A demand analysis of spring cantaloupes

A DEMAND ANALYSIS OF
SPRING CANTALOUPES

by

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ABSTRACT

Spring cantaloupes for United States markets are produced in Arizona, California, Mexico, and Texas. Arizona is the largest producer of cantaloupes. Melon growers in Arizona are confronted with competition from the other spring producing areas. This separation of markets results in seasonal variation in the timing of production from each area in terms of quantities marketed and farm prices. An overlapping of harvesting periods usually exists between these regions for each season which results in this interregional competition. Canteloupes are highly perishable and can be stored for only very short periods of time. These characteristics of spring cantaloupe production make it particularly advantageous for producers and handlers to be aware of the exact relationship between the quantity of cantaloupes shipped and prices.

Thus, the objective of this thesis was to measure the quantity-price relationship for spring cantaloupes in the United States from which estimates and forecasts could be made. This type study also provides implications for supply control or supply expansion.

The study found the demand for spring cantaloupes to be highly elastic regardless of the source of melon shipments. The major implication is that spring melon production should be expanded in all producing regions in order that total revenue to the industry will be maximized.

CHAPTER I

INTRODUCTION

Problem Identification

The marketing system for cataloupes in the United States, like many specialized agricultural crops, is characterized by a wide geographic separation of producing areas. The areas that produce melons in the spring for United States markets are Mexico, Arizona, California and Texas.

This separation of markets results in seasonal variation in the timing of production from each area in terms of quantities marketed and farm prices. Generally, an overlapping of harvesting periods exists between these regions for each season which results in interregional competition. In addition, cantaloupes are highly perishable and cannot be withheld from the market without spoilage. Therefore, farmers sell practically their entire crop regardless of price, provided the price they receive exceeds the harvest cost. Cantaloupes are bulky in relation to their value. There are no processing outlets for the crop; and supplies for any given year are largely influenced by weather. These factors make cantaloupe production a high risk venture.

The characteristics of cantaloupe production described above would make it particularly advantageous for producers and handlers to be aware of the exact relationship between the quantity of cantaloupes shipped and prices. Thus, the purpose of this thesis will be to conduct an analysis of demand for spring cantaloupes in the United States from which estimates and forecasts of prices and revenue can be made. Waugh (1964) wrote, "that in most practical cases, estimating and forecasting are not aims in themselves. Rather, we need estimates and forecasts in order to accomplish other important purposes . . . such forecasts are intended to give farmers and food trades basic information they need for making profitable adjustments in producing and marketing (p. 2)."

Objectives

This study is primarily concerned with an analysis of demand for Arizona cantaloupes harvested during May and June. Cantaloupes are produced in California, Mexico and Texas during these two months, providing competition for Arizona cantaloupe growers. The importance of this high risk crop to Arizona agriculture and the interrelation if the four spring cantaloupe producing areas provide the basis and background for developing the major objectives of the study. The objectives are:

1) Describe the structure of the cantaloupe industry in the United States and Mexico.

2) Develop an economic model for analyzing the structure of demand for Arizona cantaloupes based on weekly average prices and weekly shipment data.
3) Determine the price elasticity of demand for spring cantaloupes produced in Arizona and other areas for United States markets.
4) Examine the income elasticity of demand for Arizona spring cantaloupes.
5) Compare the findings of this analysis with a recent demand study of California cantaloupes prepared by Boles (1969).

Chapter II is devoted to a descriptive study of the structure of the cantaloupe industry in the United States and Mexico. Discussions of production and packing costs by areas, the development of the industry and statistical comparisons of production are included in this chapter.

Chapter III is concerned with market demand theory which includes discussions on derived demand, excess demand, price and income elasticities of demand. Chapter III also includes a review of the statistical techniques and models used in the analysis.

Chapter IV presents the analysis of demand and a description of the data used in the analysis and the data limitations.

Chapter V summarizes the findings of this study and discusses some of the implications.

CHAPTER II

STRUCTURE OF THE SPRING CANTALOUPE INDUSTRY

The production of cantaloupes on a commercial scale began around 1870. Prior to that, cantaloupes were grown almost exclusively in home gardens. The first commercial cantaloupes were grown in Maryland, Delaware, and New Jersey primarily to supply the New York market. However, the modern melon industry began with the introduction of the Netted Gem variety in 1881 and was grown commercially in Illinois and Colorado. Production expanded in Colorado and Illinois, but this expansion was limited by poor transportation facilities to the major markets.

Seed of the Rocky Ford variety (same as the Netted Gem but renamed Rocky Ford in 1897) was tested in the South and found to produce earlier melons of better quality than the seed from other varieties. This led to the planting of large acreages in the southern states in 1899. Shortly after 1900, the opening of vast tracts of sandy soil under irrigation in Arizona and California and the development of transcontinental refrigeration service speeded up development of the melon industry in the United States. Tests with Rocky Ford cantaloupe seed proved this variety to be particularly adapted to the Imperial Valley; and in 1905, the now famous Imperial Valley cantaloupe industry was started with Rocky Ford seed. Experts from Rocky Ford were invited to organize and supervise the growing of melons in the desert areas. In 1910 irrigation was made available in the Salt River Valley area and the cantaloupe industry was expanded further (Roberts 1959).

Marketing Channels

The typical marketing channel for cantaloupes from grower to consumer may be classified into six mutually exclusive functions. These functions include the following: grower, shipper, broker, wholesaler, retailer, and consumer.

The growing function is performed either by integrated or non-integrated firms. A non-integrated firm is typified by an independent grower selling his output to a shipper. Most growing firms have a "tie-in" with a shipper normally referred to as a joint venture. Under a joint venture contract, the shipping firm usually finances the growing firm. There are many variations among joint venture contracts. Some shipping firms provide risk capital and share in the output, while others may only serve the function of a credit lending institution. The grower returns for a non-integrated firm is a residual after deducting the cost of harvesting, packing, and selling from F.O.B. shipping prices. Most of the spring cantaloupes that move into the marketing system in the United States are controlled by vertically integrated firms which perform both the growing and shipping functions.

The market outlets for cantaloupes after they are packed and ready for shipment are brokers, wholesalers and retailers. Some of the national chain retail grocers such as Safeway, Great Atlantic and Pacific Tea Company and Kroger have buying offices located in the Imperial Valley of California and the Rio Grande Valley of Texas to buy cantaloupes direct from the shipping firms. A portion of the South Texas melon crop is sold directly to a wholesaler or retailer each year. A grower who sells direct will load the cantaloupes into trucks in the bulk form and move them quickly to nearby markets. Cantaloupes that are sold in this manner cannot be shipped over long distances because they lack refrigeration.

Production by Seasons

The Statistical Reporting Service designates cantaloupe production by seasons which includes the spring, early summer, mid-summer, late summer and early fall crops. Table 1, located in the Appendix, presents planting and harvesting dates for the various production areas with seasonal breakdowns. These dates are not fixed; they are only approximations. There is, in fact, considerable overlapping of harvesting dates between the seasonal groups and weather may frequently disturb normal harvesting periods. However, this breakdown into seasonal groups is useful in discussing the existing situation, recent development and the outlook of the cantaloupe industry. The classification of states by harvesting periods, together with information relative to changes in production by states and seasonal groups permits an analysis of the probable influence of changes in production in specific states upon market supplies and competition during fairly short intraseasonal periods.

The spring and mid-summer melon crops comprise the bulk of commercial cantaloupe production in the United States. The relative importance of the five different seasonal groups is presented in Appendix Table 2. The mid-summer crop represented an average of 55.4 percent of the total cantaloupe production for the years 1960 to 1969. Spring cantaloupe production was next with an average of 30 percent of the total production. The early summer, late summer, and early fall melon crops are relatively small as they have averaged 5.3, 7.3 and 2.0 percent of total production for the same ten years.

Spring Cantaloupes

Cantaloupes that are produced in the spring for United States markets come mainly from Arizona, California, Mexico, and Texas. Florida produces a small quantity of melons which move to market during April and May. Appendix Table 3 compares the relative importance of spring melon production of these five areas. Arizona is the largest supplier of spring melons with an average of 40.2 percent share for the years 1960 to 1969. For the same years, California produced 24.9 percent of the spring crop, Texas averaged 19.3 percent, and Mexican imports represented 13.6 of the spring melons produced for consumption in the United States.

Arizona

The Federal-State Market News Reports from Phoenix, Arizona, indicated that Arizona's cantaloupe acreage was concentrated in the central part of the state during the 1940's. In the 1950's and early 1960's, cantaloupe acreage decreased in Central Arizona while the production shifted to the Yuma District.

There were two main reasons for the trend. First, seasonality of production was a factor. Cantaloupes produced in Yuma matured in late May and June while the crop in Central Arizona reached maturity in late June and July. Prices were generally higher during May and June when melons were shipped from Yuma and South Texas. However, when the melon growers in Central Arizona began shipping their crop in the late June, the edge had been taken off the market and prices were usually lower. Second, growers in Central Arizona experienced reduced yields because of melon crown blight, curly top, and cantaloupe mosaic. Diseases in combination with low prices made it difficult for Central Arizona cantaloupe growers and shippers to operate profitably.

Some of the Central Arizona melon growers extended their operations to new areas such as Casa Grande, Eloy, and Sells in an effort to avoid the disease problems in growing around Phoenix. Others shifted their growing operations to the Yuma District. Most of the cantaloupes grown in Arizona in recent years have been grown in the Yuma and Parker areas for harvest in May and June. Shipping records reveal the Yuma District melon season beginning around May 20 and peak movement being reached by June 12. The Parker area will follow Yuma by one week to ten days.

The states of Arizona and California have state laws which standardize cantaloupe grades and containers. These laws have helped the western cantaloupe producing regions eliminate many unfair trading practices and maintain stability in the cantaloupe marketing system.

Texas

During the late 1940's and until the mid 1950's, cantaloupe production was scattered over various sectors of Texas. Starting in the late 1950's, cantaloupe production in Texas began to concentrate in the Rio Grande and Pecos River Valleys.

The melons produced in the Rio Grande Valley mature in the early spring, and those grown in the Pecos Valley are considered a mid-summer crop. The concentration of cantaloupe production in these two areas took place for two reasons. First, the early spring melons grown in the Rio Grande Valley are the first to mature in the United States and they bring relatively higher prices than those melons produced in other parts of the state. Second, competition from California and other states located closer to the major population centers virtually eliminated the growing of mid-summer cantaloupes in Texas except for the Pecos region. Pecos growers have been able to maintain their competitive position because of the quality reputation of the Pecos melon.

The cantaloupe industry in the Rio Grande Valley is concentrated in Hidalgo and Starr Counties. The importance of these two counties as spring cantaloupe producers increased in recent years with the development of the Perlita and Dulce varieties by Texas A&M University. These two melon varieties were developed for resistance to diseases and viruses which had caused a reduction in cantaloupe acreage in South Texas in past years. The early harvesting period of this area is also important. However, frequent rains in the Rio Grande Valley during April and May is still of major concern to the cantaloupe industry in that area. Rains will reduce the yield and quality of cantaloupes and create additional production expenditures for the producer because immature melons must be turned by hand to prevent decay. Rains usually weaken the market because cantaloupe buyers become more cautious in trading.

Texas does not have state laws for the standardization of cantaloupe quality and containers as do Arizona and California. This created problems for the industry and an attempt was made to obtain a federal marketing order and agreement in 1968. The major purpose of the order was to restrict the movement of bulk cantaloupe shipments from the producing area of the Rio Grande Valley. Many industry leaders felt that these bulk shipments consisted of "field run" cantaloupes which were not graded or sized and whenever these shipments reached a major market they weakened the market and reduced prices on the best grade melons. Another purpose of the order was to regulate melon maturity and provide for market research and development.

The Secretary of Agriculture decided against the proposed order after strong opposition was voiced by many of the cantaloupe growers. Objections were raised for two reasons. First, the Laredo area's melon season overlapped with that of the Rio Grande Valley and these growers would not be subject to the proposed grade, size, container, and maturity regulations. Second, growers would be required to have a local shipper grade, size, and pack his melons or perform this function themselves. Either alternative results in additional expense. Some growers contended that bulk loading and hauling of melons was more efficient.

Mexico

The key to the development of Mexico's vegetable industry was a good transportation system. The first attempted commercial vegetable production in Mexico began in the states of Sonora and Sinaloa. All of the produce was grown for export to the United States and Canada (The Packer 1968). As transportation improved vegetable production expanded rapidly in this area; and the Rio Culiacan Valley of Sinaloa is the major producing area for fresh vegetables. The exceptions are melons, onions, and strawberries.

Cantaloupes are Mexico's second most important vegetable crop (Cook 1966). The major areas for cantaloupe production are near Apatzingan, Tampico, Culiacan, and Los Mochis. Apatzingan is in the state of Michoacan and cantaloupes are the principal export crop. Production of melons in this area has not increased as it has in other areas of Mexico because of production difficulties experienced by farmers. Cool, cloudy weather which often occurs early in the growing season will impede melon growth. Diseases are also a problem.

A large part of the melon crop grown in Apatzingan has been controlled by the Melon Producers Association, a relatively powerful growers' association which has authority to establish regulatory measures. This area has a large amount of ejido (cooperative) land which is public land used by small growers. These farms are smaller than those found on the West Coast and the acreage of melons is deliberately kept small by the Association. The Association has adopted a more aggressive policy in recent years with regard to outsiders renting land. Most melons are packed in Association facilities and sold to United States firms. In the past, importing firms had gone into the area and controlled the growing and packing (Higgins 1968).

It is unlikely that melon production will increase materially from Apatzingan because of the Association policies, competition from other crops, and the economic risks of melon production. Apatzingan's advantage for melons is its early marketing season, but cantaloupes grown in the area are usually small, and yields are low. Cantaloupe growers in Apatzingan experience the same marketing situation as do West Coast growers. They must be able to take advantage of the early market in order to compete. Apatzingan melons are marketed from January to April. Most of the cantaloupes exported from Apatzingan enter the United States through Laredo, Texas.

The Tampico area of Mexico is located on the East Coast and a small volume of cantaloupes has been produced there for several years. However, this area's importance as an export producing area began to materialize in 1968. Melon production around Tampico is still relatively small, but it has the potential of expanding. Tampico produces a good quality melon which matures in late March, April, and May for an early market in the United States. Cantaloupes from Tampico enter through Hidalgo and Laredo, Texas until the start of the South Texas melon season.

The rapid expansion of cantaloupe production on the West Coast has been stemmed in recent years. The fast growth which has been characteristic of other vegetable crops for this area has not occurred with cantaloupes because yields have not improved nor has acreage increased as substantially as for other crops. This is particularly true in the Culiacan Valley where the main emphasis is on tomatoes. Cantaloupes present a greater risk. Mildew, viruses, pests, and weather have critical effects on cantaloupe yields and quality in the Culiacan Valley because it has greater natural moisture due to its closer proximity to the ocean than other cantaloupe growing areas.

Any marketing advantages in growing cantaloupes on the West Coast depends upon timing. The crop must mature early enough to insure a good volume of shipments prior to the opening of the Yuma, Arizona, cantaloupe season. Harvesting is usually mid-April to mid-June. Exports to the United States and Canada are shipped through Nogales, Arizona.

The process of crossing cantaloupes into the United States from Mexico involves the following steps: United States government inspection, clearance for export by Mexican authorities, clearance for import by United States authorities, and delivery of the product to the distributors in the United States (Firch and Young 1968).

There are two custom brokers involved in the passage of cantaloupe shipments across the border: the Mexican broker who takes charge of the exportation procedures, and the United States broker who takes charge of the importation (Firch and Young 1968). Most of the Mexican cantaloupe growers have financial and marketing arrangements with distributors in the United States who sell the cantaloupes to buyers.

Mexico imposes an export duty of 7 percent ad valorem on an arbitrarily selected price for cantaloupes. The United States levies an import tariff of 35 percent ad valorem on cantaloupes. The United States tariff on cantaloupes is applied to the Mexican price rather than the F.O.B. price in the United States.

Gehring (1968) projected an increase of cantaloupe exports from Mexico for each year from 1966 to 1975. These projections were based on past trends which show Mexican cantaloupe exports increasing each year from 1958 to 1965, (Appendix Table 4). However, in 1966 Mexican cantaloupe growers began experiencing weather and disease problems which reduced yields sharply. As a consequence, cantaloupe exports declined from a high of 146 million pounds in 1965 to 72 million pounds in 1968 (Appendix Table 4). Appendix Table 4 also reveals that over the ten year period from 1960 to 1969, the bulk of cantaloupe imports from Mexico are imported in April and May.

