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The purpose of the present study has been the specification and measurement of the characteristics of the intraseasonal demand for fresh Bartlett pears. In particular, the study has focused attention on a particular producing area, the Rogue River Valley of Oregon.

The intraseasonal analysis for fresh Bartlett pears was performed using two alternative specifications on the model of the Bartlett pear market. In the first model, it was assumed that each bi-weekly supply function was perfectly inelastic and that the supply quantity was determined by factors other than the current price of fresh Bartlett pears. The bi-weekly demand functions were estimated by the ordinary least-squares method. In the second model, it was assumed that growers set prices on

the basis of the market prices they had most recently observed and of their total holdings of Bartlett pears. A price predicting equation was then estimated by ordinary least-squares and the resulting predicted prices were used in estimating the parameters of the demand functions.

In both models, the analysis was performed alternatively by subperiods and by marketing seasons. The latter differed from the former in that the years under study were separated into sets of years having the same number of subperiods.

The subperiod analyses were performed by two approaches: 1) a demand equation was estimated for each subperiod, and 2) a single equation was specified in which the observations were indexed by year and by subperiod. Dummy variables and product terms of the quantity variables were employed to permit shifts in the level and the slope of the demand function. The marketing-season analyses were performed by the second approach.

The results obtained from the investigation of the two hypotheses show that the Medford demand function changes level within season. This finding is more pronounced in the marketing-season analysis. The marketing-season analysis of the first model indicated that changes in the slope of the demand function also took place. These results suggest that there is, in fact, a seasonal pattern to the derived demand facing the sellers of fresh Bartlett pears from Medford district. The elasticity of the Medford demand curve changes in response to the shifts of the California supply curve and possibly the appearance of the winter varieties. The two hypotheses yielded consistent results.

An Analysis of the Intraseasonal Demand for Bartlett Pears

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AN ANALYSIS OF THE INTRASEASONAL DEMAND FOR BARTLETT PEARS

I INTRODUCTION

There are several varieties of pears, such as Bartlett, Red Bartlett, D'Anjou, Comice, Hardy. The first two varieties are commonly referred to as the "Bartlett" varieties, while the remainder are the "winter" varieties. This terminology is employed in the present study.

Because physiological characteristics of the fruit permit storage with little loss of quality, winter pears are sold almost exclusively in the fresh form. Bartlett pears, on the other hand, may reach the final consumer in either a processed or a fresh form. Bartlett pears which are processed may, for example, be combined with peaches, cherries, and other fruits, to make fruit cocktail or salad, may be sold as canned pears, may be dried, or may be pureed for baby food.

Bartlett pear production is concentrated in a few major producing areas in each Pacific Coast state. In Washington there are two commercial producing areas: the Wenatchee region and the Yakima Valley. In Oregon, production is centered in the Medford area of southwestern Oregon, the Hood River Valley, and, to a lesser extent, the Willamette Valley. The principal production areas of California are the Sacramento River area, the Sierra Foothills area, the Santa Clara County area, and the Lake and Mendocino Counties area.

While harvest of the winter varieties generally begins in September, almost all of the crop is usually placed in storage and held until Bartlett pears are no longer being marketed in significant quantities. Thus, Bartlett and winter pears seldom appear on the market together in the fresh form.

While Bartlett and winter pears have many physical similarities, and while it is true that many Northwest growers produce and market both types, it seems reasonable at least for analytical purposes to separate the industry into segments. This is justifiable on the grounds 1) that fresh Bartlett and winter pears do not appear on the market at the same time, except for a brief period, and 2) that while both winter and Bartlett pears do appear on the market during the winter and spring months, the latter is in a processed form, while the former is marketed fresh. There is no reason, *a priori*, to expect substitution between these two commodities to be greater than substitution between fresh winter pears and other processed fruit and/or processed Bartlett pears and other fresh fruit.

Accordingly, this study is concerned with the analysis of demand for fresh Bartlet pears.

The Problem

During each marketing season Bartlett pears are sold for final consumption in either the fresh or processed form.

Prices of Bartlett pears vary according to the various end uses. Prices to growers vary from year to year due to changes in the supply and demand for fresh Bartlett pears. Reasons for the fresh price variation may be changes in the total production of Bartlett pears, in population, and in consumers' income, tastes and preferences. Conditions in foreign markets and changes in the production of competing fruits may also affect the demand and supply relationship of fresh Bartlett pears.

Processors' prices to growers may vary from year to year for similar reasons. In addition, carry-over stocks and expected prices for processed pear products may influence the processors' demand for Bartlett pears. Technological improvements and marketing developments may also affect the supply and demand for Bartlett pears in each sector of the market.

The within-year price change of fresh pears may also result from changes in the demand for processed Bartlett pears. Simultaneously, the fresh market interacts upon the quantities sold and the prices in the processing market.

The mutual interaction of the fresh and processing markets necessitates the collection of information concerning the factors which influence the determination of quantities sold and prices of Bartlett pears within each marketing season. Knowledge of factors which influence the intraseasonal demand for Bartlett pears in the two outlets may permit better distribution patterns and improved returns from this crop to growers.

Objectives of the Study

The objective of the present study is the specification and measurement of the characteristics of intraseasonal demand for Bartlett pears. In particular, the study will focus on a particular producing district, the Rogue River Valley of Oregon, and estimate the parameters of the derived demand for fresh Bartlett pears facing sellers in that district.

The specification will provide the necessary information for the description of the behavioral relationships among the factors of the Bartlett pear market. The construction of the suitable econometric model will lead to the second step of the study, namely, the measurement. The estimated relationships, in turn, should provide the needed information to examine the seasonal nature of the demand for fresh Bartlett pears.

The study is not oriented toward a direct consideration of the demand in the consumers' market. The investigation attempts a statistical derivation of "demand" relations facing the growers of Bartlett pears on the Pacific Coast, and particularly in the Rogue River Valley. In other words, concern of the study is the demand for Bartlett pears in the producers' market at the wholesale level.

Previous Studies

A large number of demand studies have been made in the past. Some of these have involved intraseasonal analysis of the relevant data.

Following is a summary of the studies related to our research. The first part summarizes simple overall demand studies; the second includes intraseasonal analyses. The overall demand studies dealing with problems of the Bartlett pear industry are directly related to the present research. The intraseasonal analyses have been considered because of their problematic similarity and the estimation techniques used.

Overall Demand Studies

B. H. Pubols (1959) studied the factors that affect prices of pears received by growers. He analysed separately the prices of: all Pacific Coast pears; Bartlett pears sold fresh; Bartlett pears sold for canning; pears other than Bartlett pears; and pears other than Pacific Coast pears. Ordinary least-squares were used in single equation models with price as the dependent variable in all cases.

Referring to the part of the research concerned with Pacific Coast Bartlett pears, the author found that the year-to-year changes in season average prices of Bartlett pears sold fresh or for canning were associated with changes in: production of Pacific Coast Bartlett pears; disposable personal income; stocks of canned pears; and production of pears other than Bartletts.

Disposable income was the strongest factor in explaining price variations. Pear production of each class of pears and stocks of canned pears were also important. Price behavior of each class of pears is influenced only to a minor extent by production of pears of other varieties.

Unlike Pubols' model, which estimated overall demand for fresh and processed pears, J. A. Edwards' study (1965) attempted the separation of the demand functions for California and Oregon-Washington Bartlett pears.

Edwards treated prices and quantities as endogenous variables in a system of four demand and supply equations. He obtained the estimates by two stage least-squares. His model was used to investigate a conviction prevalent at that time among Northwest growers that the trade differentiated in favor of California Bartlett pears. However, the results obtained satisfied the conditions for "same" commodities. Hence, it was concluded that Bartlett pears of California and the Northwest are a homogeneous product as far as market behavior is concerned.

Another overall demand study was made by D. J. Ricks and J. A. Edwards (1964). These authors studied: 1) the future economic situation of the Pacific Coast Bartlett pear industry by comparing alternative price and production levels and 2) future changes in regional production.

The authors have developed long-run demand and supply functions. The demand function expresses the relationship between the season-average grower prices for Pacific Coast Bartlett pears and various factors which have an important influence in determining these prices. Statistical results indicated that the following variables have been important determinants of grower prices: per capita farm production of Pacific Coast Bartlett pears; per capita production of all pears in Michigan and New York; grower returns for California cling peaches; per capita stocks of canned pears at the beginning of the marketing year; and quantity of canned pear exports.

The supply function includes prices and production in the previous period as supply-determining variables. The rationale for the lagged variables is the influence of past profits on future production decisions.

The demand and the supply equations along with projected estimates of the independent variables in the demand function were used to predict future prices and production. Six alternative projections were developed using alternative assumed values of the price-determining variables. All projections indicated that pear prices would continue to increase in the future with an intermediary decline around 1972-1975.[1/]

Changes in the regional pattern of production were projected on the basis of bearing and nonbearing acreage trends, and on relative cost estimates in the various areas in relation to future price predictions.

Intraseasonal Demand Studies

An early attempt to study intraseasonal variations in demand is that made by J. Foytik (1951) for California plums. He analysed the demand for plums at auction markets on a varietal, temporal and size bases.

1/ Since 1962, last reported year in the study, actual prices have shown a higher upward movement than those projected by all alternatives. Prices continued to increase in 1967 despite opposite projections. The 1968 prices were higher than those projected, but lower than the actual 1967 prices.

He classified the main commercial varieties of plums into three groups--early, midseason and late varieties--according to their marketing periods. The linear relation fitted to the data of each subperiod included four variables--auction sales, previously marketed quantities, nonagricultural income, and supply of other fruits--and a time trend variable. He found nonagricultural income to be much more highly correlated with auction prices than with sales. Hence, he used auction prices as dependent variables. The inclusion of the first two variables is justified on theoretical grounds. The lagged term was included in order to test the hypothesis that earlier sales tend to "make or break" the market for later varieties. The time-trend factor was used to account for the net effect of variables not explicitly introduced in the model, although they caused the demand for plums to change smoothly and slowly over time.

For each varietal group, variation in auction prices was explained by the combined effect of the independent variables used in the analysis. Auction sales, nonagricultural income and variables taken to represent "supply of other fruits" were statistically significant. The time-trend factor proved to be a significant variable only in the case of midseason varieties. The data indicated that a portion of the influence of "time" entered through other variables into the analysis. This may partially explain why time-trend was insignificant in early and late varieties.

In the temporal analysis Foytik used the weekly auction prices as an entirety, and formulated a single regression equation for the whole marketing season. The temporal model included auction sales, sales in the previous week, nonagricultural income, and a dummy variable corresponding to the "week of the season" to account for shifts in the level of demand for plums. To account for changes in the slope of the demand, he included product terms of all variables. The fitted equation gave satisfactory results.

Next Foytik considered the size of plums in relation to demand. He examined the price relation of small and large size plums by variety. The dichotomization in size categories complies with 1) the marketing control program that restricts out-of-state shipments of small sizes and 2) data limitations. He specified and tested four different equations.

The first equation expressed the price of large size plums as a function of the price of the small size plums, consumer purchasing power and a variable representing the week of the season. The second equation expressed the price-ratios of the two sizes as a function of the corresponding quantity ratio, a trend variable and a term representing product terms of the two previous variables. The price premium received for large size plums (expressed as a ratio to the season average price for sales of all sizes) appeared as a function of the same variables in the third formulation. These equations provided specific relations between auction prices of the two sizes, but they did not permit a direct determination of returns to growers received for a given volume of sales of large and small plums. This was accomplished by the fourth equation. It indicated how changes in the quantity of either size sold affected the prices of both large and small plums.

The results of this investigation were ambiguous, but showed that plums of different size categories are close substitutes.

Another intraseasonal analysis is that made by S. Sosnick (1962) for California avocados. He developed a procedure for allocating a season's sales of avocados at optimum advantage to the members of Calavo Growers of California. For this purpose information concerning the demand for Calavo avocados was necessary.

Sosnick analysed the demand for Calavo avocados annually and weekly. He used a single least-squares multiple regression equation with average Calavo prices the dependent variable in both analyses. He treated the volume of California avocados sold fresh as an independent variable. Calavo prices were chosen because of the availability of reliable data and the orientation of the study. For the annual demand equation the statistical independence of sales was justified on the grounds that the production of avocados is annual and nature-dependent, harvests are virtually equal to fresh sales, use value, i.e., home consumption, to growers is slight, carry-over at year's end is relatively small, and imports have a level trend. On the other hand, the treatment of sales as an independent variable in the weekly demand equations was based on the fact that a week is a short period of time, so that harvest schedules may have been substantially predetermined, and variations in warehouse inventories may have been substantially restricted by perishability.

The final annual demand equation included two independent variables: California sales and nonagricultural personal income. Season average f. o. b. Calavo selling prices in cents per pound was the dependent variable. Non-California sales and other variables were deleted because of statistical insignificance.

For the measurement of the weekly demand Sosnick used two approaches: the independent functions approach and the generalized function approach. Since these procedures were also employed in the present study, this terminology is retained. Both approaches produced a satisfactory expression for the relation of weekly average Calavo prices to California sales, total non-California sales, nonagricultural personal income, and week of the season. The equations obtained used data for one week in each month. Strong evidence was found that the demand for avocados fluctuated systematically during the season.

The heterogeneity of avocados was represented by indexes of varietal and grade composition in the equations. The size distribution of avocados was not explicitly introduced into the equations, because it was felt to be adequately represented by the varietal and grade composition of the product. Both indexes did not pass the statistical test of significance.

On the basis of the weekly demand and cost information, optimal intraseasonal allocation was estimated under conditions of both certainty and uncertainty.

Another study using a similar approach is that made by S. Logan and J. Boles (1962). Their analysis was concerned with intraseasonal fluctuations in the retail prices of meat. To determine the nature of seasonal fluctuations in selected meat prices, they divided the year into quarters. In order to test the within-quarters changes in demand, they developed three models. Each model consists of a demand, a supply, and an equilibrium relationship, with prices as functions of the same set of independent variables--per capita consumption of individual meat and per capita disposable personal income. All models assumed quarterly supply as predetermined.

The first model was determined without consideration of quarterly variation in demand. The second model allowed the demand curve to shift among quarters while holding the slope of the curve constant. The third model allowed quarterly variations in both the slope and the intercept of the demand. They used dummy variables as quarterly shift variables. The incorporation of dummy variables into the regression equations allowed for changes in the level of demand. The fit of a separate equation to the data of each quarter allowed for both variations in the demand curve.

The similarity of this study to the previous work is obvious. The estimated results, however, led to rejection of the postulated hypothesis of identical level of demand (i. e., identical intercept terms), while the hypothesis that the slope of the demand curve was constant failed to be rejected in three out of four cases.

E. C. Pasour and R. L. Gustafson (1966) studied the intra-seasonal demand for apples nationally. They divided the marketing year into three seasons. The determination of the subperiods was based on the economic and physical characteristics of the apple industry. Data limitations were also responsible for the selection of the periods used.

The first within-year period is the beginning of the apple marketing season, and includes the months of July through November. Almost all apples are harvested during this period and are sold either fresh or processed or stored. The second period includes the months December through March. During this period apples are moved out of storage mainly to meet the demand for fresh apples. The rest of the year constitutes the third period, during which all apples in storage are assumed sold fresh before the new season.

The economic model of the apple industry consists of: 1) a fresh apple demand function; 2) a demand relationship for all apples sold (to both processing and fresh outlets) in period one; 3) an allocation function; 4) a storage function; 5) a function which defines a weighted average of fresh and processing price for apples, and 6) a production-stock identity.

The demand for fresh apples includes four independent variables: fresh price, lagged fresh price, disposable income and quantity of competing fruits. In periods one and two the quantity of fresh apples sold is determined jointly with the quantities sold to processors or stored; hence, the corresponding equations are estimated simultaneously. In period three the quantity of apples sold is predetermined, since there is no storage or processing. Thus the demand equation is estimated by single equation least squares. The demand function for all apple sales includes three independent variables: weighted price of fresh and processed apples, carry-over stocks, and quantity of apples utilized by all processors. The allocation function explains the quantity of apples utilized by the processors as a function of the processing-fresh apple price ratio, quantities of apples sold in Eastern and other parts of the country. The storage function of period one is a function of the same variables included in the processing allocation function. In period two, quantities of apples remaining in storage and percent of apples stored in controlled atmosphere are independent variables. Finally, the production-stock identity expresses the relationship among production, storage and consumption. On the basis of the aforementioned model, the authors measured the demand for apples in each period. Thus, within-season shifts in the slope and level of the demand were taken into consideration.

The study has not considered the demand for specific grades, varieties, and sizes, of apples for different geographical locations. The authors suggested that the interdependence among regions and among various varieties and grades answered the problem partially. However, they recognized that the individual producer is most interested in the demand for his production, characterized by variety, size, and other factors, rather than by overall averages, on which they based their study.

Another intraseasonal demand study was made by R. Moffett, J. Brand, L. Myers and S. Seavers (1966).

The purpose of their study was to explain fluctuations in wholesale quantities of McIntosh apples sold on the fresh market. The authors divided the marketing season of the crop into nine monthly periods, September through May. They applied the postulated demand function for McIntosh apples to each month for the years under analysis. The equation that represented the demand function contained four variables on a monthly basis--wholesale price of fresh McIntosh apples, wholesale price of fresh Delicious apples, wholesale price of other apple varieties, and personal income--and a time variable. They used the quantity of McIntosh apples sold on the fresh market as the dependent variable. They based the selection of price as the independent variable on the relatively smaller fluctuations of prices in comparison with those of quantities sold. They found the signs of the coefficients of the wholesale prices of McIntosh apples and of the prices of other eating apples to be consistent with a priori expectations. A priori expectations were not met by the coefficients of the price of Delicious apples. The coefficients of personal income were negative during the harvest season and statistically insignificant. For the remainder of the season the coefficients were positive, indicating that apples are a normal good with respect to personal income. For this portion of the marketing season, income coefficients were statistically significant in only four months. Time had both negative and positive effects on quantities sold. There was a negative time trend for January through April and a positive time trend during the remainder of the season. The coefficients were significant in December through April.

