quite similar to the standard uses of the technique. Using the predetermined information as to the level of demand and supply as well as production and transport coefficient, estimates are made of changes in production and trade flows.

Development of the Basic Linear Programming Model

General Characteristics of the Model

The linear programming model is developed to simulate production, trade, and resource use for 1967. The objective of the model is cost minimization since the study seeks to estimate production and an efficient pattern of trade. After the basic model is developed two variations are developed to test various hypothesis as to the structure of the system. All of the variation are simulations of 1967. Subsequently the basic model and one variation are used to simulate 1977 and to make projections.

The base year 1967 is chosen for two reasons. First, this is the most recent year for which reliable and comparable production data for all types of production data for all the products is available; second, trade during this year is unencumbered by size restrictions which were imposed on January 8, 1969.

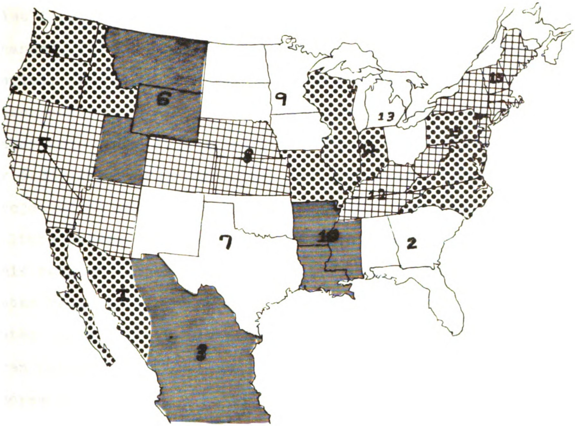
The basic model deals with the production of fresh tomatoes. Each of the producing regions produces vine ripened tomatoes while the Florida producing region also produces mature green tomatoes. All of these products can be used to supply the demands of the consuming regions. The production activities are three resources: land, labor, and capital. All of these resources are limited in varying degrees. Production and trade have to be sufficient to meet the demand requirements in each area. The models minimize the cost at wholesale from production and transfers of product.

Regions

The model uses two production regions (numbers 1 and 2 in figure 1) and 15 consumption regions. The two production regions are those described in Chapter 2 (i.e. Florida and the West Coast of Mexico primarily Sinaloa). The fifteen consumption regions are divided between the two countries. The production regions serve also as two of the consumption regions. The other consumption regions are constructed primarily on the basis of geographic continuity and historical trade patterns. The consumption centers are usually the major city in the regional group and therefore serves as a distributional center for the region. The use of such a large number of regions is required to create a reasonable simulation for 1967 and to provide a more meaningful information about trade patterns.

Input Data

The production data for all of the Models for 1967 is taken from "Supplying U.S. Markets with Fresh Winter Produce." (22) This data covers the entire production cycle including picking and packing. Appendix Table I shows the costs that are used for Models I and II both for 1967 and the projection period of 1977.



No.	Area	Locational Center
1	West Coast Mexico	Culican, Sinaloa
2	Florida, Georgia, Alabama, South Carolina	Miami, Florida
3	Mexico except West Coast	Mexico City, D. F.
4	Washington, Oregon, Idaho	Seattle, Washington
5	California, Arizona, Nevada	San Francisco, Calif.
6	Montana, Utah, Wyoming	Salt Lake City, Utah
7	New Mexico, Oklahoma, Texas	Dallas, Texas
8	Colorado, Kansas, Nebraska	Denver, Colorado
9	North Dakota, South Dakota, Minnesota, Iowa	Minneapolis, Minn.
10	Arkansas, Louisiana, Mississippi	New Orleans, Louisiana
11	Illinois, Indiana, Missouri, Wisconsin	Chicago, Illinois
12	Kentucky, Tennessee, West Virginia	Louisville, Kentucky
13	Michigan, Ohio	Detroit, Michigan
14	North Carolina, Maryland, Delaware, Virginia, Pennsylvania, Washington, D.C.	Washington, D.C.
15	New York, New Jersey, Connecticut, Massachusetts, Rhode Island, Vermont, New Hampshire, Maine	New York City, New York

The derivation of the 1977 costs are based on the following assumptions: (1) land and capital costs will not rise in real terms over the period (i.e. no technical change), (2) Labor costs will rise in real terms over the period. The only cost that need be explained then is the labor cost. For Mexico, the trend from 1956 to 1968 in labor wage rates is assumed to continue. Real wages rose by 6.3% (22, p. 21) per annum; therefore wages in Mexico are projected to rise by 84.2%. For Florida, wages in agriculture between 1963-68 rose by 10% per year;(22, p. 19) this rate of increase is assumed to continue for tariff rates below 100% resulting in a 96.7% rise. For tariff rates above 100% it is assumed that real wages will rise even faster, 12.5% per annum; this rate will result in an increase of 147.8%. The higher wage rate is predicted on the assumption that higher tariffs would probably lead to laborers forming unions and driving up wages.

Appendix Table 2 shows that land and labor costs in Mexico and land and capital costs for Florida are the same in Model II as those in Models I and III. Capital for Mexico and labor in Florida are handled differently. The interest cost of capital is removed from the cost of producing vine-ripened tomatoes in Mexico. This allows capital to be purchased. The two sources of capital have costs of 9% and 12%. The 9% rate is obtained from cross sectional data.(22, p. 84)

The 12% rate is assumed to apply to capital above that available at 9%.[3]

Transfer Costs

Appendix Tables 3 and 4 show the transfer costs used for the Model and the two variations. Transfer costs for Florida are assumed to be unaffected by any changes in tariff levels and are therefore not listed again in Table 4. Transfer costs for Mexico include all costs to move the product from Culiacan, Sinaloa to the consumption center. The cost to move the product from Culiacan to Nogales, Arizona, is taken from Table 60 of Agricultural Economic Report No. 154.(22)

The transportation cost from Nogales to consumption centers is shown in Appendix Table 5. Actual data are available for only three routes (1. Nogales-New York, 2. Nogales-Chicago, 3. Nogales-San Francisco). Therefore, transportation costs are estimated to the other U.S. centers by the following method. First, the average cost per mile for each route is calculated. Second, the U.S. centers are divided regionally into three groups. Third, the transportation charge for a center in Group 1 is obtained by multiplying the Nogales-New York rate by the distance from Nogales to the Center. Transportation charges for centers in Groups 2 and 3 were obtained in a similar manner.

Since transportation data for Florida was also only available for three routes, the same technique was used to construct transportation costs for other routes. The value

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[3] Private correspondence with Clinton Cook.

for region 2 was set at zero since production and consumption is assumed to occur at the same point.

Mathematical Exposition of the Basic Model

The exposition of the mathematical model is shown below.

Linear Programming System for the Basic Model

Exporting Regions

$i = 1$ = West Coast Mexico including Sinaloa
$i = 2$ = Florida

Importing Regions ($j = 1, \ldots, 15$)

1 = West Coast Mexico - Sinaloa

2 = Florida, Georgia, Alabama, South Carolina - Miami

3 = Mexico except West Coast - Mexico City

4 = Washington, Oregon, Idaho - Seattle

5 = Arizona, California, Nevada - San Francisco

6 = Montana, Utah, Wyoming - Salt Lake City

7 = New Mexico, Oklahoma, Texas - Dallas

8 = Colorado, Kandas, Nebraska - Denver

9 = North Dakota, South Dakota, Minnesota, Iowa - Minneapolis

10 = Arkansas, Louisiana, Mississippi - New Orleans

11 = Illinois, Indiana, Missouri, Wisconsin - Chicago

12 = Kentucky, Tennessee, West Virginia - Louisville

13 = Michigan, Ohio - Detroit

14 = North Carolina, Maryland, Delaware, Virginia, Washington, D. C., Pennsylvania - Washington, D. C.

15 = New York, New Jersey, Connecticut, Massachusetts, Rhode Island, Vermont, New Hampshire, Maine - New York City

Product (g - 7,8)

g = 7 = vine ripened tomatoes
g = 8 = mature green tomatoes

Resources (h = 1,2,3)

h = 1 = land
h = 2 = labor
h = 3 = capital

$$\text{obj (Fn)} = \text{Min } P(x) = \sum_{i=1}^{2} \sum_{g=7}^{8} Wig\ Xig + \sum_{i=1}^{2} \sum_{j=1}^{5} \sum_{g=7}^{8} Mijg\ Xijg$$

Wig = production cost of the gth commodity in the ith region

Xig = Level of the gth production in the ith region

Mig = Transfer cost of moving the gth commodity from the ith region to the jth region

Xijg = level of the gth commodity transferred from the ith region to the jth region.

Restraints - Resources

Land (Ah = 1), Labor (Ah = 2), Capital (Ah = 3)

$$\sum_{h=1}^{3} \sum_{g=7}^{8} Ahig\ Xig \leq Rhi$$

Ahig = quantity of resource h required to produce one unit of the gth commodity in the ith region.

Rhi = the quantity of the gth resource available in the ith region.

Xig = level of production of gth commodity in ith region.

Restraints - Demand one for each j

$$\sum_{i=1}^{2} Aijg\ Xijg \leq Djg$$

Aijg = +1.0 allows region j to import commodity from region i

Xijg = level of transfer of commodity g from region i to region j where i = j, regional production is being used to satisfy regional demand.

Djg = regional demand requirement for the gth commodity in the jth region.

Supply restraint

$$\sum_{j=1}^{15} Aijg\ Xijg = Pig$$

Pig = the quantity of the gth commodity produced in the ith region

Aijg and Xijg are same as defined before

Minimum and Maximum Production Restraints

$P_{27} \leq C_m$

$P_{27} \leq C_n$

$P_{28} \leq B_m$

$P_{28} \leq B_n$

where C_m, B_m are minimum production

C_n, B_n are production maximums

Objective Function

The objective function for Model I minimized the wholesale cost including transportation and production costs at the consumption centers. The constants for multiplying are the production cost including packing and harvesting costs and a quality differential and the transfer costs. A quality differential cost of $0.80/20 lb. carton is applied to the mature green product of Florida to reflect the lower price paid for this product as relative to vine ripened tomatoes. The units used for all variables are based twenty pound cartons for both the production and transfer activities. This objective function was chosen because it allowed for analyzing the macro effects of tariff changes such as gross changes in production, consumption, regional trade and resource use.

Activities

Two types of activities are specified for this model; production and transfer. The production activities are specified for only areas one and two. During the winter season, these are only areas which produce a significant quantity of product. Production was further broken down for area 2 into vine-ripened and mature green. These activities are differentiable: the products are close but not perfect substitutes.

Transfer activities are specified for the products of both areas. The domestic demand of Mexico was satisfied from the production of area 2 because of barriers placed by

Mexico on the importation of vegetables. In order to preclude shipments, a $100.00 per carton-transfer cost is placed on shipments from Florida to either Mexican consumption area. Table 1 shows the sources and uses of product which were used to determine transfer costs. Each X in the intersection of any row and column shows that transfer can occur, representing movement from the region in that two to the region in the column.

Table 1. Model I Transfer Activities of Winter Tomatoes

Sources

Users	Mexican Vine Ripened	Florida Vine Ripened	Florida Mature Green
1	X		
2	X	X	X
3	X		
4	X	X	X
5	X	X	X
6	X	X	X
7	X	X	X
8	X	X	X
9	X	X	X
10	X	X	X
11	X	X	X
12	X	X	X
13	X	X	X
14	X	X	X
15	X	X	X

Restraints

Three types of restraints were employed in Model I: (1) Resource restraints, (2) Demand restraints, (3) Minimum and maximum production restraints.

The availability of land, labor, and capital was limited in each region. All restraints were stated in monetary terms with the unit of account being the U.S. dollars in Florida. A typical restraint would be that the amount of land used to produce mature greens in Florida plus the amount of land used to produce vine ripes in Florida must be less than the total amount of land available in Florida for tomato production. To determine total land availability expressed in monetary terms, the average rental rate is multiplied by the total acreage available for tomato production. For Mexico, this is the amount of irrigated acreage in Sinaloa which in 1967 was 100,000 acres(22-p. 5). In Florida, available acreage is also 100,000 acres which is the sum of actual acreage used for tomatoes and about 60% green pepper, sweet corn, and snap bean acreage which could be converted. The land restraint was unchanged for all models.

As explained in Chapter 2 labor is virtually unlimited in Mexico.(22-p. 10) Labor can expect to make 5 to 8 times as much working in the fields as working their mountain farms.(22-p. 21) Therefore, the Mexican labor restraint is entered at a high level of $100 million dollars or 300 million hours.

In contrast to the labor abundance in Mexico, Florida has a very limited amount of labor. The amount of labor available is the major restriction on the level of production which can occur. For the basic Model (1967) the amount of labor was assumed to be the actual amount of labor employed or $34 million.(22-p. 82)

The capital restraints included the capital input requirements for the entire production, a picking and packing process. For the Model in (1967), the capital available in Florida is set at the amount used in tomato production ($50 million) plus the amount of capital used in the next best alternatives, cucumbers and green peppers, of 7.2 and 14.0 million dollars for a total of roughly $70 million. The capital available for Mexican production is entered at $50 million. This is twice the actual amount of capital used and was estimated on the basis of information on the apparent amount of capital available at a 9% interest rate.(8)

As previously mentioned, land restraint for the projection period was unchanged for both Florida and Mexico. However, the restraints for labor and capital were changed. The labor restraint for Mexico of $1.5 million reflects the increase in real wages expected to occur over the 1967-1977 period. It is obtained by multiplying the estimated hourly wage times the expected available number of hours.

The wage restraints for Florida are divided into two groups. The labor restraint above and below a 100% tariff. If this is less than or equal to the 1967, it is assumed that the level of wages will rise by 10% per year. This is the continuation of the rate of change in labor wages during the 1963 to 1968 period.(20-p. 19) It is further assumed that the labor force will continue to shrink as it did for the 1963-68 period, and resulting in a 10% decrease by 1977. This is also a continuation of past trends. If alternatively, the tariff rate is raised above the 1967 level wages are assumed to rise by 12.5% per year as previously discussed. With the higher wage rate, the author projects that labor force would drop by only 5%. This is based on the assumption that some laborers (especially housewives and other persons who would not seek employment) would be willing to work in this enterprise that would not if wages were lower. The restraints shown in Appendix Table II are therefore calculated by multiplying the wage rate by the amount of available labor.

The capital restraints are increased for both regions. In Mexico capital is assumed to increase by 50%. This is derived from the sum of the public and private investment increase for the 1951-1960 period which was about 50%. (21, p. 40)

In Florida, the amount of available capital is increased by 25%. This increase is based on expected availability of capital (22, p. 52) and the expected rate of growth of demand for tomatoes.

Because of temporal problems discussed earlier, production and marketing of tomatoes does not occur simply on a cost basis. As a means of accounting for the fact that, particularly in Florida, different crops are harvested and sold at different times during the season minimum and maximum production restraints were imposed. The restraints are shown in Appendix Table 12.

The minimum restraints for 1967 in all Models were set at 10 million 20# cartons. These minimum levels reflect the fact that there is a demand for both types of tomatoes. It is assumed that at least in the eastern region that vine ripened are preferred to mature green by certain segments of the population.(22-p. 49) Since there is not an ever present adequate supply of vine ripened tomatoes, there must be some production of vine ripened in Florida. The minimum production restraint for mature greens was entered at the same amount. This was also based on the fact that Mexican tomatoes are not always available.

For Model I (1977) production minimums for Florida are reduced. In large part these minimums reflect the fact that Florida would be in an increasingly less competitive position. The minimums are based on the estimate of the local Florida and Southeastern U.S. demand.

The maximum restraints are set primarily as an allocative measure to ensure that production is not of just one product. The maximum amount of Florida vine ripe is set at its 1967 level plus 25%. The mature green production is set at 125% of actual 1967 production. These levels are an attempt like the minimum restraints to allocate production between products and through time.

The production maximums for the projection period are contrasting in their levels. The maximum for vine ripes is left at the same level since on a cost basis their product is highly uncompetitive. Therefore, it is assumed that resources used for vine ripes could be used for mature greens and therefore the maximum mature green production is raised to 50 million 20# cartons.

The demand restraints are shown in Appendix Tables 9 and 10. The restraints are listed for two time periods; the historical period of 1967 and the projection period of 1977. Demand restrains are formulated for each of the five tariff policy levels. For the base period the quantity demanded is fixed at the level of per capita marketings for that year multiplied by the population of each region. The fixed quantity demand means that at any given point in time the regional product demand curve is perfectly inelastic. The satisfaction of demand involves three quantities, the use of Florida mature green, Florida vine ripened, or Mexican vine ripened. The utilization of supplies must equal the fixed demand. Also, the total supply produced and utilized must equal the total fixed demand.

As the tariff and hence the retail or wholesale price level is altered the quantity demanded changes. A demand elasticity of -3.6 was chosen.(8-p. 36) Since the relevant demand curve is the derived wholesale demand curve, constant percentage marketing margins are assumed. This means that the elasticity of demand at the wholesale is equal to the elasticity of demand at retail.

Demand estimates for the projection period in the U.S. were based on the projection of population, the expected rate of growth of income, and the income elasticity of demand for tomatoes. Population estimates for 1975 were obtained from the U.S. Census Bureau and extended to 1977 using the 1970-1975 annual growth rate of 1.4%. For the U.S. real income has been projected to increase by 21.90% (20, p. 199) for the period 1967-1977-8. By using the FAO income elasticity of .25(7, p. 75), the total percapita change is 5.475%. Now in order to obtain the total restraint, multiply the per capita consumption times the projected population.

Demand estimates for Mexico were based on population estimates and per capital consumption estimates from Government sources.(21, p. 32 and 38) The population estimates were for 1975, these estimates were then projected to 1977-8 by using the growth rate of 3.6% per year. (21, p. 32)

Quality Differentials

Because of quality differences between vine ripened and mature green tomatoes, it was necessary to assess an additional cost to the mature green product to reflect this fact. An investigation of F.O.B. prices for Mature Green and Vine Ripe tomatoes show that over the period 1964-1968 that on the average there was a $.80 per twenty pound crate difference.(9) This was the differential which was entered into the objective function for Models I and II.

In Model III the actual differences for 1967 is used. Here Florida vine ripes (FVR) have a 28.6 cents per 20#

carton premium over Mexican vine ripe (MVR) and an 88.6 premium over Florida mature greens (FMG). In this model MVR is taken as the base and adjustments were made to the values in objective function for FVR and FMG.

Simulation with Some Flexible Inputs--Model II

Model II is similar to Model I except that it treats capital in Mexico and labor in Florida differently. This model reflects the fact that capital is scarce in Mexico and that above a certain level of lending, a higher interest rate will be charged. Likewise, in Florida in order to obtain additional laborers above a certain level, wages would have to rise to bid labor from alternative occupations. These changes would show up in two places--a different objective function and reformulated resource restraints.

$$\text{Obj } F(n) = \text{Min } P(x) = \sum_{i=1}^{2} \sum_{g=7}^{8} C_{ig} X_{ig} + \sum_{i=1}^{2} r_{1k} K_{1k} +$$

$$\sum_{g=7}^{8} \sum_{n=1}^{2} L_{2n} N_{ng} + \text{transfer costs}$$

C_{ig} = production cost of the gth commodity, excluding interest cost in Mexico and labor cost in Florida, in the ith region.