Other

California is the second largest producer of spring cantaloupes. From 1960 to 1969 the Desert Valleys of California accounted for 24.9 percent (Table 3 Appendix) of the total spring production. The growing, harvesting, and packing of spring melons in California is similar to the operations in Arizona. Florida is another spring melon producing area and a small acreage of cantaloupes has been grown each year around Gainesville, Florida.

California is the major supplier of cantaloupes for the other seasonal groups. A breakdown of cantaloupe production by seasonal groups (other than spring), states and years is presented in Tables 17-20 of the Appendix.

Production and Marketing Costs by Areas

Appendix Tables 5-7 present preharvest production costs for cantaloupes grown in the Imperial Valley of California, the Rio Grande Valley of Texas, and Sinaloa, Mexico. These costs are computed on a per acre basis. Cost information was not available for Yuma, Arizona; however, the cultural practices of cantaloupes grown in Yuma are similar to those of the Imperial Valley and for the purposes of this study the production costs are assumed to be the same for the two areas. A comparison of cantaloupe marketing costs per crate for Northwest Mexico and Texas is presented in Table 8 (Appendix).

Texas has the lowest preharvest production cost per crate even though melon yields are relatively low. The average preharvest production cost per 80 pound crate of cantaloupes in Texas is $1.76 compared to $1.99 in California, and $3.11 in Sinaloa. These costs differences are due to the fact that Texas has relatively cheaper labor than California while equipment and material costs in Mexico are greater than in the United States. The average yield in 80 pound crates per acre for California, Texas, and Mexico is 160, 125, and 110 crates respectively.

The cost for harvesting, packing, and selling a crate of cantaloupes in Texas is estimated to be $3.42 and for Sinaloa, Mexico, it is $2.33. However, Mexico has an additional cost of exporting (Appendix Table 8) which brings the total F.O.B. marketing cost per crate of cantaloupes to $6.67. Harvesting, packing, and selling cost information for Arizona and California was not available.

The total production and marketing cost or break-even price per crate in Texas is $5.18 versus $9.78 per crate for Sinaloa, Mexico. The cost of producing and marketing an acre of cantaloupes in Mexico with an average yield of 110 crates is $1,075.80. The importance to the Mexican producer of an early market with high prices is very apparent in light of the required investment and attendant risk.

Harvesting and Handling

Cantaloupes are harvested at three stages of maturity, depending on market destination. The three stages of maturity include the "fall slip" or hard ripe stage when the entire stem separates from the melon under slight pressure, leaving a clean stem scar but it is still firm and yellow green. The second stage is called "choice" when the melons are full slip and yellowish. The last stage of maturity is known as full ripe. Cantaloupes for distant markets, i.e., western cantaloupes for eastern markets, are harvested at "full slip." "Choice" melons are shipped locally or to markets in the mid-west. Cantaloupes that are marketed in nearby markets are permitted to ripen longer on the vine (Roberts 1959).

In the first week of the cantaloupe ripening season, the fields are gone over every other day. As the season advances and cantaloupes ripen more rapidly, the fields are harvested every day. Most melons are bulk hauled from the field to a shed for grading and packing.

Grading usually consists of removing inferior melons and sorting the melons as to size and maturity. Some cantaloupes are waxed. Cantaloupes are packed according to size, with 36 or 45 melons per jumbo crate being the most popular packs. Sizes may range from 27 (large melons) to as many as 60 melons per crate.

Cooling

Most western cantaloupes are packed in wood crates and pre-cooled in pre-iced fan cars or trucks before shipping. However, in recent years, many cantaloupe shippers have started shipping their melons in corrugated cartons. This change from wood crates, which are usually top-iced, to cartons has required melon shippers to change their method of cooling cantaloupes.

Two methods, hydrocooling and package-icing, can be used to effectively and economically cool cantaloupes in cartons. Water-tolerant cartons must be used for package-iced cantaloupes. Hydrocooled melons, if dried between cooling and packing, can be shipped in non-treated, less expensive cartons. Hydrocooled cantaloupes are thoroughly cooled before packing, packed immediately after cooling, and then placed in cold storage. This cold storage includes refrigerated cars, trucks, or rooms. Packaged-iced melons are placed in cold storage immediately after icing to obtain maximum cooling from the added ice (Kasmire 1969).

Cold water is the coolant for hydrocooling and cold air is used for forced-air cooling. Hydrocooling, like forced-air cooling, is a method of "conveyorized cooling" which involves moving cantaloupes through a cross flow of coolant. Package-iced cantaloupes must be shipped in water-tolerant cartons which are coated or impregnated with wax. These cartons are more expensive than those made from non-treated fiberboard; however, a hydrocooler and dryer would be needed for packing.

Containers

In Arizona and California, container dimensions and packs are standardized by State laws. Containers are referred to according to pack counts, which in turn refer to size of the cantaloupes. Packs for jumbo sizes in jumbo cantaloupe crates are 18, 23, 27, 36, 41, and 45. Sizes packed in the standard crate are 27, 36, and 45; pony crate melon counts are 46 and 54. Jumbo packs and the jumbo container account for most cantaloupe shipments (Roberts 1959).

The use of corrugated cartons for packing cantaloupes has been increasing in recent years. There are a number of different size cartons in use. Statistical information was not available to determine the portion of cantaloupe shipments that are packed in cartons. The reasons for the increased use of cartons are: 1. Cartons have enabled shippers to operate more efficiently by reducing the amount of labor required for packing. 2. Buyers have demanded smaller packs for easier handling, and 3. Cartons are more adaptable to pallitization.

CHAPTER III

MARKET DEMAND THEORY

The term demand is defined as a schedule showing the quantities of a product that will be purchased at various prices. The demand schedule refers to a specific market and a specific time period, with all other factors affecting demand remaining unchanged. The demand curve is a means of describing how consumers behave. The factors which can affect demand include the level and distribution of money incomes, the preferences of consumers, and prices of closely related commodities. These factors are called demand shifters.

Demand studies must consider the level at which demand is measured in the marketing system. Demand at the farm or producer level is a derived demand. The demand for products at the farm end of the marketing system consists of consumer demand minus a schedule of marketing charges (Thomsen and Foote 1952). The farm level demand for most commodities is generally less elastic at any given level of quantity than demand at the retail level.

Interest is centered on the following questions in this study. First, with a given demand function, what is the influence on price of a change in quantity? Second, what is the influence of a change in income on the level of the demand function? Third, has there been a shift in the net price-quantity relation over the period analyzed due to factors not included in the analysis? Finally, what is the influence of the size of a given year's crop on the total farm income from that crop? That is, will a small crop of cantaloupes result in a larger or smaller income to farmers than a large crop?

The answer to the last question depends upon the responsiveness of consumers to changes in price which is measured by the "price elasticity" of demand. Price elasticity is a proportional concept, independent of unit of measure, and is equal to the percentage change in quantity divided by the associated percentage change in the price.

The theory of derived demand, excess demand, price elasticity of demand and income elasticity of demand will be discussed more specifically in the remainder of this chapter. A discussion is also included on the statistical techniques and models used in the analysis.

Derived Demand and Price Elasticity

It was indicated in the foregoing discussion that the farm level demand is a derived demand. Thomsen (1952) explains why people believe that the chain of events culminating in both retail and farm prices starts in the big wholesale markets instead of at the consumer level. The reasons for this belief is, first, that price changes generally occur first in the wholesale markets and, secondly, retailers are observed to take the amount they pay for the commodity, add on a certain markup, and charge the resulting price which they usually get. The fallacy of this belief, as explained by Thomsen (1952), lies in the fact that consumers can and will pay only so much money for the products offered them at any given time or over any period of time. Therefore, the retailer buys only those amounts of a commodity from a wholesaler that can be sold at a particular price. The retail price is composed of the wholesale price plus the retailer's markup. From this, it can be concluded that the wholesale price is derived from the retail price by subtracting those marketing services added between the wholesale and retail level from the retail price. This same analogy can be used to show that price or demand at the farm level is derived by this same method.

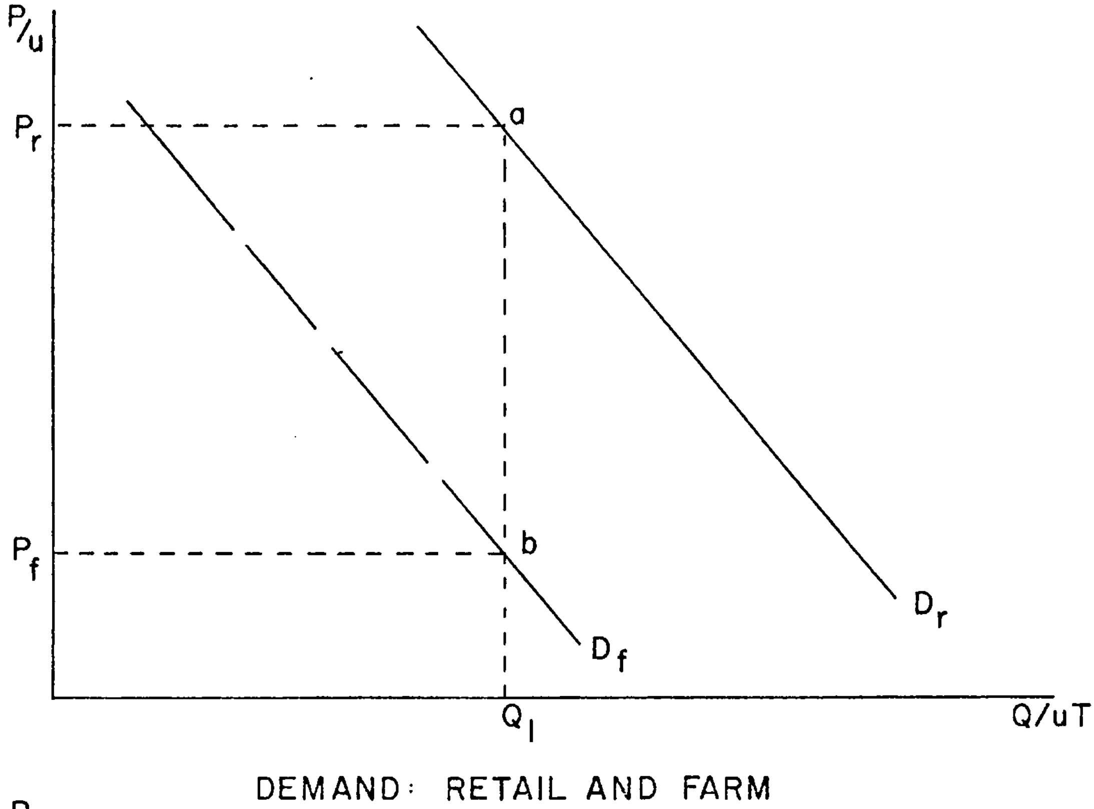
Marketing margins or marketing services can be related to the quantity of a particular commodity moving through the marketing channels in three different ways. The type of marketing service also determines the relationship of price elasticities between retail demand and farm demand. The three kinds of margins are: (1) an absolute or a flat per unit charge regardless of the price paid by consumers or the quantity marketed, (2) a markup which increases as the quantity marketed increases, and (3) a charge per unit which is a constant percentage of the retail price. Each of these three kinds of marketing services and the derivation of the farm level demand curve are illustrated graphically in Figures 1, 2 and 3. For each illustration, the lower diagram represents the particular kind of marketing charge while the upper diagram shows the derivation of farm level demand. Since the farm level demand curve is obtained by subtracting a schedule of marketing charges from a schedule of retail prices for various quantities, the type of markup determines the relationship of the elasticities of demand between the farm and retail level. Price elasticity of demand is defined by the formula:

$$E_d = \frac{\triangle Q}{\triangle P} \cdot \frac{P}{Q}$$

If the marketing service charge is a constant absolute markup per unit, the implied cost curve is a horizontal line representing constant costs (Figure 1). The derived farm level demand curve lies below and is parallel to the retail demand curve. For a given quantity (Q_1) the retail price is greater than farm price ($P_r > P_f$). Therefore, the price elasticity of demand at the farm level is less in absolute value than that at the retail level for the same quantity as is demonstrated by the following equation:

Given quantity Q_1

Price $P_r >$ Price P_f



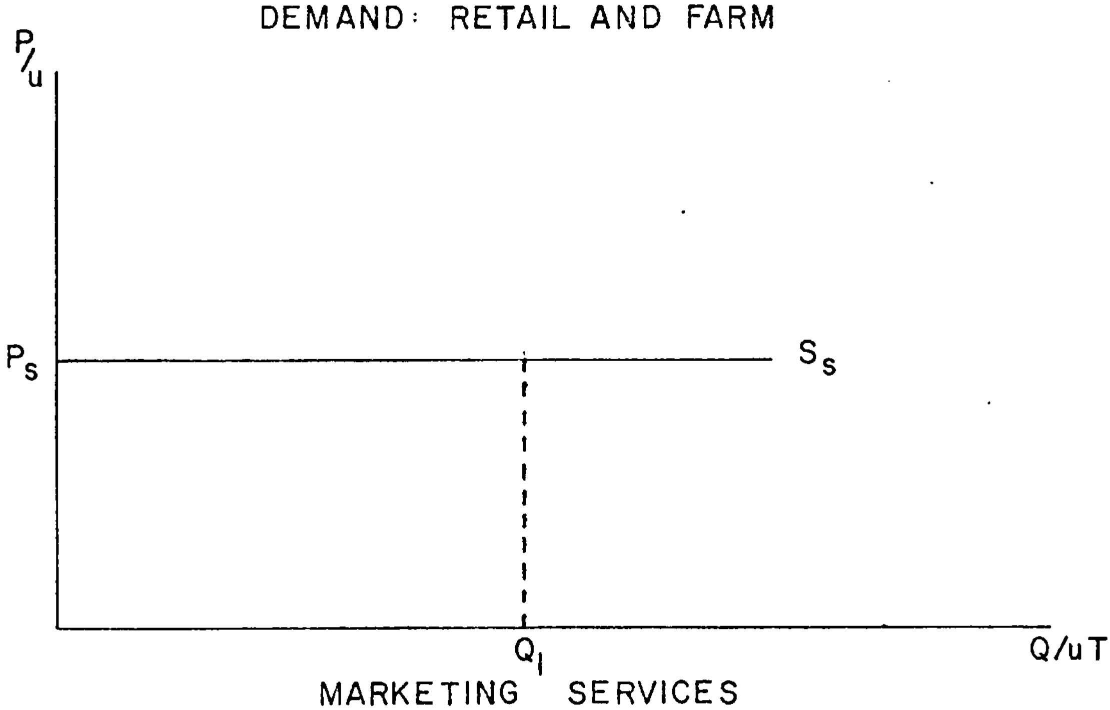


Figure 1. FLAT RATE PER UNIT MARKUP

$$\left|\frac{\Delta Q}{\Delta P}\right| \text{ at point a } = \left|\frac{\Delta Q}{\Delta P}\right| \text{ at point b}$$

$$\text{Price elasticity of demand } (E_d) = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q}$$

$$\therefore \left|E_{dr}\right| > \left|E_{df}\right|$$

Figure 2 illustrates the relationship between the farm level demand curve and the retail demand curve in the case of an increasing markup for marketing services. Farm level demand is also less elastic than retail level demand. The slope of the farm demand curve is more steep than the retail demand curve, therefore:

Given quantity Q_1

Price $P_r >$ Price P_f

$$\frac{\Delta Q}{\Delta P} \text{ at point a } > \frac{\Delta Q}{\Delta P} \text{ at point b}$$

$$\text{Price elasticity of demand } (E_d) = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q}$$

$$\therefore \left|E_{dr}\right| > \left|E_{df}\right|$$

In the case of a percentage markup, either of the elasticities may be greater than the other. If the marketing charge is a constant percentage of retail price, the demand curve at the farm level is more horizontal than the retail demand curve (Figure 3). The relative elasticities between retail and farm demand, under percentage markup circumstances, depends upon whether the percentage change in the slope is greater or less than the percentage change in price.