The similarity of this analysis to the aforementioned studies is obvious. By dividing the marketing season for McIntosh apples into subperiods and by applying to each of them the postulated function, the authors treated each month as a different market with a different demand for apples. Thus, they accounted for within-season changes in demand. Furthermore, the time variable which accounted for variations in the consumption of McIntosh apples due to unmeasurable factors, illustrated the appropriateness of this technique for estimating demand characteristics. However, this study is dissimilar to the previous works in one respect. The authors developed a price discrimination framework in order to allocate the given supply of McIntosh apples over a period of time. After determining monthly demand functions, they derived corresponding cost relationships. Subtraction of cost functions from demand functions at the wholesale level provided a net demand relationship. Given the net demand relationship for each of the nine months, they determined optimal allocations by the use of quadratic programming. Subsequently, they compared the optimum allocations for each year of the study with actual marketings. On this matter the authors found that actual marketings on the average showed a similar seasonal pattern and greater fluctuations than the optimal allocations.

A recent intraseasonal study by D. Mathews and R. Firch (1969) analysed the demand for Arizona lettuce.

A descriptive analysis was used to present the seasonal shipping patterns of the major lettuce producing areas. The incoming and outgoing districts in the market create "excess demands" for lettuce in the several producing areas.

The average weekly f. o. b. price of lettuce was the dependent variable; quantity produced by each district and production in other areas were independent variables. The perishability of the commodity, the single market nature of lettuce as a unique fresh salad item, and the time unit in which price-quantity data were collected made it appropriate to use single least-squares regression in estimating lettuce demand. The same model and statistical technique were used throughout the analysis.

The combined analysis for all years and by marketing seasons per producing district, gave satisfactory results which were consistent with a priori expectations. Dummy variables were included in the model to determine if changes in the demand relationship occurred. The estimated coefficients of most of these variables were statistically significant, indicating that demand shifts had in fact taken place.

A separate yearly analysis for each district was also made. To determine within-season changes, the demand for Arizona lettuce was analysed in sets of four and two-week periods. The inclusion of dummy variables to account for within-season changes in demand improved the statistical results.

The computed excess demand curves and their respective price flexibility coefficients gave strong support to the formulated excess demand model.

Present and Previous Studies

It is appropriate to discuss the market characteristics of Bartlett pears before discussing the relationship between the present and previous studies.

Bartlett pears are seasonally produced fruits with rather short marketing periods. The marketing period of Bartlett pears could be prolonged by storage, as for other deciduous fruits. However, technoeconomic factors 2/ favoring short processing periods and the existence of winter pears 3/ shorten their trading period.

2/ Technoeconomic factors refer to 1) technical conditions of the processing industry, such as size and utilization of plants and 2) financial considerations of production, such as storage costs.

3/ Most winter pears are usually placed in storage until Bartlett pears are no longer in the fresh market in large quantities. While the withholding of winter pears from the market reduces the competition between the two types of pears, it cannot be extended indefinitely. Many growers are producers of both commodities, and they are interested in selling both. When a grower or a producing region exhausts its supplies of Bartlett pears, it is

Presently, storage of fresh Bartlett pears does not extend beyond December 15, at least in important quantities.

A period of several years is required to raise a pear tree to full production. Hence, price changes do not immediately affect the amount of pears available for sale. Rather, they have a long-run impact on production decisions.

Bartlett pears are not homogeneous as far as consumer demand is concerned. Prices do not vary only by grade and quality but also by size. Bartlett pears can be considered as a line of different products with different prices.

They are poly-usage products. Bartlett pears may be used fresh, processed, dried or in combination with other fruits. Nevertheless, Bartlett pears are not unique fruits. A variety of substitute fruits exists. Fruits of the same variety, like winter pears, or other kinds of fruits are substitutes in some uses for Bartlett pears.

Bartlett pears differ in usage from plums. Although both can be consumed fresh, Bartlett pears are mostly consumed in a processed form. They differ from lettuce in perishability and usage.

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anxious to start marketing its harvest of winter varieties. Consequently, winter pears indirectly determine the length of the marketing period of Bartlett pears.

Lettuce is a unique salad item, and it is consumed fresh. Bartlett pears differ also from avocados in storability and usage. To some greater extent Bartlett pears resemble apples. However, apples have long production and marketing periods. They are stored for long periods and are consumed mainly as fresh fruits.

Hence, it must be stressed that what techniques 4/ are practicable and applicable in one commodity may be impossible and useless in the other, because of varying characteristics. However, it is worth noting here that the previous studies provide:

1) A better understanding of the problem under investigation. Knowledge of the industry gives a better background for gaining an insight into the problem.

2) Useful hypotheses.5/ The previous works are a source of useful hypotheses by analogy. Variables that may influence the demand for Bartlett pears may be found in these studies.

3) Usable hypotheses.6/ Knowledge of the techniques used

4/ Techniques are specific procedures by which the data are gathered and ordered prior to their logical or statistical manipulation.

5/ Useful hypothesis refers to formulating precise and testable propositions.

6/ Usable hypothesis refers to selecting those ideas which may actually prove useful.

by other researchers helps to formulate usable questions.

The present study has taken a deviant position toward the size of pears. It examines the pear size as part of the framework of constructing a weighted average price index. In contrast, Foytik examined the problem of size in the framework of the orderly marketing agreement. The division of sizes into the categories "small" and "large" did not correspond to the natural measurement of the size of the fruit. It was an artificial division on the basis of the largest marketed percentage of the fruit during each season. As explained in Chapter III, the gathering and ordering of the data in the present study are based on the natural measurement of the commodity. However, while this approach differs from Foytik's in the treatment of the problem of size, the two are similar at the level of abstraction, and consequently at the level of formulating hypotheses concerning this problem. Foytik investigated the proposition in the plum industry that the auction price for plums of a specific size was affected by the size distribution of all sales, as well as by the total quantity being marketed. The present analysis is concerned with the relation of pear size to price index, i.e., whether a single price index can be constructed without reference to the size of pears. In other words, both studies put common sense ideas into precisely defined concepts and subject the propositions to statistical tests.

Other authors did not investigate the size of the fruits studied. They considered the problem of size as solved by other characteristics of the commodity, such as variety and grade, or they considered modal values as representing the total crop.

The subperiods in the present analysis were designated on the basis of the marketing season regardless of the calendar classification. The present study differs from some of the previous studies in this aspect (Moffett, et al., 1966) where the designation of the subperiods was based on the calendar year.

The striking difference between the present study and those reviewed is the intraseasonal analysis based on the length of the marketing season. While previous studies analysed the within-season demand on the basis of subperiods the present study analyses also the demand for Bartletts on the basis of the length of the marketing period. Thus, explicit account is taken of the fact that the number of subperiods into which each period can be divided varies according to the length of the period.

Nature and Adequacy of the Data

In the present work, past data on market behavior are employed to calculate statistical demand and supply functions for Bartlett pears.

The information used for the empirical study of the demand and supply functions pertained to prices and quantities of Bartlett pears, peaches, disposable personal income, and indexes of quantities of competing fruits and labor cost. The price and quantity series were the data on f. o. b. sales of Bartlett pears at Medford, Oregon, and Yakima, Washington, (the only available data in the desired form) and corresponding auction prices and quantities for California. Personal disposable income, quantities of competing fruits, and labor cost were obtained from various publications. Limitations of these data are explained below.

Prices for f. o. b. sales at Medford were listed in daily sales reports by the Rogue Valley Marketing Association, which give information on grade, variety, sizes, prices, financing, marketing, and destination for each transaction involving pears sold fresh in standard boxes. Prices for sales at Yakima were reported similarly by the United Marketers, Inc.

On the basis of this information, weekly weighted average prices by grade of Bartlett pears were calculated. The quantities listed in the daily sales reports, however, do not coincide with those contained in the weekly fruit reports published by the same agency. This lack of coincidence results in lack of agreement between the sum of daily quantities and weekly quantities reported. Reasons for this include: lags in reporting, reports made in advance of shipment, and improper reporting by some members apprehensive of revealing information. However, it was hypothesized that the information provided by the daily sales reports is a sample taken from the total quantities sold during each marketing period. Furthermore, it was assumed that this sample is representative and reliable enough to yield acceptable results for the analyses attempted here.

In the calculation of the weekly average prices no account is taken of the financial and marketing considerations given in the sales reports. However, these factors which include magnitude of transaction, promptness of delivery, way of settlement, and trade appearance of pears exert an influence on the determination of the fresh prices.

The classification of the sizes within the same grade is difficult and ambiguous. Sales are often made of a range of sizes. An example will serve to illustrate this difficulty. Size 70 means that it takes 70 pears of this size to fill a standard (48 pound) box. Size 135 means that it takes 135 pears of this size to fill a standard box. Size 70/135 means that there are representatives of sizes between the 70 and 135 classes inclusive in a standard box, while size 135L means that a standard box so designated contains pears of the 135 size and larger. Thus, it is difficult to obtain an estimate of the volume of size 135 pears sold and a corresponding price. For sizes with ambiguous content such as 70/135 or 135L a compromise was made. For the first category, i.e., 70/135, it was assumed that the entire range of sizes is represented in a standard box, and they are classified on the basis of the average size by averaging the two reported sizes. For the second class, i.e., 135L, sizes are considered as simple numbers (in this example, 135's) without any other qualification. This assumption may have overestimated the volume of small sizes.

Auction prices and quantities for California Bartletts are reported by the Federal State News Service. They are weekly average prices per standard box. Grade and size composition and other characteristics of the product are not reported. The same comments apply to California peach prices and quantities.

Medford and California prices are comparable, although they refer to different market levels. However, despite the fact that auction quantities decreased in favor of private sales over time, there is considerable justification for assuming that f.o.b. level and auction level prices are highly correlated.

The size composition of fresh sales may have changed over time. The fact that fresh sales constitute only about one half of what percentage they were 30 years ago (Table 6) gives the growers the ability to be more selective than before in the quality of their fresh shipments. Besides, growers may have been forced to this trade behavior by trying to maintain the level of fresh sales and to prevent further reduction. Federal and state marketing programs also contributed to this behavior.

It is important to add that grade characterization and size measurement may also have changed over time. Such factors were not considered.

The publications which have provided the data do not record factors such as importance of buyer and quality of the product. However, these factors influence also the determination of prices. This is apparent in daily sales reports where observed differences in prices cannot be explained by the reported factors.

Auction sales of fruits used in the present analysis not only have decreased considerably over time, but also have suffered a decline in importance as sale outlets. It is a common practice to divert to auction markets the quantities that cannot be sold otherwise. Thus, auction market data have become less representative of movements in the market.

The totality of the factors mentioned here prevented examination of all of the desired demand and supply determinants. Thus, some ambiguities are likely to be present in the research. The demand and supply functions are the evidence of the responsiveness of this totality of factors. Consequently, the findings are not what should be expected from an analysis of the commodity on the basis of each factor separately. It is unfortunate indeed that the available data set limitations in the research that cannot be overcome by statistical methods.

II ECONOMIC BEHAVIOR OF THE BARTLETT PEAR INDUSTRY

The deciduous fruit industry has undergone changes in production and marketing during the last decades. These developments may be summarized as:

1. Declined per capita total consumption of all noncitrus fruits,

2. Greater decline in fresh than in total per capita consumption, and

3. Increased yields and grower prices.

During the period 1935-1967, a decline is observed in the total per capita consumption of all deciduous fruits (Table 1). From 112.6 pounds in the 1935-1939 period, consumption of deciduous fruits decreased to 85.7 pounds per capita in the 1965-1967 period, or an overall decline of 23.9 percent. The decline in fresh per capita consumption of deciduous fruits is even greater. Fresh per capita consumption was 79.5 percent of total per capita consumption in the 1935-1939 period and 59.0 percent of the total in the 1965-1967 period. In other words, fresh fruit consumption of all noncitrus fruits has decreased at a more rapid rate than total consumption. During the same period, consumption of processed deciduous fruits has increased. However, increases in processed fruit consumption have not compensated for fresh fruit consumption

Table 1. Changes in United States Per Capita Consumption of All Noncitrus Fruits.

Period	Total consumption		Fresh consumption			Processed consumption		
	Retail fresh weight equiv.	Percent change total 32-year period	Retail fresh weight	Percent change total 32-year period	Percent, fresh of total	Retail fresh weight equiv.	Percent change total 32-year period	Percent, processed of total
	(pounds)	(percent)	(pounds)	(percent)	(percent)	(pounds)	(percent)	(percent)
1935-1939	112.6		89.5		79.5	23.1		20.5
1940-1944	101.7		76.5		75.3	25.1		24.7
1945-1949	105.1		75.6		71.9	29.5		28.1
1950-1954	97.8		66.0		67.5	31.8		32.5
1955-1959	93.2		58.0		62.2	35.2		37.8
1960-1964	89.0		53.4		60.0	35.6		40.0
1965-1967	85.7	-23.9	50.6	-43.5	59.0	35.1	+51.9	41.0

Source: United States Department of Agriculture. Economic Research Service. Food. Consumption, Prices, Expenditures. Agricultural Economic Report No. 138, 1968, p. 66-67, and Supplement, 1970, p. 16.

decreases in the aggregate.

Table 2 shows that yield per bearing acre and prices to growers for selected deciduous fruits have increased during the 1934-1967 period.

The Bartlett Pear Industry

The commercial growing of Bartlett pears is concentrated on the West Coast. The production of the West Coast states increased from 76.25 percent of total production of Bartletts in the 1935-1939 period to 92.14 percent in the 1965-1967 span (Table 3). In comparison with the total national pear production, Bartletts account for 67.77 percent of the 1965-1967 production.

The increased role of West Coast states in the pear industry is due to the outstanding yields. Table 4 shows that California's combined yield for all pears is three times above the yield of Michigan, the major pear producer outside of the West Coast.

Bartlett production is concentrated in a few major producing areas in each Pacific Coast state. The geographical distribution and the consequent climatic differences create a dispersion in the timing of harvest and marketing of Bartlett pears. California's harvest typically precedes that of Oregon and Washington by four to six weeks. The most active marketing dates are July 10 to September 5 for California, August 20 to October 31 for Oregon,

Table 2. Yield and Grower Prices of Selected Deciduous Fruits: All Uses. United States.

Period	Yield, seven fruits	Annual average prices					
		Apples	Apricots	Grapes	Peaches	Pears	Plums and prunes
	(tons)	(dollars per ton)					
1934-1938	--	34.17	42.90	18.20	38.08	30.50	46.12
1939-1943	--	51.33	66.58	31.00	55.92	53.50	83.72
1944-1948	--	93.41	98.62	62.00	86.17	94.58	138.00
1949-1953	4.3	70.42	104.52	46.34	78.58	67.42	159.80
1954-1958	5.2	72.92	124.80	55.38	86.17	75.67	173.80
1959-1963	5.9	85.20	116.70	55.94	80.00	86.40	168.40
1964-1967	6.2	91.80	122.73	56.92	102.40	112.68	102.88

Source: B. Bain and S. Hoos. Trends in Deciduous Fruits: Production, Prices, and Utilization. California Agricultural Experiment Station. Giannini Foundation Research Report No. 299. August 1968. p. 27, 31.

U.S. Dept. of Agriculture. Statistical Reporting Service. Fruits, noncitrus, by states. Production, Use, Value. Statistical Bulletin No. 407.

Part I: Fr Nt 2-1 (5-67), (5-68).

Part II: Fr Nt 2-1 (7-67), (7-68).

Table 3. Pear Production, United States and Pacific Coast.

Period	Total pear production	Bartletts		Percent of Bartlett to total pear production	Percent of Pacific Coast Bartlett to total U.S. Bartlett
		Total U.S.	Pacific Coast		
	(thousand tons)			(percent)	(percent
1935-1939	707.6	458.2	349.4	64.75	76.25
1950-1954	707.5	500.5	453.0	70.74	90.51
1955-1959	732.3	531.0	489.0	72.51	92.09
1960-1964	641.2	472.3	434.1	73.66	91.91
1965-1967	570.7	386.8	356.4	67.77	92.14

Source: Oregon State University. Cooperative Extension Service, Oregon Commodity Data Sheets for the years 1958, 1961, 1965, and 1968.

Table 4. Yield, California and Michigan: All pears.

Period	Yield	
	California	Michigan
	(tons per bearing acre)	
1949-1953	8.58	2.95
1954-1958	10.03	2.99
1959-1963	9.59	3.63

Source: B. Bain and S. Hoos, Trends in deciduous fruits: Production, Prices and Utilization. California Agricultural Experiment Station, Giannini Foundation Research Report No. 299. August, 1968. p. 144.
Michigan Agricultural Statistics. Michigan Department of Agriculture. 1957. p. 23. 1961, p. 23, and 1965, p. 21.

and August 15 to September 15 for Washington. These "average" dates are given for comparative purposes only, since of course there has been considerable variation in these dates over time.

In the 1964-1968 period the revenues from all pear sales averaged $63 million. By states the revenues were: California, $34 million; Oregon, $15 million; and Washington, $14 million (U. S. D. A. Statistical Reporting Service). Consequently, the concentration of production renders the Bartlett pear industry an important economic factor in the producing areas.

The Market for Fresh Bartlett Pears

The Bartlett pear industry has experienced the developments that characterize the deciduous fruit industry described earlier.