X_{ig} = level of the gth production in the ith region.

r_{1k} = interest cost for capital in Mexico, either 9% or 12%.

K_{1k} = amount in K used in Mexico.

L_{2n} = cost of the nth type of labor in Florida.

N_{ng} = amount of the nth type of labor used in the production of the gth commodity in Florida.

k = 1 Capital in Mexico costing 9%.

k = 2 Capital in Mexico costing 12%.

n = 1 Labor in Florida costing $1.25 an hour.

n = 2 Labor in Florida costing $1.30 an hour.

The C_{1g} of this equation is equal to the W_{1g} for Model I if the labor cost was subtracted for Florida and the capital cost was subtracted for Mexico.

The transfer activities in the objective function, remains exactly the same as in Model I.

Resource Restraints

The resource restraints for land and labor in Mexico and land and capital in Florida are the same as in Model I. The restraint for Mexican capital takes account of the fact that there is a limit on the amount of capital at 9% which is $50 million and that additional capital will cost more. The 12% pool has $30 million.[4] Likewise, the Florida labor restraint accounts for the fact that only a limited number of laborers can be hired for $1.25 per hours: additional labor would require higher wages.

If the different capital is designated as K_{11} and K_{12}, where K_{11} = .09 capital and K_{12} = .12 capital, then mathematically the Mexican capital restraint is:

$$A_{17k}\, X_{17} = K_{11} + K_{12}$$

$$K_{11} \leq R_1$$

$$K_{12} \leq R_2$$

[4] An estimate by the author based on conversions with a number of people knowledgeable of the financing tomato production in Mexico.

A_{17k} = amount of capital used in Mexico to produce one unit of vine ripe tomatoes.

X_{17} = amount of vine ripe tomatoes produced in Mexico.

K_{11} = 9% capital in Mexico.

K_{12} = 12% capital in Mexico.

R_1 = amount of 9% capital available for Mexican tomato production.

R_2 = amount of 12% capital available for Mexican tomato production. Likewise, if Florida labor is designated as N_{21} and N_{22}, where

N_{21} = \$1.25 per hour and N_{22} = \$1.30 per hour, then mathematically this resource restraint can be expressed as follows:

$$\sum_{g=7}^{8} A_{2gn} X_{2g} = N_{21} + N_{22}$$

$$N_{21} \leq R_3$$

$$N_{22} \leq R_4$$

A_{2gn} = amount of labor used in Florida to produce one unit of the gth commodity.

X_{2g} = amount of the gth commodity produced in Florida.

N_{21} = \$1.25 per hour labor in Florida.

N_{22} = \$1.30 per hour labor in Florida.

R_3 = amount of N_{21} available.

R_4 = amount of N_{22} available.

Simulation with 1967 Quality Differentials--Model III

Model III is exactly identical to Model I except for the quality differentials. Whereas, Model I assumes as differential between all vine ripes and mature greens of $.80 per carton, Model III assumes that the differential between Mexican Vine Ripened and Florida Vine Ripened is $.60 per carton and 88.6 cents per carton between Florida Vine Ripened and Florida Mature Green. Therefore, using the Wig of MVR as a base, the Wig for Florida Mature Green was raised by $.60 per carton and Wig for FVR was lowered by 28.6 cents per carton in the objective function. With these changes in the objective function, Model III was run for both the base period (1967) and for the projection period (1977).

Summary

This chapter discusses the two techniques which will be used to analyze the thesis problem. The linear programming models are formulated and developed. In the next chapter, the partial equilibrium approach will be discussed and developed.

CHAPTER IV: THEORY OF TARIFFS AND ITS APPLICATION TO TOMATOES

As explained in Chapter 3, it is possible to assess the impact of tariff changes by the use of partial equalibrium analysis. The basic theory of tariffs will be discussed and the implications of the theory for the problem at hand will be developed.

Theory of Tariffs

Trade Under No Transfer Costs

International trade in a world with no imperfections, or transport costs will result in prices being equalized among countries.(15) The introduction of transfer costs (i.e. transportation costs, tariffs, etc.) cause a price diversion. The good becomes more expensive in the importing country and less valuable in the exporting country. This can be shown diagramatically in a partial equilibrium analysis. While partial equilibrium deals only with the immediate position after trade is begun and abstracts from secondary effects, it is useful to analyze the impact of transfer costs. Figure 2 shows the situation if there are no barriers to trade. The exporting country produces OB and demands OA. Therefore, AB is available for export. In the deficit country O'C is produced and O'D is demanded;

therefore, CD must be imported. The equilibrium price is P_1 and AB equals CD.

Trade With Transfer Costs

Now introduce a transfer cost of EF as shown in Figure 2, the price of the product will differ between countries. The forces of supply and demand will operate until the amount exported by exporting country, X, is equal to the amount desired for import by country Y, the importing country. The price between the countries will differ by the amount of the transfer costs. At equilibrium the price in country X is P_2 and in country Y is P_3. The quantity traded is LM or NP since these quantities are equal.

Figure 2 has three sectors, an exporting country X, an importing country Y, and an exchange sector. The third sector is introduced to simplify the analysis. In this third sector are an export supply curve and an import demand curve. These curves are constructed by taking the horizontal difference between the supply and demand curves for each country. Therefore, the import demand curve (ID) would apply to country Y where over the relevant range D_S; similarily the export supply curve (ES) applies to country X where S_D over the relevant range.

By using the model shown in Figure 2, one can see the results of policy changes. Given no transfer costs ES would equal ID and the price would be P_1. Now if a transfer cost of EF is imposed, Figure 2 shows that the price of good T in country X will drop to P_2 while the price in country Y will rise to P_3. At these prices the quantity exported will equal the quantity imported.

An interesting aspect of using the model in Figure 1 is that it is possible to indicate how each country will be affected by a change in transfer cost. If the ES curve is perfectly elastic and the ID curve is negatively sloped, any change in the transfer cost will be borne by the importing country (Figure 3). Conversely, if the ID curve is infinitely elastic and the ES is positively sloped any change in transfer costs will be borne by the exporting country (Figure 4). In summary, who bears what part of a change in transfer costs depends on the relative elasticities of the ES and ID. The country with the relatively more elastic curve absorbs less of any change which occurs. This means, for example, in Figure 3 the imposition of a transfer cost of EF will not change the price in country X but will raise the price in Y by the full amount.

Effects of Changing Transfer Costs

Figure 2 can be used to analyze the effects of a change in tariffs. Assume that transfer costs amounting to EF exist between the two countries. Part of this cost is transportation costs while the remainder is tariffs levied by the importing country. Now under this situation the price of good T will be P_2 in country X and P_3 in country Y. Country X produces OM of commodity T and consumes OL of it domestically leaving LM for export. In country Y at P_3 production will equal O'N while domestic demand will equal

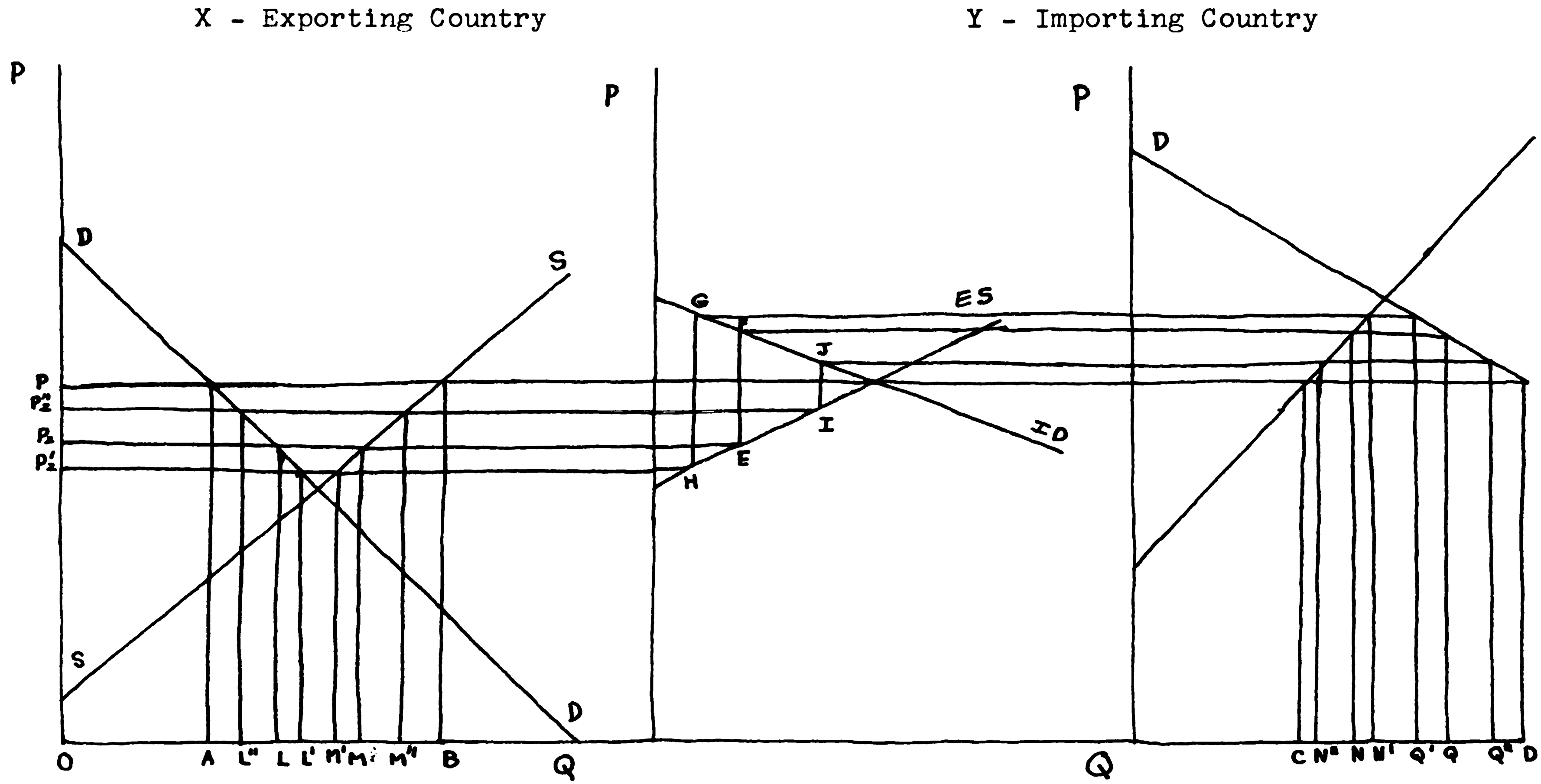

Figure 2. Graphic Representation of the Impacts of Alternative Tariffs.

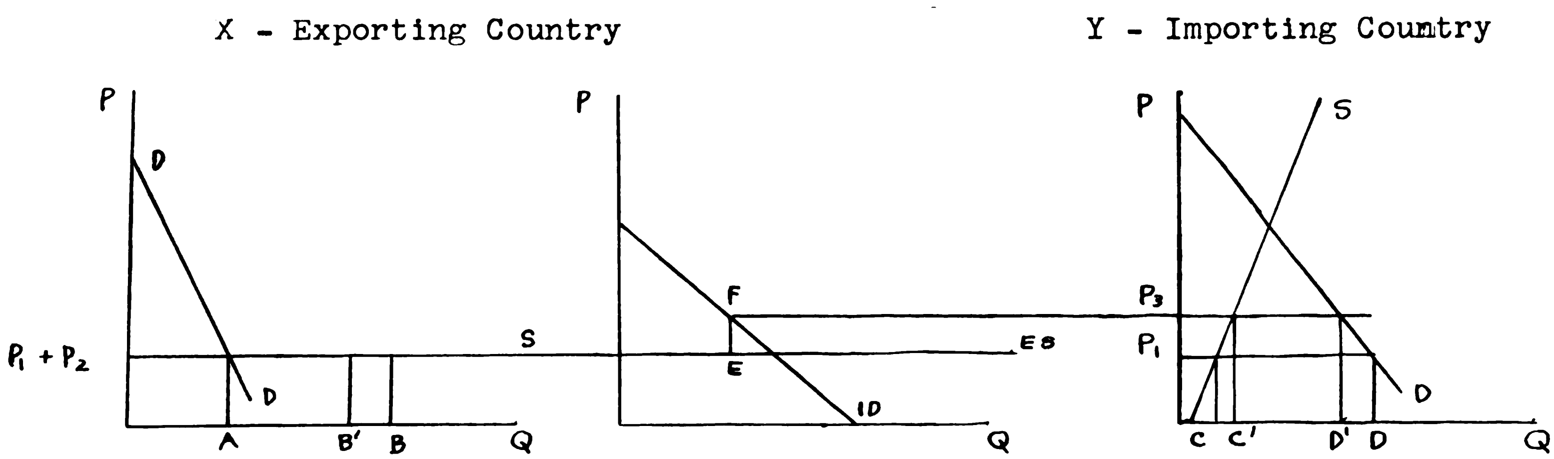

Figure 3. The Impact of a Tariff With An Infinitely Elastic ES Curve.

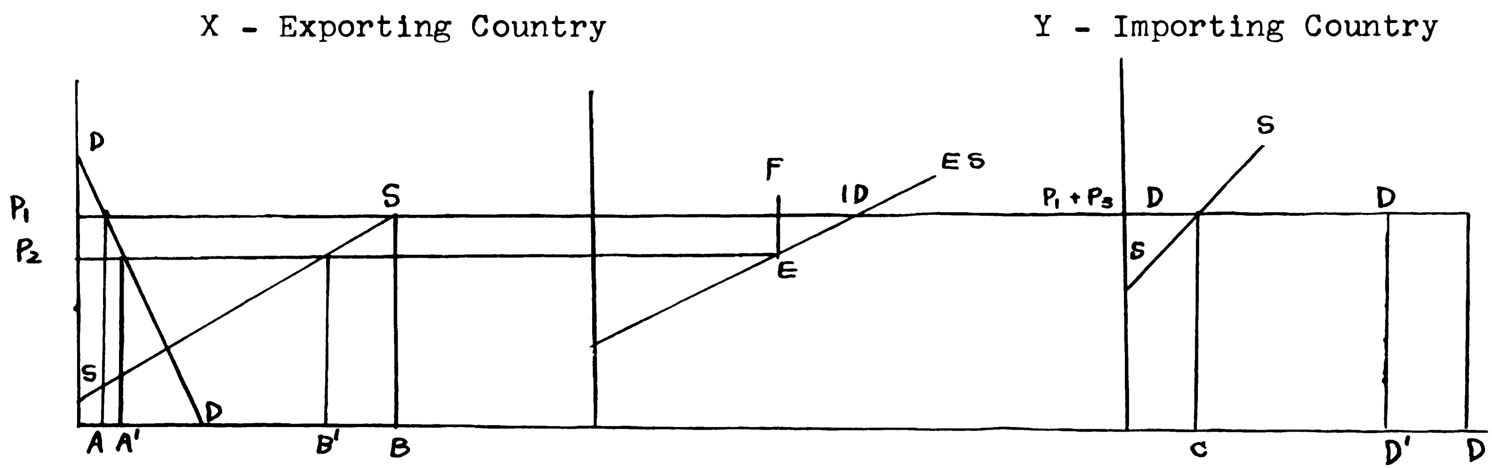

Figure 4. The Impact of a Tariff With An Infinitely Elastic ID Curve.

O'P. Therefore, at the prevailing prices NP which equals LM will be imported.

Any change in the transfer costs will change the relative prices between the countries and will also change the production and consumption of T in each country. Assume that the transfer costs decreases to IJ in Figure 1 due to a reduction in the import tariff. The resulting changes in country X are that the price of T will rise from P_2 to P_2'' while production also increases from OM to OM''. On the other hand consumption of T in X will drop to OL'' from OL. The result is a higher price, lower domestic consumption and higher production. In country Y the price will drop from P_3 to P_3''; thereby increasing demand from O'P to O'P'' and reducing supply from O'N to O'N''. The quantity which must be imported rises by the amount N''N + PP''.

A rise in tariffs will cause exactly the opposite reaction. Assume that transfer costs rise to GH as shown in Figure 2. In country Y the price will rise to P_3' production will increase to O'N' and demand will drop to O'P'. Import will also drop to N'P'. In country X, prices, supply and exports will drop and consumption will increase.

Table 2 shows the changes which occur under each assumption. In summary, as import tariffs are lowered, in country Y the price drops, the quantity demanded rises and the amount of domestic demand satisfied by domestic suppliers drops. In country X price rises, supply increases and quantity demanded fall. Exactly the opposite occurs when tariffs are raised.

Table 2. Summary of Production and Consumption Levels Under Different Tariff Assumption

Level of Transfer Cost	Country X				Country Y			
	Price	Production	Consumption	Exports	Price	Production	Consumption	Imports
O	P_1	OB	OA	AB	P_1	O'C	O'D	CD
EF	P_2	OM	OL	LM	P_3	O'N	O'P	NP
GH	P_2'	OM'	OL'	L'M	P_3'	O'N'	O'P'	N'P'
IJ	P_2''	OM"	OL"	L"M"	P_3''	O'N"	O'P"	N"P"

If tariff increases are carried to the extreme where the price in the importing country causes domestic supply to equal the domestic demand then there will be no more trade. Consequently, any further increases in tariffs will have no effect on the internal price of good T in the importing country.

Partial Equilibrium Theory Applied to Tomatoes

The question at this point is how does the theory developed in the preceeding sections apply to the product under consideration (i.e., tomatoes). In order to do this analysis the following information is necessary: 1) what is the US tariff system, 2) what is the approximate shape of the ES curve and 3) what is the shape of the ID curve. The tariff information is required so that we can determine the size of transfer cost changes. The shapes of the ES and ID curves is necessary to analyze the impact of cost changes.

U.S. Tariff Policy on Tomatoes

The United States imposes specific tariffs on the importation of fresh tomatoes as it does on other fruits and vegetables. As with tariffs on other fresh products, the tomato tariff changes over the years. During the domestic season the rate is set at 2.1¢ per pound; however, in the off-season the rate drops to 1.5¢ per pound.(24-p. 41) The domestic season is defined as being from 3/1 to 7/14 and from 9/1 to 11/14. The period of 7/15-8/31 and 11/15 to 2/28 is designated as the off-season with the lower tariff rate.