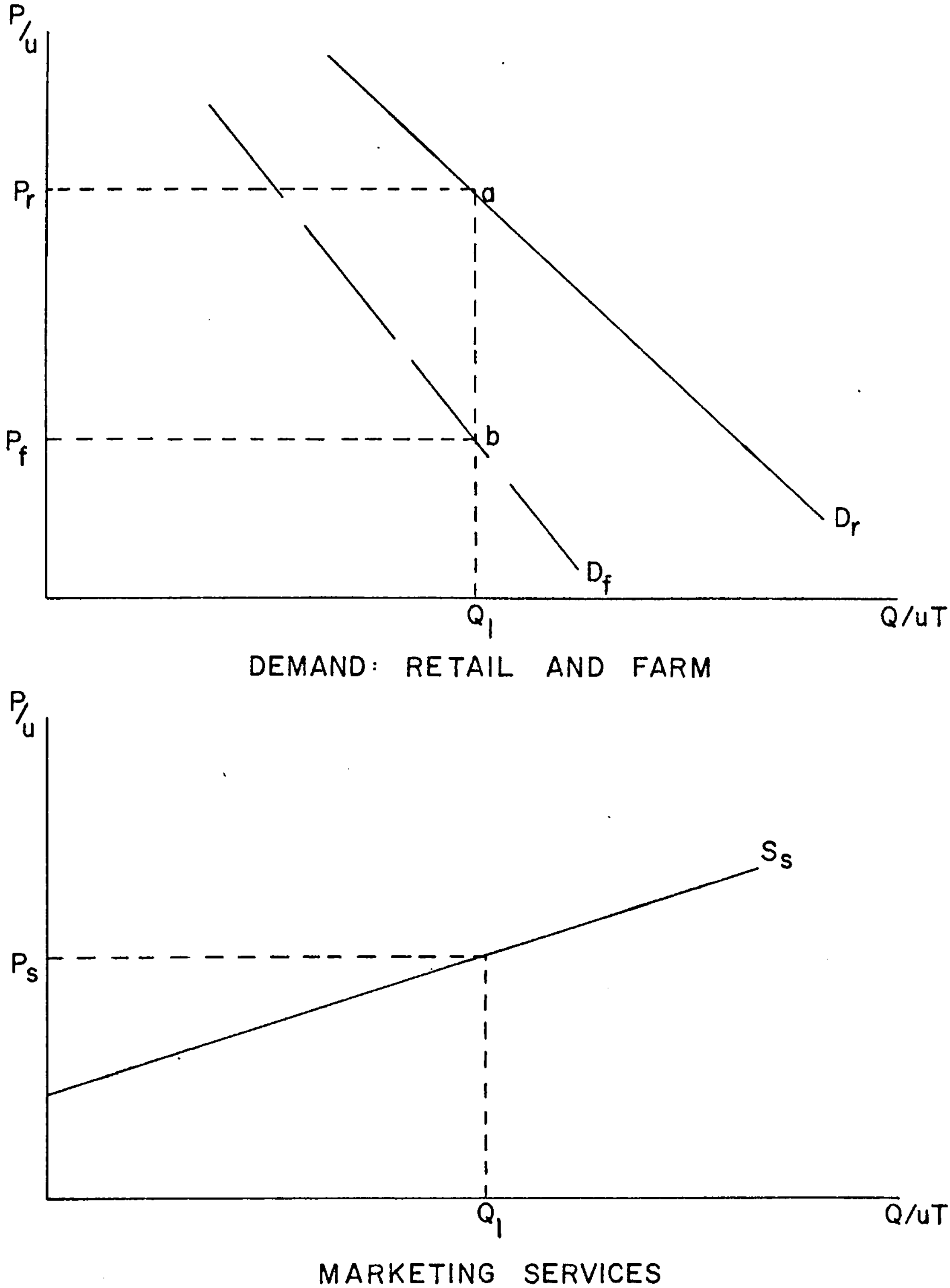


Figure 2. INCREASING MARKUP

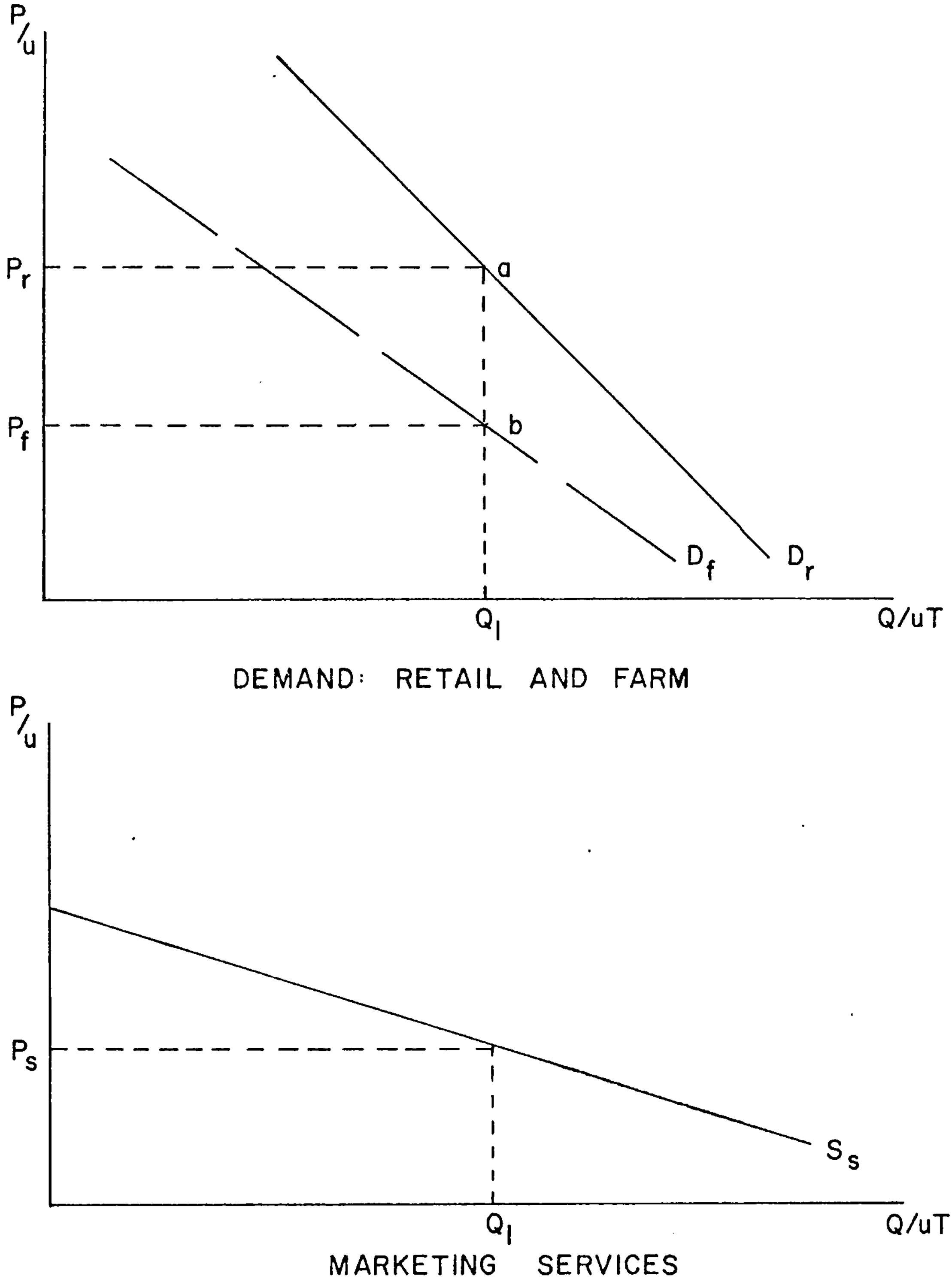


Figure 3. PERCENTAGE MARKUP

If the proportionate change in the slope is greater than the proportionate change in price, then the elasticity at the farm level will be greater than at the retail level.

Many studies by various agencies have shown that price spreads decline somewhat with increased quantities and that they tend to be somewhat between percentage and absolute amounts; however, theory alone is not a sure guide on this matter (Waugh 1964). The nature of the price spreads in this study could not be determined since retail prices of cantaloupes on a daily or weekly basis were not available. However, it is assumed that the marketing charges on cantaloupes from the farm level to the retail level are a combination of the various kinds of marketing markups.

The marketing services of cantaloupes between the producer and the consumer include charges for harvesting, packing, transportation, brokerage, wholesaling and retailing. Many of the larger chain-store organizations buy direct from the packing house and this reduces the number of individual markups added to the F.O.B. price; however, it does not necessarily reduce the amount of the total markup between packing house and consumer.

In this study, demand for cantaloupes is measured at the packing house level for which prices were readily available. The price elasticity of demand for Arizona cantaloupes at retail is expected to be more elastic than the packing house level and the farm level demand to be less elastic than the packing house demand.

Excess Demand and Price Elasticity

The relevant demand for Arizona spring cantaloupes is the total market demand for spring melons less the quantities supplied by California, Mexico and Texas at each price. This concept is known as excess demand and this is the significant demand facing any decision making unit. At any price below equilibrium of the total market demand and supply of other producing regions an excess demand exists. This demand is more elastic than total demand provided supply is not perfectly inelastic.

Figure 4 is included to illustrate theoretically the derivation of excess demand for Arizona cantaloupes. Excess demand is also shown to be more elastic than total market demand in Figure 4.

Total market demand for spring cantaloupes is represented by line D_t. Line S_o represents the supply of spring melons from areas other than Arizona. Excess demand curve D_e is the horizontal difference between S_o and D_t at various prices below P_1. This diagram is helpful in illustrating excess demand for Arizona cantaloupes to be more elastic than the total market demand for cantaloupes. For example, given points a and a' on demand curves D_t and D_e respectfully, the resulting quantities are Q and Q'. The following results:

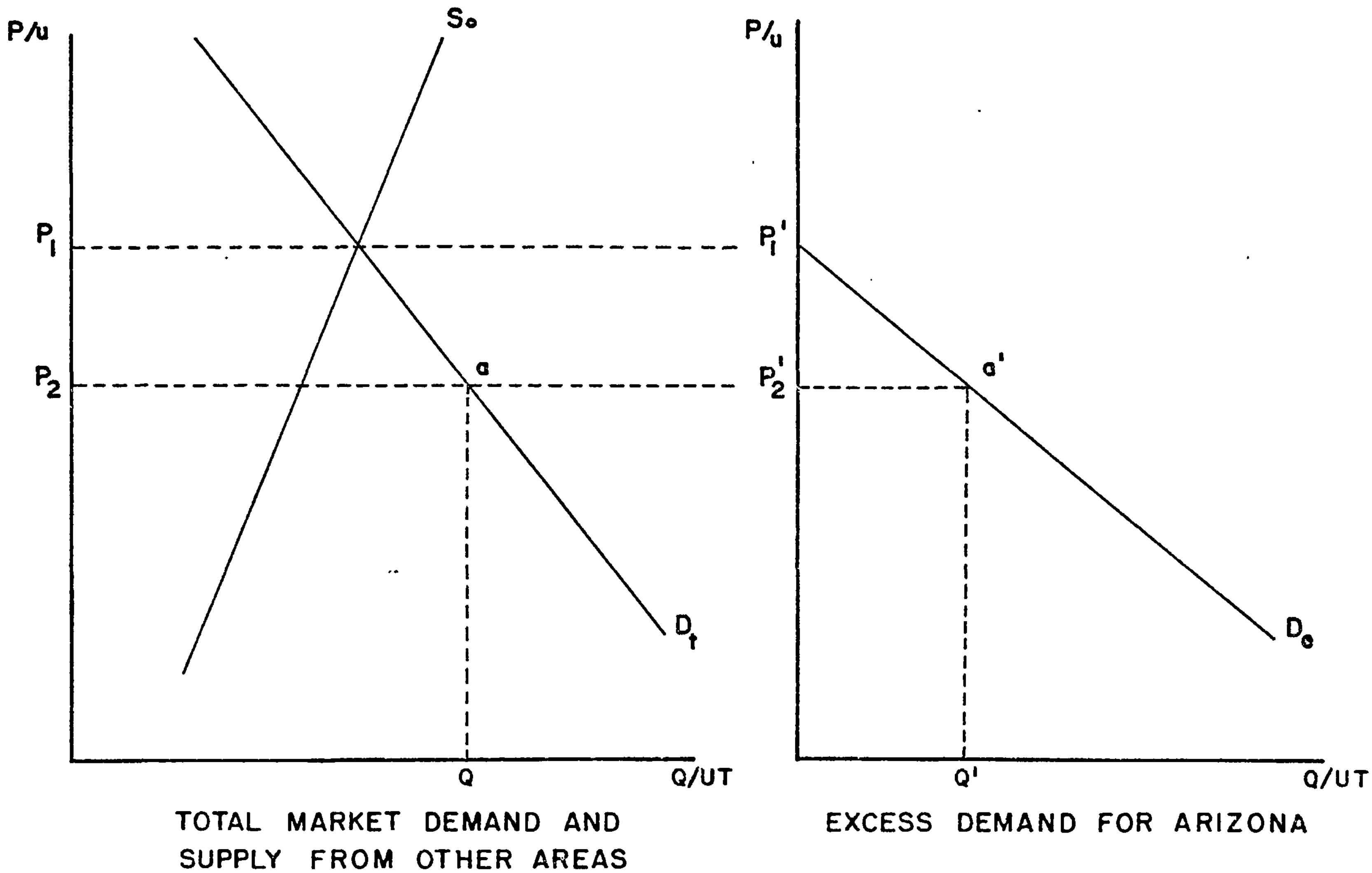


Figure 4. EXCESS DEMAND

$P_2 = P'_2$

$Q > Q'$

$\frac{\Delta Q}{\Delta P}$ of $D_t < \frac{\Delta Q}{\Delta P}$ of D_e

Price elasticity of demand $(E_D) = \frac{\Delta Q}{\Delta P} \cdot \frac{\Delta P}{\Delta Q}$

$\therefore \left|E_{D_e}\right| > E_{D_t}$

If the excess demand curve is used to measure the price elasticity of demand for spring cantaloupes from a particular district, the resulting elasticity should exceed that of the total demand curve at each price when other areas are supplying significant quantities of cantaloupes to the market. Therefore, it is to be expected that the effective price elasticity of demand for a particular district will decline as its share of the market increases, and the price elasticity of demand would increase as its share of the market declined near the end of the season (Mathews 1969).

Demand-Income Relationships

Fluctuations in the general level of prices received by producers for farm products, or for any group of products such as fruits and vegetables may be affected by changes in consumer money incomes. The income effect upon consumption of a commodity can be negative, positive, or no change, depending on whether the commodity is a superior good, an inferior good, or neutral. A positive increase in cantaloupe consumption is expected since consumer disposable income has increased since 1953 (Appendix Table 10); and, it is hypothesized that there is a positive relationship between changes in income and cantaloupe consumption. The theoretical concept of this relationship is presented in Figure 5.

The income consumption function (I) represents the consumption of cantaloupes at price P_1. The demand curve (D) represents the demand for cantaloupes at income level I_1. If income increases to I_2, demand shifts to the right or increases to D'.