Fresh per capita consumption has decreased substantially. Fresh consumption was 55.79 percent of total per capita consumption in the 1935-1939 period, and 23.27 percent of the total in the 1965-1966 period. Total per capita consumption of Bartlett pears shows a downward trend since the 1950-1954 period (Table 5). Referring to the Pacific Coast states in particular, Table 6 shows that the fresh market has absorbed a declining amount of the total marketings of the area. From 41.83 percent of the 1935-1939 period, the fresh market share has fallen to 19.58 percent in the 1965-1967 period.

Table 5. Per Capita Consumption of Bartlett Pears in the United States.

Period	Total	Fresh	Processed	Fresh	Processed
	(pounds, fresh basis)			(percent)	
1935-1939	4.66	2.60	2.06	55.79	44.21
1950-1954	5.70	1.74	3.96	30.52	69.48
1955-1959	5.48	1.58	3.90	28.83	71.17
1960-1964	4.48	1.20	3.28	26.78	73.22
1965-1966	3.91	.91	3.00	23.27	76.73

Source: Oregon State University. Cooperative Extension Service. Oregon Commodity Data Sheets for the years 1958, 1961, 1965, and 1968.

The Market for Processing Bartlett Pears

Table 6 shows that the percentage of Bartlett pears entering processing outlets has experienced a substantial increase in recent years. For the Pacific Coast states, the processing market has absorbed an increasing amount of the total marketings of the area. From 58.17 percent in the 1935-1939 period, the processing market share rose to 80.42 percent in the 1965-1967 period. Canning is the dominant processing use. Drying has declined from 11.29 percent in the 1935-1939 period to 1.04 percent of the total in the 1965-1967 period. However, the technological improvements, the convenience aspects, and the marketing developments which have been concentrated in large part in the processing market have not succeeded in reversing the decline in the per capita consumption

Table 6. Sales and Utilization of Sales of Pacific Coast Bartlett Pears.

Period	Total	Fresh	Processed		Fresh	Canned	Dried
			Canned	Dried			
	(thousand tons, fresh basis)				(percent)	(percent)	(percent)
1935-1939	324.4	135.7	152.1	36.6	41.83	46.88	11.29
1950-1954	442.3	123.7	309.3	9.3	27.97	69.93	2.10
1955-1959	480.4	124.5	346.2	9.7	25.91	72.06	2.03
1960-1964	429.3	100.6	321.4	7.3	23.43	74.86	1.71
1965-1967	347.8	68.1	276.1	3.6	19.58	79.38	1.04

Source: U.S. Dept. of Agriculture. Statistical Reporting Service. Fruits, noncitrus, by states. Production, Use, Value.

of all Bartlett pears.

The Export Market for Bartlett Pears

The Bartlett pear export market has experienced considerable fluctuation in quantities sold and shifts in sales destinations. The export quantities, varying from year to year, have never regained their pre-war levels (Table 7). A factor that has contributed to the decline of fresh exports is the formation of the European Economic Community. The major pear producers in Europe are currently supplying the other European Economic Community member countries where formerly the United States had some additional markets. In addition, the United Kingdom, formerly a large importer of United States fresh pears, is now supplied in large part from Commonwealth countries (e.g., Australia) that have become pear producers in recent years. Canada is the largest and most stable market for fresh United States exports, largely because of proximity.

The situation for exports of canned pears is similar. The European Economic Community policies and the upsurge in exports of Commonwealth countries to the United Kingdom market have deprived the United States in large part of traditional markets. Canada is still a primary market for canned exports. However, Canada has recently increased its imports of canned pears from

Table 7. United States Production and Export of Bartlett Pears.

Period	Total Bartlett production	Exports		
		Total	Fresh	Processed
	(Thousand tons, fresh basis)			
1935-1939	458.2	106.8	32.5	74.3
1950-1954	500.5	25.2	7.0	18.2
1955-1959	531.0	43.3	12.0	31.3
1960-1964	472.3	45.8	7.7	38.1
1965-1966	433.5	46.9	8.5	38.4

Source: Oregon State University. Cooperative Extension Service. Oregon Commodity Data Sheets for the years 1958, 1961, 1965, and 1968.

Australia. This development in the Canadian market sheds doubt upon the future of canned pear exports even at the currently reduced export levels.

The Structure of the Bartlett Pear Industry and Pricing Policies

The market for processing pears is characterized by several large canners on the buying side and many small growers, most of whom commit their production to bargaining associations for price negotiations. Prices of pears for processing are established immediately before or during the harvest season, and prevail throughout the marketing season. Discussions and interviews with industry and Extension Service representatives reveal that processors do not agree to buy, nor do sellers agree to sell specified quantities of pears. However, both attempt to enter into contracts based on supply and demand expectations.

Pears for the fresh market are sometimes sold by growers to wholesale packer-shippers for a cash price at the time of delivery. In many production areas, however, a more common arrangement is that of fresh sales on a commission basis, or through cooperative organizations. In this case, growers are paid a return which is based on prices received by the packer-shipper for packed fruit, minus all costs for packing, grading, and shipping. Some pears move through eastern fruit auctions.

Pears differ by grade, quality, and size. Since transactions generally specify the nature of these characteristics, there may be different prices associated with different combinations of these characteristics. On the other hand, pears with identical physical characteristics may be sold at very different shipping point prices to different buyers or at different points in time. Price differences may be associated with differences in quantity exchanged. However, trade positions of the purchasers, among other variables which are difficult to discern and to measure, are undoubtedly important factors as well.

Interestingly enough, under present federal and state marketing programs, fresh Bartlett pears are subject to quality regulations. Such restrictions aim at increasing the producers' net returns by improving the average quality or grading of marketings.

However, quality regulations may be used merely to limit total fresh shipments for the season. In California, Bartlett pears for processing are also subject to volume controls.

In the Medford region of Oregon, almost all of the growers market their pears through one or more of 11 packer-shippers. These packers belong to the Rogue River Valley Traffic Association, which is ostensibly a data-gathering organization, and which records reported data on prices and quantities sold for the use of members and traffic associations from other regions.

III SPECIAL PROBLEMS

The Relation Between Size and Price of Bartlett Pears

Since fresh pear sales are reported by size, it was conjectured that pear prices may vary systematically with size. Consequently, the use of weighted average prices in the econometric work would obscure the size influence on prices. The problem, then, was to study price variations due to size.

Foytik (Chapter I) examined the size of plums in an orderly marketing agreement framework. He found that plums of different size categories are close substitutes. Other writers have either treated the size as being approximated by other characteristics of the commodity they studied, or they have considered modal values as representing the total crop.

The size-price analysis is classified into two types of relations:

1. Price-quantity
2. Inter-price

Price-quantity relations refer to relationships among variables representing prices and quantities of identically sized pears. In contrast, inter-price relations refer to relationships among variables representing only prices of different grades and sizes of

Bartlett pears.

Data used in the size-price analysis were weekly average prices and quantities of Medford area Bartlett pears sold fresh in the domestic market. Average prices have been computed by size and grade, and they have been weighted by the corresponding quantities. The selection of the grades and sizes used in the analysis of price-quantity and inter-price relationships was based on the appropriateness of the data. The number of observations per year was the main concern in selecting a specific size of pears.

In order to account for the size of pears, the analysis should consider the relation of size and price within grades. Unfortunately, not enough observations for all sizes were available to permit a statistical investigation for every size. For those sizes for which sufficient data were available, the appropriate statistical investigation was performed. In other cases, however, a compromise was made: sizes were grouped by grade into large, medium, and small. The grouping of sizes was based on the frequency of daily quotations of fresh sales.

It is worth noting here that the data did not indicate any pattern approximating a known distribution. Nor was an attempt made to fit a mathematical function to the distribution for Bartlett pears. The reason was the variability of sizes from year to year. Sizes were evenly dispersed in some years and skewed toward smaller or larger sizes in others. Despite this fact, sizes 120-150 showed an annual frequency in quantities greater than that of smaller and larger sizes. These sizes, as well as combinations of sizes averaged in 120-150, were considered as the medium size group. Sizes up to 120 and combinations formed the large group, and from 150 and on the small size group. Nevertheless, the division of sizes into groups, although arbitrary, was based on the market measurement of Bartlett pears.

In the discussion below, symbols used in the analysis and their indicated meaning are presented. As is usual in economic literature, either the first letter of the variable or some related concept is chosen in order to facilitate recognition of the symbols. This way of expressing variables is followed in the rest of the present work.

a_o = constant term to be estimated

a_i = coefficients to be estimated

P_w^{ef} = average f. o. b. price per standard box of Bartlett pears sold fresh in the domestic market

$(P_h)_w^{ef}$ = average f. o. b. price of size h, where h = 135L

$(P_k)_w^{ef}$ = average f. o. b. price of size k, where k = 150 L

$P_w^{r, ef}$ = price ratio of 135L to 150L

$(P_L)_w^{ef}$ = average f. o. b. price of large Bartlett pears

$(P_M)_w^{ef}$ = average f.o.b. price of medium Bartlett pears

$(P_S)_w^{ef}$ = average f.o.b. price of small Bartlett pears

Q_w^{ef} = quantity of Bartlett pears in standard boxes sold fresh in the domestic market

$Q_w^{r,\,ef}$ = quantity ratio of large and small pears to total extra fancy pears.

${}^{t}Q_w^{r}$ = quantity ratio of extra fancy to all grades

$(Q_h)_w^{ef}$ = quantities of size h pears, where h = 135L

$(Q\ h/k)_w^{r,\,ef}$ = quantity ratio of 135L to 150L sizes

X_j = (1 in j year
(0 otherwise, and j=1964, 1965

w = week

ef = extra fancy grade Bartlett pears

e_w = error term

Numbers within parentheses denote t values. Asterisks and addition signs denote the level of significance. One asterisk indicates that the corresponding variable coefficient is significant at the five percent level, and two asterisks indicate significance at the ten percent level. One and two addition signs indicate significance at the one and two-and-a-half level correspondingly.

The symbol R-square denotes the coefficient of determination, and the symbol S_y denotes the standard error of the regression line. This way of denoting significance levels is followed in the rest of the present work.

Price-quantity Relationships

The first approach to the study of the relation between size and price of Bartlett pears was the following equation:

$$P_w^{ef} = a_o + a_1 Q_w^{ef} + a_2 Q_w^{r, ef} + e_w \quad (3.1)$$

This approach was aimed at determining what proportion of variation in weekly average prices for a specific grade, i. e., extra fancy, could be explained by weekly variations in the proportion of large and small sizes in the total quantity of pears marketed.

The formulated equation was fitted to the data for the years 1964, 1965, and 1966. Weekly f. o. b. domestic prices for extra fancy grade Bartlett pears were regressed against corresponding quantities and the ratio of the quantity for large and small sizes over the total extra fancy quantity sold fresh in the domestic market. The relevant data are presented in Appendix Table 1. The results obtained are presented in Table 8.

The estimated coefficients for the weekly extra fancy quantities were not consistent with a priori expectations for all years. The negative sign of the ratio coefficient implies that when large

Table 8. Bartlett Pears: Regression Coefficients of Price-quantity Relations.

Equation	Year	Dependent variable	Constant coefficient a_0	Regression coefficients, ai: Quantity of extra fancy Q_w^{ef}	Quantity ratio of large and small to total extra fancy $Q_w^{r,ef}$	Quantity ratio of extra fancy to all grades ${}^tQ_w^r$	Quantity of 135 L size extra fancy $(Q_h)_w^{ef}$	Price of 150 L size extra fancy $(P_k)_w^{ef}$	Quantity ratio of 135 L to 150 L Sizes $(Q_{h/k})^{r,ef}$	R^2	S_y
	1964		4.1897	-0.000005 (-0.942)	-0.1446 (-0.373)					0.114	0.274
3.1	1965	P_w^{ef}	6.7134	-0.000008 (-1.802)	0.4518 (0.685)					0.358	0.292
	1966		4.5048	0.000003 (0.625)	-0.4361 (-0.735)					0.101	0.388
	1964		4.6307		0.2092 (0.547)	-0.7949 (-0.909)				0.107	0.276
3.2	1965	P_w^{ef}	9.1360		1.0313 (1.680)	-3.0196 (-2.737)*				0.559	0.242
	1966		3.5008		-0.3674 (-0.562)	1.0962 (0.360)				0.742	0.394
	1964		-1.1614				0.0151 (1.787)	1.2893 (6.079)+		0.861	0.103
3.3	1965	$(P_h)_w^{ef}$	-1.7851				-0.00001 (-0.721)	1.2875 (5.908)++		0.941	0.064
	1966		1.1213				-0.000008 (-2.436)**	0.8160 (11.474)+		0.965	0.083
	1964		1.0557						-0.0286 (-1.619)	0.272	0.026
3.4	1965	$P_w^{r,ef}$	1.0186						-0.0243 (-2.385)**	0.587	0.007
	1966		1.0323						-0.0011 (-0.280)	0.012	0.033

The symbols +, ++, * and ** indicate statistical significance at the one, two-and-a-half, five and ten percent levels respectively.

and small sizes increase relative to medium sizes, the price of pears decreases. This conclusion is in accordance with economic reasoning. Large sizes may not be economically attractive because of their weight, and small size pears may not be attractive because of their physical appearance. Prices, then, must be lower in order to compensate the consumer for the size disadvantage. However, the positive sign of the coefficient for the year 1965 precludes such an inference. In addition, the coefficients were not statistically significant.

The second price-quantity relation was:

$$P_w^{ef} = a_o + a_1 \, {}^tQ_w^r + a_2 \, Q_w^{r,\,ef} + e_w \qquad (3.2)$$

This approach was aimed at determining what proportion of variation in weekly average prices for a specific grade, i.e., extra fancy, could be explained by weekly variations in the proportion of quantities of this grade to the total quantity in all grades marketed and the size composition of the same grade.

The equation was fitted to the data for the years 1964, 1965, and 1966. Weekly f.o.b. fresh domestic prices for extra fancy grade Bartlett pears were regressed against the ratio of extra fancy quantities to total quantity of all grades marketed and the ratio of the quantity for large and small sizes over the total extra fancy quantity sold fresh in the domestic market. The relevant data are presented in Appendix Table 1. The results obtained are presented in Table 8.

The ratio coefficient of large and small sizes over the total extra fancy quantities had the wrong sign relative to *a priori* expectations for 1964 and 1965. The ratio coefficient of extra fancy quantities to total quantities marketed had the expected sign for 1964 and 1965. That is, given the demand for Bartlett pears, as the quantity of better quality pears increases relatively, the price of extra fancy pears must decrease. However, the t values indicated that the estimated parameters (except in one case) were not significantly different from zero.

The third approach was aimed at investigating the relation between the price of a particular size and the price of a close size of the same grade. The form of the fitted equation was:

$$(P_h)_w^{ef} = a_o + a_1 (Q_h)_w^{ef} + a_2 (P_k)_w^{ef} + e_w \qquad (3.3)$$

The price of 135L size extra fancy pears for the years 1964, 1965, and 1966 was regressed against the corresponding quantities and the price of the close 150L size extra fancy Bartletts. The relevant data are presented in Appendix Table 2. The statistical results are presented in Table 8.

The estimated coefficient for the quantity 135L had the wrong sign for 1964. The t values were significantly different from zero at the ten percent level only for the year 1966. In contrast, the estimated parameters for the price 150L size pears had the expected sign, and they were statistically significant at the one and two-and-a-half level. This finding indicated a linear relation between prices for 135L and 150L size pears. The coefficients of determination were high, indicating that the variables in the equation 3.3 are, apparently, linearly related.

The price ratio of the sizes in the third approach was regressed against the ratio of the corresponding quantities for the same years. The relevant data are presented in Appendix Table 2.

In mathematical terms the fourth equation was:

$$P_{w}^{r,\,ef} = a_{o} + a_{1}\,(Q_{h/k})_{w}^{r,\,ef} + e_{w} \qquad (3.4)$$

The results secured by means of this equation are presented in Table 8.

For each year the regression of the price ratio on the quantity ratio was negative. That is, the price of 135L size pears tended to change (relative to the price of 150L) in the opposite direction to which sales of 135L (relative to sales of 150L) were changed. This conclusion is in accord with economic reasoning. In other words, the distribution of sizes influences inversely the corresponding prices. However, the insignificance of the estimated parameters does not support such inference.

In all price-quantity relations a term indicative of size distribution was included. The results secured do not support the hypothesis that the average prices are related to size distribution of pears.

Inter-price Relationships

For inter-price comparisons, extra fancy Bartlett pears were divided on the basis of size into large, medium, and small sizes, and the average weekly price per size group was computed. The sizes 120-150 constituted the medium group, and the off-modal sizes were grouped as large and small sizes. The relevant data for the years 1964, 1965, and 1966 are presented in Appendix Table 3.

The average weekly price of each group was regressed against the price of each other group. The form of the fitted equation was:

$$(P_L)_w^{ef} = a_o + a_1 (P_M)_w^{ef} + e_w \qquad (3.5)$$

The statistical results are presented in Table 9. The important feature about these results is that the independent variables (medium, large) gave a satisfactory explanation for changes in the dependent variables (large, small). The coefficient of determination was high in most cases, and the standard error of estimate

Table 9. Extra Fancy Bartlett Pears: Regression Coefficients of Inter-Price Relations.