Until 1969 there were no other barriers to importing Mexican tomatoes except the tariffs imposed by the US. In January 1969 under a federal marketing order, minimum size restrictions were imposed. These regulations required that all vine ripe tomatoes be at least 2-17/32 inches in diameter while mature green tomatoes must be at least 2-9/32 inches in diameter.(5-p. 1) While this non-tariff barrier will have some effects, for this study it was ignored.

Development of Approximations for the ES and ID Curves

It is possible to mathematically derive an approximation to the export supply curve. The method requires some estimate of domestic supply and demand elasticities.

E_x = export supply elasticity = $\frac{P}{Qc} \cdot \frac{dQe}{dP}$

Q_e = quantity supplied for export = Domestic Production - Domestic Consumption $Q_s - Q_d$

$$E_x = \frac{P}{Q_s - Q_d} \frac{d(Q_s - Q_d)}{dP}$$

$$E_x = \frac{P}{Q_s - Q_d} \frac{dQ_s}{dP} - \frac{P}{Q_s - Q_d} \frac{dQ_d}{dP}$$

$$E_x = \frac{Q_s}{Q_s - Q_d} \frac{P}{Q_s} \cdot \frac{dQ_s}{dP} - \frac{Q_d}{Q_s - Q_d} \frac{P}{Q_d} \cdot \frac{dQ_d}{dP}$$

$$E_x = \frac{Q_s}{Q_e} e_s - \frac{Q_d}{Q_e} e_d$$

Since e_d is negative, take the absolute value for e_d.

$$E_x = \frac{Q_s}{Q_e} e_s + \frac{Q_d}{Q_e} e_d$$

For Mexico for 1967(18, 20, 22)

$Qs = 4.67512 \times 10^7$ $\quad e_s = .9$

$Qd = 3.42496 \times 10^7$ $\quad e_d = 1$

$Qe = 1.25016$

$$E_x = \frac{4.67512}{1.25016} .9 + \frac{3.42496}{1.25016} 1 = 3.74 (.9) + 2.74 (1) = 6.0$$

The approximation of the export supply curve by the above method would indicate that the curve is quite elastic if long-run supply responses are employed. If Nerlove's short-run price elasticity of .23 is used, the elasticity of export supply drops to 3.60 which is still very elastic. (18, p. 865)

As shown in the theoretical section, the shape of the ES curve is only half of the story. In order to analyze the impact of any tariff change it is necessary to also know whether the ID curve is elastic or inelastic. The derivation of the approximation to the ID curve is similar to the development of the ES.

E_I = import demand elasticity = $\frac{-P}{Q_I} \cdot \frac{dQI}{dP}$

Q_I = quantity demand for import = Domestic Consumption-Domestic Production

Q_d = quantity domestically consumed

Q_s = domestic supply

$$E_I = - \frac{P}{Q_I} \cdot \frac{dQ_I}{dP}$$

$$E_I = - \frac{P}{Q_d - Q_s} \quad \frac{dQ_d - Q_s}{dP}$$

$$E_I = - \frac{P}{Q_d - Q_s} \quad \frac{dQ_d}{dP} - \frac{dQ_s}{dP}$$

$$E_I = -\frac{P}{Q_d - Q_s} \quad \frac{dQ_d}{dP} + \frac{P}{Q_d - Q_s} \quad \frac{dQ_s}{dP}$$

$$E_I = -\frac{Q_d}{Q_d - Q_s} \quad \frac{P}{Q_d} \cdot \frac{dQ_d}{dP} + \frac{Q_s}{Q_d - Q_s} \quad \frac{P}{Q_s} \cdot \frac{dQ_s}{dP}$$

$$E_I = -\frac{Q_d}{Q_I} e_d + \frac{Q_s}{Q_I} e_s$$

Again allow e_d to take on its absolute value.

$$E_I = \frac{Q_d}{Q_I} e_d + \frac{Q_s}{Q_I} e_s$$

For the U.S. in 1967

$Qs = 44,753,800$ $\qquad e_s = .9$

$Qd = 57,255,400$ $\qquad e_d = 3.6$

$Q_I = 12,501,600$

$$E_I = \frac{57,255,400}{12,501,600} \; 3.6 + \frac{44,753,800}{12,501,600} \; .9 = 16.49 + 3.2 = 19.7$$

Impact of Tariff Changes

In the earlier section, it was shown that the impact on the relative prices caused by a tariff change depended on the elasticity of the curves. The country with the relatively more inelastic curve receives larger price fluctuations due to changes in the tariff. If the elasticity of ID should happen to equal the elasticity of ES, then the countries share equally any change in tariffs or other transfer costs.

The preceding derivation of approximations of ID and ES indicate that Mexican producers should benefit more from tariff reduction than American consumers. Similarly, an increase in tariffs would cause a smaller change in prices to American consumers than the change in prices to Mexican exporters. This can be illustrated as in figure 5. The ID curve for the U.S. being relatively more elastic is

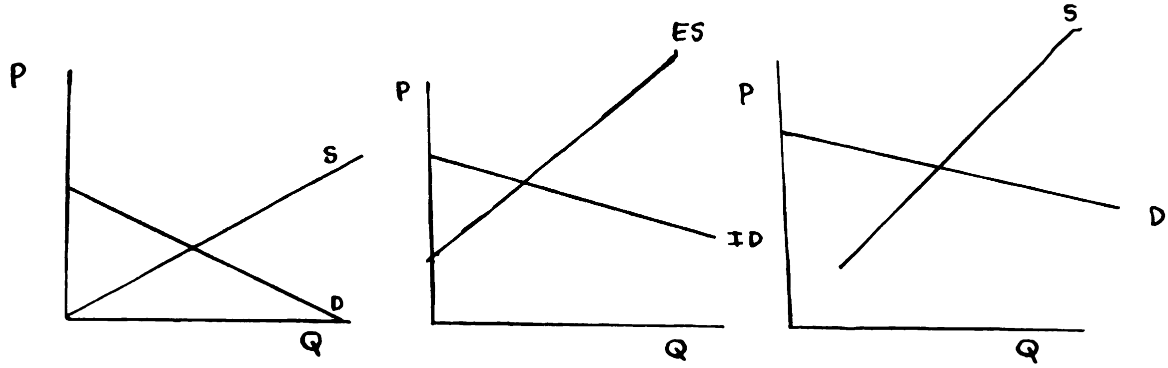

Figure 5. A Graphic Representation of Partial Equilibrium Analysis Applied to Tomatoes

shown as having a slight negative slope while the Mexican ES curve has an upward slope.

Given the elasticities calculated for ES and ID it is possible to determine the impact of a given tariff change. For purposes of exposition, the impact of reducing tariffs from 100% to 0% is presented. To estimate the relative impact, it is necessary to know (1) the equation of the ES and ID curves and (2) the price in each country.

Let $e_D = 19.7$

$P = 3.26$[5]

$Q_I = 1.25 \times 10^7$

$$\frac{dQ}{dP} \cdot \frac{P}{Q} = e_D$$

---

[5]This the average weekly price for the 1966-1967 season for 5x6 Mexican vine ripened tomatoes at Nogales.

U.S. $\frac{dQ}{dP} \cdot \frac{3.26}{1.25} = 19.7$ $\frac{dQ}{dP} \cdot 2.608 = 19.7$ $\frac{dQ}{dP} = 7.55$

Now since a demand equation can be written as $D = a + bP$ where a = constant and $b = \frac{dQ}{dP}$, the equation can be estimated.

$D = a - bP$

$D = a - 7.55P$

For D = 1.25 and P = 3.26 the equation becomes

$1.25 = a - 7.55\ (3.26)$

$a = 25.86$

$D = 25.86 - 7.55P$

Now the equation can be written in terms to agree with the graph in figure 5.

(1) $P_D = 3.43 - .13Q_D$.

In a like manner it is necessary to determine the equation for Mexican export supply. The supply equation can be written as $Q_s = c + dP$ where $d = \frac{dQ}{dP}$. In order to obtain the equation given P, Q and the elasticity, first determine $\frac{dQ}{dP}$ or d; then solve for C.

$e_S = 6.0$ (derived in previous section)

$Q_S = 1.25$

$P = 1.62$[6]

Mexican $\frac{dQ}{dP} \cdot \frac{P}{Q} = e_S$

$\frac{dQ}{dP} \cdot \frac{1.62}{1.25} = 6.0$

$\frac{dQ}{dP} = \frac{6.0}{1.3}$

$\frac{dQ}{dP} = 4.615$

---

[6] The price in Culiacan, Sinaloa was assumed to be the average price in Nogales less transfer costs of $1.637/20# carton.

Now $Q_S = c + 4.615\ P_S$

$1.25 = c + 4.615\ P_S$

$c = 6.22$

Like the demand equation for the U.S., it is wise to write this equation to agree with the graph in figure 5. Therefore,

(2) $P_S = 1.35 + .22\ Q_S$

To determine how much price would change in each country it is necessary that $P_D - P_s = 1.244$ which is the amount of transportation and handling costs when the tariff equals 0%. If $P_D - P_S = 1.244$, then $3.43 - .13\ Q_D - 1.35 - .22Q_S = 1.244$. Therefore $-.35Q = -.84$ and $Q_S = Q_D = 2.4$. Now to obtain P_D and P_S, substitute for Q in equation 1 and 2 $P_D = 3.43 - .13\ Q_D = 3.12$ and $P_S = 1.35 + .22\ Q_S = 1.88$.

Therefore, the price in Mexico rose by 26 cents/20# carton and the price in the U.S. dropped by 14 cents/20# carton as a result of a change in tariffs.

Conclusion

The theory of tariffs presented in this chapter indicates that changing tariffs will have impacts on production and trade. Development of the ES and ID allow an estimation of the distribution of gross benefits. However, it gives no indication as to the composition of production in Florida (mature green vs vine ripe). Also, this analysis provides no insight into the distribution of gains among the factors of production. In order to obtain the distributional aspects, the results of the linear program must be investigated.

CHAPTER V: QUANTITATIVE RESULTS OF THE L.P. ANALYSIS

Introduction

Chapter III discusses the development of the three models used in the study. Recall that the basic model is cost minimizing and that the other two models are simply variations which have slightly different objective functions. Further recall that the basic model and the model based on 1967 quality differentials (Model III) are used to make projections to 1977. All of the models both for simulation and projection have two production and fifteen consumption regions. There are two products involved which are close but not perfect substitutes vine ripe and mature green tomatoes. Minimum and maximum production restraints are imposed to allocate production in Florida. The production inputs are land, labor, and capital. Finally, demand restraints specify the amount of product required for consumption.

Results of Simulation of 1967 Using Average Quality Differentials of the 1960-69 Period (Model I)

The use of average quality differentials (Model I) to simulate 1967 is unsuccessful. Production and Resource Use as well as trade are in error by about 50% from the actual. It is possible though to analyze the results of this model as a normative model and to compare changes which might have occurred if the tariff had been different for the base period.

Production

The production for each product in each region for the five tariff levels is shown in Table 3. The level of production for Florida vine ripened is at the minimum level for all tariff rates which is an indication that this product is at a competitive disadvantage.

In general, the production pattern followed the theoretical model described in Chapter IV. The shift in production is between Mexican vine ripened and Florida mature greens. Mexican production is the highest under a zero tariff level and the lowest under a 200% level. Conversely, Florida marketings are the lowest with a zero tariff and greatest under a 200% tariff.

If the Mexican internal demand is removed from the Mexican production figures, Mexican marketings go from 46.4 million cartons at 0% tariff to 5.2 million cartons at 200% which amounts to 89.8% drop in their marketings. At the same time, Florida marketings rose from 22.3 million cartons at zero to 39.5 million cartons at 200% or a 77.1% increase. This figure includes both vine ripe and mature green production in Florida.

Transfer Activities

The transfer activities for this model in 1967 are shown in Appendix Table 17. Using the transfer pattern resulting from a 100% tariff as a benchmark it is possible

Table 3. Production Under Various Tariff Levels For The Basic Model In 1967 (Millions of 20# Cartons)

Product / Tariff	0%	50%	100%	150%	200%
Mexico Vine Ripe	80.6	71.0	57.2	46.6	39.4
Florida Vine Ripe	10.0	10.0	10.0	10.0	10.0
Florida Mature Green	12.3	16.0	23.6	28.2	29.5

to observe how various regions shift from one supplier to another with only a change in the level of tariff.

From Table 4, it can be seen that with a 100% tariff under this model that Mexico would supply all the consumption regions except the Miami, New Orleans, Detroit, Washington, D.C., New York, and Louisville markets (See Chapter III p. 28 for a map showing the regions). The composition of Florida's trade is for vine ripes to supply Miami, New Orleans, and Louisville while mature greens are shipped to Detroit and New York. The demand in the Washington Market is split between the two Florida products. This is not a realistic trade pattern in that most regions normally would be supplied by more than one product. This trade pattern also reflects the competitive disadvantage of the Florida vine-ripe product by allocating all its shipments to the regions close to Florida in order to allocate the minimum production of this product.

As the assumed tariff rate falls to 50% and finally to zero, Mexico extends its market which is consistent with the partial equilibrium analysis of the preceeding chapter. With a 50% tariff, Mexico's market includes New Orleans, Louisville and Detroit and with a zero tariff part of the New York market shifts to the Mexican product as well. The result is that at the zero level, the Florida products have only the Miami and Washington markets and a small part of the New York market.

Table 4. The Pattern of Supply for the Different Levels of Tariffs Under the Basic Model[1]

Consumption Region	Tariff 0%	50%	100%	150%	200%
1	X	X	X	X	X
2	0	0	0	0	0
3	X	X	X	X	X
4	X	X	X	X	+
5	X	X	X	X	X
6	X	X	X	X	X
7	X	X	X	X	+
8	X	X	X	X	0
9	X	X	X	0	0
10	X	X	0	0	0
11	X	X	X	+	+
12	X	X	0	0+	0+
13	X	X	+	+	+
14	+0[2]	0+	+0	+	+
15	+X	+	+	+	+

[1]Code X = Vine Ripe (Mexico)
0 = Vine Ripe (Florida)
+ = Mature Green (Florida)

[2]When two products supply a given region, the first one listed is the primary supplier.

As tariff rates rise, the balance tips the opposite direction and Mexico's shipments fall while Florida's shipments rise. Simultaneously, there is a shift in markets supplied by the two Florida products. When the tariff is raised to 150%, Mexico supplies its own domestic demand and all of the U.S. area it did under a 100% tariff except Minneapolis and Chicago. Florida vine ripes now supply the Miami, Minneapolis, New Orleans, and most of the Louisville market with the Florida mature green supplying Chicago, Detroit, Washington and New York and the remainder at the Louisville market. This realignment of the Florida shipments is again the result of the model being force to allocate the minimum production of the Florida vine ripe commodity. The product is shipped to the market where it has the least cost disadvantage.

When the tariff is raised to 200%, this model estimates that Mexico will lose the Seattle and Dallas markets to the Florida mature green product. The remaining transfers are the same as with a 150% tariff.

In general, the results of the transfer activities for this model follow the standard locational theory. As the tariff fell, Mexico increased its share of the U.S. market it supplies increasing numbers of regions while Florida's share of the market declines as expected from theory. In essence, as the tariff falls the cost of the Mexico product to wholesalers drops and therefore, the product can be shipped further than before and still have a cost equal to the Florida products. If the tariff increases, the opposite is true.

Resource Use

The use of resources for all tariff levels for both countries is shown in Table 5. In as much as this model uses fixed production coefficients the increase in production of a product will be accompanied by an increase in resources use to produce the product.

The use of land in Mexico shifts moderately as the tariff level is changed. For tariffs of 0 and 50 percent, the land use is close to 40 thousand acres. As the tariff level rose, the amount of land used dropped off to a low of 21.3 thousand acres when the tariff reaches 200%.

Florida land use moves in opposite directions from that in Mexico and also has a much wider spread. Throughout the entire range of tariffs, Florida Vine Ripes use only 5.5 thousand acres.[7] The large shift in acreage is due to increased production of Florida Mature Greens. Since the yield of this product is only 39% of vine ripened yields, increased production would require the use of more land.

At a zero tariff level, only 23.2 thousand acres is used for all tomato production in Florida. With a 100% tariff, land use rises to 40.8 thousand acres; and at 200% tariff land use is 52.6 thousand acres. If 100% tariff is taken as a benchmark, then the land use in Florida under

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[7]This was calculated by taking production and dividing it by the yield or $1.0 \times 10^7 \div 1.8 \times 10^3 = 5.5 \times 10^3$

Table 5. Resource Use Model I (1967) Thousand of Units

Tariff Version	0%	50%	100%	150%	200%
Area-Resource					
Mexico					
Land (acres)	39.8	38.4	30.9	25.2	21.3
Labor ($) hours	88,462.0	78,077.0	63,077.0	51,154.0	43,462.0
Capital ($)	50,000.0	44,000.0	36,000.0	28,800.0	24,400.0
Florida					
Land (acres)	23.2	28.8	40.8	47.7	52.6
Labor hours	11,680.0	12,640.0	14,720.0	15,920.0	16,240.0
Capital ($)	22,000.0	25,400.0	32,400.0	36,500.0	37,700.0

a 200% tariff is a rise of 28.9%. Conversely a zero percent tariff would result in a 43.1% fall in the land use.

The total available labor for Mexico is not used under any of the policies. As with land, the higher the production the greater is the use of labor. However, even at a zero tariff rate only 23% of the available labor is utilized. Still, twice as much labor is used with zero tariff as is used when the tariff is (200%) and 50% more than in the simulation (i.e. 100%).

Labor utilization in Florida does not change much throughout the range of tariff rates. This is a direct result of the fact that the expansion or contraction of production occurs in Florida mature greens which require very little labor input. In all cases, the amount of labor employed is less than the available amount ranging from 60% with a 200% tariff to 41% if the tariff was zero.

Capital utilization for Mexico goes from a low of 24.4 million dollars with a 200% tariff to a high of 50 million dollars when the tariff is zero. The level of use at the zero level represents complete exhaustion of the available capital. This fact leads to utilization of other sources of supply which are less efficient. The program indicated that an additional unit of capital would be worth 4 cents.

Capital in Florida is never completely used. The maximum use is 37.7 million dollars at the 200% level. This is $15.7 million more than is used at the zero level and only

5.3 million dollars more than the amount used under the simulation.

In summary, the resource use pattern for Mexico is for use of each type of resource to change by about the same percentage as does production for any given tariff level. In contrast, the only resource in Florida which changes in use by very much is lang. This is directly attributable to the fact that all production shifts which occur in Florida occur in the land intensive mature green product.

Results of Using Flexible Resource Restraints (Model II)

Model II is an attempt to allow what appeared to be the limiting resources of the basic model to be bought into the program. This model removes from the production cost in Mexico the interest cost of capital; for Florida the labor cost is removed from the production cost. Then two pools of Mexican capital and two pools of labor in Florida are established. The two pools for these resources are recognition of the fact that there is a limited amount of any resource available at a given price. Therefore, any additional amount of resource which is employed will command a higher price.