The income elasticity of demand is used to indicate consumer preference for the commodity. For example, a commodity is considered superior if the income elasticity is greater than zero and an inferior good has an income elasticity less than zero. In the demand-income illustration, the following is derived as income increases the quantity demanded:

$$I_2 > I_1$$

$$Q_2 > Q_1$$

$$E_I = \Delta Q / \Delta I \cdot I/Q$$

$$\therefore E_I > 0$$

Statistical Techniques and Other Considerations in Demand Analysis

The first step in any analysis is to develop a thorough understanding of the economic factors that affect the

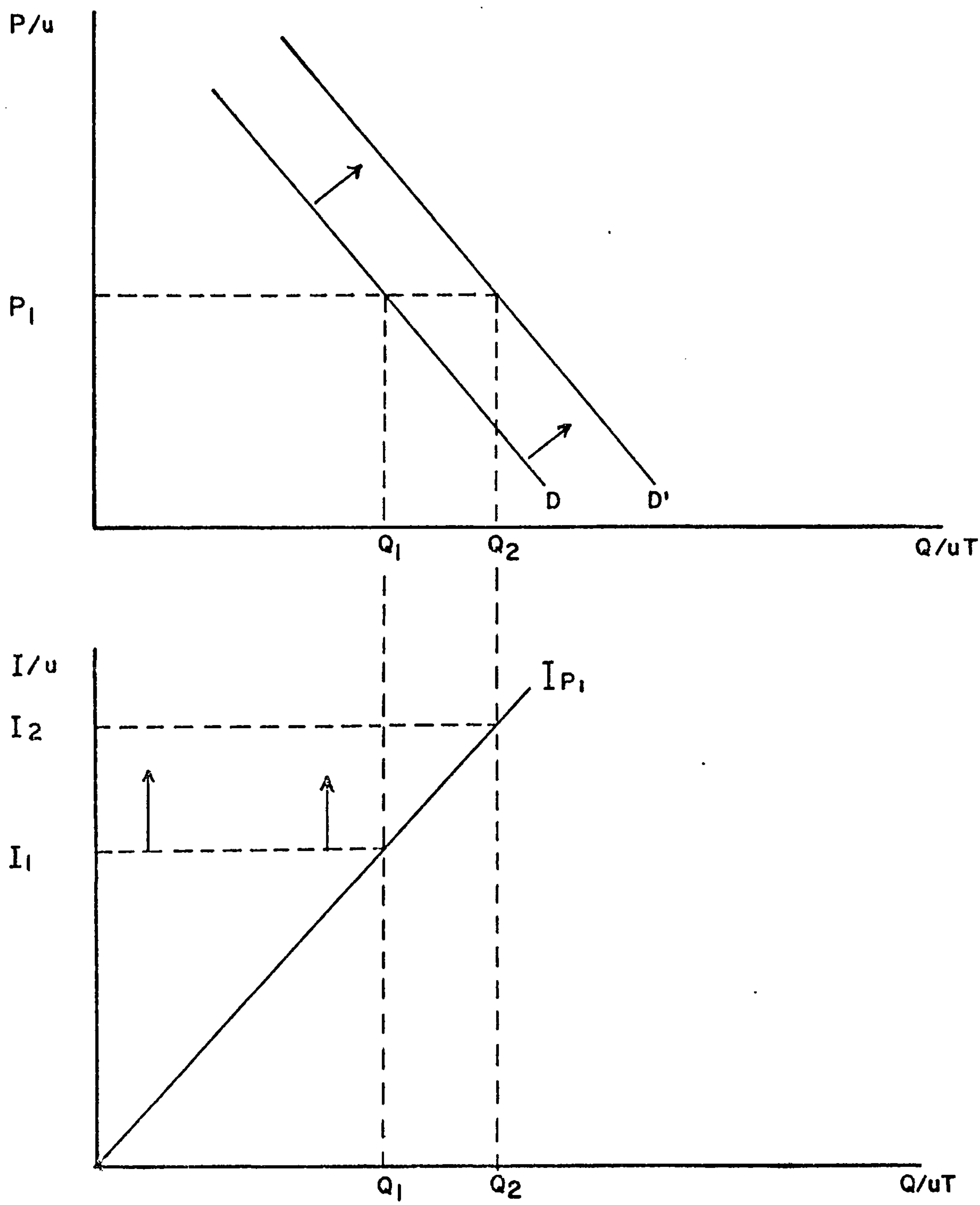


Figure 5. DEMAND AND INCOME RELATIONSHIP

commodity and how the markets for that commodity work. This information is helpful in setting up a theoretical model which describes those factors that are believed to affect the supply, demand, and price of the commodity. Diagrams that show the flow of a commodity through the marketing channels from producer to consumer are helpful in portraying various interrelationships. Figure 6 is included to aid in the understanding of the demand and supply structures of cantaloupes (Foote 1958).

Figure 6 can also be used to indicate the kind of statistical questions that should be discussed. The diagram indicates that: 1) there is no economic abandonment or unharvested cantaloupe production, 2) all of the production moved directly to a single outlet, 3) melon consumption is determined by current production since there is no significant amount of waste between producer and consumer, and 4) cantaloupes have no close substitutes. Fox (1953) pointed out that when these conditions exist, then unbiased estimates of the structural coefficients of demand can be obtained through the use of a single equation fitted by least-squares. Both Fox (1953) and Waugh (1964) found that, in actual practice, least-squares equations for agricultural products were practically identical with those obtained from the more elaborate simultaneous methods.

The main purpose of the statistical techniques used in this study was to estimate the elasticity of demand for

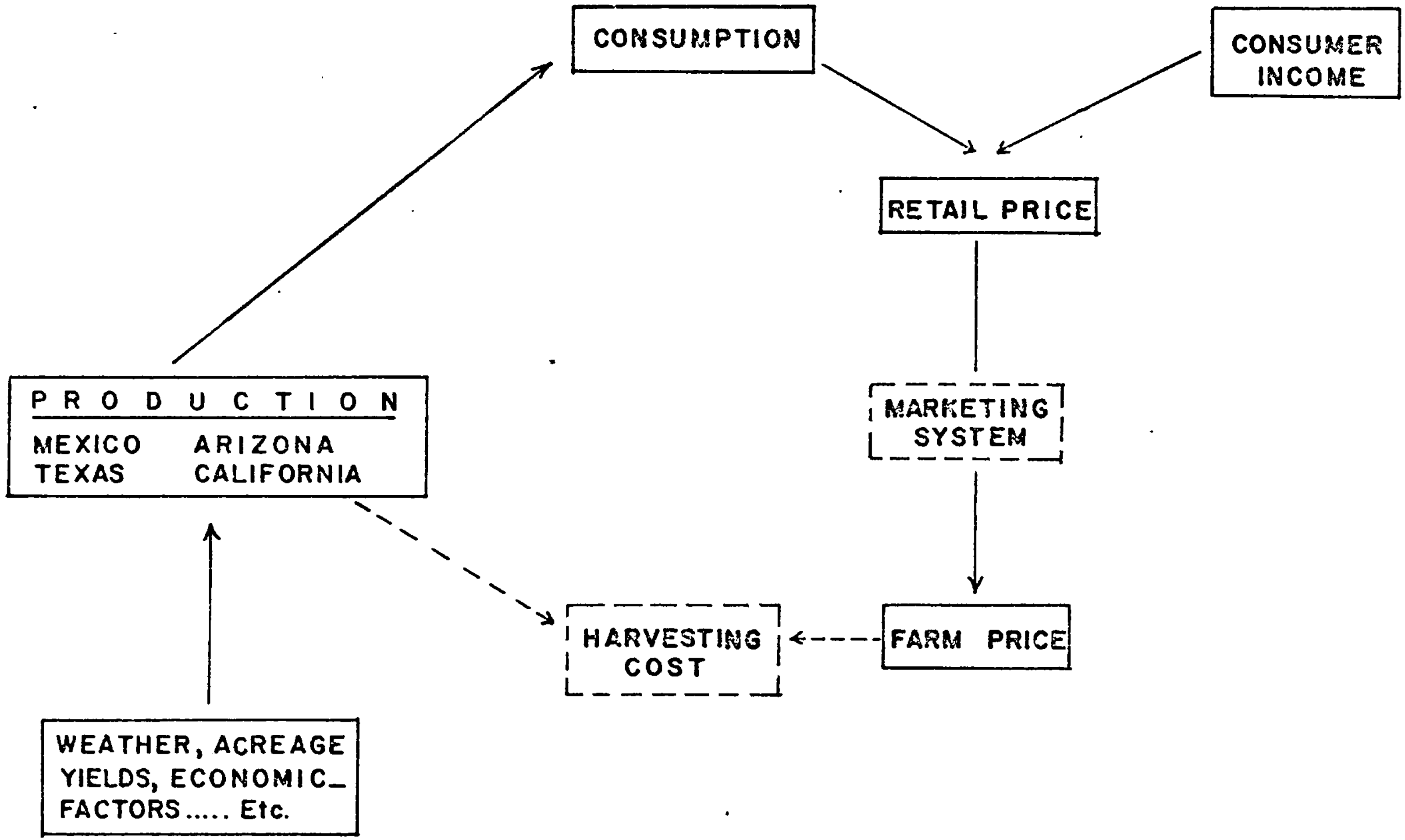


Figure 6. DEMAND AND SUPPLY STRUCTURES FOR SPRING CANTALOUPES CONSUMED IN THE UNITED STATES

spring cantaloupes. Many questions of economic importance hinge upon elasticity and without it we can make only vague conclusions (Working 1953). Working (1953) also pointed out that when a research worker begins a demand study he is confronted with a set of dots which can be thought of as the intersection of a demand and supply curve. Without further information, neither curve can be determined from the data. Working (1953) then noted that if the demand curve has shifted over time but the supply curve has remained relatively stable, the dots trace out a supply curve. Conversely, if the supply curve has shifted but the demand curve has remained stable, the dots trace out a demand curve. If shifts for each curve take place, the dots trace out what may look like a structural demand or supply curve, but the slope will be too flat or too steep.

In many analyses of the demand for agricultural products, factors that cause the demand curve to shift over time are included as separate variables in a multiple regression equation. In effect, an average demand curve is derived from the estimating equation (Foote 1958). In this study it was assumed that the quantity supplied was essentially unaffected by current price. Foote (1958) explained that in such a case when price is plotted on the vertical scale the supply curve will be a vertical line and year-to-year shifts in the supply curve trace out a demand curve. Under these circumstances, valid estimates of the elasticity of demand can be obtained by use of a least-squares multiple regression analysis for which price is the dependent variable and supply, and some demand shifters are used as independent variables.

In general the next step after preparing the diagram is a consideration of the equations that describe the more important economic relations. The process by which a set of economic variables are believed to be generated is called a structure. The variables whose values are explained by the structure are known as endogenous variables, whereas those whose values are determined outside the structure are called exogenous. The set of structures that are compatible with the investigators advance assumptions about the statistical universe from which the data are drawn is called a model. Thus, within a model, it is specified which structural relations are assumed to hold exactly and which include an unexplained residual or relation. The term economic model is applied to the set of structures consistent with the assumptions developed by the investigator from economic theory and knowledge of existing factors that relate to a particular commodity area. Thus, an economic model is a set of equations that is consistent with the relationships and identities implied by the diagram (Foote 1958). For example, from the diagram it can be assumed that production (shipments) is equal to consumption.

Another consideration in formulating statistical models is the choice of the time unit to be used. Many crops normally are published by marketing years; therefore, this would be a convenient time period to use. However, for cantaloupes, the economic structure differs considerably in one part of the year from that in other parts. Thus, the economic model that relates to spring cantaloupes may differ from one that relates to the summer melon crops. Foote (1958) wrote that decisions with respect to the time unit are based more on economic consideration than on statistical ones and frequently must be made before formulating the economic model.

For spring cantaloupes, the marketing season covers only a few weeks. The variables (income, population, and consumption) are on an annual basis, but it was assumed for this analysis that the two periods are related. Interest was centered on the prediction of melon prices during specific weeks. Shorter periods tend to be more homogeneous than longer ones but the effect of this on the analysis may have been offset, partly, in the event that irregular or non-measurable factors became more important.

Certain refinements are needed in statistical studies to correct the data in order to remove the effect of various extraneous and complicating factors. For example, adjustments are needed for changes in purchasing power of money, changes in population, and shifts in consumption habits. The adjustments made for this study are explained in the next chapter.

CHAPTER IV

COLLECTION OF RELEVANT DATA AND DEMAND ANALYSIS OF ARIZONA CANTALOUPES

Data

Price and Quantity

Price and quantity information for this study was obtained from daily and seasonal summary reports issued by the Federal-State Market News Service field offices in Phoenix and Yuma, Arizona, and Weslaco, Texas.

Price data are F.O.B. prices per jumbo crate containing 36 cantaloupes. These prices were quoted for cantaloupes of good merchantable quality and condition. The jumbo crate of size 36 is the predominant pack and price information for this size melon were consistently reported for all years that prices were available. Prices for sizes other than 36 were also reported by Market News whenever volume shipments were attained. These prices were not used in the analysis because these crates were not regularly available.

Price and quantity data for this study were developed on a weekly basis. The weekly price is a weighted average by shipments of the daily prices reported for size 36 cantaloupes. A mid-point price was used when a range in prices was reported. Market News did not report prices for Saturday or Sunday; therefore, this information was generated by averaging the Friday and Monday cantaloupe prices. Each week ends with Saturday and week 15 always includes May 30 regardless of the week day it occurred.

In order to isolate real price-quantity relationships for this study, all prices were divided by the gross national product implicit price index using 1958 as the base year (Appendix Table 10).

Quantity data is expressed in thousands of crates and this information was obtained by multiplying the number of cars shipped by a conversion factor (Appendix Table 11). This conversion factor, which is the number of cantaloupe crates per carlot equivalent, changed three times from 1953 to 1969 because of the use of larger transportation equipment. The conversion factor for Mexican imports is different from the United States conversion factor for cantaloupe shipments.

The shift effect of population changes on the demand curves was removed by dividing all quantity data by an index of United States population using 1958 as the base year (Appendix Table 10).

After the price and quantity adjustments were made, the data for the years 1954 to 1969 was graphed, Figure 7. An inverse relationship between cantaloupe prices and quantities shipped is dominant.