	Large vs. Medium				Small vs. Medium				Small vs. Large			
	Year				Year				Year			
Coefficient	1964	1965	1966	1964-66	1964	1965	1966	1964-66	1964	1965	1966	1964-66
a_0	-1.1882	7.4302	3.4131	2.4778	-0.6814	-15.8523	2.5549	1.8913	0.0086	-0.6421	0.6719	-1.2368
a_1	1.3411 (1.444)	-0.1296 (-0.149)	0.3434 (0.947)	0.5241 (1.388)	1.0952 (4.830)+	3.4557 (1.101)	0.2977 (2.690)++	0.4367 (2.060)**	0.8869 (8.362)+	1.1093 (10.087)+	0.6504 (0.951)	1.0181 (11.511)+
a_2				-0.00004 (-0.845)				0.000002 (0.110)				0.00006 (5.795)+
a_3				0.00006 (1.086)				0.0001 (4.820)+				0.0001 (7.769)+
R^2	0.967	0.003	0.230	0.917	0.795	0.232	0.419	0.939	0.909	0.962	0.231	0.991
S_y	0.053	0.526	0.158	0.357	0.120	0.635	0.164	0.338	0.098	0.141	0.213	0.143

The symbols +, ++, and ** indicate statistical significance at the one, two-and-a-half, and ten percent levels respectively.

SOURCE: Derived from equations 3.5 and 3.6.

showed that the postulated linear relation fitted the observations very closely. However, at the ten percent level, the estimated variable coefficients were not significant in most cases.

The grouped prices for the three years combined were regressed against each other. Dummy variables were introduced into the equation as shift variables.

The form of the fitted equation was:

$$(P_L)_w^{ef} = a_o + a_1 (P_M)_w^{ef} + a_2 X_1 + a_3 X_2 + e_w \qquad (3.6)$$

The results obtained are presented in Table 9. The linear relation between the grouped prices for the three years combined was more apparent than the relation for each year separately. The simple correlation coefficients were high, verifying the expected intercorrelation between the dependent and independent variables. The dummy variable coefficients indicated that no significant shifts had taken place in the level of the regression line for the large versus medium size prices.

The overall picture of this section and the results obtained from equation 3.3 support a linear dependency among the prices. Consequently, an average price can be expressed as a function of any other price. Therefore, the weighted average price of pears is an appropriate index for our study.

The Nature of Processing and Fresh Supply

Another problem of concern early in this study was the nature of the supply of Bartlett pears. For reasons to be discussed in Chapter IV, the total annual supply is considered as fixed for each production season. This section is confined to the study of the processing and fresh supply. The separate treatment stems from their importance in the determination of the estimation methods.

The first attempt to determine the nature of the processing supply was based on observations about the annual percentage of Bartlett pears processed. It was expected that examination of the percentage of pears processed would lead to an inference about the processing supply, i.e., whether the processing supply could be considered as independent of the processing prices. However, the data did not suggest a pattern conducive to such inference of independence. Consequently, it was necessary to investigate the within-season supply behavior analytically.

In the present section the following symbols are used with the indicated meaning:

a_o = constant term to be estimated

a_i = coefficients to be estimated

R_j = percent of Pacific Coast Bartlett pear production processed

Q_j^{pc} = Pacific Coast Bartlett pear production in tons

Q_j^{fm} = total U. S. farm marketings of Bartlett pears in tons

Q_j^{p} = total U. S. Bartlett pears processed in tons

P_j^{r} = ratio of processing to fresh returns to growers

S_j = beginning stocks of canned Bartlett pears, June 30th, in tons (fresh equivalent)

E_j = total exports of Bartlett pears (fresh equivalent)

E_j^{p} = processed exports of Bartlett pears in tons (fresh equivalent)

T_j = time variable, years numbered consecutively with 1954=1

j = time period (years)

e_j = error term representing unexplained residuals

The relevant data are presented in Appendix Table 4.

The first empirically tested formulation was:

$$R_j^{r} = a_o + a_1 Q_j^{pc} + a_2 S_j + e_j \qquad (3.7)$$

The equation was fitted to the data for the years 1954-1966, since for these years only data were available. The results obtained were:

$$R_j^r = 100.8309 - 0.0418\ Q_j^{pc} - 0.0755\ S_j$$

$$(-4.871)^{+} \qquad (-2.264)^{*}$$

$$R^2 = 0.704 \qquad S_y = 2.031$$

The estimated coefficient of the Pacific Coast Bartlett pear production variable was significant at the one percent level. The coefficient of the stocks of canned Bartlett pear variable was significant at the five percent level.

The same form of equation with a time variable was fitted to the data. The results obtained were:

$$R_j^r = 95.5824 - 0.0352\ Q_j^{pc} - 0.0842\ S_j + 0.3865\ T_j \qquad (3.8)$$

$$(-5.479)^{+} \qquad (-3.525)^{+} \qquad (3.276)^{+}$$

$$R^2 = 0.865 \qquad S_y = 1.445$$

The estimated variable coefficients were significant at the one percent level. The coefficient of determination ($R^2 = 0.865$) indicated that the modified equation expressing the percentage of Bartlett pears processed as a linear function of the independent variables gave a better explanation to the data. The sign of the quantity coefficient showed that the percentage processed was inversely related to the Pacific Coast Bartlett production. The sign of the stock coefficient was in accordance with a priori expectations. That is, the percentage processed is inversely related to the carry-over stocks. The sign of the time trend indicated that during the period under analysis the percentage of Bartlett pears processed had increased. This conclusion is in conformity with Table 6.

In order to indicate how changes in total exports[7/] affect the percentage of pears processed, an export variable was introduced into the original equation. The new equation was fitted to the data for the years 1954-1966. The results obtained were:

$$R_j^r = 98.8044 - 0.0520\, Q_j^{pc} - 0.0994\, S_j + 0.1962\, E_j \qquad (3.9)$$

$$(-6.037)^{+} \qquad (-3.285)^{+} \qquad (2.215)^{**}$$

$$R^2 = 0.808 \qquad S_y = 1.722$$

The sign of the coefficient of the newly introduced variable indicated that the percentage of pears processed was directly related to exports. This conclusion is in accordance with a priori expectations. The estimated coefficient was significant at the ten percent level.

Next the quantity of all U.S. Bartlett pears processed was regressed against total U.S. farm marketings of Bartlett pears

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7/ Trade restrictions and the desire to maintain trade relations are important factors in determining the foreign demand for domestic pears. Hence, exports are treated as predetermined.

and annual stocks. The formulated equation was:

$$Q_j^p = a_o + a_1 Q_j^{fm} + a_2 S_j + e_j \qquad (3.10)$$

The results for the years 1954-1966 were:

$$Q_j^p = 113.2284 + 0.5794\, Q_j^{fm} - 0.4541\, S_j$$
$$(12.058)^{+} \qquad (-2.465)^{*}$$
$$R^2 = 0.961 \qquad S_y = 11.080$$

The equation 3.10 gave a good explanation to the data ($R^2 = 0.961$).

In order to eliminate the influence of exports, the annual exports were subtracted from the total farm marketings and the annual processed exports from the quantity of Bartlett pears processed. The new equation was fitted to the data of the same period. The results obtained were:

$$(Q_j^p - E_j^p) = 93.5961 + 0.5986\, (Q_j^{fm} - E_j) - 0.4261\, S_j \qquad (3.11)$$
$$(15.499)^{+} \qquad (-2.972)^{++}$$
$$R^2 = 0.977 \qquad S_y = 8.482$$

The simple relation expressing the annual quantity of Bartlett pears processed net of exports as a linear function of total marketings minus total exports and annual stocks gave the overall highest fit to the data ($R^2 = 0.977$). In comparison with the previous equation, the standard error of the dependent variable was lower and the coefficient of the stock variable significant at the two-and-a-half percent level.

To investigate whether prices influence the quantity of Bartlett pears processed, the ratio of processing to fresh returns to growers was introduced into the previous equation. The results obtained were:

$$(Q_j^p - E_j^p) = 81.4244 + \underset{(14.858)^{+}}{0.6016} (Q_j^{fm} - E_j) - \underset{(-2.592)^{*}}{0.4026} S_j + \underset{(0.528)}{9.5271} P_j^r \qquad (3.12)$$

$$R^2 = 0.9777 \qquad S_y = 8.805$$

The coefficient of the ratio variable was insignificant at the ten percent level of significance.

This analysis may now be summarized:

At the beginning of the marketing period the only known factor is the total supply of Bartlett pears. Producers and processors then enter into negotiations and finally agree on pear prices. Their agreements, as explained in Chapter II, are based on supply and demand expectations. Following the time of agreement, the quantity of Bartlett pears to be sold in the processing market can be considered as independent of pear prices. This hypothesis was substantiated by the results of the present section. That is, the contract prices for processing pears are established at the beginning of the season (prior to July 1) on the basis of quantities of Bartletts expected to enter the processing market. However, the volume of Bartlett pears that in fact enters the processing market is determined by the physical characteristics of the annual crop, which is a function of its size, and the existing stocks. The quantity of Bartlett pears to be sold in the fresh market can be considered also as independent of prices, since the fresh and the processing quantities sum up to the total annual supply, which is fixed during every production period. In other words, the total annual volume of Bartlett pears shipped to the fresh market depends only on the total production and the beginning inventories of processed pears. Since the magnitudes of these variables are determined by past decisions and certain "noneconomic" variables (e. g., weather), the total shipment of Bartletts to the fresh market is treated as an "exogenous" variable in the intraseasonal models. Nevertheless, the within-season allocation of the annual quantity sold in the fresh and processing markets depends upon the particular characteristics of each market.

The above analysis has important implications for the determination of the estimation method to be used in the analysis of intraseasonal demand. In the next chapter, discussion will focus on a model which does not consider the institutional constraints treated in this chapter. This economic model is, in fact, an application of the "perfect markets in time, form and space" framework and the statistical technique employed is appropriate to that model. Its usefulness is primarily for purposes of comparing the intraseasonal demand functions with the seasonal demand functions. More explicit recognition of the institutional constraints may have led to different results.

IV THE ECONOMIC AND STATISTICAL MODELS

In this chapter the models used in the present analysis are developed. The subject is approached in two steps:

1. Analysis and formulation of the economic models.

2. Formulation of the statistical models.

In the first step are examined: (a) the supply functions of Bartlett pears and (b) the demand function for them.

In the second step are presented: (a) the specific forms of the supply and demand functions to be estimated and (b) the estimation methods applied to the present study.

The following conditions are assumed: 1) perfect competition in the fresh and processing markets; 2) a homogeneous product; 3) product produced seasonally; 4) perishable product; and 5) absence of interseasonal storage. Bartlett pears meet the assumptions three, four, and five. Assumptions one and two are made for generality and better exposition.

Analysis and Formulation of the Economic Models

The Supply Functions

The factors determining the supply of farm products are in sharp contrast to those affecting manufacturing commodities and services. Farm products differ from manufacturing commodities and services in cost composition, in the time that is required to expand their production, and in market control. These supply factors exert a basic influence on price behavior. Since total supply is limited to what can be harvested, price changes have no effect on the supply except through speculation, storage or exports. In the absence of these factors, the supply curve of farm products in the short run rises steeply. This nearly vertical supply curve means that prices received by producers depend mainly on demand.

Farm products differ in storability. Storability, in turn, determines the timing of farm marketings. If the commodity can not be stored by the producers, the time distribution of the product is determined by its maturity.

An analysis of the supply of Bartlett pears follows:

A period of several years is required to raise a pear tree to full production. In addition, commercial pear orchards are concentrated in a few geographical areas, and pear production has become a more specialized operation. Consequently, the total quantity of Bartlett pears harvested during any given marketing season can be regarded as being independent of the market price of Bartletts for that season. For any season, then, the supply curve for Bartlett pears is perfectly inelastic.

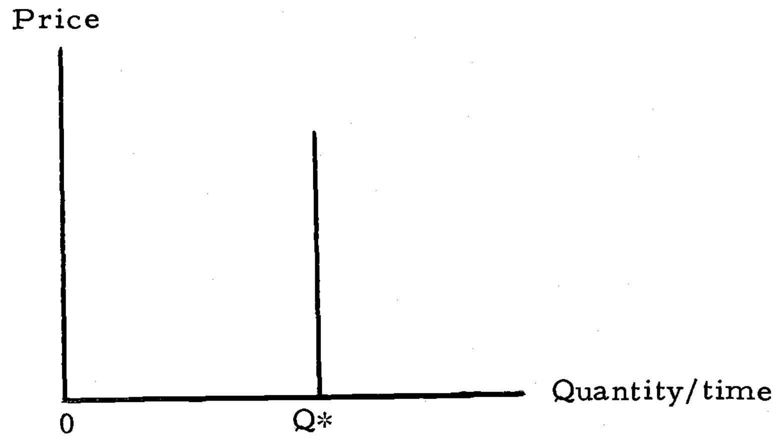

Figure 1. Annual supply of Bartlett pears

In Figure 1, Q^* is the total quantity of Bartlett pears produced and marketed during the season. The fixed quantity Q^* may be sold in one or both of the two markets: 1) the market for processing Bartletts, or 2) the market for fresh Bartletts. The aggregate allocation of any portion of Q^* in either the processing or fresh market depends upon the factors prevailing in the two markets. These factors are discussed in the following section. The temporal allocation within one market, on the other hand, depends upon the particular characteristics of that market. These are discussed later.

Aggregate Allocation

If constant per unit cost of processing is assumed, the equilibrium price which would result from arbitrage would differ only by the cost of processing. This can be shown graphically:

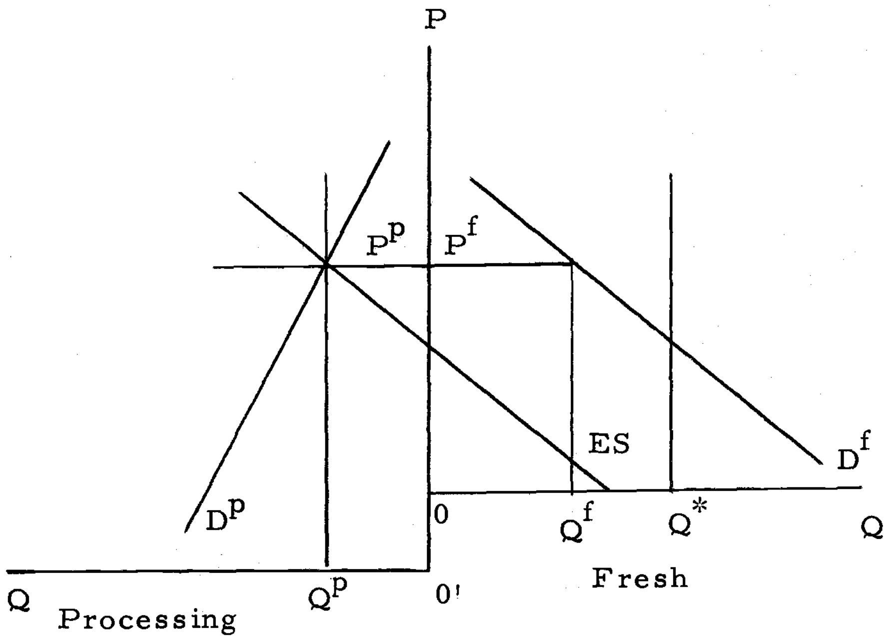

Figure 2. Equilibrium price and excess supply curve

In the "back-to-back" diagram of Figure 2, quantities of Bartlett pears bought by the fresh market are measured from left to right starting at point 0. Quantities of Bartlett pears bought by the processing market are measured from right to left starting at point 0'. Prices are represented on the vertical axis starting from 0 for the fresh market and from 0' for the processing market. The distance 00', then, is the unit cost of processing. The curves D^f and D^p are the demand curves for fresh and processing Bartlett pears, respectively. The perpendicular line Q^*, the seasonal supply of Bartlett pears, represents the same quantity depicted in Figure 1. The line Q^* is shown as a "supply" curve in the fresh market only for convenience of presentation. It could just as well have been placed in the processing market.

The curve ES is the "excess supply curve" to the processing market. It can be interpreted as showing, at each price in the processing market, how many units of Bartlett pears would be offered for sale. It is derived by subtracting from Q^* the quantity which would be demanded at each price in the fresh market. At quantity Q^p and price P^p, the excess supply curve intersects the demand curve for processing Bartlett pears. This leaves Q^f to be sold fresh at the equilibrium price P^f. Prices P^p and P^f and quantities Q^p and Q^f are observed in the market place and are the data for the econometric model described below.

Demand for fresh Bartlett pears: $Q_d^f = f(P_d^f, \ldots)$

Demand for processing Bartlett pears: $Q_d^p = g(P_d^p, \ldots)$

Supply of processing Bartlett pears: $P_s^p = h(Q_s^p, \ldots)$

As stated above, the "excess supply" curve to the processing market is simply the difference between the demand curve for fresh pears and a constant quantity Q^*. Thus, the relationship between the quantities supplied to the fresh and processing markets holds exactly for any marketing season, and can be written in the form of an identity: $Q^* \equiv Q^f + Q^p$. Hence, $Q_s^p = Q^* - Q_d^f$ can be used instead of the equation

$$P_s^p = h(Q_s^p, \ldots).$$

In equilibrium the quantity demanded in the fresh market will equal the quantity supplied in the fresh market. A similar relationship holds in the processing market. Further, the equilibrium demand prices will equal the corresponding supply prices in each market. Or,

$$Q_d^f = Q_s^f = \text{the equilibrium quantity } Q^f$$

$$Q_d^p = Q_s^p = \text{the equilibrium quantity } Q^p$$

$$P_d^f = P_s^f = \text{the equilibrium price } P^f$$

$$P_d^p = P_s^p = \text{the equilibrium price } P^p$$

The relationship between fresh and processing prices holds also for any marketing season. This relationship can be expressed in the following form: $P_d^p = P_d^f + K$, where K is the per unit cost of processing. Hence, in equilibrium

$$P_d^f = P_d^p - K.$$

Since all price and quantity data will have "equilibrium" values, the above system is reduced to:

$$Q^f = f(P^f, \ldots)$$

$$Q^p = g(P^p, \ldots)$$

$$Q^p = Q^* - Q^f \quad (4.1)$$

$$P^f = P^p - K \quad (4.2)$$

The specification of the variables in the demand equations is discussed in the section of demand functions.