The results of this model were basically no different from the results achieved in the basic model. Because of the minimum production restraints of the model, even if the tariff is zero Mexican production only increased by 2.3 million cartons. All of this increased production is shipped to the New York market. In general, the use of this

variation of the basic model did not give materially different results from the basic model.

Simulation Using 1967 Quality Differentials (Model III)

This model is basically the same model as Model I; there are two changes. First, the quality differential between mature green and Mexican Vine Ripes is set at $.60 per 20# carton which is the actual 1967 spread rather than the .80 used in the basic Model. Second, a premium is inserted for Florida vine ripened tomatoes of $0.268 per 20# carton. Since this model like the rest is a cost minimizing model, these differentials are incorporated by raising the value in the objective function for Florida Mature Greens which is the sum of the costs of land, labor, and capital to produce a 20# carton and adding $0.60, thereby obtaining a cost for production of FMG of $1.905 per carton. To adjust the value for FVR the procedure is much the same. The input costs are summed and then the premium of $0.268 per carton is subtracted, leaving a value of $1.863 per carton for the objective value of FVR.

Production

The production results are shown in Table 6. The column labeled "actual" is an estimate of marketings based on data from various sources.(22) Comparing the simulated production with the actual shows that the major discrepancy is for Florida Vine Ripe. This deviation is about 2.8% while the deviation for Mexican Vine Ripe is 1.0% and for Florida Mature Greens it is .4%.

Table 6. Production for Model III 1967 and Actual 1967 Production (millions of 20 pound cartons)

Tariff	100%	100% actual	0%	50%	150%	200%
Production MVR	48.130	48.600	74.500	54.860	40.060	34.220
Production FVR	20.120	20.700	10.000	19.900	19.720	19.620
Production FMG	22.630	22.715	18.420	22.210	25.000	25.000

Production for Mexico follows the theoretical model developed earlier. As the tariff is raised the Mexican production falls and vice versa. The maximum production is 74.5 million cartons at 0% tariff; this would be a 63.1% increase. At the other extreme with a 200% tariff, Mexican tomatoes are completely eliminated from the U.S. market.

Florida production rises as the tariff increases until a tariff of 200%. Since Mexico is eliminated from the U.S. market at a 200% tariff, there is no reason to expect that the price of Florida tomatoes will rise to the level of Mexican tomatoes, if as a result total revenue fell. It is assumed for this study that demand was elastic; therefore, the results of the 200% tariff is inconsistent since marketings should continue to rise.

For tariffs between 0 and 100%, production of both Florida products increase as the tariff rises. However, when the tariff goes to 150% the production of Florida vine-ripened tomatoes drops while the production of FMG rises to its upper bound. Analysis of the trade patterns shows that while FMG supplies an additional two rather large areas which overcome the drop in per capita demand due to increased price; FVR supplied only one new area. The extra demand from that one additional area was not sufficient to compensate for the drop in demand due to the higher prices.

<u>Trade</u>

The pattern of trade is shown in Appendix Table 15. As in all of the other models, Mexico supplies the Mexican consumption regions. Mexico also supplies the San Francisco, Seattle, Salt Lake City, Denver, and Dallas markets in the U.S. Actual data (22-p. 135) shows that Mexico should also supply Minneapolis. However, total shipments for the model are very close to actual shipments. The reason is that while in reality Mexico is the major supplier for these regions, it is not the only one. In the model, the entire demand for a region is supplied by the lowest cost supplier, As a result, the shipments for regions 4 to 8 which actually come from Florida are shown to come from Mexico.

Florida shipments as shown in the model can not be compared with actual shipments since the data does not distinguish shipments by type of product. It is probable that Florida ships both products to the markets it supplies. Therefore, the shipment pattern results of Florida will be discussed in total rather than for each product.

Since Florida's shipments are the compliment to Mexican shipments, when Mexico loses a consumption area Florida picks that area up. For the simulation, Florida supplies Miami as well as the Minneapolis, New Orleans, Chicago, Louisville, Detroit, Washington and New York markets. This means that for the simulation Mexico supplies the Western part of the United States while Florida supplies the Eastern part.

Tariff changes effect Florida in the opposite manner that they effect Mexico; lower tariffs cause Florida to lose consumption regions while higher tariffs result in Florida supplying more areas than under the simulation. For a reduction in the tariff level to zero, this model estimates that Florida's shipments would be restricted to the Miami, Washington, D.C., and New York City markets, Mexico supplies the rest of the U.S. at a 50% tariff, Florida is supplying New Orleans, Louisville, Detroit and part of Chicago as well as the areas which it supplies under the zero tariff again Mexico has the remaining regions if the tariff goes to 150% Florida supplies all the markets except San Francisco and Salt Lake City. Finally, at some tariff greater than 150% and less than 200% Florida has the entire market and Mexico has been completely eliminated from the market.

Resource Use

Resource use is directly related to production for each product. Therefore, resource use for this simulation is as close to the actual resource use for 1967 as the predicted production is to "actual" production. Also, since production for the 200% level under this model is considered to be irrelevant, resource use for this version is also irrelevant.

Land use as well as the use of other resources can be found in Table 7. Land use rose as production in Mexico rose for this model. If the tariff is 0% for 1967 in this formulation land use in Mexico is 54% higher than the amount used in the simulation 40 thousand versus 26 thousand acres. On the other hand, if the tariff is 150%, land use for Mexico in tomato production would be 21.65 thousand acres or 83.1% of the amount predicted for the simulation using the 1967 quality differentials.

Land use in Florida is fairly stable for the assumed tariff rates from 50% to 150% varying by less than 10%. The only major deviation is for a 0% tariff where land use is 24.9% lower than the simulation as only 32.7 thousand acres would be used.

Labor utilization for Mexico also is inversely related to the level of tariff. At its height, labor utilization is 74.5 million hours or 21.3 million dollars; this occurs at a tariff of zero. At its lowest, utilization falls to 40.2 million hours or 11.5 million dollars; this is when the tariff rises to 150%.

Florida's labor use follows the same pattern as land use with tariffs of 50% to 150% having very similar labor use with the largest variation being only 2.7%. As with land use, Florida shows a large decrease in labor use for a tariff of 40%. The drop for labor use is 38.4% when compared with the simulated labor use.

Capital use for both production areas follows the same pattern as the other resources. In contrast, with Model I a zero percent tariff level does not cause the capital available to Mexico to be exhausted.

<u>Projections for 1977</u>

Two sets of projections are made for 1977. The first set is based on the model (Model I) which simulates 1967 using the historical quality differentials of the 1960-68

Table 7. Resource Use for Model III (Simulation using 1967 quality differentials) (Thousands of units)

Tariff level	0	50	100	150
County-Resource				
Mexico				
Land (acres)	40.25	29.64	26.10	21.65
Labor (hours)	74,475.4	54,895.0	48,251.7	40,209.8
Capital (dollars)	46,190.0	34,020.0	29,840.0	24,840.0
Florida				
Land (acres)	32.71	42.77	43.54	47.03
Labor (hours)	14,088.0	22,560.0	22,876.0	23,160.0
Capital (dollars)	27,610.0	41,710.0	42,340.0	44,080.0

period and assumes no difference between vine-ripe tomatoes from Mexico and those from Florida. The second set of projections is based on the model (Model III) which simulated 1967 using the actual 1967 quality differentials. The demand and labor costs are changed from the 1967 models as is explained in Chapter III. Both models assume that there is no change in transfer costs or technology. The projection results of each model are discussed separately and are compared to the simulation of the 1967 situation made by that model.

Projections Using the Historical Quality Differentials

Production projections under this model are shown in Table 8. The most important result is that total Florida production is lower than the base period estimates for the same tariff except for a 50% tariff level. Now when using the predicted total Florida production for 100% in 1967 as a standard, production with a 150% tariff is estimated to rise by 7.4% and 14.3% higher for a 200% tariff. However, for lower tariffs total Florida production is expected to be lower than the 1967 production at the 100% tariff.

Mexican production is estimated to rise for every tariff level form the base period. This is the case whether the predicted production is compared with the same tariff or with the simulation of 1967 under this model. Using the simulation of 1967 as the benchmark, production in Mexico is estimated to rise between 17.0 million (at 200%) and 48.3 million cartons (if the tariff is 0%).

Table 8. Production for Model I 1967 and Model I 1977 (millions of cartons)

Tariff	0%		50%		100%		150%		200%	
year	1967	1977	1967	1977	1967	1977	1967	1977	1967	1977
Production MVR	80.6	121.0	71.0	103.5	57.2	94.2	46.6	83.7	39.4	74.2
Production FVR	10.0	2.5	10.0	2.5	10.0	2.5	10.0	2.5	10.0	2.5
Production FMG	12.3	18.7	16.0	28.7	23.6	31.5	28.2	33.6	29.5	35.9

In general, the estimates shown in Table 8 indicate that while Mexico production will rise no matter what the tariff level in 1977, total Florida production will rise only for the higher tariffs. Also, the increases in Florida production would be in the Florida mature green product. The production of Florida vine ripes is estimated to fall to the minimum production level of 2.5 million cartons. This is a drop of 7.5 million cartons from 1967. This production pattern indicates that Mexican vine ripes and Florida mature greens are competitive in this model while Florida vine ripes are not and simply are forced into the solution.

The trade pattern for the various tariff levels for both 1967 and 1977 as estimated by using average quality differentials is shown in Table 9. In general, shifts in the trade pattern reflect the production phenomenon discussed above. In comparison with the 1967 trade pattern, Mexico ships to at least as many regions under each tariff level. Florida vine ripes are shipped only to the Miami market and even this market is shared with Florida mature greens. This means that in most cases where a region would be supplied by a different source in 1977 than it would in 1967 the change is from Florida vine ripes to one of the other products. This is not true for the 150% and 200% levels where the model estimates that the Mexican product will gain regions at the expense of both Florida products. A further observation is that Mexico supplies the same

Table 9. Pattern of Transfer Activities under Model I 1967 and 1977[1]

Tariff	0%		50%		100%		150%		200%	
Consumption Region	1967	1977	1967	1977	1967	1977	1967	1977	1967	1977
1	1	1	1	1	1	1	1	1	1	1
2	2	23	2	23	2	23	2	23	2	23
3	1	1	1	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1	1	3	1
5	1	1	1	1	1	1	1	1	1	1
6	1	1	1	1	1	1	1	1	1	1
7	1	1	1	1	1	1	1	1	3	1
8	1	1	1	1	1	1	1	1	2	1
9	1	1	1	1	1	1	2	1	2	1
10	1	1	1	1	2	3	2	3	2	3
11	1	1	1	1	1	1	3	1	3	3
12	1	1	1	1	2	3	23	3	23	3

(Table 10-con't)

13	1	1	1	1	3	1	3	3	3	3
14	23	3	23	3	23	3	3	3	3	3
15	13	13	3	3	3	3	3	3	3	3

Code: 1 = Mexican Vine Ripe
2 = Florida Vine Ripe
3 = Florida Mature Green

[1]The product number which appears for a given consumption region indicates that this product is used to supply the demand for that region. When two product codes appear for a given consumption region under some tariff level, the first product is the major supplier.

number or more regions in 1977 than it did in simulation of 1967 (i.e. 100% tariff) except when the tariff goes to 200%.

In summary, most changes in trade patterns which occured in the projection model from the base model were shifts to Mexico from Florida. The increased dominance of Mexican Vine Ripe indicates that the projected increases in Florida's labor costs more than offset Mexico's larger transfer costs.

Land use in Mexico in 1977 is estimated to be greater than estimated land use in 1967 because land use is directly related to the level of production. Since the greatest production gains relatively are also found at these tariff rates. Even so, if land use is compared with the amount of land used in Model I's simulation at the base period all tariff levels show an increase in land utilization. The minimum increase is nine thousand acres while the maximum increase is thirty four thousand acres.

Land use in Florida for 1977 is only slightly greater for all tariff levels than is the use in the simulation (1967-100%). The reason for this occurance is that FMG, which is land intensive, increased in production.

Labor utilization for both production areas is shown in Appendix Table 14. The dollar value of labor, of course, rose for Mexico; but since real wages also rose, the actual increase in hours of labor is less than suggested. Still, in comparison with the 61 million hours used in the simulation, the figures in Table 10 show that, in fact, at least

Table 10. Resource Utilization Changes in 1967 and 1977 Under Model I
(thousands of units)

Tariff and Year / Country	1967 100%	0%	50%	1977 100%	150%	200%
Mexico						
Land (acres)	30.9	65.4	55.9	50.9	45.2	40.0
Labor (hours)	61,081.3	128,947.4	110,040.5	100,404.8	89,271.2	79,149.8
Capital ($)	36,000.0	75,000.0	64,190.0	58,380.0	51,920.0	45,970.0
Florida						
Land (acres)	40.7	29.9	45.4	49.6	52.8	56.5
Labor (hours)	14,688.0	7,101	9,803.9	10,540.9	11,097.5	11,739.8
Capital ($)	32,390.0	19,790	29,010.0	31,510.0	33,420.0	35,610.0

a 33% rise in the number of hours worked should be expected. If the tariff should fall to 0%, then labor utilization in Mexico would more than double.

Labor utilization in Florida for all tariffs in 1977 is projected to be lower than 1967. The lower labor utilization is the result of reduction in the amount of vine-ripes produced and the shift of production toward more capital intensive mature green tomatoes.

Capital utilization is also shown in Table 10. For 1977, it is assumed that there would be no technological change. As a result the same real capital coefficients are used. The implication is that there would be no mechanical picking of vine ripe tomatoes.

Every version for 1977 predicts capital use in Mexico to exceed the quantity used in the simulation. A tariff of zero results in the available capital for Mexico being exhausted despite the fact that capital availability for Mexico was increased by 50%. Capital use in Florida, by contrast, does not change by much from the amount predicted to be used with a tariff of 100% in 1967 using the historical differentials. Only when the tariff is zero does Florida's capital use vary much from the simulation quantity. This variation is estimated decrease of $12 million or 39%.

Results of Projection of 1977 Using 1967 Quality Differentials (Model III)

As a counterpart to projections to 1977 using the historical quality differentials (Model I), projections are made using the actual 1967 quality differentials (Model III).

Except for the change in the assumption as to the relevant set of quality differentials, these two models are structurally the same. All of the input data for this model is identical to the data used for prediction in Model I.

Production

Production under this model is shown in Appendix Table 16. Mexican production follows the same pattern as in the previous models. Maximum production is achieved at a zero tariff level with 108 million 20# cartons. While the lowest Mexican production occurs at 200% tariff with 65 million cartons. If one compares projections for each tariff level in Model III with Model I for 1977, Mexican production is always lower in Model III. As an example for a zero tariff, projected Mexican production is 10% less under Model III than under Model I.

The interesting production activity is the Florida mature greens. In this model production of Florida Mature Green for tariffs between 0% and 100% follows the conventional pattern seen in previous models. However, projected production for the 150% tariff falls below the level for either a 50% or 100% tariff which mean that Florida would be better off if the tariff is between 50 and 100% rather than 150%. Likewise production for a 200% tariff is less than for the 100% level or Florida would be better off if the tariff were 100% rather than 200%. This inversion appears to be the result of two factors. The first is the assumption that Florida's labor cost would rise more rapidly at higher tariff levels. This changes the comparative costs among the various production. The second factor appears to be the lower differential which allows FMG to obtain a larger share of the markets at the lower tariff level. As a result, the increase tariff which is a positive factor for FMG is offset by the higher costs.

Comparison of Model III - 1977 with Model I for 1977 shows that at every tariff level production of Florida Mature Greens is higher under Model III. Even with the reversal, Model III production is about 25% higher for tariff levels from 50 to 200%. For the zero level, Model III - 1977 production is 3.7 times as great as the production for the same level in Model I - 1977.

Trade

The pattern of trade under this model is different than other models. The pattern of trade is related to the production phenomenon discussed above. The transfers which occurred under each version are shown in Appendix Table 16. The most obvious point which arises from looking at this table is that the trade pattern for (150%) is exactly the same as for (100%). However, since the price has risen and demand has dropped, total shipments for each product are either the same as in the case of Florida Vine-Ripes or lower in the 150% case.

Resource Use

Table 11 shows the resource use for the two production areas. The resource use follows the same pattern as production which means that it dropped for Mexico continually as the tariff level is raised. For Florida, the use rises as the tariff level goes from 0% to 100%; then it drops back to less than the use rate at the 50% level for 150% raising again as the tariff goes to 200%.

Land utilization in Mexico rises by between 35.4% and 142.2% for 1977 as compared with the base period simulation by this model. The lower increase is mostly a result of internal gorwth in Mexican demand. The higher increases are the result of both expansion in demand and expansion in the number of regions Mexico supplies.

Florida land use has increased which are much more moderate than those for Mexico only 15.3% to 67.5%. The large increase in the production of the land intensive mature green accounts for much of the increase in land use.

Labor utilization sees an increase of 17 to 59 million hours for Mexico. If this is translated into employment levels it amounts to between an additional 10 to 30 thousand jobs. This is based on a 70 hour week and a 24 week season.

Florida's labor utilization drops to about 50% of the level employed in the simulation. The lower production of FVR accounts for much of the drop in labor use.

Capital use like labor increased in Mexico. As compared with the simulation an additional 10 to 37 million dollars would be employed for 1977. Florida's capital use was just about the same as for the simulation for this model.

Table 11. Resource Use for Model III - 1977 (thousands of units)

Tariff	0%	50%	100%	150%	200%
Mexico					
Land (acres)	58.3	48.6	42.8	41.3	35.2
Labor (hours)	107,818	89,596	79,345	76,308	65,109
Capital (dollars)	66,900	55,800	49,200	47,300	40,300
Florida					
Land (acres)	50.0	66.3	72.6	64.3	70.6
Labor (hours)	10,615	13,421	14,520	13,107	14,205
Capital (dollars)	31,800	41,400	45,100	40,200	44,000

Model I and Model III Compared

Model I which assumed that there is no difference in quality between vine ripe tomatoes and an $0.80 per carton difference between mature green and vine ripes is not as good a predictor of 1967 as is Model III. Model III reproduces the production pattern for 1967 within 1.2% overall. Model I, on the other hand, is off by 20% to 50% of the actual production.

Further, production under Model III for tariff levels other than 100% is more balanced allowing FVR to enter at above the minimum production level. As a result, Model III appears to be a better model for representing what would have occurred in 1967 under the various tariff levels.

The trade pattern for Model III is also more realistic than the pattern for Model I. However, the 200% tariff level run results for Model III are not rational because of the complete elimination of all competition (i.e. at some level of tariff below 200% Mexico is eliminated from the U.S. market in Model III).

With respect to projection, however, Model I appears to be more realistic. The results are consistent with theory while Model III results show discontinuities particularly in production. The trend indicates that wholesalers are rating Mexican tomatoes as being even with Florida vine ripends. Therefore, a zero quality differential between these two products seems justified in the projection period.