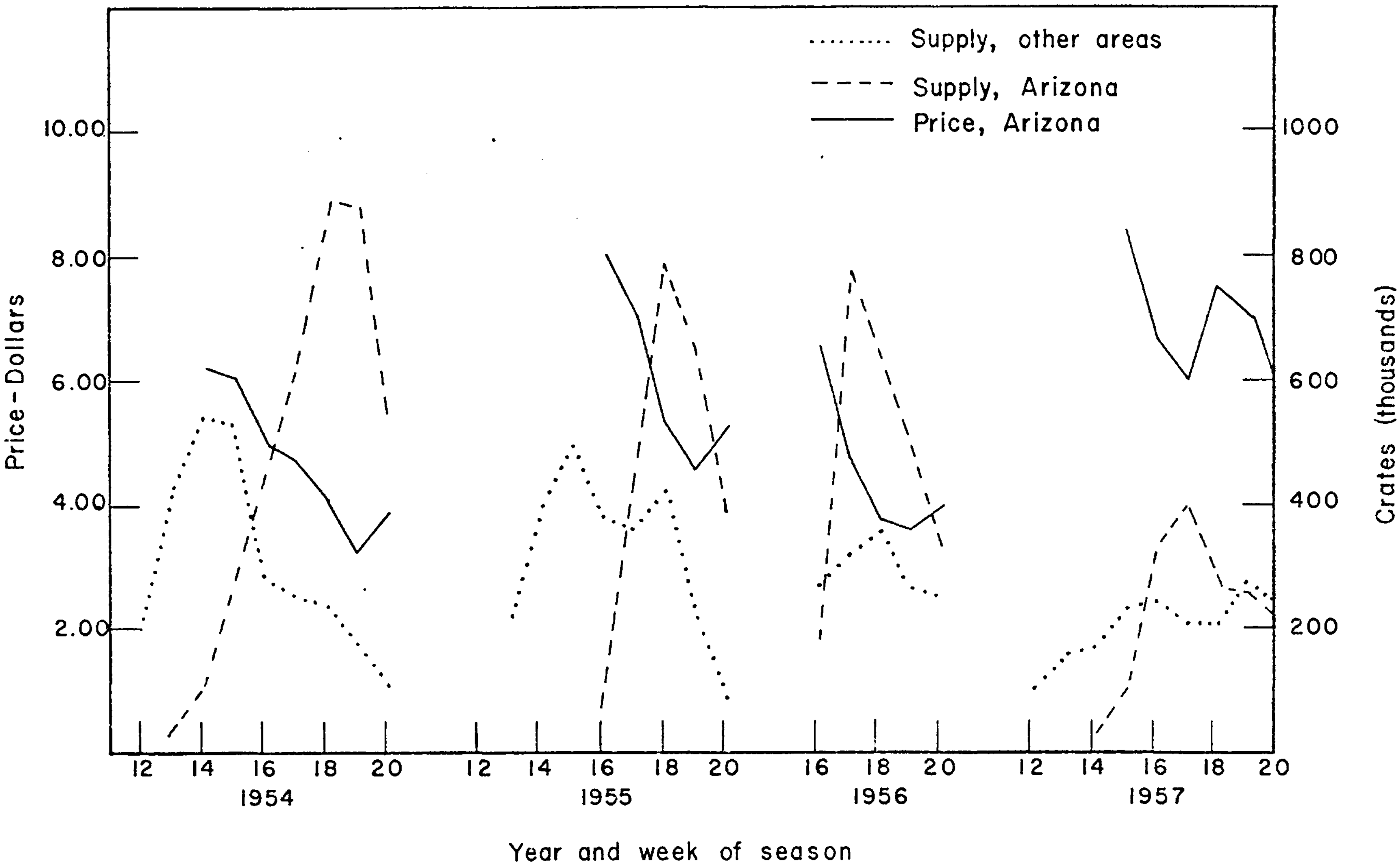


Figure 7. PRICE AND QUANTITY RELATIONSHIP OF U. S. CANTALOUPES

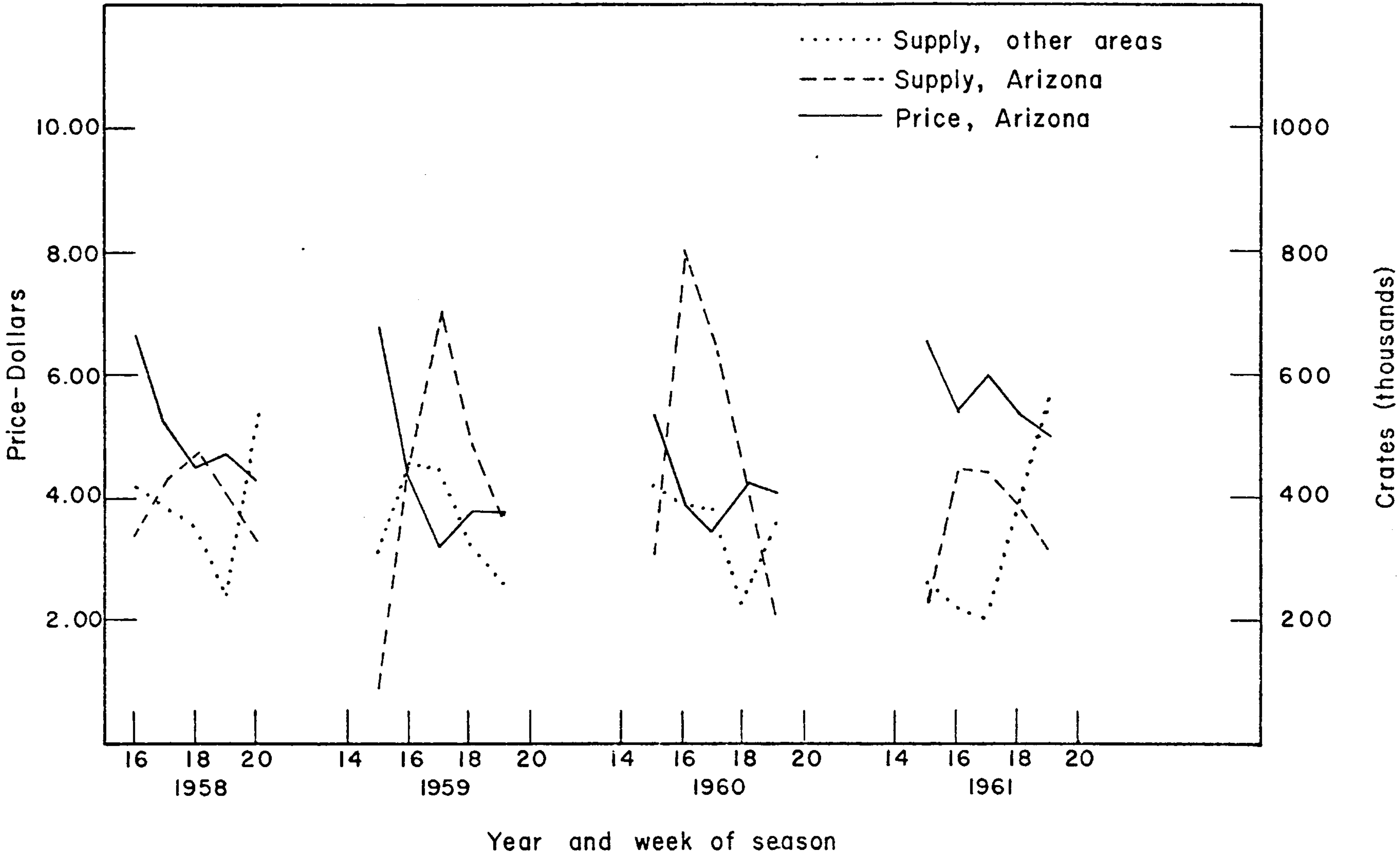


Figure 7. PRICE AND QUANTITY RELATIONSHIP OF U. S. CANTALOUPES--Continued

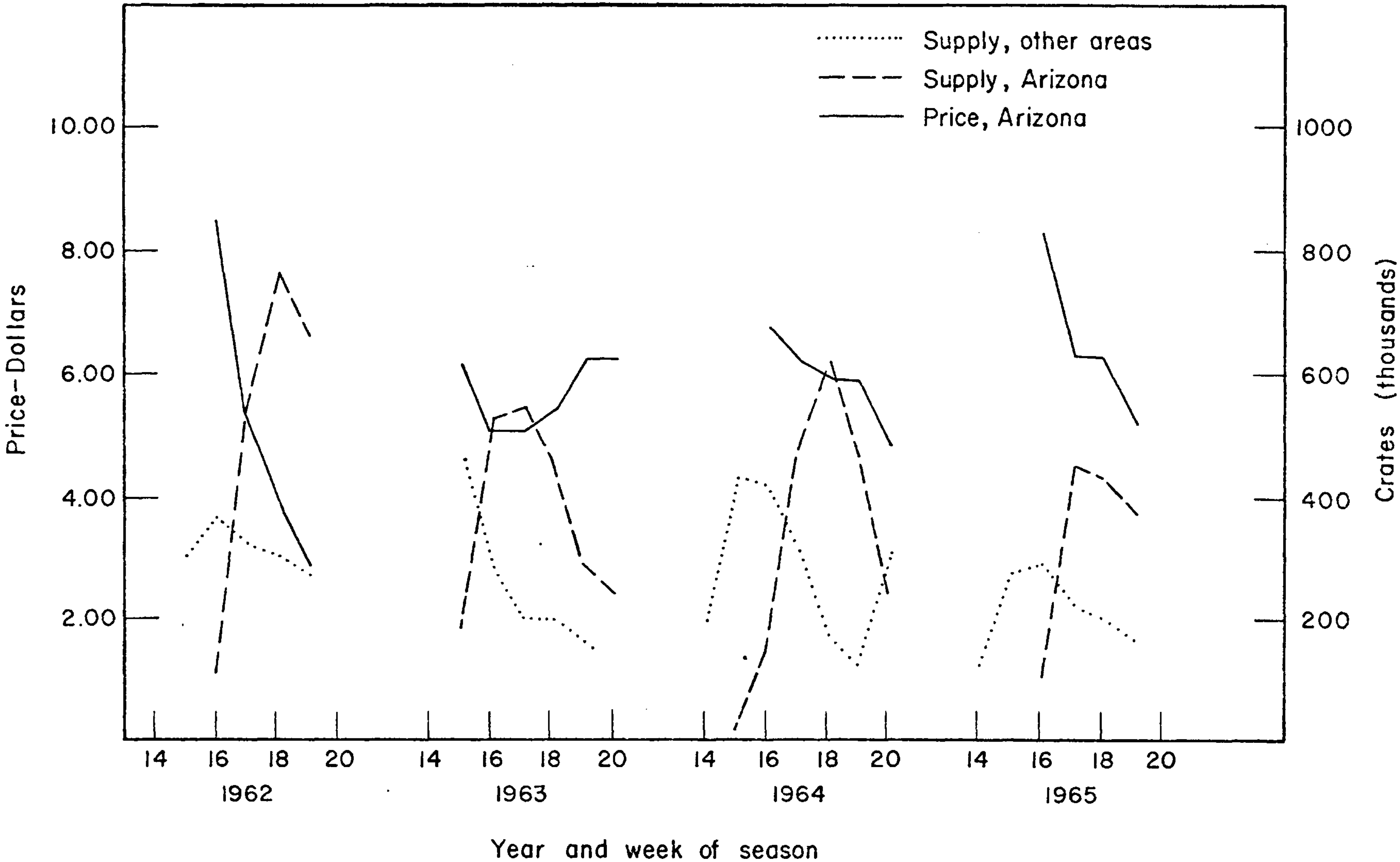


Figure 7. PRICE AND QUANTITY RELATIONSHIP OF U. S. CANTALOUPES--Continued

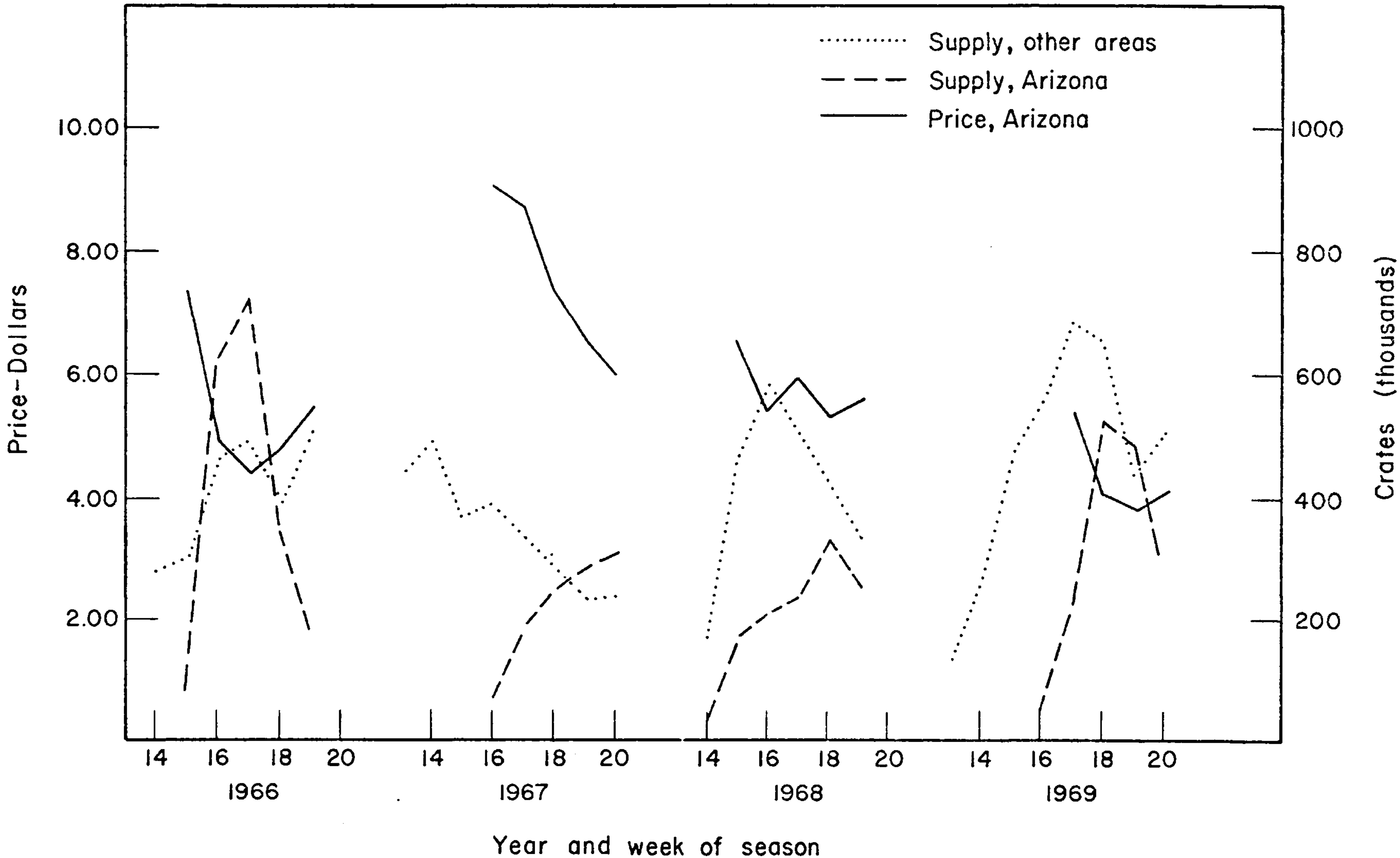


Figure 7. PRICE AND QUANTITY RELATIONSHIP OF U. S. CANTALOUPES--Continued

Other Data and Adjustments

In any regression analysis the structure generating the data should remain constant over the period of time covered by the data. A zero-one variable can be introduced in the analysis to allow for discrete changes in the structure over time. The purpose of the zero-one variable could be to determine if the structure has changed significantly from one period to another. However, the dummy variable has limited predictive value as it does not indicate the reason for the change.

Income level has been considered a demand shifter in many quantitative studies. Increases in income, for a superior good, increases demand, and vice versa. Income was included in the demand analysis to determine the income effect on cantaloupe prices in Arizona. The income variable was deflated to reflect 1958 dollars (Appendix Table 10).

Prior to 1958 the Market News Service reported truck shipments on an irregular basis. The data for those periods when truck shipments were not available was generated by using a ratio of rail versus truck shipments where both means of transportation were reported. Truck shipments by months were obtained from the Market Reports Section of the Consumer and Marketing Service in Washington, D.C., and these figures were used as a check for the method of generating shipments on a daily basis.

The only limitation of the data was the unavailability of complete shipment information from South Texas. This restriction was caused by the Market News Service closing their field office in Weslaco early each June. However, a large part of the Texas spring cantaloupe crop was generally harvested before the closing of the field station.

Application of Single Equation Least-Squares Multiple Regression

Several single equation linear multiple regression models were specified to estimate the price per crate of Arizona cantaloupes (at the packing house level) consistent with spring cantaloupe shipments and consumer income. The justification for using the single equation least-squares approach is presented in the latter part of Chapter III. Because causal relationships are difficult to determine, it is hypothesized that causation runs in one direction. That is, the dependent variable (price) is directly influenced by the independent variables. These single equation relationships were used to determine the price flexibility and elasticity of demand for Arizona cantaloupes.

The variables included in the analysis are identified as follows:

P - is the dependent variable which represents the F.O.B. price for a crate of size 36 cantaloupes.

Q_1 - weekly quantity of cantaloupes, in thousands of crates, shipped from Arizona.

Q_2 - weekly quantity of cantaloupes, in thousands of crates, shipped from Texas.

Q_3 - weekly quantity of cantaloupes, in thousands of crates, shipped from Mexico.

Q_4 - weekly quantity of cantaloupes, in thousands of crates, shipped from California.

Q_5 - weekly quantity of cantaloupes, in thousands of crates, shipped from all areas producing spring melons other than Arizona.

Q_6 - weekly quantity of cantaloupes, in thousands of crates, shipped from all spring melon producing regions.

I - United States per capita disposable income in 1958 dollars.

W - Zero-one dummy variable for each of the various weeks.

The University of Arizona's Computer Data Center conducted the analysis for each model by using the Multiple Regression technique. The following analyses were then performed on the data:

1. The "t" test was applied to each regression coefficient to determine if it was significantly different from zero at the 5 percent level. The computed "t" values appear in parenthesis below each regression coefficient. The following sign is used to indicate significance: *

2. The price elasticity of demand was determined in each model by calculating the price flexibility and then transposing. Price flexibility is the inverse of price elasticity. Price flexibility is calculated first since price is the dependent variable. Price elasticity of demand for each model represents the price elasticity of a particular point on the excess demand curve.

3. Income was not significant in any of the models tested; therefore, income elasticities are not calculated in this study.

Model I

The first relationship specified was:

$$P_A = (Q_1, Q_5, I)$$

where P_A is the price of Arizona cantaloupes. The least-squares regression equation, $P_A = b_o + b_1Q_1 + b_5 Q_5 + b_7 I$, is used to analyze weeks 15 through 20 for the years 1953-1969. The results of this model are presented in Table 12. It was hypothesized that cantaloupe shipments from Arizona and other areas would have a negative influence on price, while income would have a positive effect.

The regression coefficients in Model I had the expected signs except for income in week 15. However, the income effect was not significant for any week. The shipment of cantaloupes from Arizona had a significant effect on the F.O.B. price per crate during all weeks of the season except week 15. This can be explained by the seasonality of cantaloupe production in Arizona. Week 15 is the beginning of the Arizona melon season and the volume of cantaloupes shipped during the early part of the season is small.

Cantaloupe shipments from competing regions had a significant influence on Arizona melon prices only in weeks 17 and 20. Week 17 is near the end of the Rio Grande Valley of Texas cantaloupe season and the start of the Parker, Arizona, and Paloverde Valley, California shipping seasons. Week 20 occurs when Arizona's spring cantaloupe shipments are declining and shipments from the Central and Southern San Joaquin Valley areas are increasing.