Price Determination in the Market for Bartlett Pears

In order to examine the nature of the demand for a commodity, it is necessary first to understand behavioral patterns of the participants who interact to generate data. In the market for a perishable commodity, prices may be "asked" by sellers when buyers indicate an interest in engaging in an exchange. If sellers desire to sell a specific quantity per time period, the supply curve pertaining to that period will be perfectly inelastic. If the asking price is higher than the price buyers are willing to pay to purchase that quantity, the asking price is lowered until the two prices are the same. This is the price on the demand curve corresponding to the given quantity.

Given this behavior of the market participants, one could estimate the parameters of the demand function by identifying those factors which determine supply quantities. Using time series data, for example, one could then regress actual quantities against observations on these factors and so "predict" supply quantities. The equation used to estimate the relationship between prices and quantity demanded would then have the exchange price as the dependent variable, with the predicted quantity as one of the independent variables. The analyst would then be examining the extent to which variations in this price (over time, for example) could be explained by variations in the quantity exchanged, plus other variables deemed relevant.

On the other hand, the price determination process may be such that sellers establish a current price for the product they wish to sell. Purchasers then buy as much as they are willing to buy at that price, and the difference between what sellers would like to have sold at their established price and what buyers actually purchased would be stored for sale at a later period. In the later period, the seller would consider both his current production and his holdings in setting the price for that period. In this case, to estimate the parameters of the demand functions, the analyst could identify those variables which determine the prices to be set in any period by the seller. Then following a procedure similar to that described above, the analyst could "predict" supply prices. These predicted prices could then be employed as one explanatory variable in a demand equation wherein the actual quantity exchanged would be the dependent variable.

There are, of course, other behavioral patterns which could lead to the formation of market prices. These two are selected here because there are probably elements of both in the Bartlett pear market. While Bartlett pears are storable, both on trees and in cold storage, their quality diminishes rapidly with storage. Thus, sales must be made within a limited period of time. On the other hand, in view of the limited number of packers in the Medford area, and in view of their belief that theirs is a "quality" commodity, it is reasonable to assume that a certain amount of this price setting activity is engaged in by sellers. Thus, it was decided to formulate separate models for each set of specifications.

The Intraseasonal Supply of Bartlett Pears is Independent of Current Prices: The importance of the processing market suggests that during each subperiod growers have available for sale in the fresh market whatever quantity of Bartletts has remained after the processors' demand has been satisfied. Hence, it is reasonable to assume that fresh prices have no effect on the intraseasonal supply of Bartletts. Growers accept the within-season fresh prices as these are determined by demand conditions in the course of the marketing season. Furthermore, it is assumed that storage does not take place within subperiods.

The Intraseasonal Supply of Bartletts Depends Upon Current Prices: Growers may allocate the quantity Q^f among subperiods so as to maximize returns from fresh sales. This objective can be accomplished by deliberate regulation of the within-season flow of Bartletts through storage. That is to say, when prices are low and expected prices high, the growers decrease current Bartlett sales, and they increase current sales when prices are high relative to expected prices. Hence, the sales decisions of the growers are reflected upon the rate of depletion of the annual fresh quantity Q^f.

However, pear growers are not free to regulate the subperiod fresh sales at will, because the annual quantity Q^f must be sold within a period determined by the appearance of winter pears and other factors. Hence, growers must form their subperiod sales decisions so as to "balance" the advantages of selling at higher prices by withholding Bartletts from the market against the overall objective of selling the quantity Q^f within the time determined by external factors. Consequently, growers base their subperiod sales decisions upon:

1. The realized prices at the w-1 subperiod, (P_{w-1}), and
2. The magnitude of the existing quantity of Bartletts at the beginning of the subperiod w, (H_w).

In other words, the growers' subperiod supply can be represented as:

$$P_w : P_{w-1}, H_w .$$

The Demand Functions

The factors that determine demand can be found easily. Consumers have a certain income to spend. They are offered goods at certain prices. They have desires which they want to satisfy. Their actual choices may not be the most logical or give them the best value, but these choices constitute reality because they are what people have decided.

Choices of a consumer may change for many reasons. His income may rise or fall. The supply and prices of goods may change. His desires may be altered. His anticipations as to future income or prices may shift. Any or all of these factors can cause a change in the consumer's demand.

The aggregate demand for fresh and processing Bartlett pears at the beginning of the marketing season is analysed separately. The separate treatment of the two outlets is dictated by the existence of different factors that influence the two markets and renders inappropriate the aggregation of the two demand curves. The factors that influence the within-season demand for fresh pears are discussed next.

The Demand for Fresh Bartlett Pears

The price that consumers are willing to pay is associated with a given quantity of Bartlett pears to be purchased. Furthermore, this price-quantity relationship is influenced by:

1. Disposable personal income

A change in income alters habitual spending such as purchase of Bartlett pears. A decreased income, which would lead to lower standards of consumption, is met slowly so that at first most of the decrease is reflected in lower saving and/or discretionary spending rather than in decreased spending on habitual purchases. On the other hand, previous studies have shown that higher income increases pear consumption (Pubols, 1959). Although spending depends upon the consumers' time perspective on their incomes, it is expected that changes in disposable personal income will influence directly the price that consumers are willing to pay for given quantities of pears.

2. Export of fresh Bartlett pears

The price that foreign consumers are willing to pay is associated with various fresh quantities of Bartlett pears to be purchased from the domestic market and other factors prevailing abroad. Hence, exports represent the influence of these factors upon the demand for fresh Bartlett pears.

3. The supply of competing fruits

The quantity of competing fruits supplied influences inversely their own price, and should influence inversely the price of Bartlett pears.

The relationships that influence the demand price for fresh Bartlett pears are summarized as follows:

$$P^f : Q^f, \ D, \ E^f, \ C^f$$

The Demand for Processing Bartlett Pears

The price that processors are willing to pay for fresh Bartlett pears is associated with a given quantity of pears to be purchased for processing. This price-quantity relationship is also influenced by:

1. The inventories of processed pears

The level of existing pear stocks at the beginning of the processing season influences inversely the price that processors are willing to pay for fresh Bartletts.

2. The cost of processing pears

The cost of processing pears, like all other costs, is determined by the rate of output (short run), the scale of operations (long run), technology, and the price of input factors. Processing costs influence the profits from processing and, in turn, the demand price of the processors.

The processing price-quantity relationship is also influenced by the price that consumers of processed pears are willing to pay for given quantities. Variables such as disposable personal income, processed exports and competing processed fruits influence consumers' decisions. Hence, the demand for Bartlett pears to be purchased for processing can be presented by the following partially reduced formulation:

$$P^p : Q^p, \ D, \ E^p, \ C^p, \ S, \ K$$

Within-season Demand for Bartlett Pears

The Processing Market

The within-season allocation of the quantity Q^p depends upon economic and technical considerations. The productive capacity of the processing plants, the seasonal nature of pear production and the perishability of pears, and the synchronization of canned pear production with the production of other seasonal fruits are among the technical factors that influence the timing of absorption of the quantity Q^p. In addition, financial considerations, such as storage costs, cost of invested funds, will be decisive. These economic and technical factors dictate a smooth pattern in absorbing the quantity Q^p within the season.

In order to give a better perspective on the timing of the absorption of the quantity sold in the processing market, the following diagram is presented:

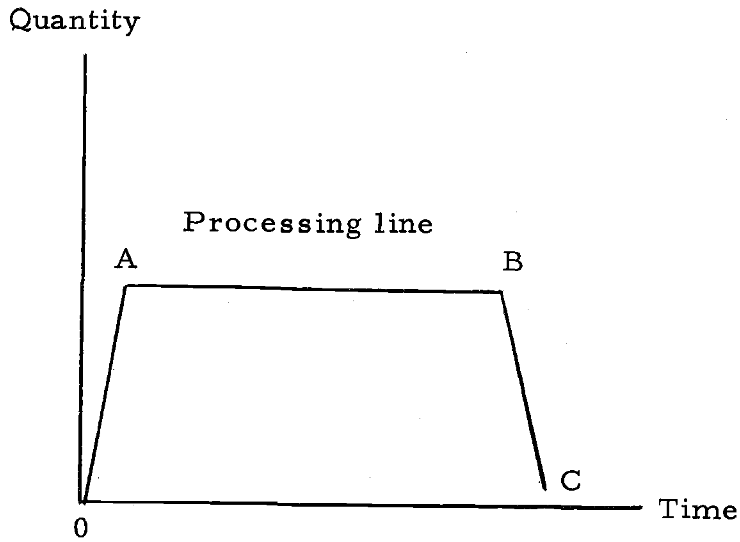

Figure 3. Within-season allocation of processing Bartlett pears

Every harvest season has the beginning date, the most active period and the ending date. These dates are determined by the maturity pattern of the fruits, demand conditions, and storage possibilities. The beginning, the most active trading dates and the end of the marketing period correspond to the supply of fruits determined by the same factors.

The line OABC in Figure 3 represents the processing period of Bartlett pears. The upward sloping segment OA of this line corresponds to the period between the beginning of the harvest and the most active marketing dates. During this period processing increases slowly as pears mature, are introduced and are available in the market in increasing quantities. The horizontal segment AB corresponds to the most active trading period. During this period pears are in abundance. However, the factors mentioned above set a ceiling on the quantity of pears that can be processed. The downward sloping segment BC of the processing line corresponds to the period between the end of the harvesting period and that of the marketing period. Quantities of pears are still available in the market and/or in the hands of the processors and hence extend the processing process beyond the end of the harvesting period.

The Fresh Market

The consumption of the quantity Q^f allocated to the fresh market depends upon:

1. The seasonal nature of fruits
2. The existence of competitive fruits
3. The length of the marketing season

The fact that fresh fruits are seasonally produced and are short lived products has a psychological impact on consumers' purchases. Consumers may feel that a postponement in fresh fruit consumption may very well result in personal disappointment because of the disappearance of the fruit from the market. Hence, as the season progresses, every fruit experiences a period of intense consumer desire. However, the existence of competitive fruits produced and marketed at the same period mitigates the consumption peak. Moreover, the production and marketing of competing fruits may be an important factor in determining the length of the marketing season for the fruits already in the market. In the case at hand, Bartlett pears are mainly marketed until winter pears appear in the market.

The influence of the previously cited factors on the timing and distribution of fresh consumption is presented in the following diagram:

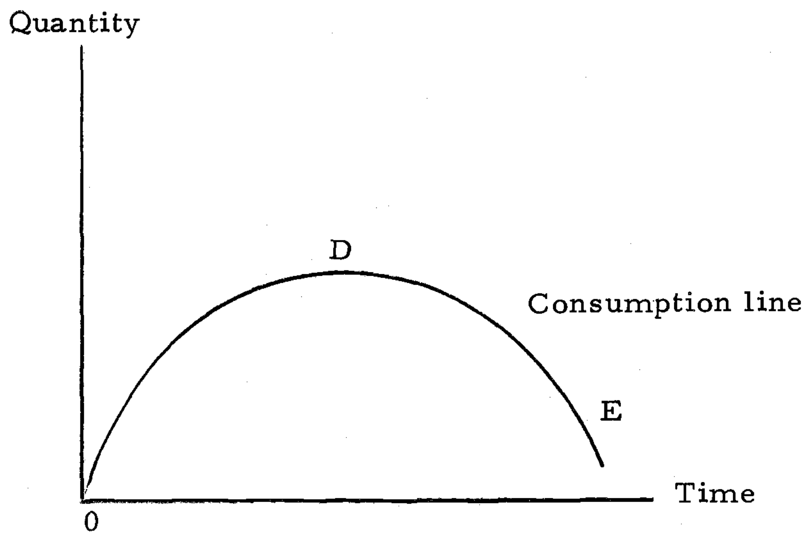

Figure 4. Within-season consumption of fresh Bartlett pears

Figure 4 is a diagrammatic representation of the fresh consumption cycle of Bartlett pears. As the season advances and the beginning harvesting dates are followed by the most active marketing dates, shipments to the fresh market gradually reach a peak.

Consumers are aware of the seasonality of Bartlett pears and are willing to purchase them. The segment OD of the line ODE reflects this stage of consumption. Psychological as well as physical needs for new commodities influence consumers to decrease their Bartlett pear purchases in favor of another fruit. The appearance of winter pears, as well as other competing fruits, enhances the downward movement in the Bartlett consumption. The segment DE shows this stage of fresh Bartlett pear consumption. Thus, the consumption cycle of Bartlett pears, once it has run its course, loses intensity and slowly disappears, giving its position to new fruits.

The Economic Model When the Intraseasonal Supply is Independent of Current Prices: The harvesting period of Bartlett pears is shorter than the corresponding marketing period. Both periods, however, experience a peak. The most active dates begin together but differ in duration. Active marketing periods surpass the corresponding most active harvesting dates. This analysis suggests the following diagram:

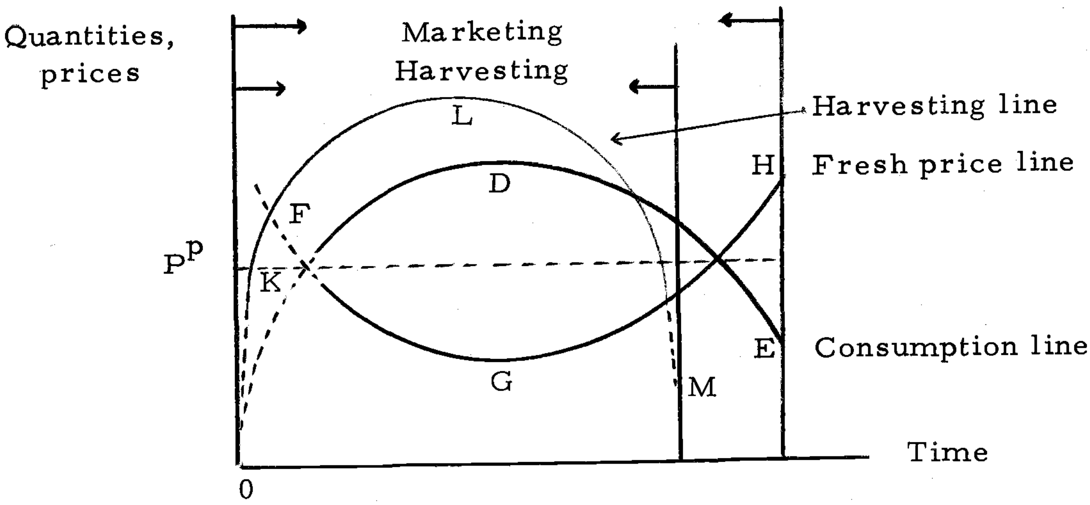

Figure 5. Within-season price-quantity relationships of fresh Bartlett pears

The line KLM represents the harvesting period. The line ODE, labeled the consumption line, shows the flow of Bartlett pears into the market. The difference of these lines represents the "cooling" period of pears. The second line FGH, labeled the fresh price line, shows the behavior of fresh prices during the marketing period. Economic theory tells us that, given the demand function, prices are related inversely to marketed quantities. This explains the concavity of the fresh price line. The consumption and the fresh price lines constitute an alternative representation of the price-quantity relationship in a regular demand diagram. For example, an increase in the quantity of Bartlett pears, while all other things remain constant, will cause the price of pears to decrease.

The within-season supply and demand functions can be observed more easily if set out in a diagram:

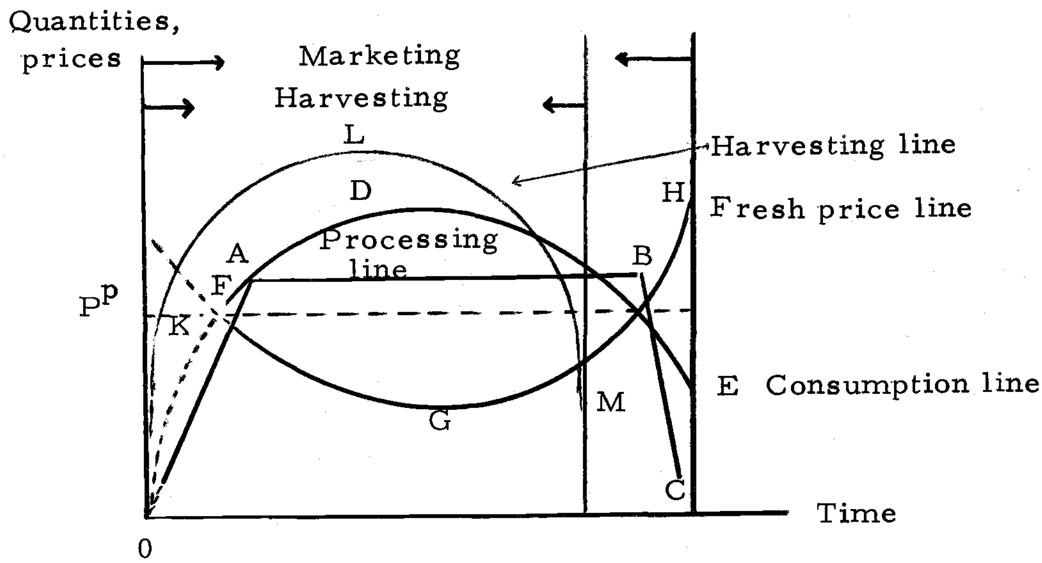

Figure 6. Within-season fresh and processing consumption of Bartlett pears

Figure 6 shows four lines. The line OABC is the processing line taken from Figure 3. The line ODE is taken from Figure 4 and represents the consumption cycle of fresh Bartlett pears. The lines KLM, and FGH are the harvesting, and the fresh price line from Figure 5. A short crop could be represented by smaller lengths of the corresponding lines in the diagram, and therefore interpreted as smaller processing and consumption periods.