CHAPTER VI: POLICY IMPLICATIONS OF TARIFF CHANGES

The results in Chapter V suggest that a number of things would have been changed if the tariff level had been different in 1967 and that a variety of situations could occur in 1977 depending on the policies imposed. The purpose of this chapter is to evaluate some of the aggregate aspects of these results and the impacts on Mexico and the U.S. As was indicated earlier, it appears that Model III is more relevant for analyzing 1967, while Model I appears to be better for assessing 1977. Therefore Model I, 1977, will be called the projection model, and Model III, 1967, the simulation model.

Impact of Lower Tariffs for 1967

Given the historical free trade stance of the United States, the lowering of tariffs is a conceivable policy. The impact on Mexico if the tariff had been lower is considerable. From 1967 simulation model it discovered that a 50% drop in tariff resulted in an increase of 156 million pounds of production or a 16.2% rise, while 100% tariff drop would have seen a 26 million carton increase in Mexican production. Therefore, a reduction in tariff would have changed the entire structure of production. Mexico, which supplied about 25% of the total tomatoes used in the U.S.

for 1967 would have supplied over 35% if the tariff had been only 50% and would have produced 59% of the tomatoes used in the U.S. if the tariff had been 0%.

The production effect in Florida is not as pronounced as it is in Mexico. Under a 50% tariff total Florida production would have been only 1.4% lower (42 million cartons rather than 42.6 million), while under a 0% tariff the Florida production would have fallen by one-third. The fall in production is shared about equally between the two Florida products for the 50% level; but for the 100% level FVR fell to one half of its initial level, while FMG recorded only a 19% drop.

The increases in production which would have occurred under lower tariff would have lead in increases in the utilization of resources in Mexico. The impact on land is discussed in detail in Chapter V and does not need to be reiterated here. The implications for labor and capital are more important and require some discussion.

The increase in the employment of laborers would have been extremely beneficial to not only the West Coast region but to the entire Mexican economy. Given the fact, as previously stated, that the opportunity cost of vegetable labor is 3 to 5 pesos a day, an increase in production would increase the amount of wages paid. If one assumed a 10 hour day, a 70 hour week, and a 24 week season, the average worker could expect a 168 day working period in the fields.

Therefore, each additional worker employed could expect an increase of 3,570 pesos per year in income.

With a 50% drop in the tariff an additional 3,950 persons would have been employed. If the tariff had been 0% instead, the increase in employment would have been 14,490 persons. This would have represented between a 13% and 54% increase in employment for tomato production.

The utilization of capital is the other major resource question. For all of the models, capital is lumped together to create a single capital input. Therefore, fixed capital expenditures such as irrigation projects and roads are combined with variable capital expenditures such as electricity and fertilizer. Now the source of funds for the different capital components varies rather markedly; therefore, increases in production and capital use result in benefits occurring to a variety of sources.

Most fixed capital such as irrigation projects, roads and communications networks are supplied by the government. These projects are normally financed by loans, grants or governmental expenditures. Therefore, increases in production do not affect these expenditures. Normally, the costs for use of these facilities is paid on the basis of the use by the producer. For example, water costs from irrigation projects are levied on the amount of water taken from the project.

In contrast to the lumpy fixed capital which is supplied by the government, working capital and other fixed capital is supplied from two sources; American shippers and the growers. The importance of the shippers in supplying capital has supposedly dropped, and yet they are an important capital source. Undoubtedly, most of the increase in capital which would have been required under lower tariffs would have come from U.S. sources since there are no Mexican institutions which will lend money to grow vegetables because these crops are considered to be too risky. The result is that while Mexican producers would achieve the benefit of employing more capital, the interest on the capital would be repatriated to U.S. banks.

The important resource questions in Florida are land and labor. Certainly, the problem of fixed assets would plague Florida farmers, but most of the equipment utilized in tomato production can be transfered to use in some other row crop enterprise.

Under the two lower tariff levels postulated, land use would have been 1.6 and 24.9 percent less in Florida than under the 100% level. Now since in the range of agricultural use tomatoes are the highest and best, lower tariffs would result in forcing land into less economic agricultural uses or ultimately into urban uses.

It is a fact that much of the land used for tomatoes is found in the rapidly exploding urban fringe areas around Miami and Pompano Beach. Lower valued use of this land such as corn or peas might have caused a more rapid movement of land into urban uses, thereby, eliminating the possibility of reclaiming it for agricultural uses if tariffs were to later be raised.

The implications of the lower tariffs on labor in Florida are important because of the fact that labor is the biggest problem that Florida growers perceive. Given the drop in size of the agricultural labor force and the demands for upgrading the quality of agricultural workers' lives, the decline in labor utilization could have had severe effects. A drop in the tariff to 50% would have caused only a 1.6% drop in Florida labor utilized, thereby not creating any significant drop in the amount of labor used. However, if the tariff had been zero, labor utilization would have dropped by 38.5%.

The implications of the larger drop would have been that more agricultural labor would have been forced into alternative lines of work or else gone on welfare. While a drop in the tariff would have eliminated jobs, adequate retraining programs if available could have accelerated the movement of labor out of this low paying and insecure professions.

Impact of Higher Tariffs, 1967

Production

Higher tariffs on Mexican tomatoes would, of course, have been in conflict with our position of free trade, but it was a logical possibility given the demands for protection arising from Florida producers. The simulation model (Model III, 1967), shows that raising the tariff to 150%

reduces Mexican production by 8 million cartons or 16.3% from the "actual" level. If the tariff is raised to 200% Mexican production is reduced to exactly the amount needed to supply its domestic demand.

The implications of complete elimination of Mexico from the U.S. market are important. Mexico views the export of tomatoes as a very important part of its economy. As stated earlier, tomato exports account for 4.6 percent of the total value of exports. It is possible that the political consequences would be more important than the economic losses. The apparent prohibition of this important agricultural crop would probably be viewed as a very anti-Mexican policy. As an example of how politically sensitive tomatoes are, when size restrictions were imposed in 1968, ostensibly to improve the quality of the product marketed, a cry of protest arose from south of the border. The Mexicans perceived this move as an attempt to eliminate them from the American market.

Florida's production is predicted to rise by only 4.6% in total with a 150% tariff. The rise in FMG's was offset by a slight drop in the production of FVR. The competitiveness of FVR then is somewhat limited. The increase in the tariff benefited only the FMG. This result seems to indicate further that FVR is in trouble and that even a rise in tariff will not provide any real relief to this product.

Resource Use

Resource use for Mexico drops by about 16.7% when the tariff rises to 150%. As Appendix Table 17 shows, this can be translated into a reduction of 5 thousand acres of land for tomato production, a drop of 8 million hours of labor, and a fall of $5 million of capital used. A recent publication (8, p. 30) indicated that the profit from an acre of tomatoes is $804. Now if all of the unemployed resources were used in the next best alternative of Summer Squash, the loss would still be $218 per acre. Therefore, the loss to the entire economy would be at a minimum $5 million dollars.

The resource use pattern also indicates that the rise in tariff did not have as large an impact on Florida as it did on Mexico. The major gain in resource use was in the area of land. The shift to the land intensive crop, FMG, accounted for the 8% increase.

The impact on the other factors of production was not as pronounced. Labor utilization rose by only 1%. Given the fact that the model's accuracy is only within about 2% of "actual", this can't be considered a very important gain. However, since the gain in labor was in the production of mature greens, which require workers of higher skill, this might have forced the upgrading of the labor force which would make it easier for laborers to later transfer to other occupations.

Capital growth amounted to only 4%. Considering the high level of capital used, this increase in capital use is not too important.

Impact on American Consumers (1967)

The production effects of the tariff are only part of the entire picture. The consumers also gain or lose with tariff changes. Under the 100% tariff, the cost of a carton of tomatoes is $2.28. With the tariff reduced to zero, the cost would fall to $2.23 per carton. Assuming that this decrease is not absorbed by shippers and wholesalers increasing their marketing margins, the consumer will get the full benefit. Therefore, under a zero tariff, the cost of a carton dropped by $0.15 and total consumption rose by 22 million cartons.

Conversely with higher tariffs while it appears that Florida producers will benefit and that Mexican producers will lose, it is obvious that American consumers will lose. The price of tomatoes will rise by at least 2¢ per carton. Because the elasticity of American Import Demand Curve is greater than the Mexican Export Demand Curve, the American consumer absorbs less of the price rise.[8]

Impact of Status Quo Tariffs for 1977

Production

As reported in Chapter V under all of the proposed tariff levels the production in Mexico increases over the production in the base period. This is the result of the rapid increase in the demand for tomatoes postulated to occur domestically in Mexico as well as any shift in production due to changes in comparative advantages (i.e.

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[8] See Chapter IV.

changes in tariff, level or changes in relative costs). Therefore, production shifts which are important are the net production changes or that production which is exported.

In the simulation of 1967 (Model III 100% tariff), the net export production amounts to 13.9 million cartons. If this figure is used as a benchmark, then the increase in exports is due to two factors; first, increases in demand in the regions which Mexico supplied; second, increases due to improved Mexican comparativeness in tomatoes. This latter reason is the result of the difference in the projected rates of change in wages between the two countries.

For no change in tariff from 1967, both factors were operative. Net production increases by 22.4 million cartons over 1967. This increase is divided into 17.4 million cartons which represented addition of new regions to Mexico's trade matrix, and 5.0 million cartons which represented increases in demand in the U.S. regions which Mexico had supplied in 1967. Therefore, it appears that inaction in the realm of changing barriers for trade between 1967 and 1977 would result in improvement of the position of Mexico. Competitive factors (i.e. rising labor costs in Florida) would overcome the tariff barriers and allow Mexico to expand its production and shipments.

Florida production is projected to fall in 1977 compared with the 1967 simulation if there is no tariff change. While the total Florida production fell by 8.8 million cartons, Florida Mature Green production actually rose by 8.8 million cartons, Florida Vine Ripe tomatoes which became very uncompetitive because of the rapid rise in labor cost fell from 20.1 million cartons to only 2.5 million cartons.

Resource Use

With the increase in Mexican production is associated a rise in resource use. Appendix Table 17 shows that a 100% increase in the use of all resources would be expected if the tariff was unchanged from 1967 to 1977. In contrast, Florida's resource use pattern reflects the composition of production. The only resource which incurred a higher use rate was land. Both labor and capital would have lower levels of utilization.

The increase in Mexican labor utilization due to the tariff change is 23.9 million hours, as shown in Table 12. Using the figure developed earlier that an individual can expect 1680 hours of work per season, this would mean that an additional 14,250 persons could be employed in toamto production in Mexico. Given the relatively low opportunity cost of labor, this increase in labor use would result in an additional $7,850,998 going to Mexican labor. This can be calculated by taking the difference between wages in vegetable production 48.4 pesos/day and the 7.4 pesos/day which can be earned in the alternative lines of work.

The number of labor hours used in Florida drops by 5.38% or 12,335,000 if the tariff remained unchanged. There has been a trend toward declining labor availability for field work in Florida over time, and this result would be consistent with the trend. Also as previously mentioned, there are forces afoot at present to speed up this trend. Also, with the rapid mechanization of many crops in other areas of the country, it has become increasingly difficult for migrant workers to make a living by moving from one production area to another.

Land use increases in Mexico would not result in displacing other uses most likely. The projected 50.9 thousand acres used is only about 50% of the available acreage for 1967. Of this acreage increase, 12.5 thousand acres is due to the tariff change and 12.3 thousand acres due to increases in demand in Mexico and in previously Mexican supplied regions.

The 9.4% increase in the number of acres employed for Florida reflects the increased production of Florida Mature Green. The only domestic resource to gain from keeping the tariff of the 1967 level is land. Therefore, land owners would gain relative to 1967.

Mexican capital use patterns and changes raise the same questions for 1977 as in 1967. Based on past trends of the growers becoming less dependent on outside sources such as shippers and packers, it is possible that a majority of working capital will be provided by the growers freeing them from control by their buyers. Since the composition of suppliers of capital is unknown, it is hard to tell whether the benefits of increased capital use will all accrue to Western United States capital sources.

Capital utilization in Florida is predicted to fall by 25%. Theoretically, if farmers are logical, costs for expensive machinery and other large fixed capital expenses will not be incurred as production adjusts to the new conditions. It is obvious, however, that even if these expenses are not incurred (i.e. no fixed asset problem), the owners of capital will be worse off than in 1967.

In summary, the retention of the tariff level at the 1967 level would present less of a barrier in 1977 than it did in 1967. Mexican production and shipments would be higher. Exports would be 61.1% higher than in the base period. Florida's total production would fall, and in fact FVR would almost disappear.

<u>Impact of Lower Tariffs (1977)</u>

Production in Mexico under both lower tariff levels is higher than in the base period. Again as with the analysis of the status quo tariff, it is necessary to look at the exportable surplus not the total of Mexican production. With a 50% tariff level in 1977, exportable surplus rises by 31.8 million cartons or by 128.8 percent; 6.2 million cartons is the increase in demand for regions supplied in 1967; the remaining 25.6 million cartons is the result of Mexico supplying additional regions. For a 100% tariff reduction, the exportable surplus rose to 63.1 million cartons or an increase of 49.2 million cartons. This increase can be allocated in the same manner used above. Here, 41.1 million cartons represent additional regions; Mexico supplies in this version and 8.1 million cartons of the total is accounted for by increases in demand for the regions previously supplied by this source.

Production in total for Florida is lower as it is when the tariff is continued at 100%. Total production is 49.7% and 73.1% of the base period level for the 50% and zero tariff levels respectively. The drop is confined only to Florida Vine Ripes which enters at its minimum of 2.5 million cartons; production of Florida Mature Green also falls for the zero tariff level being 4 million cartons less than the base period. The loss of production is accounted for by transfer of regions from being supplied by Florida to being supplied by Mexico.

The resource use in the two production areas reflected the changes which occurred in production. Mexico with its single product recorded gains in all resource categories for both of the lower tariffs. Land use for Mexico doubles for both of the tariffs in comparison with the base period simulation. Labor use is predicted to increase with between 24,000 and 46,000 additional workers being employed in tomato production in 1977 over the number employed in 1967. Capital utilization is also predicted to increase; ultimately the capital is predicted to be exhausted when the tariff reaches zero. In general, then a lower tariff for 1977 appears to benefit all of the production factors in Mexico.

Florida's resource use for the lower tariffs is predicted to fall for all resources except for land at the 50% level.

The 4.4% gain in acreage for this tariff level is the result of the increase in the production of mature greens which overcame the decline in land use caused by the falling Florida vine ripe production. In general, though, all resources in Florida are less utilized than they were in the base period. In particular, the number of jobs in tomato production falls. However, if the government or the society has as a goal the elimination of migrant labor, then this impact may not be too serious.

Impact of Higher Tariffs for (1977)

Mexican exportable surplus is higher even for the higher tariff rates. If the tariff goes to 150%, the exportable surplus is 12.8 million cartons greater than in the base period. In comparison with 100% tariff for 1977, land use would be 10% less if the tariff were 150% and 20% less if the tariff were 200%.

Of this increase, 9.7 million is from Mexico supplying additional regions, while the remaining 3.1 million cartons is from increased demand in those regions which Mexico previously supplied. If the tariff were 200% the exportable surplus would be 3.2 million cartons greater than the base period, 2.0 million from new regions and 1.2 million from increased demand in the old regions.

The same situation with respect to Florida's production exists for tariff policies greater than 100% as does for a tariff of 100%. FVR production still enters at the minimum production level of 2.5 million cartons. FMG production rises by 45.8% and 59.0% respectively for the two levels. The rises in FMG production doesn't overcome the fall for FVR, and so the total production in Florida is lower than in 1967.

Land use in Mexico follows the same pattern as production. Therefore, the use of land rises for both of the higher tariffs. However, the higher the tariff the less was the increase over the base period.

The change in the tariff to 150% causes land use to only rise by 5.4 thousand acres and by only 1.1 thousand acres if the tariff is 200%. In general, the increase in land use for Mexico declines as the tariff rate rises.

Labor utilization for Mexico follows the same pattern as the land utilization for the higher tariffs. The increases in labor utilization are smaller as the tariff rises. As can be seen in Table 12, labor utilization increases due to the non-demand increase factor amounts to 10.4 million hours for a 150% tariff and 2.1 million hours for the 200% level. These increases are the reflection of the change in relative wage rates. Here the fast rising wage rates in Florida are at least partially offsetting the rising tariff rates. But since wages rise faster in Florida than the tariff, Mexico is still able to ship to additional regions.

Capital use also rises under these policies. Capital use would be 54% higher under a 200% tariff and 74% higher with a 150% tariff. In comparison the 100% tariff had a 95.6% increase. The increase in capital used caused by changes in the trade pattern for the two higher tariffs is much lower than the similar increase for the 100% level. With a 150% level, capital use attributable to Mexico supplying new regions is $6 million; this is only a quarter of the increase registered when the tariff is allowed to remain at 100%. The $1.2 million increase predicted for the 200% level is only about 5% of the increase for 100%.

Table 12. Resource Utilization Changes From the 1967 Simulation Caused by Tariff Changes for 1977 (thousands of units)

Tariff	100%	50%	0%	150%	200%
Mexico					
Land (acres)	12.5	14.2	22.8	5.4	1.1
Labor (hours)	23,866	27,213	42,772	10,390	2,129
Capital (dollars)	13,888	15,872	25,482	6,014	1,240

For Florida with higher tariffs for 1977, land use is predicted to rise, but all other resources are expected to fall in use. Land use rises of 20% to 30% from the base period are the result of increases in mature green production. The increase in tariff for 1977 appears not to improve the utilization of labor and capital when compared to the 1967 simulation.

It therefore appears that increased tariffs will not really prevent the decline in the competitiveness of the Florida vine ripe product with the other two products. Mexico appears to benefit under all of the tariff levels when compared to the simulation; and benefits most the lower the tariff. Conversely, Florida has the highest production and the least decrease in resource utilization for the 200% tariff.

Impact on U.S. Consumers of the Different Tariff Policies for 1977

The impact of the different tariff policies for 1977 can be approximated by observing the range of average cost per carton of winter tomatoes. All of the models assume that regional prices differ only by the cost of transportation. Therefore, the average cost per carton concept really applies only to some hypothetical region. The cost would be higher the farther the consumption point was from Nogales which is the cheapest source.

Table 13 shows the range of average costs for the five tariff policies and a comparison with the calculated cost for the base period. If it is assumed that constant percentage markups are used, then changes in average costs will be slightly more at retail than at wholesale. This means that a rise in the tariff will cause a greater rise at retail; likewise a tariff reduction will cause prices at retail to drop by more than just the tariff.