The regression equation used in Model I had the highest R^2 value (.83) for week 16 and the lowest R^2 (.43) for week 18. The concept of excess demand was also illustrated by the results of this model (Table 12). As Arizona's market share increased, price elasticity of demand decreased, and vice versa.

The excess demand concept was used in constructing the demand curves for Arizona cantaloupes for each week of the season (Figure 8). These excess demand curves were computed by using the equation for excess demand which is expressed as:

$$P_A = b_0' + b_1Q_1$$

The value of the regression constant (b_0') in the above equation was computed by multiplying the regression coefficients by the average value of the independent variables and adding the results to the regression constant. In other words, the average influence of shipments from competing districts and the average influence of income were added to the regression

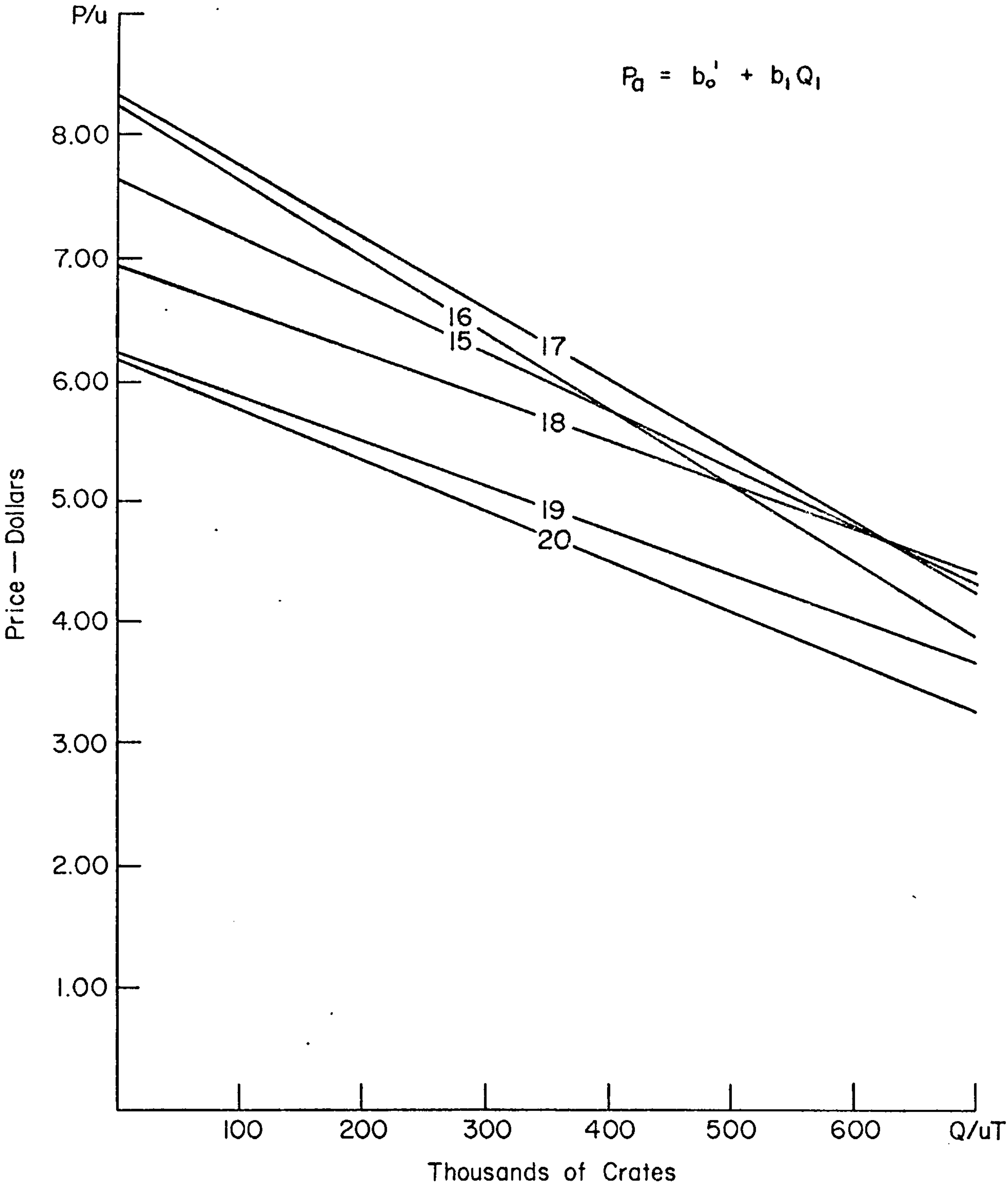


Figure 8. EXCESS DEMAND ANALYSIS OF ARIZONA CANTALOUPES BY WEEKS

constant to obtain b_0'. This step was performed for each week. The formula used was:

$$b_0' = b_0 + b_2\overline{Q}_5 + b_7\overline{I}$$

The position of the demand curves in Figure 8 indicates a seasonal shift in demand for Arizona cantaloupes; however, this does not indicate whether shift was significant. The purpose of Model III will be to determine if this shift in demand was significant. The position of the demand curves for weeks 16 and 17 indicates an increase in the demand for Arizona cantaloupes. This is expected since melon supplies are declining in Texas and increasing in Arizona; therefore, more buyers would be seeking melons in Arizona.

Model II

Model II was used to measure the structural coefficients of demand for cantaloupes by combining the quantities shipped from all spring producing areas. The functional form of the equation specified for multiple regression analyses was

$$P_A = f\ (Q_6, I)$$

In a sense, this functional relationship expresses total demands for cantaloupes in the United States for weeks 15 through 20. The results of Model II are presented in Table 13. The R^2 for each week was the same as those obtained in Model I. The combined effect of shipments from Arizona and competing areas had a significant influence on

Arizona cantaloupe prices. Per capita income was not significant. The price elasticities of total demand for each week were less elastic than the elasticities of Arizona's excess demand curves which were derived from Model I. This relationship holds true with excess demand theory.

The total demand curve for each week is illustrated in Figure 9. The relative position of these curves was the same as Arizona's excess demand curves in Figure 8 except for weeks 16 and 17. The demand during week 16 for this model was greater than cantaloupe demand in week 17. This shifting in total demand from week 15 to 16 was expected since supplies in competing districts normally decline in week 15 and more buyers seek cantaloupe supplies from Arizona. Quality could be another factor causing this shift since buyers are able to obtain the quality they are seeking as supplies become more plentiful beginning with week 16. Demand for cantaloupes declined as expected in each week succeeding week 16 as supplies increased and buyers became more cautious in trading.

Model III

The purpose of Model III was to determine if a seasonal shift in demand for Arizona cantaloupes occurred between weeks 15 and 20. The analysis was made with the inclusion of a zero-one dummy variable to represent each week of the season. Week 18 was used as the base period. The

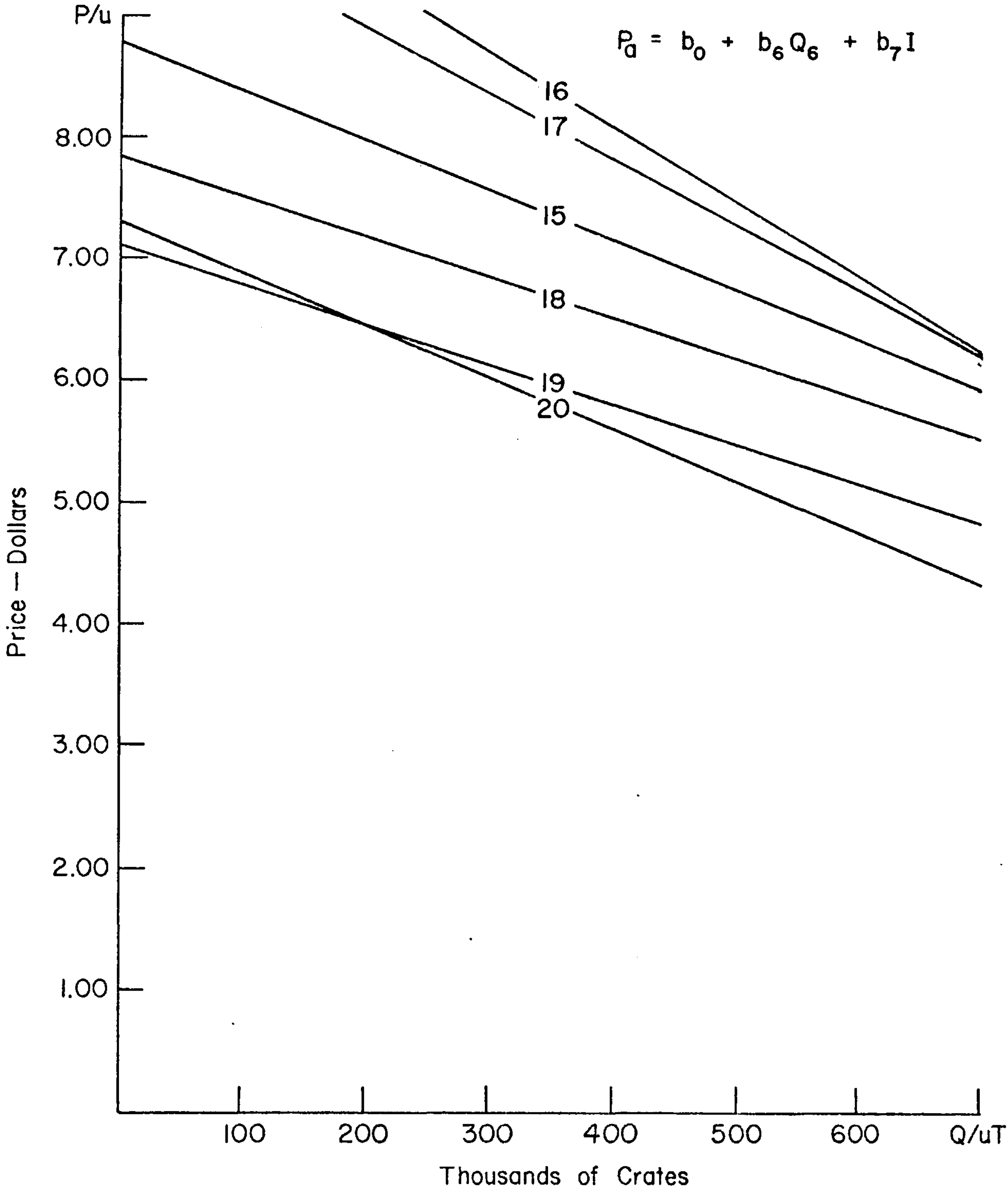


Figure 9. TOTAL DEMAND ANALYSIS OF U. S. SPRING CANTALOUPES BY WEEKS

MR (multiple regression) function specified was:

$$P_A = f\ (Q_1, Q_5, W_{15}, W_{16}, W_{17}, W_{19}, W_{20}, I)$$

The resulting statistical equation and the estimated regression coefficients were as follows:

$$P_A = 8.24 - \underset{(8.62)*}{(.0048)}\ (Q_1) - \underset{(4.16)*}{(.0033)}\ (Q_5) + \underset{(.38)}{(.1522)}\ (W_{15}) +$$

$$\underset{(1.34)}{(.4216)}\ (W_{16}) + \underset{(1.08)}{(.3106)}\ (W_{17}) - \underset{(2.90)*}{(.8415)}\ (W_{19})$$

$$- \underset{(3.62)*}{(1.2564)}\ (W_{20}) + \underset{(.38)}{(.0002)}\ (I)$$

$R^2 = .68$ d.f. = 74 $E_d = -2.78$

The computed "t" value for weeks 19 and 20 were significant while weeks 15, 16, and 17 were found to be nonsignificant. This indicates that a seasonal shift in the demand for Arizona cantaloupes occurred as expected and as suggested by the graphic position of the excess demand curves in Model I. Weeks 19 and 20 occur during late June and early July when cantaloupe supplies from Arizona are declining, shipments of the mid-summer crop are increasing, and the quality of the spring crop generally declines.

The analysis of Model III, in effect, is total demand for the entire Arizona cantaloupe season. The resulting price elasticity of demand of spring cantaloupes for weeks 15 through 20 was -2.78.

Model IV

This model attempts to measure the total demand for spring cantaloupes in the United States by specifying a MR analysis of the following form:

$$P_U = f\ (Q_6,\ I,\ W_4\ \ldots\ldots\ldots W_{20})$$

where P_U represents the price for cantaloupes regardless of the source of supply (Mexico, Texas, Arizona, or California). Implicit in this approach are the assumptions that cantaloupes from the various areas are a homogeneous commodity and that the price in a particular area primarily reflects the total supply of all areas. The Market News Service generally reports prices for Mexican cantaloupes in March and April before United States melons mature. Starting in May, prices are quoted for Texas cantaloupes and in June prices are reported from Arizona and California. Cantaloupe shipments from all sources are combined as one independent variable. A zero-one variable was also employed in this model to determine if demand for spring cantaloupes changes significantly during the spring season. Week 18 was again used as the base week. The results of Model IV are presented in Table 14.

The R^2 (.85) obtained with Model IV is an improvement over the predictive value obtained from the other models used in this study. Cantaloupe shipments from all areas have a highly significant influence on cantaloupe prices as expected. The "t" values for weeks 4, 11, 12, 13, 19, and 20 show that the demand for cantaloupes during these weeks was significantly different from week 18. Week 4 occurs in early March when Mexico is the only area shipping cantaloupes and supplies are small. The exact position of the demand curve for week 4 relative to week 18 is unknown; and, it cannot be determined in this analysis since only one observation was available. Weeks 11, 12, and 13 are the first three weeks of May when Texas becomes a major supplier of cantaloupes. The expected influence of Texas shipments would be a downward shift in the demand curves. Weeks 19 and 20 are at the end of the season when spring cantaloupe supplies and quality are declining and melon shipments from the mid-summer producing areas begin to move into the major markets.

Model V

This model was used in an attempt to measure the structural coefficients of demand for Mexican cantaloupes in United States markets. The functional form of the MR analysis used was:

$$P_m = b_o + b_3Q_3 + b_1Q_1 + b_2Q_2 + b_4Q_4 + b_7I$$

where P_m represents the price of Mexican cantaloupes. The independent variables used in the analysis besides Mexican quantities included cantaloupe shipments from Arizona, California, and Texas plus per capita income. Price and quantity data from Mexico was available from the years 1964 to 1969. The results of Model V are presented in Table 15.

Shipments from Mexico and Arizona had a significant influence on Mexican cantaloupe prices. Income and quantities shipped from California and Texas were nonsignificant. The price elasticity of demand for Mexican cantaloupes with respect to Mexican shipments was estimated to be -5.88. Gehring (1968) estimated the price flexibility of Mexican melon imports to be -.87 and the price elasticity of demand to be -1.15 for the years 1964 to 1966.

Excess demand theory was applied to Mexican cantaloupe imports and the resulting demand curve is presented in Figure 10. The average price and quantity obtained with this model was $9.90 and 99.7 respectively. The price is the F.O.B. price per crate and the quantity is the average number of crates (in thousands) exported each year from Mexico for the time that data was available.

Other Research

Boles (1969) prepared a statistical analysis of the intraseasonal variation in F.O.B. cantaloupe prices in four sub-areas of California including Wheeler Ridge (Bakersfield), Blythe, Westside (Fresno), El Centro and the Yuma area of Arizona. These five sub-areas produce the spring and summer cantaloupe crops in Arizona and California. Boles' (1969) attempts to predict an average seasonal pattern of prices after considering cantaloupe shipments and consumer income.