Ceteris paribus, price variations may be attributed to: 1) changes in the quantity demanded and supplied and/or 2) shifts in the demand and supply functions as such. Hence, an economic model designed to explain within-season price variations must account for all possible changes that may occur during a period.

The matter is of particular importance when the estimation interest is restricted to one producing area, as at present. The production and marketing of pears in the neighboring states of California and Washington may cause price variations at Medford. To account for these influences, variables representing the quantities produced and marketed in other areas are introduced in the demand function. Other variables that may influence the demand are: quantity of Bartlett pears sold fresh at Medford; quantities of competing fruits sold fresh; disposable personal income.

The relationships implied by the economic model are summarized as follows:

$$P_w^m \; : \; Q_w^m, \; Q_w^c, \; Q_w^w, \; D_j, \; C_w^f$$

<u>The Economic Model When Intraseasonal Supply Depends Upon Current Prices</u>: Under the present hypothesis the economic model consists of:

(a) A supply (price-predicting) function which has been described earlier:

$$P_w^m \; : \; P_{w-1}^m, \; H_w$$

(b) A demand function expressing the variables that may influence consumers in their purchase of Bartlett pears:

$$Q_w^m \; : \; P_w^m, \; P_w^c, \; P_w^w, \; P_w^p, \; D_j$$

where the symbols Q_w^m, P_w^m, D_j represent the same variables as before, P_w^c, P_w^w denote California and Washington prices of Bartlett pears, and P_w^p denotes California fresh peach prices. These variables are discussed in Chapter V.

Formulation of the Statistical Models

It is hypothesized that, on the basis of the models described, the observed economic variables are generated.

The estimation method applied to the aggregate allocation model is the two-stage least-squares. This statistical technique is appropriate for estimating parameters of variables in systems of simultaneous equations. The method applied to the within-season allocation models is the ordinary least-squares.

Aggregate Statistical Model

It is postulated that the specified variables of the aggregate allocation model are related linearly. For any year "j" the demand function for fresh Bartlett pears can be written:

$$P^f_j = a_0 + a_1 Q^f_j + a_2 E^f_j + a_3 D_j + a_4 C^f_j + u_j \qquad (4.3)$$

Similarly, the aggregate demand function for processing Bartlett pears is written:

$$P^p_j = b_o + b_1 Q^p_j + b_2 E^p_j + b_3 D_j + b_4 C^p_j + b_5 S_j + b_6 K_j + v_j \qquad (4.4)$$

For any year "j" the production utilization identity can be written:

$$Q^p_j \equiv Q^*_j - Q^f_j \qquad (4.5)$$

Similarly, the price equilibrium equation can be written:

$$P^f_j = P^p_j - K_j \qquad (4.6)$$

where:

> the symbols represent the same variables as before. u_j and v_j are error terms representing unexplained residuals.

The equations 4.3 to 4.6 constitute a complete model in the sense that there exist as many equations as endogenous variables, namely: P^f_j, Q^f_j, P^p_j and Q^p_j. Correlation that may exist between the endogenous variables Q^f_j and Q^p_j and the corresponding error terms u_j and v_j is avoided by expressing the endogenous variables as functions only of the predetermined variables.

Using equations 4.5 and 4.6, the system of equations is reduced to:

$$Q_j^f = c_o + c_1 Q_j^* + c_2 S_j + c_3 E_j^f + c_4 E_j^p + c_5 C_j^f$$

$$+ c_6 C_j^p + c_7 D_j + c_8 K_j + w_j \qquad (4.7)$$

The estimated values of $\hat{Q}_j^f$ given by 4.7 are substituted into the original equation 4.3. Hence,

$$P_j^f = d_o + d_1 \hat{Q}_j^f + d_2 E_j^f + d_3 D_j + d_4 C_j^f + z_j \qquad (4.8)$$

Thus, in the reformulation 4.8 of the equation 4.3, the quantity $\hat{Q}_j^f$ is an exact function of all predetermined variables in the model. In addition, the quantity $\hat{Q}_j^f$ is uncorrelated with the disturbance term z_j.

A similar procedure will give a reformulation of equation 4.4 :

$$P_j^p = h_o + h_1 \hat{Q}_j^p + h_2 E_j^p + h_3 D_j + h_4 C_j^p + h_5 S_j$$

$$+ h_6 K_j + x_j \qquad (4.9)$$

where $\hat{Q}_j^f$ and $\hat{Q}_j^p$ are predicted quantities.

The statistical results of the equations 4.8 and 4.9 are presented in Chapter V.

Within-season Statistical Models

Two alternative specifications on the model of the Bartlett pear market are employed in this study. In the first model, it is assumed that each supply function is perfectly inelastic and that the supply quantity is determined by factors other than the current price of fresh Bartlett pears; namely, factors in the processing market. Total quantities available for sale in the fresh market, then, are treated as if they were "residual" in nature (although quality is treated as being subject to some control by suppliers). In the second model, it is assumed that growers set prices on the basis of the market prices which they have most recently observed, and of their total holdings of Bartlett pears.

Because of the availability of appropriate data and an interest in the impact of seasonal shifts in the supply of competing regions on the demand facing a particular region, the study examines the situation in a particular producing region: the Rogue River Valley of Oregon. The purpose of the present section is to determine if standard statistical procedures will yield estimates of the demand parameters sufficiently accurate to predict intraseasonal shifts in price-quantity relationships.

The specification of variables that enter the within-season demand relationship may omit important shift variables which vary systematically over the marketing season. In order to compensate for these neglected variables different demand equations must be shown for different subperiods.

Three alternative approaches have been used by other researchers to determine intraseasonal variations. The first approach distinguishes subperiods and considers the data for each subperiod over a number of years as a separate set of observations. Demand equations, generally of the same form, are fitted to each set of observations. Differences between the subperiods are appraised by the following: 1) applying significance tests, 2) noting the pattern of the regression coefficients over a period of time, 3) observing whether a graph of the demand functions displays an "orderly fan-shaped arrangement" (Mehren and Erdman, 1946).

In diagrammatic form an orderly fan- shaped arrangement is:

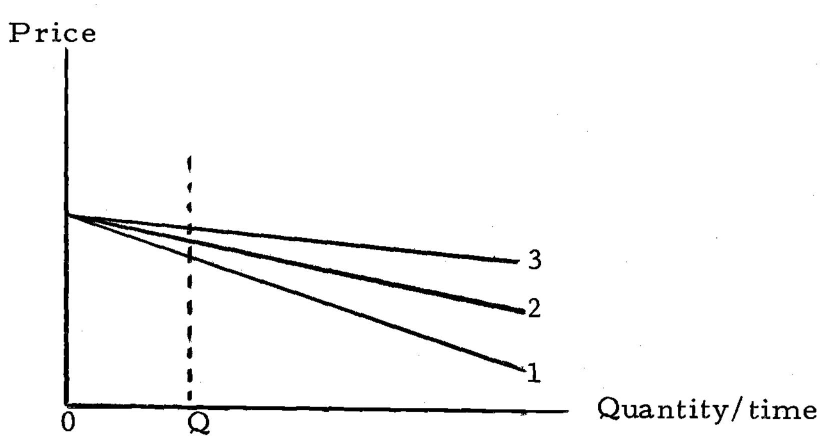

Figure 7. An orderly fan-shaped arrangement

As the season progresses, the slope of the regression lines changes systematically in a way that shows an orderly change in the elasticity of demand. In Figure 7, at quantity Q, the elasticity of demand increases as the season advances from period one to period three.

The second approach considers all observations as an entirety and obtains a single regression equation. Each observation, however, is quantified with dummy variables in n-1 additional dimensions, where n is the number of subperiods distinguished. The coefficients of the dummy variables provide for intraseasonal variations at the height of each subperiod's demand relative to the height in the n-th subperiod. The presence of intraseasonal variations is appraised by the statistical significance of these coefficients.

The third approach also considers all observations as an entirety and obtains a single regression equation. This time, however, each observation is quantified in one additional dimension, the value of the associated subperiod. Subperiod, then, becomes an additional variable in the regression equation, introduced additively, in product terms, etc. The presence of intraseasonal variations is appraised by the statistical significance of coefficients of the terms that include the variable "subperiod" (Foytik, 1951).

Demand equations of the second and third type restrict the changes in the regression coefficients to a well-defined pattern, which has been imposed on the data by the use of the additional quantifiers. In contrast, a pattern has not been imposed on the first type equations. They express intraseasonal variations with fewer restrictions on the level and slope of the demand functions.

Statistical Model When the Intraseasonal Supply is Independent of Current Prices

With regard to the form, a linear relationship among the specified variables of the model is postulated. Hence, the demand equation is:

$$P_w^m = a_o + a_1 Q_w^m + a_2 Q_w^c + a_3 D_j + a_4 Q_j^p + e_w \qquad (4.10)$$

where:

a_o = constant term to be estimated

a_i = coefficients to be estimated, i=1, ... 4.

P_w^m = Medford f.o.b. average price per standard box of fresh Bartlett pears sold in the domestic market

Q_w^m = quantity of Medford fresh Bartlett pears sold in the domestic market in standard boxes

Q_w^c = quantity of California fresh Bartlett pears sold in auction markets in standard boxes

D_j = disposable personal income

Q^p_j = quantity of peaches sold fresh in standard boxes

w = bi-weekly period

j = time period (years)

e_w = error term representing unexplained residuals

The method of ordinary least squares is applied to this analysis. The use of the method of least squares is justified by the characteristics of the first model. Under the assumptions of that model, fresh Bartlett pears meet the necessary conditions that have been set for the application of this method (Fox, 1953). These conditions are:

1. The supply of a given commodity must not be affected by current price.
2. The consumption of a given commodity must be determined by current production.
3. The consumer income must not be significantly affected by changes in price or consumption of the given commodity.
4. The supply of any competing commodity must not be affected by the current price of the given commodity.
5. No more than one domestic outlet must be available for the given commodity.

The first and second conditions have been explained in previous sections. A change in Bartlett supply is unlikely to affect significantly disposable personal income. The fourth condition is satisfied by reasons analogous to condition one. Finally, the fifth condition is met by the predetermined nature of the quantity of Bartlett pears sold in the fresh market. Consequently, it is expected that the statistical demand function fitted by least squares will approximate the "true" within-season demand function.

Statistical Model When the Intraseasonal Supply Depends Upon Current Prices

For this model, a linear relationship among the specified variables is postulated. Hence, the supply equation is:

$$P^m_w = a'_o + a'_1 P^m_{w-1} - a'_2 H_w + u'_w$$

The variable H_w shows the quantity of Bartlett pears in the hands of growers at the beginning of subperiod w. Because of unavailability of data showing the unsold quantities of Bartletts in the hands of growers at the beginning of period w, H_w was replaced by the variable $(Q^m_j - \sum_{w=1}^{K} Q^m_w)$, where j denotes year and w subperiod. The rationale for this substitution is that growers estimate accurately the quantity Q^m_j to be sold in the fresh market. The supply equation then becomes:

$$P^m_w = a_o + a_1 P^m_{w-1} - a_2 (Q^m_j - \sum_{w=1}^{K} Q^m_w) + u_w \quad (4.11)$$

The demand equation is:

$$Q^m_w = b_o - b_1 \hat{P}^m_w + b_2 P^c_w + b_3 P^w_w + b_4 P^p_w$$

$$+ b_5 D_j + v_w \qquad (4.12)$$

where:

a_o = constant term to be estimated

b_o = constant term to be estimated

a_i = coefficients to be estimated, i=1, 2

b_i = coefficients to be estimated, i=1, ... 5

Q^m_w = quantity of fresh Bartlett pears sold f.o.b. Medford in standard boxes

Q^m_j = total quantity of fresh Bartlett pears sold in Medford in standard boxes

P^m_w = average f.o.b. Medford price of fresh Bartlett pears in standard boxes

$\hat{P}^m_w$ = average f.o.b. Medford price of fresh Bartlett pears as predicted by the supply equation

P^c_w = average price of California fresh Bartlett pears sold at auction markets in standard boxes

P^w_w = average price of Yakima, Washington, fresh Bartlett pears sold f.o.b. in standard boxes

P^p_w = average price of California fresh peaches sold at auction markets in standard boxes

D_j = disposable personal income

w = bi-weekly period

j = time period (years)

u_w = error term representing unexplained residuals

v_w = error term representing unexplained residuals

V STATISTICAL RESULTS OF DEMAND ANALYSIS

The first section of this chapter includes the results of the aggregate demand for Bartlett pears. In the second and third sections the within-season results are discussed. Interpretations immediately follow the results presented in each section.

The aggregate demand analysis was included in this study because of an interest in exploring the nature of the annual demand facing all regions producing Bartlett pears.

As mentioned earlier, the within-season statistical analysis was performed for the Medford area.

Aggregate Demand Analysis

The equations 4.7 to 4.9 were used in the aggregate demand analysis. The symbols in these equations have the following meaning:

P_j^f = deflated returns to growers per thousand tons of Pacific Coast fresh sales of Bartlett pears

P_j^p = deflated returns to growers per thousand tons of Pacific Coast processing sales of Bartlett pears

$\hat{Q}_j^f$ = estimated Pacific Coast fresh sales in thousand tons

$\hat{Q}^p_j$ = estimated Pacific Coast processing sales in thousand tons

S_j = total U.S. canners' stocks in thousand tons at the beginning of the marketing season

E^f_j = total U.S. fresh exports in thousand tons

E^p_j = total U.S. canned exports in thousand tons

C^f_j = quantity index of competing fresh fruits

C^p_j = quantity index of competing canning fruits

D_j = deflated U.S. disposable personal income

I_j = index of processing costs (in lieu of K_j).

j = time period (years)

w_j = error term representing unexplained residuals

z_j = error term representing unexplained residuals

x_j = error term representing unexplained residuals

Returns to growers and disposable personal income were deflated by the wholesale price index for all commodities.

For fresh and canned exports, a moving average of annual export levels during two previous years was used. Maintenance of trade relations, duration of trade restrictions, and fluctuations in export levels due to annual variations in size of the crop, were reasons for using lagged measures of fresh and processed exports (Ricks, 1965).

The index of quantities of competing fresh fruits includes U.S. fresh sales of apples and peaches and California grapes, plums, nectarines and oranges. The index of quantities of competing canning fruits includes Pacific Coast peaches and California apricots. In both indexes the total tonnage of competing fruits was divided by U.S. population, and the per capita figures were converted to the corresponding index on the basis of 1947-1949=100 (Ricks, 1965).

The index of processing costs includes only labor cost of Food and Kindred products as reported by the U.S. Department of Commerce.

The data used in the aggregate demand analysis are presented in Appendix Tables 5 and 6.

The estimated values of $\hat{Q}_j^f$ from equation 4.7 were inserted in equation 4.8. The results obtained were:

$$P_j^f = 161.6191 \underset{(-4.376)^{+}}{-0.9415\, \hat{Q}_j^f} + \underset{(0.392)}{0.6823\, E_j^f} + \underset{(0.058)}{0.7647\, D_j}$$

$$+ \underset{(0.434)}{0.3790\, C_j^f}$$

$$R^2 = 0.669 \qquad S_y = 21.063$$

Similarly, the results obtained from estimating equation 4.9 were:

$$P^p_j = 183.898 - 0.413\ \hat{Q}^p_j + 1.846\ E^p_j - 0.578\ S_j$$
$$(-3.997)^{+} \qquad (1.158) \qquad (-1.798)^{**}$$

$$+\ 20.543\ D_j + 0.267\ C^p_j - 0.413\ I_j$$
$$(0.668) \qquad (0.515) \qquad (-0.426)$$

$$R^2 = 0.756 \qquad S_y = 18.536$$

The price flexibility of the fresh demand curve at the centroid is -1.127, and that of the processing demand is -1.495. Thus, the demand for processing pears is more inelastic than the fresh demand for Bartletts.[8/]

8/ A statistical analysis of the annual demand for fresh Bartlett pears at Medford was performed by means of equation 4.3. The results obtained were:

$$P^m_j = 0.1018 - 0.00000002\ Q^m_j - 0.00000006\ E^{fm}_j - 0.0013\ D_j$$
$$(-2.364)^{*} \qquad (-0.745) \qquad (-0.271)$$

$$-\ 0.0005\ C^f_j$$
$$(-1.486)$$

$$R^2 = 0.686 \qquad S_y = 0.005$$

where the symbols P^m_j, Q^m_j, and E^{fm}_j denote annual f.o.b. Medford data, and D_j and C^f_j represent the same variables as above.

The price flexibility of the annual fresh demand at the centroid

Within-season Demand Analysis for Fresh Bartlett Pears (Model One)

Subperiod Analysis:

Independent functions approach

The intraseasonal demand relationships were analysed by sets of two-week periods. The time period 1947-1967, except for the years 1960 and 1962 for which data were not available, was divided into two-week periods. The relevant data are presented in Appendix Tables 7 to 9, 13, 15, and 18.

Equation 4.10 was used to analyse each biweekly period. The resulting regression coefficients and the calculated price flexibilities are presented in Table 10. This table shows that the signs of the coefficients for all subperiods are not consistent with *a priori* expectations. Moreover, the insignificance of the estimates and their random variation do not permit an appraisal of the observed differences.

The period 1959-1967 was analysed separately. The data for these years were analysed by grade and size of Bartlett pears. Independent variables expressing quantities were retained.

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is -0.199. Thus, the total Medford demand is more elastic than the Pacific Coast demand for fresh Bartlett pears and more inelastic than the within-season demands (Table 10).

Table 10. Model One: Regression Coefficients and Price Flexibilities, Period 1947-1967.