The average cost for 1967 was calculated at $2.28; retention of the tariff at the 1967 rate caused the average cost to rise to $2.74. This cost increase is caused by increases in labor costs. If the average cost for 100% tariff 1977 is used as a base, the impact of tariff changes can be observed. If the tariff were 50%, the cost would fall by .12¢ to the wholesaler in the average region. It would fall by $.25/ carton if the tariff was zero. Conversely if the tariff were raised, the average cost would rise; at 150% the cost rose by $.20/ carton and at 200% it rose by $.27/ carton.

The results of the average cost approach to impact on consumers do not agree with the results in Chapter IV. The analysis in that chapter indicated that the price in the consuming country would fall by 14 cents for each 39.3 cent change in the tariff. The analysis that the chapter assumed consumption all took place at the border, and that there were no transportation costs and that consumption occurs at many points on surface.

Table 13. Impact of Tariff Policies on U.S. Consumers

Year	1967	- - - - - - - -	- - - 1977	- - - - - - - -		
Tariff	100%	100%	50%	0%	150%	200%
Ave. Cost/Carton	$2.28	$2.74	$2.62	$2.49	$2.94	$3.01

Summary of Impacts for 1967

The impact of the various tariff policies has been discussed for different segments of the system. However, policy decisions require some insight into the net results of any tariff decision.

The general scheme is to analyze the net change in monetary terms to each country from each policy. This can be accomplished by determining the change in U.S. government revenue, the change in the Florida production sector, and the change in the Mexican production. The models derived for this study do not provide adequate information on gains and losses to consumers. The information on consumer gains and losses reported earlier are only indications of changes, not actual changes. For this reason, consumer changes will not be included. Therefore, the above effects can be measured using either of two approaches. The first is to assume that resources have a zero opportunity cost. This method would have the effect of giving the maximum loss for a tariff reduction and the maximum gain for a tariff increase to U.S. producers. The second approach is to assume that resources have a positive opportunity cost. This method provides a lower estimate of the losses and gains from policy changes and is the one used.

The gains and losses for 1967 are shown in Table 14. The first column reports the estimated returns to different factors under the 100% tariff from the simulation model (Model III, 1967). The succeeding columns show the estimated returns to the various factors and the net change from the first column. The net change incorporates the concept of positive opportunity costs. Also for each of the alternative tariffs in 1967 is a summation of the total effects for each country. For the U.S. this summation

Table 14. Gains and Losses in 1967 for Various Tariff Policies (in thousands of U.S. dollars)

Region / Tariff	100%	0%	Net Change	50%	Net Change	150%	Net Change
United States							
Government							
Revenue	+5,458.8	0	-5,458.8	4,066.0	-1,392.8	3,439.8	-2,019.0
Production							
Factors							
Land	1,524.0	1,505.3	-18.7	1,522.8	-1.2	1,530.1	+6.1
Labor	28,570.0	21,979	-6,591.0	28,333.0	-237.0	28,783.0	+213.0
Capital	42,340.0	40,504	-1,836.0	42,121.0	-119.0	42,935.0	+595.0
Profits	41,168.4	34,354.4	-6,814.0	40,716.8	-441.6	43,376.7	+2,208.3
Total Government & Prod. Effects			-20,718.5		-2,191.6		+1,003.4
Mexico							
Production							
Factors							
Land	674.0	1,039.3	+ 365.3	760.7	+90.7	557.4	-116.6
Labor	13,800.0	19,044.6	+5,244.6	15,128.6	+1,328.6	12,191.6	-1,608.4
Capital	29,840.0	33,785.3	+3,945.3	30,819.3	+979.3	28,580.9	-1,259.1
Profits	20,984.4	24,058.2	+3,073.8	21,747.4	+763.0	20,003.4	-981.0
Total Mexican Change			+12,629.1		+3,161.6		-3,965.1

includes the effect on government revenue. Since the U.S. does not impose tariffs as a revenue measure, policy decisions should not weight the government revenue effects very heavily.

Now if the tariff had been changed to zero for 1967 from its level of 100%, the following would have been the gains and losses in the U.S.: Government revenue would have fallen by 39.3¢/carton x (1.389×10^7) or $5,458,770. Land use would have fallen by 10,800 acres ($1.73/acre)[9] = $18,684. Labor use would fall by 8,788,000 hours ($.75/hour)[10] = $6,591,000. Capital use would have fallen by at most $170,00/acre.(21-p. 80) Therefore capital loss is 10,800 acres x ($170/acre) or $1,836,000.

In order to complete the production effects for the U.S., it is necessary to ascertain a proxy for profits to estimate the changes in returns to management. This proxy can be gained from data in a recent publication.(21-p. 37) If profit for tomatoes is about $946.40/acre, then using the profit ratios from this publication, the alternative profit is around 1/3 of the profit for tomatoes. Therefore, the assumed profit rate is $315.47/acre for some alternative crops such as cucumbers or eggplant. For this tariff rate the profit loss would be about 10,800 acres x $630.93/acre or $6,814,044.

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[9] The opportunity cost of land in Dade County for growing cucumbers or strawberries.

[10] The approximate welfare benefit is $.50/hour or $1000/year.

In summary, then, total U.S. production losses are \$15,259,700 rising to \$20,718,500 if the changes in government revenues are taken into account.

In contrast to the losses for the U.S., a change to a zero tariff in 1967 would have resulted in production gains for Mexico of \$12,629,200. Data from Table 14 shows that the gains would have accrued to all production factors. The calculation of changes is as follows: Land Use= Δ in land use x opportunity cost of land=14,100/ac x \$25.91/ac (21-p. 85) Labor use= Δ in no. of hrs. x opportunity cost of labor=26,223,000 hrs x \$.20/hr. Capital use= Δ in capital fixed in tomatoes x land use=14,100 acre x 279.81/acre. (21-p. 5) Profit=profit in next best crop x acreage=14,100 x 218.00.(8-p. 37)

Using a similar set of calculations, it is determined that if the tariff had been changed to 50% from the actual 1967 level that U.S. government revenue would fall by \$1.4 million, while losses to Florida production factors would lose about \$800 thousand dollars. However, gains in the production factors to Mexico are more than the losses to the U.S. production sector and the government. Mexican production gains are calculated to be \$3.1 million. Therefore, regardless of the benefits which are sure to accrue to U.S. consumers the calculated Mexican benefits outweigh the losses to the U.S. This result has some important policy implications which will be discussed later.

The last tariff policy for 1967 investigated is a change to 150% from the actual 1967 level. The same technique used to calculate gains and losses above is used here. While there would be gains for the Florida production factors, there would be a decline in the government revenue. This result reflects the fact that imports declined by so much that the product of the increased tariff times the remaining imports provides a lower total revenue. Therefore, the net gain to the U.S. producers of $3.0 million dollars in partial offset by the $2.0 million decline in the government revenue. A similar calculation of Mexican losses under this tariff indicates that the sum of losses would be $3,965,140. The total net production loss then would be approximately $3.0 million.

Summary of Impacts for 1977

The projected impacts of various tariff policies for 1977 are shown in Table 15. The same technique can be used to measure these changes for the projection year as is used to measure the changes in the base year. The expected returns in 1977 under the 100% tariff are shown in the first column of Table 15. In the succeeding column are the expected returns under the alternative tariffs and the net change in returns from the expected returns under the 100% tariff for 1977.

One should note that the opportunity cost of labor has been projected to change for this period. In the U.S. the welfare level by 1977 is projected to be at least $4,000

Table 15. Gains and Losses in 1977 for Various Tariff Policies (thousands of U.S. dollars)

Region / Tariff	100%	0%	Net Change	50%	Net Change
United States					
Government Revenue	14,273.8	0	-14,273.8	8,995.0	-5,278.8
Production					
Land	1,737.0	1,706.4	-30.6	1,733.2	-3.8
Labor	25,920.0	24,200.0	-1,720.0	25,554.0	-366.0
Capital	31,510.0	28,501.0	-3,009.0	31,136.0	-374.0
Profits	45,048.6	33,881.1	-11,167.5	43,660.6	-1,388.0
Total U.S. Production and Government Effects			-30,200.9		-7,410.6
Mexico					
Production					
Land	1,318.0	1,717.0	+399.0	1,447.6	+129.6
Labor	49,600.0	65,946.9	+16,346.9	55,702.4	+6,102.4
Capital	58,380.0	62,689.1	+4,309.1	59,779.0	+1,399.0
Profits	40,923.6	44,280.8	+3,357.2	42,013.6	+1,090.0
Total Mexican Production Effects			+24,412.2		+8,721.0

(Table 15 con't)

Region / Tariff	150%	Net Change	200%	Net Change
United States				
Government Revenue	15,275.1	+1,001.3	12,892.0	-1,381.8
Production				
Land	1,746.0	+9.0	1,752.4	+15.4
Labor	26,198.5	+278.5	26,519.5	+599.5
Capital	32,394.0	+884.0	33,023.0	+1,513.0
Profits	46,182.2	+1,133.6	50,663.9	+5,615.3
Total U.S. Production and Government Effects		+3,306.4		+6,361.4
Mexico				
Production				
Land	1,170.3	-147.7	1,035.6	-282.4
Labor	42,474.2	-7,125.8	36,636.8	-12,963.2
Capital	56,785.1	-1,594.9	55,330.1	-3,049.9
Profits	39,681.0	-1,242.6	38,547.4	-2,376.2
Total Mexican Production Effects		-10,111.0		-18,671.7

per year or $2.00 per hour. Therefore, the opportunity cost of Florida labor is $2.50/hour (the projected wage in agriculture) -$2.00/hour or $.50/hour. In Mexico the opportunity cost is $.44/hour. This is the projected difference between wages in agriculture of $0.48/hour and $.04/hour working on mountain farms.

As with changes for 1967, Florida benefits with the higher tariffs and Mexico with lower ones. The first thing one can notice is that for only one tariff rate (150%) is government revenue expected to exceed the amount collected by keeping the 1967 level. Since as stated earlier, the intent of American tariffs is not revenue generation, this is not too important. A second general point is that the gross changes in Mexico are greater than the changes in the U.S. If the changes in government revenue are removed from the United States figures, then the magnitude of American shift is generally smaller. As shown in Table 15, the U.S. losses would fall from $30.2 to $15.9 million for a tariff of zero if the change in government revenue is eliminated.

From the U.S. producers standpoint, a reduction in the tariff to 50% is far superior to a complete elimination. A drop in tariff to 50% would apparently cost them only $2.2 million dollars directly; conversely, a complete elimination would apparently result in a $15.9 million in losses directly to Florida production factors.

On the Mexican side, the most interesting thing shown in Table 15 is that labor would benefit most under Mexican production increases and would lose the most under production decreases. The reason for this is that labor does not have very good alternatives (i.e. the next best opportunity is low paying).

In general, for 1977 it appears that disregarding the changes in U.S. government revenues that changes in the U.S. will be more than counter-balanced by opposite changes in Mexico. The gains which Mexico is predicted to achieve under lower tariffs exceed to losses predicted for Florida. In contrast, losses to Mexican producers under higher tariffs more than affect the gains accruing to Florida.

CHAPTER VII: SUMMARY AND CONCLUSIONS

Problem

The formation of the U.N.C.T.A.D. in 1964 brought about a more coordinated statement of the demands of the L.D.C.'s on the questions of trade and aid policy. Among the demands that arose from the conference was that developed nations grant tariff relief to the products of their less developed trading partners.

There could probably be many cases investigated to determine the actual effects of tariff relief but for this study Mexican winter tomatoes are examined. In the winter season (Dec. 1-May 30), Mexican tomatoes supply from 1/4 to 1/3 of the U.S. demand for tomatoes. The remaining tomatoes are produced in Florida. The conflict between the official United States Government position favoring free trade and the rising demand from domestic tomato producers for increased protection makes this a good case to study the effects of tariff changes.

Method

The study measures some possible production, trade and resource use changes resulting from variations in the U.S. tariff policy for both the base year of 1967 and for a projection year (i.e. 1977). Two techniques are employed to make measurements for the basic year, partial equilibrium analysis and linear programming. The partial approach assumes that there is one product which is homogeneous. It further assumes that all consumption and production occurs at one point in each country. If one develops an import demand curve for the importing country and an export supply curve for the exporting country, it is possible to estimate the gross effects of a change in the tariff. This investigative tool is not able to provide the detailed information which is desired and therefore another technique is employed (linear programming).

Three alternative formulations of the basic production and transportation linear program are employed to simulate 1967 and to measure the impacts on various societal groups of different tariff structures. The models use the policy variable of tariff changes as well as the technical production relations and transfer costs. There are three commodities; 1) Mexican vine ripened (MVR), 2) Florida vine ripened (FVR), and 3) Florida mature green (FMG).

All of the models are cost minimizing. Two production regions (Florida and the west coast of Mexico) and fifteen consumption regions, two in Mexico and thirteen in the U.S., are specified. Florida produces two products while Mexico produces only the vine ripened. All of the products can be shipped to the 13 U.S. consumption regions, but only MVR can be shipped to the two Mexican consumption areas. Production for Florida products have both minimum and maximum production restraints. Demand restraints specify the amount of product required for each consumption region. Therefore, the objective function minimized the total wholesale cost of supplying the demand for tomatoes.

The three formulations of the basic program are essentially the same. The basic model (called Model I) is a simulation of the basic year using historical quality differentials between products for the years 1960-1968. The formulation called Model III uses the quality differentials for the base year of 1967. The quality differential is an additional cost (either positive or negative) entered into the objective function to reflect differences in quality among products. In both formulations Mexican Vine Ripe is used as the base. In Model I it is assumed that there is no quality differential between Mexican vine ripe and Florida vine ripe and that an \$.80/20 pound carton differential exists between vine ripened tomatoes and mature green tomatoes. In Model III, the quality differential for Florida mature green was reduced to \$.60 per 20 pound carton; also, the observed quality difference for 1967 between Mexican and Florida vine ripes of \$0.268 per carton is entered in the objective function. As a result, FMG has 60 cents added to its value in the objective function while FVR has 28.6 cents subtracted from its value in the objective function.

Model II is identical to Model I except that capital for Mexico and labor for Florida are made flexible in the amount available. This allows these two resources to be purchased if necessary. The initial pools of resource are available at the same cost used in Model I but additional units of the resource above the predetermined levels used in Model I command higher prices.

After the simulation of the base period and the estimation for this year of the situation if the tariff structure had been different, projections are made. This involved estimating growth of demand in both countries, changes in production costs, and differences in various restraints by 1977. The growth in demand is based on expected population and income growth and the income elasticity of demand for tomatoes. Production cost changes are limited to increases in labor costs which is based on historical data. Changes in the restraints included a lowering of the minimum production restraint for Florida vine ripes and the increase in the number of dollars of capital and labor available.

Simulation Results

Of the three linear programming formulations employed only the model using actual 1967 quality differentials (Model III) gives results which are close to the actual. Under Models I and II, the production of Florida Vine Ripes are estimated to always be at the minimum level. The result is that the total Florida production under these two formulations deviates from actual by about 35%.

In contrast, by using the 1967 quality differentials the simulated production of the base period is quite close to the actual production. In total the estimates deviate by only about 2% from the 1967 figures. Therefore, this formulation is the one chosen to make judgements on the impact of tariff changes in the base year. The range of relevant tariff policies for 1967 does not include a 200% tariff level since at this level Mexico will no longer ship to the U.S. market. This means that Florida supplies the entire American market.

Production under this model ranges from 74.5 to 34.2 million cartons for Mexico depending on the level of tariff. Alternatively, production in Florida ranged from 28.4 to 44.7 million cartons. In comparison with Model I, FVR is at the minimum production level only for a zero tariff.

The potential impacts of various groups of alternative tariff structures is discussed in Chapter VI. Therefore, only the highlights will be covered here. It is estimated that a 50% tariff would have resulted in U.S. production interests losing 798.8 thousand dollars. The majority of the loss ($441.6 thousand) is in the form of lower profits to producers. Conversely, a 50% tariff would have caused Mexican production factors to gain $3,161,600, 40% of which would have accrued to labor.

Lowering the tariff to zero would have had severe impacts on Florida producers. It is estimated that U.S. production losses would have been $15.3 million as opposed to only $12.6 million in gains for Mexican production factors.

Raising the tariff to 150% of the actual 1967 level would have caused a $3.96 million decrease in returns to Mexican production factors and a $3.02 million increase in U.S. producer returns. If changes in government revenue are included, the net U.S. production and government figure is $1.003 million dollars. This figure reflects the decrease in government tax collections due to lower levels of imports.

The pattern of trade reflects the pattern of production; under lower tariffs Mexico supplies most of the regions, while with higher tariff levels Florida supplies more. The shift in the trade pattern amount to the Mexican product replacing Florida product or vice versa. There is no shift between the two Florida products.

In summary, this model indicated that for tariffs 50 percent on either side of the status quo that the changes in production, trade, and resource use are found primarily in Mexico. However, reduction of the tariff to zero would cause a large reduction in Florida's production, trade and resource use.

Projections Results

The projection results are the opposite of the simulation results in terms of the relevant model. Model III which is a good simulator of 1967 provides inconsistent results for the projection period indicating that Florida would be better off with a 100% tariff than with a higher tariff. This LP formulation is also considered to be unrealistic since it continues the 1967 structure of quality differentials. This assumption conflicts with the historical evidence which indicates that the difference between the two vine ripened is narrowing yearly.

In contrast to the inconsistent results of Model III, the results from the formulation which used historical differentials (Model I) are consistent and revealing. This model estimates that for 1977 no matter what the tariff level is up to 200% that Mexican production will exceed the actual 1967 Mexican production shipped to the U.S. market. The range of increase is from 2.4 million cartons with a 200% tariff to 49.3 million cartons with a zero tariff. Some of this projected increased production is allocated to fill increases in demand for regions previously supplied by Mexico. However, for every tariff level Mexico supplies some regions over and above the ones it supplies under the 1967 simulation.

In contrast to rising Mexican production, total Florida production is estimated to be less for all tariff levels than the actual production for 1967. FVR falls to its minimum production restraint of 2.5 million cartons, while FMG production ranged between 8.5 and 35.9 million cartons. In fact, Florida mature green production is estimated to exceed 1967 actual production levels for every tariff level investigated of 50% or above. For this reason, the Florida picture is somewhat confused. It appears that no matter what tariff policy is imposed that Florida vine ripes cannot compete; the same is not true for the mature greens. This fact does have some serious policy conclusions which will be discussed later.

Trade patterns also reflect the increased importance of Mexico. Mexico supplies between 1 and 5 additional regions in 1977, depending on the tariff level. Florida, conversely, loses the same number of regions. The most important factor is that FVR tomatoes are shipped only to region 2, and even then this product only supplies a part of the total quantity demanded.

The impact on the various groups under the different policies is quite revealing. Mexican resources all gain. Land use rises by between 1.1 and 22.5 thousand acres. Similarly, Mexican labor is employed 2.1 to 42.8 million more hours in 1977 than in 1967. Capital use grows by 1.2 to 25.5 million dollars. These gains are for the increase in production and trade caused by the tariff policy and are net of gains in demand for regions originally supplied by Mexico. Alternatively, with lower total production in Florida and shift in production to mature greens, the only resource which gains is land use. The other resources all have lower levels of utilization.