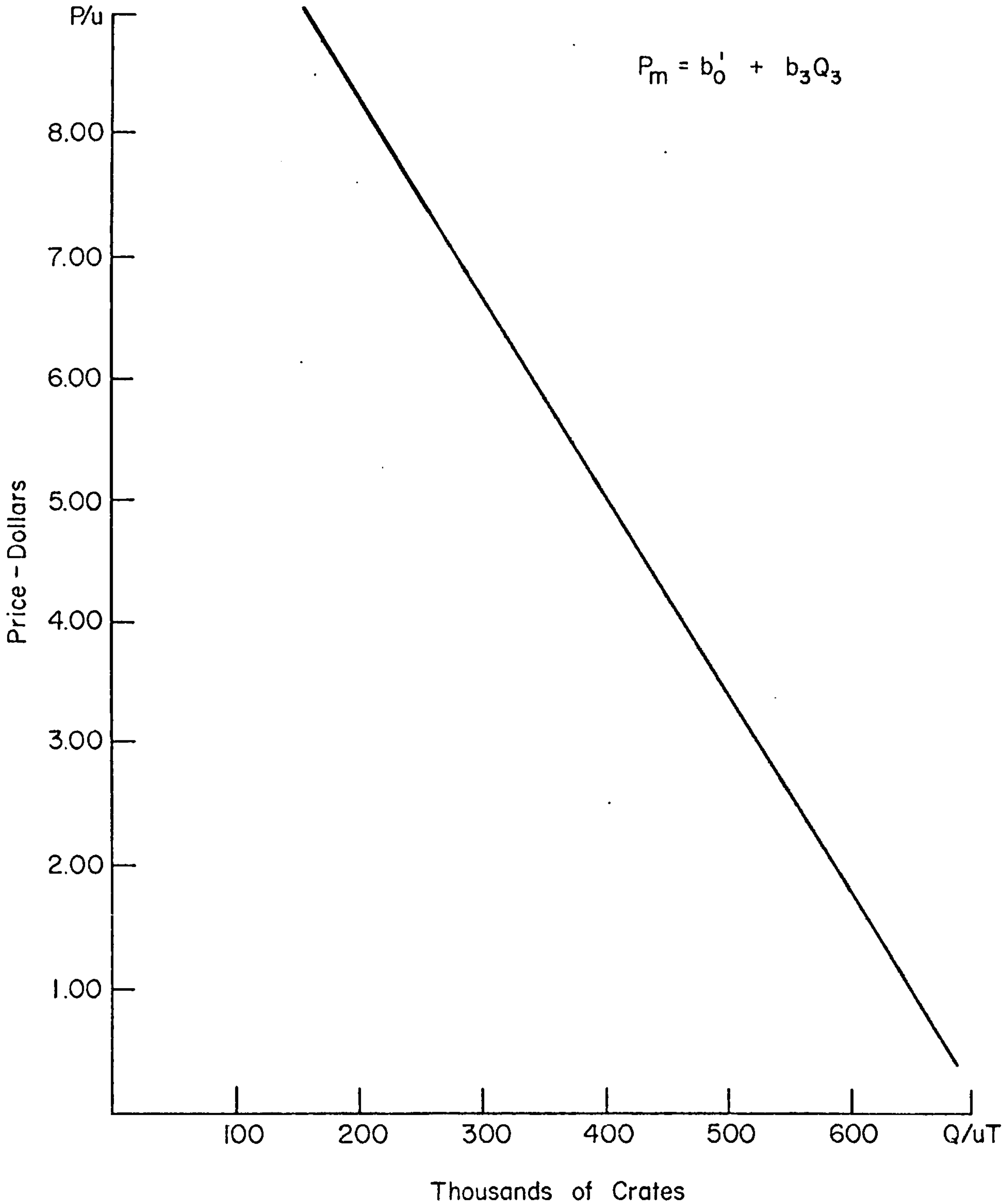


Figure 10. EXCESS DEMAND ANALYSIS OF MEXICAN CANTALOUPES, 1964-69

Boles' (1969) basic data consisted of daily cantaloupe shipments and daily F.O.B. prices from the five subareas mentioned as well as daily shipments from other United States areas and from Mexico. This data was reduced to a weekly average for the years 1963 to 1968. The following equation was obtained:

$$y = 8.595 + 1.409\, X_1 - .356\, X_2$$

where y is the price in dollars per jumbo crate of size 36 cantaloupes; X_1 is per capita income in thousands of dollars; X_2 is per capita shipments in carlots per million persons. The resulting R^2 was a .86. Boles (1969) also found cantaloupe shipments for all weeks caused a significant and systematic reduction in cantaloupe prices. When considering average shipments per week (averaged over 1963 to 1968) and 1968 population and income, the seasonal pattern of F.O.B. prices generated by Boles' (1969) demand equation are presented in Table 16.

CHAPTER V

SUMMARY AND CONCLUSIONS

Arizona ships a large portion of the spring cantaloupe supplies for United States markets. The production and marketing of spring cantaloupes contributes significantly to the economy of Arizona, especially the economy of the Yuma district. California, Texas, and Mexico are the other major sources of spring cantaloupe supplies which compete with Arizona melons during May and June. The overlapping of the harvesting periods that exists between these four regions results in seasonal variation in the quantities of cantaloupes marketed and the prices received at the farm level.

Cantaloupe production is a high risk venture. This characteristic makes it particularly advantageous for Arizona producers and handlers to be aware of the relationship between the quantity of cantaloupes shipped each spring and prices. Thus, the purpose of this study was to conduct a demand analysis of spring cantaloupes from which estimates and forecasts of economic phenomenon could be made. This study was primarily interested in developing an economic model for analyzing the structure of demand for Arizona cantaloupes at the packing house level. Price and income elasticities were also estimated.

Market demand theory was applied in developing the models used in this analysis. Demand was measured at the packing house level. Even though farm and retail prices appear to be related by some absolute and some percentage markups, it was assumed in this study that demand at the packing house level was a derived demand and less elastic at any given level of quantity than demand at the retail level. Excess demand theory was also applied in the study since the relevant demand for Arizona cantaloupes is the total market demand for spring melons less the quantities supplied by other areas at each price. This is the significant demand facing any decision making unit. At any price below equilibrium of the total market demand and supply of other producing regions an excess demand exists. This demand is more elastic than total demand provided supply is not perfectly inelastic.

The first step of the analysis was to determine the economic factors that affect cantaloupes and how the markets work. A diagram was developed to show the flow of cantaloupes through the marketing channels from producer to consumer which was helpful in portraying various interrelationships in the marketing system. This information was helpful in setting up the theoretical models used in an attempt to explain or describe those factors that were to affect the demand and price of cantaloupes. In other words, the flow chart gave an indication of the kind of statistical techniques that could be used in the analysis. The diagram indicated that: 1) there is no economic abandonment or unharvested spring cantaloupe production, 2) all of the production moved directly to a single outlet, 3) melon consumption is determined by current production since there is no significant amount of waste between the producer and consumer, and 4) cantaloupes have no close substitutes. When these conditions exist, then unbiased estimates of the structural coefficients of demand can be obtained through the use of a single equation fitted by least-squares.

In the analysis, several single equation multiple linear regression models were specified to estimate the price per crate of Arizona cantaloupes consistent with spring cantaloupe shipments and consumer income. The "t" test was applied to each regression coefficient to determine if it was significantly different from zero. The price elasticity of demand was also determined in each model by calculating the price flexibility and then transposing. Income did not have a significant influence on cantaloupe prices in any of the models; therefore, income elasticities were not calculated. It was assumed that cantaloupes are a neutral commodity.

The results of Models I and II were the same except that the price elasticities of demand for each week in Model II were lower than Model I. Model I was an excess demand analysis of Arizona cantaloupes and Model II was a total demand analysis of spring cantaloupes. The price elasticity of demand for Arizona cantaloupes was found to be highly elastic in both models for all weeks (15 through 20) of Arizona's melon season. This indicates that the cantaloupe industry of Arizona could increase total revenue by increasing melon shipments. This would not apply to the individual firm who may already be operating at the most efficient scale. A high R^2 of .83 was obtained for week 16 and week 18 had a low R^2 of .43. Factors other than those included in Model I and Model II had an influence on Arizona cantaloupe prices during week 18. Excess demand theory was found to hold true in Model I since price elasticity of demand for Arizona cantaloupes decreased as Arizona's share of supply increased and vice versa.

A seasonal shift in demand for Arizona cantaloupes was found in Model III with the inclusion of a zero-one dummy variable to represent each week. The graphic position of the excess demand curves in Figure 8 suggests a downward shift in demand for Arizona cantaloupes toward the end of the spring season. This was expected since supplies in Arizona are declining at this time while shipments of the mid-summer melon crop are increasing. Also, the quality of the spring crop declines near the end of the season. The resulting price elasticity of demand for Arizona cantaloupes for all weeks combined (15 through 20) was -2.78. The R^2 for Model III was .68.

Model IV attempted to measure the total demand for spring cantaloupes in the United States regardless of the source of supply. Implicit in this approach were the assumptions that cantaloupes from the various areas are a homogeneous commodity and that the price in a particular area primarily reflects the total supply of all areas. Shipment and income data for weeks 4 through 20 were used in this model and the price elasticity of demand for these weeks was estimated to be -2.77 which is the same as the elasticity of demand obtained in Model III. The R^2 (.85) obtained with Model IV was an improvement over the predictive value of the other models used in this study.

The last model used attempted to measure the structural coefficients of demand for Mexican cantaloupe imports for the years 1964 to 1969. Arizona cantaloupe shipments were found to have a significant influence on Mexican cantaloupe prices. Quantities shipped from Texas were nonsignificant even though Texas starts shipping melons earlier than Arizona. The price elasticity of Mexican cantaloupe imports were highly elastic at -5.88. However, the predictive value of Model V was poor since the resulting R^2 (.44) was low.

A description of the structure of the spring cantaloupe industry was also included in the thesis. The purpose was to aid in the development of a thorough understanding of the interrelationships of the industry and to add to the understanding of the economic factors that affect cantaloupe prices. The marketing channels for cantaloupes are similar to those of most perishable commodities. The marketing system is classified by separate functions which include the following: grower, packer, broker, wholesaler, retailer, and consumer. Many of the firms operating in the Western United States perform all of these functions except for retailing and consuming.

A review of shipment data revealed that Mexico begins exporting cantaloupes in February and continues shipping until Texas and Arizona start their harvesting season. Arizona has averaged shipping 40.2 percent of all spring cantaloupe shipments compared to 24.9 percent for California. Texas and Mexico have averaged shipping 19.3 and 13.6 percent respectively. Exports from Mexico have declined from 1965 because diseases and viruses reduced yields. California also had disease difficulties in the mid 1960's which sharply reduced cantaloupe production. New disease resistant varieties have been developed for California; however, production has not returned to previous levels because of competition from Arizona and Texas. Spring cantaloupe production in Arizona has remained relatively more stable while the importance of Texas as a supplier has been increasing in recent years.

Production cost per 80-pound crate in Texas, California, and Mexico were shown to be \$1.76, \$1.99, and \$3.11

respectively. Average yields per acre for these three areas are 160 crates in California, 125 crates for Texas, and 110 crates in Mexico. The total production, harvesting, and marketing cost or break-even price per 80-pound crate for Texas was $5.18 compared to $9.78 per crate for Mexican growers. Harvesting and marketing information was not available for Arizona or California. The harvesting and marketing cost is more near an absolute cost; therefore, it was assumed that the cost for performing these functions is greater in Arizona and California than in Texas because of higher labor expenditures.

APPENDIX A

STATISTICAL TABLES

TABLE 1. CANTALOUPES--USUAL HARVESTING DATES FOR THE PRINCIPAL PRODUCING AREAS AND SEASONAL GROUPS

Seasonal Group & State	Usual Harvesting Dates: Begins	Most Active	Ends	Principal Producing Districts or Areas
Spring				
Texas	4/25	5/10-6/15	6/30	Rio Grande Valley
Florida	4/15	5/15-6/15	6/30	Gainesville
California	5/1	June	7/10	Desert Valleys
Arizona	5/20	6/10-7/10	7/20	Yuma
Early Summer				
Arizona	5/15	July	7/31	Salt River Valley
Georgia	6/1	6/15-7/31	8/15	Coastal Plain, Piedmont
South Carolina	6/10	6/20-7/20	8/20	Blackville, Pageland
Mid-Summer				
Texas	6/10	6/25-8/15	9/15	Elgin, Milano, East Texas, Pecos, El Paso, Dallas-Ft. Worth
California	7/1	7/10-9/10	10/10	San Joaquin Valley, Sacramento Valley, Southern California
Indiana	7/10	7/10-8/31	9/20	
Late Summer				
Michigan	8/1	8/15-9/15	9/20	Detroit
Ohio	7/25	8/10-9/15	9/30	
New Jersey	8/1	8/10-9/10	10/10	
Colorado	8/10	8/20-9/20	10/10	Brighton-Greeley, Arkansas Valley, Western Slope

TABLE 1--Continued

Seasonal Group & State	Usual Harvesting Dates			Principal Producing Districts or Areas
	Begins	Most Active	Ends	
Early Fall				
California		October		Westside San Joaquin Valley, Central California
Arizona		October		Maricopa

Sources: United States Department of Agriculture (1963), Federal-State Market News Service, Marketing California Melons, 1962 Season, Fresno, California.

United States Department of Agriculture (1954), Agricultural Marketing Service, Agricultural Handbook No. 80, Washington, D. C.

TABLE 2. COMMERCIAL CANTALOUPE PRODUCTION BY SEASONAL GROUPS AND YEARS, 1953-69

Year	Spring	Early Summer	Mid-Summer	Late Summer	Early Fall	Total
			1,000 cwt.			
1953	4,280	1,726	5,617	1,035	N.A.	12,659
1954	4,924	1,541	5,590	1,095	N.A.	13,197
1955	4,574	1,174	5,926	1,129	N.A.	12,937
1956	4,684	941	5,497	1,165	N.A.	12,333
1957	3,044	689	6,232	1,150	N.A.	11,110
1958	3,173	1,279	7,110	1,039	N.A.	12,420
1959	4,064	998	6,585	1,179	N.A.	12,870
1960	3,669	679	7,115	1,160	N.A.	12,562
1961	3,249	659	7,693	1,165	126	12,765
1962	3,964	624	7,542	1,080	324	13,343
1963	4,181	570	7,559	1,119	242	13,409
1964	3,438	561	7,402	1,066	228	12,162
1965	3,725	730	6,184	791	284	11,714

TABLE 2--Continued

Year	Spring	Early Summer	Mid-Summer	Late Summer	Early Fall	Total
1966	3,230	646	5,789	851	237	10,753
1967	3,885	751	6,655	801	460	12,552
1968	3,841	806	7,732	794	362	13,535
1969	5,175	708	7,249	566	354	13,725
Average 1960-69	3,836	673	7,092	939	291	12,802
Percent of Total	30.0%	5.3%	55.4%	7.3%	2.0%	100%

Sources: United States Department of Agriculture (1955-1968), Agricultural Statistics, Washington, D. C., annual issues.

United States Department of Agriculture (1968-1969), Statistical Reporting Service, Crop Reporting Board, Commercial Vegetables, Austin, Texas, periodic releases.

TABLE 3. SPRING CANTALOUPE PRODUCTION FOR U. S. MARKETS BY AREAS, 1953-69

Year	Arizona	California	Florida	Texas	Mexico[a] Imports	Total
			1,000 cwt.			
1953	1,992	1,598	53	631	N.A.	4,274
1954	2,160	1,500	74	1,190	N.A.	4,924
1955	1,848	1,216	110	1,400	N.A.	4,574
1956	1,955	1,310	139	1,280	N.A.	4,684
1957	1,155	981	56	852	87	3,131
1958	1,331	1,130	72	640	267	3,440
1959	1,762	1,812	85	405	286	4,350
1960	2,010	1,188	72	399	509	4,178
1961	1,668	988	75	518	354	3,603
1962	2,062	1,068	78	756	497	4,461
1963	2,249	942	77	913	527	4,708
1964	1,970	570	88	810	858	4,296
1965	1,932	611	120	1,062	839	4,564

TABLE 3--Continued

Year	Arizona	California	Florida	Texas	Mexico Imports[a]	Total
1966	1,800	912	90	428	875	4,105
1967	1,308	1,175	90	1,312	692	4,577
1968	1,392	1,441	70	938	343	4,184
1969	1,472	2,172	91	1,440	529	5,704
Average 1960-69	1,786	1,107	85	858	602	4,438
Percent of Total	40.2	24.9	1.9	19.3	13.6	100%

a. Imports from Mexico are for the months of May and June only.

Sources: United States Department of Agriculture (1955-1968), Agricultural Statistics, Washington, D. C., annual issues.

United States Department of Agriculture (1968-1969), Statistical Reporting Service, Crop Reporting Board, Commercial Vegetables, Austin, Texas, periodic releases.