Subperiod	Regression constant a_0	Regression coefficients: Medford quantity a_1	Regression coefficients: California quantity a_2	Regression coefficients: Disposable personal income a_3	Regression coefficients: Annual quantities of peaches a_4	R^2	S_y	Means: $\bar{P}_w^m$	Means: $\bar{Q}_w^m$	Means: $\bar{Q}_w^c$	Price flexibilities with respect to: Q_w^m	Price flexibilities with respect to: Q_w^c
1	.073	.0024	-.008	.0026	-.025	.509	.007	.043	21069.3	169168.1	.011	-.30
		(.240)	(-2.382)*	(-.647)	(-.662)							
2	.058	-.003	-.0061	-.00002	-.014	.354	.008	.044	90720.0	151162.3	-.006	-.20
		(-.087)	(-1.264)	(-.005)	(-.344)							
3	.062	-.0036	-.0071	-.0008	-.003	.401	.008	.046	117269.3	117308.4	-.090	-.17
		(-1.243)	(-1.612)	(-.231)	(-.091)							
4	.031	-.0025	-.0029	.004	.021	.321	.009	.047	78012.6	79771.7	-.041	-.04
		(-.754)	(-.764)	(1.526)	(.504)							
5	.015	-.016	.018	.009	.011	.578	.007	.047	51368.0	46488.5	-.174	.17
		(-2.043)*	(1.350)	(3.145)*	(.276)							

Quantities of pears and peaches are expressed in units of 100,000 standard boxes.

*T values significant at the five percent level.

SOURCE: Derived from equation 4.10.

Disposable personal income and annual quantities of peaches sold fresh were omitted. A variable indicative of size distribution of pears was included.

In mathematical terms the new equation was:

$$P_w^m = a_o + a_1 Q_w^m + a_2 Q_w^c + a_3 Q_w^r + e_w \qquad (5.1)$$

The dependent variable is bi-weekly f. o. b. average price per standard box of fresh Bartlett pears sold in the domestic market, deflated by the wholesale price index for all goods and:

Q_w^m = per capita quantity of fresh Bartlett pears sold in the domestic market in standard boxes

Q_w^c = per capita quantity of California fresh Bartlett pears sold in auction markets in standard boxes

Q_w^r = ratio of medium sizes to total quantities of Bartlett pears sold at Medford.

The estimated coefficients were not significant except for the California quantity variable in the first subperiod (Table 11). Hence, the observed differences in the estimates can not be appraised. Despite this fact, the value of the coefficients representing quantities of California pears shows a systematic variation. This pattern leads to the hypothesis that the California quantity variable is a very important factor in determining the Medford demand. The dominance of the neighboring state in the production

Table 11. Model One: Regression Coefficients and Price Flexibilities, Period 1959-1967.

Period	Regression constant a_0	Regression coefficients: Medford quantity a_1	Regression coefficients: California quantity a_2	Regression coefficients: Ratio of medium size to total a_3	R^2	S_y	Price flexibilities with respect to: Q_w^m	Price flexibilities with respect to: Q_w^c
1	.042	10.194	-43.477	.033	.821	.008	.16	-.30
		(.140)	(-3.339)*	(1.525)				
2	.053	-3.287	-38.144	.0194	.618	.011	-.01	-.24
		(-.077)	(-1.899)	(.667)				
3	.053	-19.104	-14.302	.019	.420	.012	-.17	-.07
		(-.436)	(-.314)	(.383)				
4	.075	-36.646	-10.425	-.015	.587	.103	-.21	-.04
		(-.657)	(-.166)	(-.331)				
5	.057	-7.622	-49.017	.005	.365	.014	-.03	-.10
		(-.181)	(-.607)	(.224)				

*T values significant at five percent.

SOURCE: Derived from equation 5.1.

and marketing of Bartlett pears is a plausible explanation for the nonexistence of a discernible pattern in the Medford demand. However, the fact that in both formulations the coefficients of California variable were statistically significant during the first subperiod may indicate that the Medford demand is perfectly elastic during this period. This hypothesis is investigated further in subsequent sections. Furthermore, Table 10 shows that Medford prices become less sensitive to changes in California quantities (in relative terms) as the season progresses.

The residuals of formulation 4.10 were plotted in time sequence. On the basis of the plot, there is no reason to conclude that the assumptions about the residuals in this regression analysis are incorrect. Next the residuals were examined for serial correlation. The Durbin-Watson test, applied to the data for the years 1947-1967, was inconclusive. (For the four subperiods the test statistic was 2.70, 2.42, 2.61, and 2.52, respectively.)

It is worth noting here that the coefficient of the size distribution in equation 5.1 is not significant. This result reenforces the findings in Chapter III pertaining to the problem of the size of Bartlett pears.

Generalized Function Approach with Dummy Variables

The data for the five subperiods of the independent functions approach were treated as a single set. Medford and California quantities were retained as independent variables. Each observation was quantified in four additional dimensions with dummy variables. The dependent variable was the same as the one used previously.

The form of the fitted equation was:

$$P^m = a_o + a_1 Q^m + a_2 Q^c + a_3 X_1 + a_4 X_2 + a_5 X_3 + a_6 X_4 + e \qquad (5.2)$$

where:

$$X_w = \begin{cases} 1 \text{ in w subperiod} \\ 0 \text{ otherwise} \end{cases} \quad \text{and } w = 1, 2, 3, 4.$$

The absence of the w subscript indicates that the data series was for all subperiods together. Quantities are in units of 100, 000 standard boxes.

The results obtained were:

$$P^m = 0.05126 - \underset{(-1.383)}{0.002\, Q^m} - \underset{(-5.592)^{+}}{0.006\, Q^c} + \underset{(1.253)}{0.0040\, X_1}$$

$$+ \underset{(1.560)}{0.0047\, X_2} + \underset{(1.787)^{**}}{0.0053\, X_3} + \underset{(-0.846)}{0.0023\, X_4}$$

$$R^2 = 0.333 \qquad S_y = 0.008$$

The estimated quantity coefficients had the correct sign.

However, the California quantity was the only statistically significant variable. The percentage of variation explained by the California variable was 0.290 out of the total explained variation 0.333. The statistical significance of the dummy variable coefficients indicate that during the period under analysis shifts in the level of the demand function took place only in the third subperiod. The standard error of the estimate indicated a very close fit to the data.

Generalized Function Approach with Dummy Variables and Product Terms

In order to permit the level as well as the slope of the demand function to shift, cross-products of the quantity variables were introduced into the equation and used in the previous section. For each subperiod the form of the equation was:

$$P^m = a_o + a_1 Q^m + a_2 Q^c + a_3 X_1 + a_4 X_2 + a_5 X_3 + a_6 X_4 + a_7 Q^m_w Q^c_w + e \qquad (5.3)$$

where:

$Q^m_w Q^c_w$ = cross-product of Medford and California quantities. The subscript w indicates the subperiod to which the quantity variable pertains.

Quantities are in units of 100, 000 standard boxes.

The results obtained were:

$$P^m = 0.052 - 0.007\, Q^m - 0.008\, Q^c + 0.0043\, X_1$$

$$(-1.903)^{**} \quad (-5.029)^{+} \quad (1.130)$$

$$+ 0.0058 X_2 + 0.0087 X_3 + 0.0036 X_4 + 0.0067 Q^m_1 Q^c_1$$

(1.468) (2.111)* (1.023) (1.219)

$$+ 0.0034 Q^m_2 Q^c_2 + 0.0024 Q^m_3 Q^c_3 + 0.0047 Q^m_4 Q^c_4$$

(1.574) (1.024) (1.229)

$$+ 0.0058 Q^m_5 Q^c_5$$

(1.180)

$$R^2 = 0.356 \qquad S_y = 0.008$$

The present formulation shows the characteristics of the generalized approach with dummy variables. The California quantity variable was statistically significant, and explains the largest part of the total variation. In addition, the Medford quantity variable was significant at the ten percent level. This finding lends little support to the hypothesis that the derived demand curve facing Medford sellers shifted in response to conditions in the California market except for the third subperiod. The insignificance of the cross-product coefficients indicates that during the period of analysis, no significant changes took place in the slope of the demand function, at least in response to variations in California quantities. The standard error of the estimate was the same.

Since such a small percentage of the total variation in prices was explained by the variables in this model, it was decided to explore the hypothesis by a somewhat different approach.

Marketing Season Analysis: Up to this point, the time period of analysis has been the two week subperiod. These subperiods have been numbered according to the calendar date in each year at which Medford supplies are reported by the Rogue River Valley Traffic Association as first appearing in the market. The length of the marketing season for Medford growers is determined, in part, by the beginning of the marketing period for winter pears. Since the latter dates are determined largely by when other producing regions (especially Oregon's Hood River area and the Washington regions) begin to market their winter varieties, the length of the Bartlett pear marketing season is, to a large extent, beyond the control of Medford sellers. If there are important behavioral characteristics of buyers and sellers determined by the length of the marketing season, then an analysis treating the marketing seasons as if they were of equal length would obscure the results of such behavioral differences.

A period of analysis then can be thought of as a set of marketing seasons with the isolength periods as subsets. Hence, Figure 5 can be modified as follows (Figure 8):

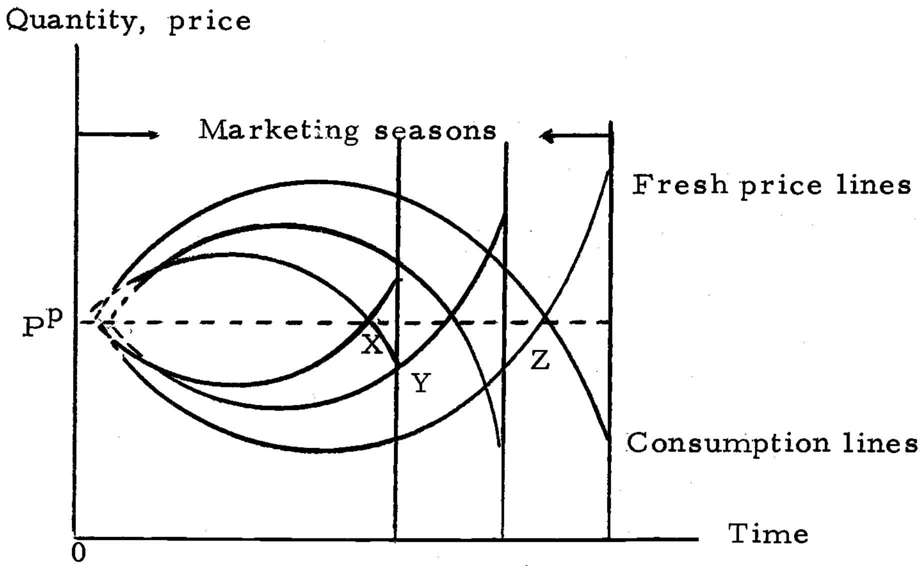

Figure 8. Sets of within-season price-quantity relationships of fresh Bartlett pears

The lines X, Y, and Z represent three sets of marketing seasons differing in time length.

Unfortunately, the variability of the marketing seasons reduced the number of observations considerably. From the period 1947-1967 four sets of years having the same number of trading weeks were separated. The generalized functions approach with dummy variables and cross-products was used (equation 5.3). The quantity variables were expressed in units of 100,000 standard boxes.

Marketing Seasons with Four Bi-weekly Trading Periods

The years 1948, 1950 and 1954 constituted the first set of marketing years. The results obtained were:

$$P^m = 0.050 - \underset{(-0.779)}{0.027\, Q^m} - \underset{(-0.286)}{0.007\, Q^c} + \underset{(0.221)}{0.013\, X_1}$$

$$+ \underset{(0.695)}{0.036\, X_2} + \underset{(1.060)}{0.019\, X_3} + \underset{(0.555)}{0.011\, Q^m_1\, Q^c_1}$$

$$\underset{(0.120)}{0.003\, Q^m_2\, Q^c_2} + \underset{(0.245)}{0.009\, Q^m_3\, Q^c_3} + \underset{(0.247)}{0.038\, Q^m_4\, Q^c_4}$$

$$R^2 = 0.534 \qquad S_y = 0.0079$$

Because of the inconclusiveness of the results, all variables but quantities were deleted. The rationale for retaining the quantity variables was to test the importance of the California variable. The California quantity variable was expected to be important because of the shortness of the marketing season. The statistical results did not verify the hypothesis. The Medford quantity variable explained the largest part of the total variation. The California variable was not significant at the ten percent level.

Marketing Seasons with Five Bi-weekly Trading Periods

The years 1947, 1949, 1952, 1959, 1963, and 1965 constituted the second set of marketing years. The results obtained were:

$$P^{m} = 0.053 - 0.006\,Q^{m} - 0.007\,Q^{c} + 0.005\,X_{1}$$

$$(-0.573) \qquad (-2.118)^{*} \qquad (0.577)$$

$$+ 0.006\,X_{2} + 0.011\,X_{3} + 0.006\,X_{4} + 0.0005\,Q^{m}_{1}\,Q^{c}_{1}$$

$$(0.608) \qquad (0.966) \qquad (0.705) \qquad (0.034)$$

$$+ 0.0015\,Q^{m}_{2}\,Q^{c}_{2} + 0.0008\,Q^{m}_{3}\,Q^{c}_{3} + 0.0004\,Q^{m}_{4}\,Q^{c}_{4}$$

$$(0.404) \qquad (0.161) \qquad (0.049)$$

$$- 0.122\,Q^{m}_{5}\,Q^{c}_{5}$$

$$(-0.598)$$

$$R^{2} = 0.513 \qquad S_{y} = 0.010$$

The present analysis showed that the California quantity variable was significant at the five per cent level and explained the largest part of the total variation. Neither the slope nor the level shifts of the demand curve were shown to be statistically significant.

Marketing Seasons with Six Bi-weekly Trading Periods

The years 1951, 1953, 1955, 1956, 1957, 1966, and 1967 constituted the third set of marketing years. Sales of California peaches at auction markets (which were not available originally) were introduced into the equation to represent quantities of competing fruits. The results obtained were:

$$P^m = 0.046 - \underset{(-2.024)^{**}}{0.181\ Q^m} - \underset{(-3.044)^{+}}{0.111\ Q^c} - \underset{(-0.326)}{0.0161\ Q^p}$$

$$+ \underset{(2.387)^{++}}{0.018\ X_1} + \underset{(2.588)^{++}}{0.020\ X_2} + \underset{(2.659)^{++}}{0.022\ X_3} + \underset{(2.374)^{++}}{0.018\ X_4}$$

$$+ \underset{(1.976)^{**}}{0.014\ X_5} + \underset{(1.131)}{0.015\ Q^m_1\ Q^c_1} + \underset{(1.719)^{**}}{0.010\ Q^m_2\ Q^c_2}$$

$$+ \underset{(1.421)}{0.009\ Q^m_3\ Q^c_3} + \underset{(1.590)}{0.012\ Q^m_4\ Q^c_4} + \underset{(1.417)}{0.012\ Q^m_5\ Q^c_5}$$

$$+ \underset{(1.239)}{0.056\ Q^m_6\ Q^c_6}$$

$$R^2 = 0.417 \qquad S_y = 0.009$$

where:

Q^p = quantity of California peaches sold in auction markets bi-weekly in standard boxes.

These results differ appreciably from those just discussed. The Medford quantity variable was shown to be statistically significant at the ten per cent level. Shifts in the level of the demand function were significant during all subperiods, while shifts in the slope were significant only during the second subperiod. The variable representing biweekly quantities of California peaches was not significant.

If it could be assumed that the total demand for all fresh pears had remained constant throughout the period, such results would be consistent with the decrease in California supplies between the first and second subperiods, and the appearance of winter pears during the last subperiod. This pattern is depicted diagrammatically in Figure 9. Changes in slope during the second subperiod have not been depicted.

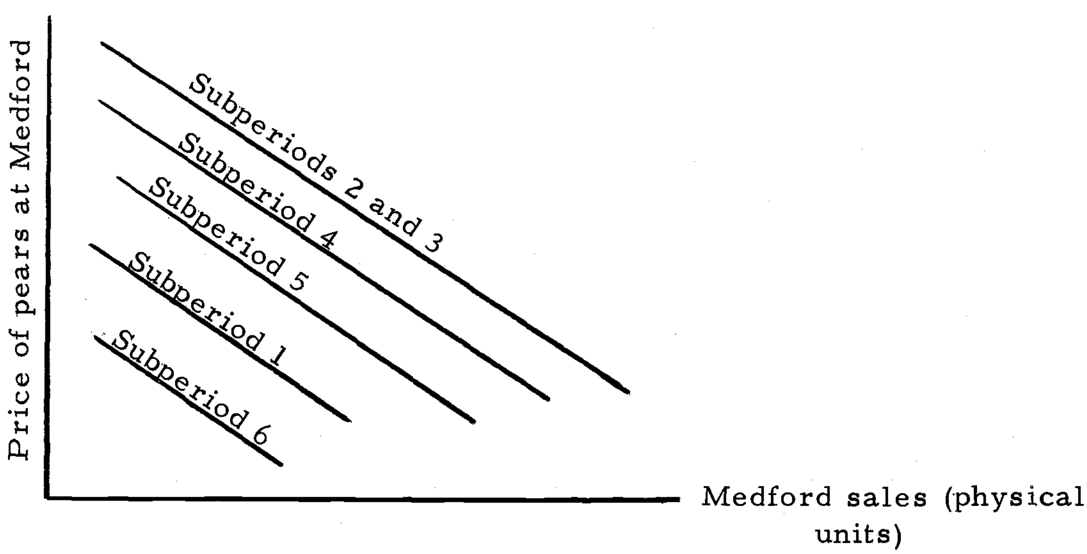

Figure 9. Seasonal demand shifts at Medford: Model one

Marketing Seasons with Seven Bi-weekly Trading Periods

The remaining years 1958, 1961, and 1964 constituted the last set of marketing years. The results obtained were:

$$P^m = 0.046 - 0.0009\,Q^m + 0.003\,Q^c - 0.009\,X_1$$
$$\qquad\qquad (-0.107) \qquad (0.628) \qquad (-0.906)$$

$$+ 0.010\,X_2 - 0.01\,X_3 - 0.007\,X_4 - 0.002\,X_5$$
$$(0.494) \qquad (-0.985) \qquad (-0.946) \qquad (-0.269)$$

$$- 0.001\,X_6 + 0.011\,Q^m_1 Q^c_1 - 0.056\,Q^m_2 Q^c_2$$
$$(-0.324) \qquad (0.178) \qquad (-0.954)$$

$$+ 0.010\,Q^m_3 Q^c_3 + 0.001\,Q^m_4 Q^c_4 - 0.003\,Q^m_5 Q^c_5$$
$$(0.555) \qquad (0.153) \qquad (-0.443)$$

$$- 0.006\,Q^m_6 Q^c_6 - 0.388\,Q^m_7 Q^c_7$$
$$(-0.405) \qquad (-2.264)^{**}$$

$$R^2 = 0.645 \qquad S_y = 0.004$$

A significant shift in the slope of the demand curve took place during the last subperiod. Data show that during this subperiod, the Medford quantities were proportionately greater than the California quantities than at any other subperiod. Based on the results of the six subperiod analysis, the Medford quantity variable was expected to be important. The results did not verify this expectation. Next all variables but quantities were deleted. The results again were inconclusive. Despite this fact the Medford quantity variable explained 0.2286 out of 0.2297 total variation. The Medford variable was not significant at the ten percent level.