If the status quo tariff (i.e. the 1967 level) in 1977 is used as a base, then the Florida producing interests gain between $2,305,100 and $7,743,200 with a 150% and a 200% tariff respectively; the losses to Mexican producers for these same levels are $10 and $18.6 million. On the other hand, a 50% tariff results in a 8.7 million dollar gain for Mexican production interests and only a 2.1 million dollar loss for Florida producers. Further reduction in the tariff brings larger gains to Mexico, $24.4 million, but also imposes a much high level of losses on Florida (i.e. $15.9 million) as well as the estimated 14.3 million dollar loss in government revenue.

The benefits and losses to U.S. consumers are harder to measure from the data gained in this investigation. It is possible to say that lower tariffs will benefit consumers by lowering their price, while higher tariffs will raise the price. The proxies for changes in consumers position developed in the study indicates a substantial movement in average cost of tomatoes dependent on the tariff policy employed. The price of tomatoes would fall by between $0.12 and $0.25 per carton for the lower tariffs and rise by between $0.20 and $0.27 per carton for higher tariffs.

The Comparison of LP Results With Results of Partial Equilibrium Analysis

The results of the linear programming analysis provides additional information not available from the partial analysis. The partial analysis provides information as to the amount traded, the amount supplied by each country as well as imports and exports under the different tariff levels. These are all gross concepts. There is no information as to levels of resource use or as to the pattern of interregional trade. This model is also unable to handle multiple products. It assumes that there is one completely homogeneous product. However, this study had in fact two products which are only close substitutes. In general, then, the partial equilibrium analysis gives the gross results of any given tariff structure. Further, this analysis provides only the gross changes arising from changes in the tariff level.

The major advantage of linear programming over the partial equilibrium approach is the more detailed information which this technique provides. As well as the information available from partial equilibrium, LP provides information as to the level of resource use, the composition of production in the area which produces the two products and the pattern of trade. The LP technique allows for investigation of trade among more than two regions. Therefore, it is no longer necessary to treat the two countries as two units; rather it is possible to divide the countries into several regions. This allows for more detailed investigation of the trade pattern.

Policy Recommendations

It appears from this study as well as others (22) that Florida will have a difficult time in the future raising vine ripe tomatoes that are competitive with either Florida mature greens or with Mexican vine ripes. This conclusion is irrespective of the tariff policy which is assumed. Therefore, from a policy standpoint it may make a good deal more sense to talk about constructing a policy program which will not injure either Mexico or the Florida mature green producers.

The reduction of the tariff to zero would cost Florida production interests an estimated $25.9 million. By comparison a reduction in tariff to 50% is estimated to cost Florida production interests only $2.0 million. Of course, the benefits to Mexico would be less with only a 50% reduction in the tariff.

Further reducing the 1977 tariff to 50% of the 1967 level is expected to allow Florida mature green production in 1977 to exceed the amount produced in the base year. In contrast, with a zero tariff in 1977, mature green production is estimated to be only 1/3 of the base year production.

Since it appears that not much can be done to maintain production of vine ripe tomatoes in Florida, it is suggested that policy emphasis shift to helping the mature green and compensating productive resources for losses incurred by tariff charges.

Conclusions

1. The impact of lower tariffs in 1967 on Mexico would have outweighed the losses to Florida. The reduction of tariffs to zero would have increased Mexican shipments by 26.4 million cartons while only reducing Florida's production by 14.2 million cartons. The net increase would have been 12.1 million cartons for consumption in the U.S.

2. Increasing the tariff rate for 1967 would not have benefited Florida by very much. An increase to 150% would

increase Florida's production by only 11.7%. Further raising the tariff would eliminate Mexico at some level of tariff between 150% and 200%.

3. In general, tariff changes will affect the Mexican producers more than they will affect the U.S. consumers. It is expected that 2/3 of any tariff drop will go to Mexican producers as higher prices while the remaining 1/3 will go to U.S. consumers.

4. Florida vine ripened tomatoes will suffer a complete collapse of its competitive position by 1977 with or without a tariff unless there is some sort of technological advance that is not obvious at present. The conditions in the labor market, both price and quantity, will continue to erode the ability of this product to compete.

5. Mexico appears certain to expand its shipments to the U.S. through 1977. It is expected that the superiority of the vine ripe product will continue. Therefore, with the demise of the FVR, the MVR can be expected to rise. Also, the rising cost of labor in Florida will hurt the competitive position of even Florida mature greens.

6. On the basis of the information obtained from this study, it appears that it might be wise for Florida producers to shift their emphasis to protecting the product in which they will most likely be able to compete (i.e. the mature green) rather than the product that seems sure to be priced out of the market (vine ripe).

7. In conjunction with the above conclusion, it is a further conclusion that the apparent relevant policy position of the U.S. government is to lower the tariff to one half the 1967 level and perhaps compensate the Florida vine ripe growers on a one shot basis.

8. In general, it appears that Florida may be faced in the future with increasing competition from Mexico in the entire range of winter fruits and vegetables. The rapidly rising labor costs in Florida could affect other products in a manner similar to that seen for tomatoes. Further research should be done to see if in fact this is the case.

Further Research

The opportunities for further research are many and quite diverse. One area of research would be to see if the analysis developed in this study is applicable to other products.

In general, it appears that Florida may be faced in the future with increasing competition from Mexico in the entire range of winter fruits and vegetables. The rapidly rising labor costs in Florida could affect other products in a manner similar to that seen for tomatoes. Further research could be done to see if in fact this is the case.

Another potential area of research would be to run extensive sensitivity analysis on various coefficients used in the study. The two most obvious coefficients to test would be the quality differentials and the estimated labor costs in Florida for 1977.

A third area of investigation would be the question of developing more adequate transportation data. The results of trade studies depend in large measure on the transportation cost data available. For the most part, transfer cost data is unavailable or unreliable. This provides an opportunity to introduce rather severe levels of error.

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STATISTICAL APPENDIX

Appendix Table 1. Input Costs for Model I and III (1967 and 1977)

1967	Production Mexican Vine Ripened	Production Florida Vine Ripened	Production Florida Mature Green
Land Mexico	.014		
Labor Mexico	.286		
Capital Mexico	.620		
Land Florida		.015	.054
Labor Florida		1.042	.336
Capital Florida		1.074	.916
1977			
Land Mexico	.014		
Labor Mexico	.527		
Capital Mexico	.620		
Land Florida		.015	.054
Labor Florida 1		2.05	.661
Labor Florida 2		2.58	.833
Capital Florida		1.074	.916

Note: Labor Florida 1 applies to where the tariff is 100%.

Labor Florida 2 applies for tariffs at 150% and 200%.

Appendix Table 2. Input Costs[1] for Model II (1967)
(unit use/20# carton)

	Production Mexico Vine Ripened	Production Florida Vine Ripened	Production Florida Mature Green	Capital Costs .09	Capital Costs .12	Labor Costs 1.25	Labor Costs 1.30
	.864						
Land Mexico	.014						
Labor Mexico	.286						
Capital Mexico	.620						
Land Florida		.015	.054				
Labor Florida		.8336	.2688				
Capital Florida		1.074	.916				

[1]All in costs in terms of dollars except for labor in Florida which is in physical units.

Appendix Table 3. Transfer Costs (per 20# carton)[2]
(Transportation + handling + tariffs)

Product Destination	Mexican Vine Ripened	Florida Vine Ripened	Florida Mature Green
1	0.00		
2	1.927	0.000	0.000
3	.415		
4	1.695	.884	.830
5	1.412	.799	.750
6	1.369	.671	.630
7	1.407	.476	.429
8	1.424	.539	.506
9	1.608	.644	.583
10	1.623	.296	.263
11	1.632	.500	.451
12	1.637	.389	.350
13	1.719	.503	.453
14	1.899	.372	.330
15	1.952	.450	.399

[2]The cost to move a 20 pound carton of a given product from the point of production to the regional consumption center.

Appendix Table 4. Model I, II, and III Transfer Costs for Mexico Under Alternative Tariff Levels (per 20# carton)[3]

	0%	50%	150%	200%
1	0	0	0	0
2	1.534	1.731	2.123	2.320
3	.415	.415	.415	.415
4	1.302	1.499	1.891	2.088
5	1.019	1.216	1.608	1.805
6	.976	1.173	1.565	1.762
7	1.014	1.211	1.603	1.800
8	1.031	1.228	1.620	1.817
9	1.215	1.412	1.804	2.001
10	1.230	1.427	1.819	2.016
11	1.239	1.436	1.828	2.025
12	1.244	1.441	1.833	2.030
13	1.326	1.523	1.915	2.112
14	1.506	1.703	2.095	2.292
15	1.559	1.756	2.148	2.345

[3]Same explanation as previous table.

Appendix Table 5. Derivation of Transportation Charges[4] For U.S. Consumption Regions

Route	Distance	Cost/Carton	Cents/Mile 20# Carton
Nogales - N.Y.	2612	.93	.0356
Nogales - Chicago	1907	.61	.0320
Nogales - San Francisco	966	.39	.0404
Vine Ripened			
Miami - New York	1336	.45	.0337
Miami - Chicago	1374	.50	.0364
Miami - San Francisco	3072	.80	.0260
Mature Green			
Miami - New York	1336	.40	.0299
Miami - Chicago	1374	.45	.0328
Miami - San Francisco	3072	.75	.0244

[4]The calculation of the transportation charge is made by taking the data on transportation costs from (22-p. 113) and divide this cost by the distance from the shipping point to the consumption point. This gives a cost in cents per mile per carton.

Appendix Table 6. Transport Cost as Derived from Table 5[5]

Region	Cost Mexican Vine Ripe	Cost Florida Vine Ripe	Cost Florida Mature Green
2	.895	0	0
10	.601	.296	.263
14	.877	.372	.330
15	.930	.450	.399
7	.385	.476	.429
9	.586	.644	.583
11	.610	.500	.451
12	.615	.389	.350
13	.697	.503	.453
4	.673	.884	.830
5	.390	.799	.750
6	.347	.671	.630
8	.402	.539	.506

[5]The consumption regions in the U.S. are placed into three geographic groups. The first four regions use the average cost calculated for New York in the previous table. The second five use Chicago's average cost and the last four use the San Francisco. The actual numbers are achieved by multiplying the appropriate average transport cost by the distance from the consumption point to the shipping point.

Appendix Table 7. Costs of Production With Fresh Winter Produce

Mexico for export Culiacan, Sinaloa (per 20# carton)		
Labor	**Capital**	**Land**
Production .064 (p. 84)	.227	.014
Harvesting .135 (p. 107)	.042	
Packing .087 (p. 107)	.351	
.285	.620	.014
Florida (Mature-green)		
Labor	**Capital**	**Land**
Production .038 (p. 82)	.534	.054
Harvesting .175 (p. 107)	.100	
Packing .122 (p. 107)	.282	
.335	.916	.054
Florida (vine-ripened)		
Labor	**Capital**	**Land**
Production .326	.502	.015
Harvesting .377	.095	
Packing .339	.477	
1.042	1.074	.015

Source: Supplying U.S. Markets

Appendix Table 8. Costs of Production, Harvesting, Packing, and Selling f.o.b.

	Vine ripe 20 lb. (lug) South Florida	NW Mexico (Nogalas)	Mature-green lug 40 lb. Florida
Preharvest cost	.84	.31	1.25
Other	1.288	1.637	1.36
	2.128	1.947	2.61
Transportation:	Vine ripened		
	N.Y.	Chicago	S.F.
Florida	.45	.50	.80
Nogalas	.93	.61	.39
	mature green		
Florida (40 lb.)	.80	.90	1.50
	Costs for vine ripened and matures at points		
	N.Y.	Chicago	S.F.
Florida	2.58	2.63	2.93
Nagalas	2.88	2.56	2.34
Florida	3.21	3.51	4.11

Source: Supplying U.S. Markets with Fresh Winter Produce, AER #154.

Appendix Table 9. Quantity of Tomatoes Demanded in Each Region for Each Tariff (1967) (in thousands of 20 pound cartons)[6]

Tariff			1967		
Region	0%	50%	100%	150%	200%
1	$2.32x10^6$	$2.32x10^6$	$2.32x10^6$	$2.32x10^6$	$2.32x10^6$
2	$5.77x10^6$	$5.27x10^6$	$4.76x10^6$	$4.25x10^6$	$3.75x10^6$
3	$3.19x10^7$	$3.19x10^7$	$3.19x10^7$	$3.19x10^7$	$3.19x10^7$
4	$2.04x10^6$	$1.86x10^6$	$1.68x10^6$	$1.50x10^6$	$1.32x10^6$
5	$7.25x10^6$	$6.62x10^6$	$5.98x10^6$	$5.33x10^6$	$4.71x10^6$
6	$6.93x10^5$	$6.34x10^5$	$5.72x10^5$	$5.10x10^5$	$4.51x10^5$
7	$4.92x10^6$	$4.50x10^6$	$4.06x10^6$	$3.62x10^6$	$3.20x10^6$
8	$1.96x10^6$	$1.79x10^6$	$1.62x10^6$	$1.45x10^6$	$1.28x10^6$
9	$2.61x10^6$	$2.38x10^6$	$2.15x10^6$	$1.92x10^6$	$1.69x10^6$
10	$2.74x10^6$	$2.50x10^6$	$2.26x10^6$	$2.02x10^6$	$1.78x10^6$
11	$8.45x10^6$	$7.72x10^6$	$6.97x10^6$	$6.22x10^6$	$5.49x10^6$
12	$3.06x10^6$	$2.79x10^6$	$2.52x10^6$	$2.25x10^6$	$1.98x10^6$
13	$6.56x10^6$	$5.99x10^6$	$5.41x10^6$	$4.83x10^6$	$4.26x10^6$
14	$1.022x10^7$	$9.34x10^6$	$8.43x10^6$	$7.52x10^6$	$6.64x10^6$
15	$1.243x10^7$	$1.136x10^7$	$1.025x10^7$	$9.14x10^6$	$8.07x10^6$

[6]For example, this table says that with a zero tariff level the quantity demanded in region 2 would be $5.77x10^6$ or 5,770,000 million 20 pound cartons.

Appendix Table 10. Quantity of Tomatoes Demanded in Each Region for Each Tariff Level (1977) (in thousands of 20 pound cartons)

Tariff	1977				
Region	0%	50%	100%	150%	200%
1	$3.245x10^6$	$3.245x10^6$	$3.245x10^6$	$3.245x10^6$	$3.245x10^6$
2	$7.38x10^6$	$6.74x10^6$	$6.09x10^6$	$5.43x10^6$	$4.79x10^6$
3	$5.46x10^7$	$5.46x10^6$	$5.46x10^7$	$5.46x10^7$	$5.46x10^7$
4	$2.39x10^6$	$2.18x10^6$	$1.97x10^6$	$1.76x10^6$	$1.55x10^6$
5	$1.019x10^6$	$9.30x10^6$	$8.40x10^6$	$7.49x10^6$	$6.62x10^6$
6	$8.81x10^5$	$8.04x10^5$	$7.27x10^5$	$6.48x10^5$	$5.72x10^5$
7	$6.19x10^6$	$5.66x10^6$	$5.91x10^6$	$4.56x10^6$	$4.03x10^6$
8	$2.38x10^6$	$2.17x10^6$	$1.96x10^6$	$1.75x10^6$	$1.54x10^6$
9	$3.06x10^6$	$2.80x10^6$	$2.53x10^6$	$2.25x10^6$	$1.99x10^6$
10	$3.37x10^6$	$3.08x10^6$	$2.78x10^6$	$2.48x10^6$	$2.19x10^6$
11	$1.01x10^7$	$9.23x10^6$	$8.34x10^6$	$7.43x10^6$	$6.57x10^6$
12	$3.60x10^6$	$3.29x10^6$	$2.97x10^6$	$2.65x10^6$	$2.34x10^6$
13	$7.85x10^6$	$7.07x10^6$	$6.48x10^6$	$5.77x10^6$	$5.10x10^6$
14	$1.13x10^7$	$1.033x10^7$	$9.33x10^6$	$8.32x10^6$	$7.35x10^6$
15	$1.56x10^7$	$1.42x10^7$	$1.28x10^7$	$1.14x10^7$	$1.01x10^7$

Appendix Table 11. Resource Availability for Tomato Production[7]

	Model I & III (1967)	Model II (1967)	Model I & III (1977) 0%-100%	150%-200%
Mexico				
Land	$2,591x10^6$	$2,591x10^6$	$2,591x10^6$	$2,591x10^6$
Labor	$1.0x.10^8$	$1.0x10^8$	$1.50x10^8$	$1.50x10^8$
$Capital_1$	$5.0x10^7$	$5.0x.0^7$	$7.5x10^7$	$7.50x10^7$
$Capital_2$		$3.0x10^7$		
Florida				
Land	$3.5x10^6$	$3.5x10^6$	$3.5x10^6$	$3.5x10^6$
$Labor_1$	$3.4x10^7$	$3.4x10^7$	$5.78x10^7$	$7.69x10^7$
$Labor_2$		$1.6x10^7$		
Capital	$7.0x10^7$	$7.0x10^7$	$8.75x10^7$	$8.75x10^7$

ALL RESTRAINTS ARE IN U.S. DOLLARS

[7]These restraints are the result of multiplying the physical units available times the value of one unit of that resource. For example, in Model I & III for 1967 $50 million dollars of capital is available for tomato production.