TABLE 4. CANTALOUPE IMPORTS FROM MEXICO BY MONTHS AND YEARS

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
						1,000 Pounds							
1957	1,139	4,481	13,693	21,663	8,136	551	-	-	-	-	-	85	49,747
1958	861	1,269	1,414	13,414	23,754	2,980	164	-	-	-	-	-	43,856
1959	196	500	5,481	21,380	26,936	2,684	128	18	-	-	-	-	56,223
1960	510	2,328	11,195	13,630	44,557	6,313	126	-	-	307	316	-	79,281
1961	2,479	2,074	9,836	29,416	32,555	2,828	37	-	-	-	327	-	79,552
1962	1,387	1,876	10,870	33,634	41,257	8,406	56	142	-	58	-	110	97,796
1963	423	1,277	11,804	43,595	50,784	1,961	409	174	-	-	-	-	110,427
1964	-	402	15,272	27,829	47,375	38,466	374	-	-	12	-	332	130,062
1965	431	732	9,190	51,097	64,170	19,694	357	108	55	367	184	148	146,533
1966	646	1,995	15,609	30,573	59,787	27,753	130	-	-	-	15	-	136,508
1967	-	259	9,014	38,401	54,332	14,899	287	18	-	-	8	-	117,218

TABLE 4--Continued

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1968	-	300	10,466	26,900	28,993	5,287	132	-	61	-	-	7	72,146
1969	-	359	17,423	47,095	37,838	15,064	487	-	-	-	-	-	118,266
Average 1960-69	588	1,160	12,068	34,217	46,165	14,067	239	44	21	74	85	60	

Source: United States Department of Agriculture (1968), Foreign Agricultural Service, Fruit and Vegetable Division, Commodity Analysis Branch, *Strawberries and Selected Fresh Vegetables, U. S. Imports (for consumption) from Mexico (by months)*, Washington, D. C.

TABLE 5. CANTALOUPES: PREHARVEST COST PER ACRE, TEXAS, 1969

Item	Units	Value Per Unit	Total Cost	
		Dollars	Dollars	
Cash Expenses				
Tractor and Equipment	15 hours	$ .80	$12.00	
Tractor Labor	17 hours	1.50	25.00	
Other Labor (thinning, moving vines, irrigation, etc.)	33 hours	1.40	46.20	
Seed	2 pounds	2.50	5.00	
Fertilizer (80-80-0)	160 pounds	.11	17.60	
Insecticide	4 applications	2.25	9.00	
Fungicide	4 applications	4.00	16.00	
Herbicide (Prefar)	½ application	16.00	8.00	
Irrigation Water	4 applications	3.00	12.00	
Pollination (Bees)	½ hive	6.00	3.00	
TOTAL GROWING COST				$154.30
Cash Overhead:				
Land Rent			30.00	
Interest on Production capital (8 Pct., 6 mo.)			6.20	36.20
				$190.50

TABLE 5--Continued

Item	Units	Value Per Unit	Total Cost
Non-Cash Overhead:			
Depreciation (equipment, building, vehicles)			$30.00
TOTAL ALL COSTS			$220.50
Total Cost per Crate (Yield: 125 crates)			$ 1.76

Source: Thomas D. Longbrake (1970), <u>Vegetables-Estimated Costs of Production</u>, Mimeo Report, Texas Agricultural Extension Service, Weslaco, Texas.

TABLE 6. CANTALOUPES: PREHARVEST COST PER ACRE, IMPERIAL VALLEY, CALIFORNIA, 1968

Item	Units	Value Per Unit	Total Cost
		Dollars	Dollars
Cash Expenses:			
Tractor and Equipment	Custom		$52.00
Labor (hoe, irrigate, thin, move vines, etc.	49 hours	$ 2.00	98.00
Seed	2 pounds	2.25	4.50
Fertilizer			
11-48-0	400 pounds	.05	20.00
Sidedress Nitrogen	150 pounds	.10	15.00
Insecticide	6 times	3.00	18.00
Funigate	1 time	14.00	14.00
Irrigation water	6 times	1.15	6.90
Pollination (Bees)	1.5 hives	4.00	6.00
TOTAL GROWING COST			$236.13

TABLE 6--Continued

Item	Units	Value Per Unit	Total Cost	
		Dollars	Dollars	
Cash Overhead				
Land Rent			$65.00	
Interest on Production Capital (6 Pct., 6 mo.)			6.57	
Miscellaneous			10.00	$81.57
TOTAL ALL COSTS				$317.70
Total Cost Per Crate (Yield: 160 crates)				1.99

Source: John C. Fliginger, et al., (1969), Supplying U. S. Markets with Fresh Winter Produce - Capabilities of U. S. and Mexican Production Areas, United States Department of Agriculture, Economic Research Service, Washington, D. C., p. 96.

TABLE 7. CANTALOUPES: PREHARVEST COST PER ACRE, SINALOA, MEXICO, 1968

Item	Total Cost	
Cash Expenses:		
Tractor and Equipment	$52.48	
All labor (machine, operators, irrigators, field hands, etc.)	85.93	
Seed	54.00	
Fertilizer	16.19	
Insecticide and Fungicide	19.43	
Irrigation water	3.89	
		$238.72
Cash Overhead:		
Land Rent	32.39	
Interest on Production Capital (9 Pct., 5 mo.)	8.95	
Other	11.94	53.28
		$292.00
Non-Cash Overhead:		
Equipment Depreciation	35.05	
Interest (9 Pct.)	14.61	49.66
TOTAL ALL COST		$341.66
Total Cost Per Crate (Yield: 110 crates)		3.11

Source: John C. Fliginger, et al., (1969), Supplying U. S. Markets with Fresh Winter Produce - Capabilities of U. S. and Mexican Production Areas, United States Department of Agriculture, Economic Research Service, Washington, D. C., p. 97.

TABLE 8. CANTALOUPES: COST PER 80-POUND CRATE OF HARVESTING, PACKING AND SELLING F.O.B., BY SELECTED LOCATIONS, MEXICO AND TEXAS, 1968

Item	Mexico (Sinaloa)	Texas (Rio Grande Valley)
Harvesting	$ .45	$1.06
Packing and Selling	1.88	2.36
TOTAL HARVESTING, PACKING, SELLING	2.33	3.42
Mexican Export Cost to Nogales:		
Union and Association Dues	.06	
U. S. Import Duty	1.58[a]	
U. S. Customs and Other Services	.04	
Mexican Taxes, Duties, and Services	.72	
Freight and Related Cost	1.13	
Labor, Materials and Miscellaneous Expenses	.08	
TOTAL EXPORT COST	3.61	
Sales Commission (U. S. Broker)	.73[b]	
TOTAL EXPORT AND SELLING COST	$4.34	
Total F.O.B. Marketing Cost	$6.67	$3.42

a 35 percent ad valorem at $4.50 per crate f.o.b. Nogales
b 8 percent of value in New York

Source: John C. Fliginger, et al., (1969), Supplying U. S. Markets with Fresh Winter Produce - Capabilities of U. S. and Mexican Production Areas, United States Department of Agriculture, Economic Research Service, Washington, D. C., p. 111.

TABLE 9. PER CAPITA CANTALOUPE CONSUMPTION BY YEARS, 1950-68

Year	Per Capita Consumption (Pounds)
1950	9.1
1951	8.9
1952	8.6
1953	9.2
1954	9.7
1955	9.4
1956	9.0
1957	7.8
1958	8.2
1959	8.6
1960	8.6
1961	8.5
1962	8.5
1963	8.7
1964	8.2
1965	7.9
1966	7.3
1967	8.1
1968	8.3
Average	8.5

Source: United States Department of Agriculture (1969), Economic Research Service, The Vegetable Situation, Washington, D. C., p. 17.

TABLE 10. SUPPLEMENTAL DATA

Year	GNP Implicit Price Index 1958=100	Index of United States Population 1958=100	Per Capita Disposable Income 1958 Dollars
1950	78.3	87.2	1646
1951	84.8	88.6	1657
1952	86.7	90.2	1678
1953	89.6	91.6	1726
1954	90.8	93.0	1714
1955	91.6	94.9	1795
1956	94.5	96.6	1839
1957	97.9	98.3	1844
1958	100.0	100.0	1831
1959	101.4	101.7	1881
1960	102.8	103.3	1883
1961	103.7	105.1	1909
1962	104.7	106.7	1968
1963	105.8	108.3	2013
1964	107.0	109.9	2123
1965	108.8	111.3	2235
1966	111.6	112.6	2331
1967	114.8	113.9	2399
1968	118.9	115.0	2374
1969	124.2	116.2	2507

Source: United States Government Printing Office (1970), Economic Report of the President, Transmitted to the Congress, Washington, D. C.

TABLE 11. CONVERSION FACTORS FOR CONVERTING JUMBO CANTALOUPE CRATES TO CARLOT EQUIVALENTS, 1950-69

Year	Number of 80 Pounds Crates Per Truck or Carlot Equivalent	
	United States	Mexico
1950	310	290
1951	310	290
1952	310	290
1953	310	290
1954	310	290
1955	310	290
1956	310	290
1957	310	290
1958	310	290
1959	310	290
1960	400	385
1961	400	385
1962	400	385
1963	400	385
1964	400	385
1965	400	385
1966	500	425
1967	500	425
1968	500	425
1969	500	425

Source: United States Department of Agriculture (1955-1968), Consumer and Marketing Service, Fruit and Vegetables Division, Market News Branch, Fresh Fruit and Vegetable Shipments by Commodities, States, Months, Washington, D. C., annual issues.

TABLE 12. ANALYSIS OF DEMAND OF ARIZONA CANTALOUPES FOR WEEKS 15 - 20

$$P_A = b_0 + b_1Q_1 + b_5Q_5 + b_7I$$

Week	Constant b_0	Regression Coefficients b_1	b_5	b_7	R^2	E_d
15	9.52	-.0048	-.0035	-.0003	.61	-7.14
		(.85)	(.74)	(.25)		
16	8.30	-.0064	-.0045	.0008	.83	-2.94
		(6.34)*	(1.73)	(.75)		
17	8.04	-.0058	-.0046	.0009	.71	-1.96
		(4.06)*	(2.36)*	(.77)		
18	7.84	-.0037	-.0026	.0000	.43	-2.70
		(2.26)*	(1.41)	(.04)		
19	6.34	-.0036	-.0026	.0003	.47	-3.13
		(2.71)*	(1.35)	(.00)		
20	6.25	-.0043	-.0042	.0005	.69	-3.13
		(2.96)*	(2.52)*	(.55)		

* Significant at the 5 percent level.

TABLE 13. ANALYSIS OF DEMAND FOR ARIZONA CANTALOUPES USING U.S. AND MEXICO SPRING SHIPMENTS WEEKS 15 - 20

$$P_A = b_0 + b_6Q_6 + b_7I$$

Week	Constant	Regression Coefficients		R^2	E_d
		b_6	b_7		
15	9.25	-.0041 (2.75)*	-.0003 (.23)	.61	-2.94
16	7.95	-.0062 (6.95)*	.0013 (1.43)	.82	-1.43
17	7.30	-.0054 (5.16)*	.0013 (1.63)	.71	-1.22
18	7.35	-.0032 (2.96)*	.0002 (.18)	.42	-1.89
19	6.08	-.0033 (2.93)*	.0005 (.51)	.46	-2.00
20	6.28	-.0042 (3.72)*	.0005 (-71)	.69	-1.82

* Significant at the 5 percent level.

TABLE 14. ANALYSIS OF DEMAND FOR SPRING CANTALOUPES FROM ALL SOURCES

$P_U = f\ (Q_6,\ I,\ W_4, \ldots\ldots\ldots W_{20})$

Variable	Regression Coefficient	"T" Value
Q_6	- .0051	10.81*
I	.0008	2.48*
W_4	2.3504	2.17*
W_5	1.3058	1.21
W_6	.7511	.91
W_7	.0007	.00
W_8	- .0921	.13
W_9	.2173	.36
W_{10}	.6728	1.16
W_{11}	1.0413	1.87*
W_{12}	1.3439	2.58*
W_{13}	1.1620	2.40*
W_{14}	.5269	1.19
W_{15}	.4618	1.23
W_{16}	.4678	1.39
W_{17}	.3876	1.16
W_{19}	- .9412	2.74*
W_{20}	-1.4077	3.45*
$R^2 = .85$	d.f. = 138	$E_d = -2.77$

* Significant at the 5 percent level.

TABLE 15. ANALYSIS OF DEMAND FOR SPRING CANTALOUPES FROM MEXICO, 1964-69

$$P_m = f\ (b_3Q_3,\ b_1Q_1,\ b_2Q_2,\ b_4Q_4,\ b_7I)$$

Variable	Regression Coefficient	"T" Value
Q_3	-.0165	-4.45*
Q_1	.0066	1.09
Q_2	-.0389	-1.93*
Q_4	.0258	1.60
I	-.0014	- .97
R^2 = .44	d.f. = 39	E_d = -5.88

* Significant at the 5 percent level.

TABLE 16. ANALYSIS OF DEMAND FOR CANTALOUPES BY WEEKS FROM ARIZONA AND CALIFORNIA, 1963 - 68

Week*	Average Shipment (carlots)	Predicted Price dollars/crate
2	1,200	10.61
3	1,800	8.94
4	1,901	8.54
5	1,524	7.85
6	1,348	7.84
7	1,312	7.63
8	1,489	7.20
9	1,406	7.46
10	1,629	7.08
11	1,670	6.57
12	1,526	5.81
13	1,225	5.77
14	943	5.52
15	882	5.65
16	760	5.78
17	482	5.98
18	369	5.87
19	248	6.17
20	191	5.50
21	58	4.45

* Week numbers used by Boles do not correspond to week numbers used in this study.

TABLE 17. EARLY SUMMER (JULY) CANTALOUPE PRODUCTION BY YEAR AND STATE

Year	Arizona	Other S.C., Ga., Nev., etc.	Total
	1,000 cwt.		
1953	1320	760	2080
1954	826	715	1541
1955	368	806	1174
1956	330	611	941
1957	188	501	689
1958	525	754	1279
1959	468	530	998
1960	218	561	679
1961	252	407	659
1963	78	492	570
1964	69	492	561
1965	66	664	730
1966	94	552	646
1967	82	669	751
1968	120	686	806
1969	231	477	708
Average 1960-69	135	538	673
Percent of Total	20.1	79.9	

Sources: United States Department of Agriculture (1955-1968), Agricultural Statistics, Washington, D. C., annual issues.

United States Department of Agriculture (1968-1969), Statistical Reporting Service, Crop Reporting Board, Commercial Vegetables, Austin, Texas, periodic releases.

TABLE 18. MID-SUMMER (AUGUST) CANTALOUPE PRODUCTION BY YEAR AND STATE

Year	California	Texas	Other Ark., N.C., Del., Ill., Ind., N.M., Okla., Wash.	Total
		1,000 cwt.		
1953	4490	950	1328	6768
1954	4298	222	1070	5590
1955	4464	204	1258	5926
1956	4102	204	1191	5497
1958	5596	385	1129	7110
1959	5264	270	1051	6585
1960	5578	315	1222	7115
1961	6209	360	1124	6793
1962	6167	248	1127	7542
1963	6192	288	1079	7559
1964	6121	325	956	7402
1965	5285	340	559	6184
1966	4989	296	504	5789
1967	5827	322	506	6655
1968	6966	264	502	7732
1969	6714	262	273	7249
Average 1960-69	6005	302	785	7092
Percent of Total	84.7	4.2	11.1	

Source: United States Department of Agriculture (1955-1968), Agricultural Statistics, Washington, D. C., annual issues.

United States Department of Agriculture (1968-1969), Statistical Reporting Service, Crop Reporting Board, Commercial Vegetables, Austin, Texas, Periodic releases.

TABLE 19. LATE SUMMER (SEPTEMBER) CANTALOUPE PRODUCTION, 1953-69

Year	Total All States Colo., Kans., Mich., N.J., N.Y., Ohio, Oreg., Utah
	1,000 cwt.
1953	1247
1954	1094
1955	1129
1956	1165
1957	1150
1958	1039
1959	1179
1960	1160
1961	1165
1962	1080
1963	1119
1964	1066
1965	791
1966	851
1967	801
1968	794
1969	566
Average 1960-69	939

Sources: United States Department of Agriculture (1955-1968), Agricultural Statistics, Washington, D. C., annual issues.

United States Department of Agriculture (1968-1969), Statistical Reporting Service, Crop Reporting Board, Commercial Vegetables, Austin, Texas, periodic releases.

TABLE 20. EARLY FALL (OCTOBER) CANTALOUPE PRODUCTION BY YEAR AND STATE

Year	Arizona	California	Total
1961		126	126
1962		324	324
1963		242	242
1964	28	200	228
1965	68	216	284
1966	49	188	237
1967	54	406	460
1968	40	322	362
1969	60	294	354

Sources: United States Department of Agriculture (1955-1968), Agricultural Statistics, Washington, D. C., annual issues.

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