Appendix Table 12. Production Restraints
(in millions of 20# cartons)

	Model I & III 1967	Model I 1977	Model II 1967
Minimum			
Mexico - Vine Ripe	0	0	0
Florida - Vine Ripe	10.0	2.5	10.0
Florida - Mature Green	10.0	5.0	10.0
Maximum			
Mexico - Vine Ripe	----	----	----
Florida - Vine Ripe	$2.5X10^7$ 25.0	25.0	25.0
Florida - Mature Green	$3.5X10^7$ 35.0	50.0	35.0

Blank space means no restraint

Appendix Table 13. Resource Use and Level of Transfer in Model I (1967)[8]

Tariff	0	50%	100%	150%	200%
Cost	197,467,574	191,689,032	182,878,398	170,758,040	157,327,402
Land in Mexico	1.03×10^{6}	9.94×10^{5}	8.02×10^{5}	6.53×10^{5}	5.51×10^{5}
Labor in Mexico	2.31×10^{7}	2.03×10^{7}	1.64×10^{7}	1.33×10^{7}	1.13×10^{7}
Capital in Mexico	5.0×10^{7}	4.40×10^{7}	3.6×10^{7}	2.88×10^{7}	2.44×10^{7}
Land in Florida	8.13×10^{5}	1.01×10^{6}	1.43×10^{6}	1.67×10^{6}	1.84×10^{6}
Labor in Florida	1.46×10^{7}	1.58×10^{7}	1.84×10^{7}	1.99×10^{7}	2.03×10^{7}
Capital in Florida	2.20×10^{7}	2.54×10^{7}	3.24×10^{7}	3.65×10^{7}	3.77×10^{7}
Production Mexico VR	8.06×10^{7}	7.10×10^{7}	5.72×10^{7}	4.66×10^{7}	3.94×10^{7}
Production Florida VR	1.0×10^{7}	1.0×10^{7}	1.0×10^{7}	1.0×10^{7}	1.0×10^{7}
Production Florida MG	1.23×10^{7}	1.60×10^{7}	2.36×10^{7}	2.82×10^{7}	2.95×10^{7}
X117	2.32×10^{6}	2.32×10^{6}	2.32×10^{6}	2.32×10^{6}	2.32×10^{6}
X127	0	0	0	0	0
X137	3.19×10^{7}	3.19×10^{7}	3.19×10^{7}	3.19×10^{7}	3.19×10^{7}
X147	2.04×10^{6}	1.86×10^{6}	1.68×10^{6}	1.50×10^{6}	0
X157	7.25×10^{6}	6.62×10^{6}	5.98×10^{6}	5.33×10^{6}	4.71×10^{6}
X167	6.93×10^{5}	6.34×10^{5}	5.72×10^{5}	5.10×10^{5}	4.51×10^{5}
X177	4.92×10^{6}	4.50×10^{6}	4.06×10^{6}	3.62×10^{6}	0
X187	1.96×10^{6}	1.79×10^{6}	1.62×10^{6}	1.45×10^{6}	0
X197	2.61×10^{6}	2.38×10^{6}	2.15×10^{6}	0	0
X110	2.74×10^{6}	2.50×10^{6}	0	0	0
X1117	8.45×10^{6}	7.72×10^{6}	6.97×10^{6}	0	0
X1127	3.06×10^{6}	2.79×10^{6}	0	0	0
X1137	6.56×10^{6}	5.99×10^{6}	0	0	0
X1147	0	0	0	0	0
X1157	6.14×10^{6}	0	0	0	0
X227	5.77×10^{6}	5.27×10^{6}	4.76×10^{6}	4.25×10^{6}	3.75×10^{6}
X247	0	0	0	0	0

(Appendix Table 13 con't)

Tariff	0	50%	100%	150%	200%
X257	0	0	0	0	0
X267	0	0	0	0	0
X277	0	0	0	0	0
X287	0	0	0	0	$1.28x10^6$
X297	0	0	0	$1.92x10^6$	$1.69x10^6$
X2107	0	0	$2.26x10^6$	$2.02x10^6$	$1.78x10^6$
X2117	0	0	0	0	0
X2127	0	0	$2.52x10^6$	$1.81x10^6$	$1.5x10^6$
X2137	0	0	0	0	0
X2147	$4.23x10^6$	$4.73x10^6$	$4.60x10^6$	0	0
X2157	0	0	0	0	0
X228	0	0	0	0	0
X248	0	0	0	0	$1.32x10^6$
X258	0	0	0	0	0
X268	0	0	0	0	0
X278	0	0	0	0	$3.2x10^6$
X288	0	0	0	0	0
X298	0	0	0	0	0
X2108	0	0	0	0	0
X2118	0	0	0	$6.22x10^6$	$5.49x10^6$
X2128	0	0	0	$4.40x10^5$	$4.8x10^5$
X2138	0	0	$5.41x10^6$	$4.83x10^6$	$4.26x10^6$
X2148	$5.99x10^6$	$4.61x10^6$	$7.97x10^6$	$7.52x10^6$	$6.64x10^6$
X2158	$6.29x10^6$	$1.14x10^7$	$1.025x10^7$	$9.14x10^6$	$8.07x10^6$

[8]Cost and the resource uses are in U.S. dollars while production and transfer activities are in 20 pound cartons.

Appendix Table 14. Resource Use and Level of Transfer in Model I 1977[10]

Tariff	0%	50%	100%	150%	200%
Cost	-2.71766321	-2.91937981	-2.82399031	-2.72015833	-2.54799261
Land in Mexico	$1.694x10^6$	$1.449x10^6$	$1.318x10^6$	$1.172x10^6$	$1.038x10^6$
Labor in Mexico	$6.370x10^7$	$5.436x10^7$	$4.960x10^7$	$4.410x10^7$	$3.910x10^7$
Capital in Mexico	$7.500x10^7$	$6.419x10^7$	$5.838x10^7$	$5.192x10^7$	$4.597x10^7$
Land in Florida	$4.960x10^5$	$1.589x10^6$	$1.737x10^6$	$1.849x10^6$	$1.978x10^6$
Labor in Florida	$1.074x10^7$	$2.412x10^7$	$2.592x10^7$	$3.438x10^7$	$3.637x10^7$
Capital in Florida	$1.047x10^7$	$2.901x10^7$	$3.151x10^7$	$3.342x10^7$	$3.561x10^7$
Production Mexico VR	$1.210x10^8$	$1.035x10^8$	$9.416x10^7$	$8.373x10^7$	$7.415x10^7$
Production Florida VR	$2.500x10^6$	$2.500x10^6$	$2.500x10^6$	$2.500x10^6$	$2.500x10^6$
Production Florida MG	$8.498x10^6$	$2.874x10^7$	$3.147x10^7$	$3.355x10^7$	$3.594x10^7$
X117	$3.245x10^6$	$3.245x10^6$	$3.245x10^6$	$3.245x10^6$	$3.245x10^6$
X127	0	0	0	0	0
X137	$5.460x10^7$	$5.460x10^7$	$5.460x10^7$	$5.460x10^7$	$5.460x10^7$
X147	$2.390x10^6$	$2.180x10^6$	$1.970x10^6$	$1.760x10^6$	$1.550x10^6$
X157	$1.019x10^7$	$9.300x10^6$	$8.400x10^6$	$7.490x10^6$	$6.620x10^6$
X167	$8.810x10^5$	$8.040x10^5$	$7.270x10^5$	$6.480x10^5$	$5.720x10^5$
X177	$6.190x10^6$	$5.660x10^6$	$5.910x10^6$	$4.560x10^6$	$4.030x10^6$
X187	$2.380x10^6$	$2.170x10^6$	$1.960x10^6$	$1.750x10^6$	$1.540x10^6$
X197	$3.060x10^6$	$2.800x10^6$	$2.530x10^6$	$2.250x10^6$	$1.990x10^6$
X1107	$3.370x10^6$	$3.080x10^6$	0	0	0
X1117	$1.010x10^7$	$9.230x10^6$	$8.340x10^6$	$7.430x10^6$	0
X1127	$3.600x10^6$	$3.290x10^6$	0	0	0
X1137	$7.850x10^6$	$7.170x10^6$	$6.480x10^6$	0	0
X1147	0	0	0	0	0
X1157	$1.311x10^7$	0	0	0	0
X227	$2.500x10^6$	$2.500x10^6$	$2.500x10^6$	$2.500x10^6$	$2.500x10^6$
X247	0	0	0	0	0
X257	0	0	0	0	0
X267	0	0	0	0	0
X277	0	0	0	0	0

(Appendix Table 14 con't)

Tariff	0%	50%	100%	150%	200%
X287	0	0	0	0	0
X297	0	0	0	0	0
X2107	0	0	0	0	0
X2117	0	0	0	0	0
X2127	0	0	0	0	0
X2137	0	0	0	0	0
X2147	0	0	0	0	0
X2157	0	0	0	0	0
X228	$4.880x10^6$	$4.240x10^6$	$3.586x10^6$	$2.930x10^6$	$2.290x10^6$
X248	0	0	0	0	0
X258	0	0	0	0	0
X268	0	0	0	0	0
X278	0	0	0	0	0
X288	0	0	0	0	0
X298	0	0	0	0	0
X2108	0	0	$2.780x10^6$	$2.480x10^6$	$2.190x10^6$
X2118	0	0	0	0	$6.570x10^6$
X2128	0	0	$2.970x10^6$	$2.650x10^6$	$2.340x10^6$
X2138	0	0	0	$5.770x10^6$	$5.100x10^6$
X2148	$1.130x10^6$	$1.030x10^7$	$9.330x10^6$	$8.320x10^6$	$7.350x10^6$
X2158	$2.488x10^6$	$1.420x10^7$	$1.280x10^7$	$1.140x10^7$	$1.010x10^7$

[10]Results of resource use are in U.S. dollars while production and transfer activities are in 20 pound cartons.

Appendix Table 15. Resource Use and Level of Transfer in Model III 1967[11]

Tariff	0%	50%	100%	150%	200%
Cost	-1.91257128	-1.84531772	-1.73929978	-1.6144999	-1.4836776
Land in Mexico	$1.043x10^6$	$7.68x10^5$	$6.740x10^5$	$5.610x10^5$	$4.79x10^5$
Labor in Mexico	$2.130x10^7$	$1.570x10^7$	$1.380x10^7$	$1.150x10^7$	$9.800x10^6$
Capital in Mexico	$4.619x10^7$	$3.402x10^7$	$2.984x10^7$	$2.484x10^7$	$2.122x10^7$
Land in Florida	$1.145x10^6$	$1.497x10^6$	$1.524x10^6$	$1.646x10^6$	$1.644x10^6$
Labor in Florida	$1.761x10^7$	$2.820x10^7$	$2.857x10^7$	$2.895x10^7$	$2.885x10^7$
Capital in Florida	$2.761x10^7$	$4.171x10^7$	$4.234x10^7$	$4.408x10^7$	$4.397x10^7$
PF 17	$7.450x10^7$	$5.486x10^7$	$4.813x10^7$	$4.006x10^7$	$3.422x10^7$
PF 27	$1.000x10^7$	$1.990x10^7$	$2.012x10^7$	$1.972x10^7$	$1.962x10^7$
PF 28	$1.842x10^7$	$2.221x10^7$	$2.263x10^7$	$2.500x10^7$	$2.500x10^7$
X117	$2.320x10^6$	$2.320x10^6$	$2.320x10^6$	$2.320x10^6$	$2.320x10^6$
X127	0	0	0	0	0
X137	$3.190x10^7$	$3.190x10^7$	$3.190x10^7$	$3.190x10^7$	$3.190x10^7$
X147	$2.040x10^6$	$1.860x10^6$	$1.680x10^6$	0	0
X157	$7.250x10^6$	$6.620x10^6$	$5.980x10^6$	$5.330x10^6$	0
X167	$6.930x10^5$	$6.340x10^5$	$5.720x10^5$	$5.100x10^5$	0
X177	$4.920x10^6$	$4.500x10^6$	$4.060x10^6$	0	0
X187	$1.960x10^6$	$1.790x10^6$	$1.620x10^6$	0	0
X197	$2.610x10^6$	$2.380x10^6$	0	0	0
X1107	$2.740x10^6$	0	0	0	0
X1117	$8.450x10^6$	$3.86x10^6$	0	0	0
X1127	$3.060x10^6$	0	0	0	0
X1137	$6.560x10^6$	0	0	0	0
X1147	0	0	0	0	0
X1157	0	0	0	0	0
X227	$5.770x10^6$	$5.270x10^6$	$4.760x10^6$	$4.250x10^6$	$3.750x10^6$
X247	0	0	0	0	0
X257	0	0	0	0	0

(Appendix Table 15 con't)

Tariff	0%	50%	100%	150%	200%
X267	0	0	0	0	$4.510x10^5$
X277	0	0	0	$3.100x10^5$	$2.050x10^6$
X287	0	0	0	$1.450x10^6$	$1.280x10^6$
X297	0	0	$2.150x10^6$	$1.920x10^6$	$1.690x10^6$
X2107	0	$2.500x10^6$	$2.260x10^6$	$2.020x10^6$	$1.780x10^6$
X2117	0	0	0	0	0
X2127	0	$2.790x10^6$	$2.520x10^6$	$2.250x10^6$	$1.980x10^6$
X2137	0	0	0	0	0
X2147	$4.230x10^6$	$9.340x10^6$	$8.430x10^6$	$7.520x10^6$	$6.640x10^6$
X2157	0	0	0	0	0
X228	0	0	0	0	0
X248	0	0	0	$1.500x10^6$	$1.320x10^6$
X258	0	0	0	0	$4.710x10^6$
X268	0	0	0	0	0
X278	0	0	0	$3.310x10^6$	$1.150x10^6$
X288	0	0	0	0	0
X298	0	0	0	0	0
X2108	0	0	0	0	0
X2118	0	$3.860x10^6$	$6.970x10^6$	$6.220x10^6$	$5.490x10^6$
X2128	0	0	0	0	0
X2138	0	$5.990x10^6$	$5.410x10^6$	$4.830x10^6$	$4.260x10^6$
X2148	$5.990x10^6$	0	0	0	0
X2158	$1.243x10^7$	$1.136x10^7$	$1.025x10^7$	$9.140x10^6$	$8.070x10^6$

[11] Same as 10.

Appendix Table 16. Resource Use and Level of Transfer in Model III 1977

	0%	50%	100%	150%	200%
Cost	294,261,982	285,161,371	273,240,011	263,632,783	245,940,091
Land in Mexico	$1.51x10^6$	$1.26x10^6$	$1.11x10^6$	$1.07x10^6$	$9.11x10^5$
Labor in Mexico	$5.68x10^7$	$4.72x10^7$	$4.18x10^7$	$4.02x10^7$	$3.43x10^7$
Capital in Mexico	$6.69x10^7$	$5.58x10^7$	$4.92x10^7$	$4.73x10^7$	$4.03x10^7$
Land in Florida	$1.75x10^6$	$2.32x10^6$	$2.54x10^6$	$2.25x10^6$	$2.47x10^6$
Labor in Florida	$2.61x10^7$	$3.307x10^7$	$3.57x10^7$	$4.06x10^7$	$4.40x10^7$
Capital in Florida	$3.18x10^7$	$4.14x10^7$	$4.51x10^7$	$4.02x10^7$	$4.40x10^7$
PF 17	$1.08x10^8$	$9.00x10^7$	$7.93x10^7$	$7.63x10^6$	$6.504x10^7$
PF 27	$2.50x10^6$	$2.50x10^6$	$2.50x10^6$	$2.50x10^6$	$2.50x10^6$
PF 28	$3.18x10^7$	$4.23x10^7$	$4.61x10^7$	$4.10x10^7$	$4.505x10^7$
X117	$3.245x10^6$	$3.245x10^6$	$3.245x10^6$	$3.245x10^6$	$3.245x10^6$
X127	0	0	0	0	0
X137	$5.46x10^7$	$5.46x10^7$	$5.46x10^7$	$5.46x10^7$	$5.46x10^7$
X147	$2.39x10^6$	$2.18x10^6$	$1.97x10^6$	$1.76x10^6$	0
X157	$1.019x10^7$	$9.30x10^6$	$8.40x10^6$	$7.49x10^6$	$6.62x10^6$
X167	$8.81x10^5$	$8.04x10^5$	$7.27x10^5$	$6.48x10^5$	$5.72x10^6$
X177	$6.19x10^6$	$5.66x10^6$	$5.91x10^6$	$4.56x10^6$	0
X187	$2.38x10^6$	$2.17x10^6$	$1.96x10^6$	$1.75x10^6$	0
X197	$3.06x10^6$	$2.80x10^6$	$2.53x10^6$	$2.25x10^6$	0
X1107	$3.37x10^6$	0	0	0	0
X1117	$1.01x10^7$	$9.23x10^6$	0	0	0
X1127	$3.60x10^6$	0	0	0	0
X1137	$7.85x10^6$	0	0	0	0
X1147	0	0	0	0	0
X1157	0	0	0	0	0
X227	$2.50x10^6$	$2.50x10^6$	$2.50x10^6$	$2.50x10^6$	$5.1x10^5$
X247	0	0	0	0	0

(Appendix Table 16 con't)

	0%	50%	100%	150%	200%
X257	0	0	0	0	0
X267	0	0	0	0	0
X277	0	0	0	0	0
X287	0	0	0	0	0
X297	0	0	0	0	$1.99x10^6$
X2107	0	0	0	0	0
X2117	0	0	0	0	0
X2127	0	0	0	0	0
X2137	0	0	0	0	0
X2147	0	0	0	0	0
X2157	0	0	0	0	0
X228	$4.88x10^6$	$4.24x10^6$	$3.586x10^6$	$2.93x10^6$	$4.28x10^6$
X248	0	0	0	0	$1.55x10^6$
X258	0	0	0	0	0
X268	0	0	0	0	0
X278	0	0	0	0	$4.03x10^6$
X288	0	0	0	0	$1.54x10^6$
X298	0	0	0	0	0
X2108	0	$3.08x10^6$	$2.78x10^6$	$2.48x10^6$	$2.19x10^6$
X2118	0	0	$8.34x10^6$	$7.43x10^6$	$6.57x10^6$
X2128	0	$3.29x10^6$	$2.97x10^6$	$2.65x10^6$	$2.34x10^6$
X2138	0	$7.17x10^6$	$6.48x10^6$	$5.77x10^6$	$5.10x10^6$
X2148	$1.13x10^7$	$1.03x10^7$	$9.33x10^6$	$8.32x10^6$	$7.35x10^6$
X2158	$1.56x10^7$	$1.42x10^7$	$1.28x10^7$	$1.14x10^7$	$1.01x10^7$

Appendix Table 17. Resource Use For the 4 Major Models (Thousands of units)

Model	Tariff	Mexico Land (acres)	Mexico Labor (hours)	Mexico Capital (dollars)	Florida Land (acres)	Florida Labor (hours)	Florida Capital (dollars)
I 1967							
	0	39.8	23,100	50,000	23.2	14,600	22,000
	50	38.4	20,300	44,000	28.8	15,800	25,400
	100	30.9	16,400	36,000	40.8	18,400	32,400
	150	25.2	13,300	28,800	47.7	19,900	36,500
	200	21.3	11,300	24,400	52.6	20,300	37,700
III 1967							
	0	40.2	74,475	46,190	32.7	14,088	27,610
	50	29.6	54,895	34,020	42.8	22,560	41,710
	100	26.1	48,252	29,840	43.5	22,876	42,340
	150	21.6	40,210	24,840	47.0	23,160	44,080
I 1977							
	0	65.4	125,947	75,000	29.9	7,101	19,790
	50	55.9	110,040	64,190	45.4	9,809	29,010
	100	50.9	100,405	58,380	47.6	10,541	31,510
	150	45.2	89,271	51,920	52.8	11,098	33,420
	200	40.0	79,150	45,970	56.5	11,740	35,610
III 1977							
	0	58.3	107,818	66,900	50.0	10,615	31,800
	50	48.6	89,596	55,800	66.3	13,421	41,400
	100	42.8	79,345	49,200	72.6	14,520	45,100
	150	41.3	76,308	47,300	64.3	13,107	40,200
	200	35.2	65,109	40,300	70.6	14,205	44,000