The marketing season analysis verified the conclusions drawn from the subperiod analysis. The results of the five and six subperiod analyses show that the California quantity variable is an important factor in the determination of Medford prices. However, this analysis indicates that the California influence may depend upon the length of Medford's marketing season. Such a finding would not have been uncovered if explicit recognition of the importance of the length of the marketing season had not been considered in the analysis. This seems to confirm a hypothesis advanced by the industry that Medford growers benefit from a longer marketing period in terms of being able to influence prices. This has implications for potential development of Controlled Atmosphere Storage and for delaying the beginning of the winter pear season.

Within-season Demand Analysis for Fresh Bartlett Pears (Model Two)

The within-season analysis was performed for the Medford area. Data that became available later, when the present hypothesis was investigated, permitted the inclusion of Yakima, Washington, pears in the analysis. It must be pointed out, however, that the unavailability of data of other producing areas in Oregon deprived the present analysis of potential results.

To facilitate the comparison of the results secured from the two models, an analytical procedure that paralleled the procedure of model one was used. However, the two analyses are not strictly comparable. The first analysis was based on data featuring prices and quantities of fresh pears sold in the domestic market, while the second dealt with prices and quantities of pears sold in the domestic and export markets for fresh Bartlett pears. Despite this difference, it was hoped that this approach would discover some features that could lead to conclusions for the intraseasonal analysis.

The intraseasonal supply and demand relationships were analysed bi-weekly. A two-stage least-squares estimation method was used in this section.

The time period of the analysis was for the years 1947-1967. The years 1960 and 1962 were omitted because of unavailability of data. The relevant data pertaining to this section are presented in Appendix Tables 10 to 18.

Supply Functions: The within-season supply relationships were estimated by means of equation 4.11. For subperiod one the auction prices of California Bartlett pears for the preceding period were used.

The coefficients of the estimated supply functions for the six subperiods are presented in Table 12. The regression coefficients for the lagged price variable had the expected sign, and they were statistically significant at the one percent level. The sign of the quantity variable was also in accordance with economic reasoning. The coefficient of the first subperiod was the only statistically significant variable at the ten percent level.

Generally, the independent variables of the supply functions satisfactorily explained the data. The standard error of the estimate indicates that the equation 4.11 gave a close fit to the data.

Demand Functions: Five independent variables were used in the within-season demand functions: Medford predicted prices (given by the estimated supply functions), California and Yakima prices for fresh Bartlett pears, California fresh peach prices and disposable personal income. The selection of these variables

Table 12. Model Two: Regression Coefficients of Supply Functions.

Subperiod	Regression constant	Regression coefficients: Deflated average price at the w-1 subperiod	Regression coefficients: Total holdings of pears at the beginning of subperiod w	R^2	S_y
		Standard Boxes			
	a_o	a_1	a_2		
1	0.0146446	0.6054597	-0.000000014	0.799	0.0048
		(6.018)+	(-1.804)**		
2	0.0055484	0.9519264	-0.000000005	0.891	0.0034
		(8.659)+	(-0.859)		
3	0.0098897	0.8418386	-0.000000003	0.958	0.0019
		(14.960)+	(-0.990)		
4	-0.0001213	1.0097956	0.000000003	0.830	0.0042
		(7.912)+	(0.385)		
5	0.0037790	0.9281434	-0.000000001	0.864	0.0040
		(8.549)+	(-0.130)		
6	0.0133395	0.6717979	-0.000000005	0.771	0.0036
		(4.664)+	(-0.249)		

Source: Derived from equation 4.11.

was based on a trial and error procedure. The main objective was to specify variables with greater explanatory power and better economic meaning. The second subperiod was selected as the test period simply on the number of observations.

Quantities and prices of California fresh Bartlett pears sold at eastern auction markets and Yakima f. o. b. quotations were used alternatively. When California and Yakima quantities were used, the results obtained were not encouraging. The quantity variables were not statistically significant at the ten percent level. The experiment was repeated with the quantity variables on a per capita basis. The results showed the same statistical characteristics, except that the coefficient of determination increased from $R^2=0.414$ to $R^2=0.433$. Next the quantity variables were replaced in the equation by corresponding prices deflated by the wholesale price index for all commodities. The regression coefficients secured were statistically significant at the two-and-a-half percent level and they had the expected sign. The coefficient of determination was higher than previously ($R^2=0.593$).

The repetition of the experiment with Medford quantities on a per capita basis showed the same statistical characteristics as before and a higher coefficient of determination ($R^2=0.638$). As a result of this procedure, prices of California and Yakima fresh Bartlett pears were selected as independent variables despite the fact that these variables were highly correlated with Medford fresh prices.

Prices of California peaches sold fresh at auction markets and apple fresh prices were used alternatively. The inclusion of these variables as indicators of competing fresh fruits did not yield satisfactory results. The coefficient of determination was the lowest obtained (R^2=0.329). However, the coefficient of the peach price variable was statistically significant at the ten percent level. Consequently, it was decided that the California peach price variable would be retained for the rest of this study.

The disposable personal income was tested on a deflated form as well as on a per capita basis. In both cases the regression coefficient was significant at the two-and-a-half percent level. The coefficient of determination was higher (R^2=0.639) when income was not specified on a per capita basis (R^2=0.610). In both cases, however, the regression coefficient had a negative sign. The reader may recall that the income variable had a similar sign when this variable was used in the price takers' hypothesis. The idea that Bartlett pears were an inferior good seemed paradoxical. This variable may have had another meaning than this. When the income variable was replaced by a trend variable, the regression coefficient of the latter was also negative and statistically significant at the two-and-a-half percent level.

The coefficient of determination was R^2=0.676. Next, both variables, per capita disposable personal income and time trend, were included in the equation simultaneously. The rationale was to discover the more important variable. The trend variable retained the previously described characteristics, while the income variable was statistically insignificant and had a positive sign. The coefficient of determination was the highest obtained for the trial subperiod (R^2=0.677). Thus, income may simply be a proxy for the trend, and accounts for the decline over the period under analysis in the per capita consumption of fresh Bartlett pears without "explaining" this trend. It seemed then that the retention of the income variable was more economically sound. However, an interpretation of the negative sign was necessary. The shift of consumption from fresh to processed Bartlett pears seemed logical. This explanation is in accord with the findings in Chapter II.

The within-season demand was also analysed in two ways: by subperiods and by marketing seasons.

The form of the equation fitted to the data is given by equation 4.12. Prices were deflated by the wholesale index for all commodities. Disposable personal income was on a per capita basis and was deflated by the same index. Medford quantities were on a per capita basis.

Subperiod Analysis

Independent Functions Approach

The sets of the bi-weekly data were analysed separately by applying the specified equation. Based on the number of observations, five bi-weekly subperiods were considered appropriate for statistical investigation. The results obtained are presented in Table 13.

The constant term appeared not to vary systematically. The coefficients of Yakima pear prices, California peach prices and income varied randomly also. An impression about the Medford price variable coefficient can not be secured from the obtained results. This coefficient was significant in only two subperiods at the two-and-a-half and ten percent levels correspondingly. In addition, the sign of this coefficient did not agree with *a priori* expectations in some of these subperiods.

Generalized Functions Approach with Dummy Variables

When the observations of the independent functions were treated as a single set of data, the sample contained 80 observations. The years 1948, 1950, and 1954 were omitted as not having the fifth observation.

Two variables, Yakima pear prices and California peach

Table 13. Model Two: Regression Coefficients and Price Elasticities, Period 1947-1967.

Subperiod	Regression constant b_0	Regression coefficients: Medford price (predicted) b_1	California price (auction) b_2	Yakima price (f. o. b.) b_3	California peach price (auction) b_4	Per capita disposable income b_5	R^2	S_y	Means: $\bar{Q}^m_w$	$\bar{P}^m_w$	$\bar{P}^c_w$	Price elasticities with respect to: P^m_w	P^c_w
1	.000027	.0046 (.462)	.0094 (.978)	-.0116 (-1.638)	.0106 (1.192)	-.002 (-1.569)	.372	.0001	.00015	.042	.055	1.29	.34
2	.000451	-.1005 (-2.850)++	.0833 (2.915)++	.0021 (.069)	.0582 (2.138)**	-.008 (-3.097)+	.610	.0003	.00062	.043	.057	-6.97	7.65
3	.002322	-.0978 (-2.166)**	.0344 (1.640)	.0430 (1.051)	-.0004 (-.018)	-.004 (-1.349)	.479	.0004	.00074	.045	.061	-5.94	2.83
4	.002685	-.0011 (-.035)	.0183 (.920)	-.0260 (-1.128)	-.0354 (-.942)	-.005 (-1.175)	.387	.0003	.00060	.045	.060	-.08	1.83
5	.001571	.0847 (.511)	-.0212 (-.920)	-.0471 (-.432)	.0146 (.607)	-.010 (-.742)	.712	.0002	.00047	.046	.060	8.28	-2.70

All prices and income were deflated by the wholesale price index.

The symbols +, ++, and ** indicate statistical significance at the one, two-and-a-half, and ten percent levels respectively.

SOURCE: Derived from equation 4.12.

prices , were omitted from the present formulation in view of their insignificance when they were included in the independent functions approach.

The estimated equation was:

$$Q^m = 0.001096 - \underset{(-2.367)^{++}}{0.021530\ P^m} + \underset{(1.573)}{0.011228\ P^c}$$

$$- \underset{(-1.656)}{0.0000002\ D_j} - \underset{(-1.661)}{0.000214\ X_1} + \underset{(1.946)^{**}}{0.000249\ X_2}$$

$$+ \underset{(3.725)^{+}}{0.000468\ X_3} + \underset{(2.115)^{*}}{0.000265\ X_4}$$

$$R^2 = 0.421 \qquad S_y = 0.0003$$

The regression coefficient of the Medford price variable was significant at the two-and-a-half percent level. At the ten percent level, the coefficients of the other independent variables did not test significantly different from zero. The significance of the dummy variable coefficients indicates that shifts in the level of the demand function took place in all subperiods.

Marketing Season Analysis

For the years 1947-1967 four sets of years having the same number of weeks were separated. However, based on the results obtained when the first hypothesis was investigated, only two sets were subjected to statistical investigation: viz., years with five and six bi-weekly periods. The form of the equation is that used in the subperiod analysis.

Yakima pear and California peach prices were omitted from the equation. The associated t ratios, when these variables were included in the subperiod analysis, were not significantly different from zero at the ten per cent level, except for California peaches in the second subperiod. Dummy variables were introduced into the equation to account for shifts in the level of the demand functions. California pear prices and personal disposable income were retained: the former to check the importance of California prices, and the latter to check the sign of the associated regression coefficient.

Marketing Seasons with Five Bi-weekly Trading Periods

The years 1947, 1949, 1952, 1959, 1963, and 1965 contained exactly five subperiods. The results obtained by using bi-weekly data from these years were:

$$Q^m = 0.001039 - 0.019872\ P^m + 0.010691\ P^c - 0.0000004\ D_j$$
$$(-1.425) \qquad (0.951) \qquad (-1.300)$$

$$+ 0.000049\ X_1 + 0.000608\ X_2 + 0.000914\ X_3$$
$$(0.219) \qquad (2.870)^+ \qquad (4.682)^+$$

$$+ 0.000435\ X_4$$
$$(2.271)^*$$

$$R^2 = 0.685 \qquad S_y = 0.0003$$

This analysis showed that none of the t ratios of the price variable coefficients was significantly different from zero at the ten percent level. On the other hand, the bi-weekly dummy variable coefficients tested significant at the one and five percent levels. An exception was the coefficient of the first subperiod. The statistical significance of the dummy variable coefficients indicates that the level of the demand function shifted during these subperiods.

Marketing Seasons with Six Bi-weekly Trading Periods

The second set of data analysed by marketing seasons was for the years 1951, 1953, 1955, 1956, 1957, 1966, and 1967. The results secured were:

$$Q^m = 0.000438 - 0.030818\, P^m + 0.027081\, P^c - 0.0000003\, D_j$$

$$(-2.477)^{++} \qquad (2.390)^{++} \qquad (-1.742)^{**}$$

$$+ 0.000182\, X_1 + 0.000738\, X_2 + 0.000835\, X_3$$

$$(0.925) \qquad (3.616)^{+} \qquad (4.214)^{+}$$

$$+ 0.000806\, X_4 + 0.000459\, X_5$$

$$(3.973)^{+} \qquad (2.383)^{++}$$

$$R^2 = 0.506 \qquad S_y = 0.0003$$

In almost all respects, the present set of data gave better results than the previous one. At the two-and-a-half percent level of significance, the price variable coefficients were significant. The income coefficient was significant at the ten percent level. The dummy variable coefficients displayed the same characteristics as those for the five subperiods. However, the coefficient of determination was lower than that obtained in the previous analysis.

The pattern is similar to that displayed in Model one, with the Medford demand curve shifting "to the right" as California supplies decrease, but shifting back at the end of the season, presumably in response to competition from the winter varieties. This pattern is depicted in Figure 10.

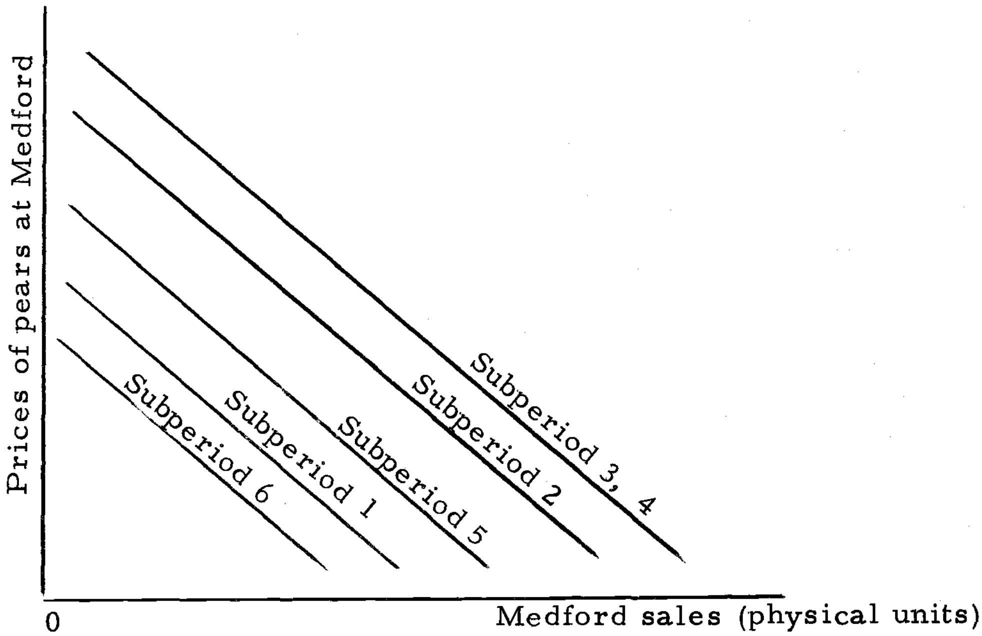

Figure 10. Seasonal demand shifts at Medford: Model two

The common characteristic of the present analyses is the shift of the demand functions in all subperiods. The statistical insignificance of the California price variable in most cases can not support the hypothesis about its importance in explaining the shifts in the Medford demand function. However, the observed unimportance of this variable can be attributed to its high correlation with the Medford price variable.

The results obtained from the investigation of the two hypotheses show that the Medford demand function changes level within season. This finding is more pronounced in the marketing season analysis than in the subperiod analysis. The marketing season analysis of the price takers' hypothesis indicated that changes in the slope of the demand curve took place also. These findings impose the following question: Which is the important variable that produces the shifts in the Medford demand function, especially during the first subperiods of analysis? Strong evidence exists, verified by the results of the price takers' hypothesis, that California quantity is the factor producing the shifts in the Medford demand function. However, the fundamental question still is: What is the shape of the Medford demand function? This question is explored in the next section.

The Shape of the Medford Demand Function

In this section the concept of excess demand, its elasticity and slope are discussed; then the shape of the Medford demand function is examined on the basis of the previous developments.

The aggregate demand for a product is satisfied by the supply of various producing areas. This demand, then, can be decomposed to as many demands as producing areas exist. To find the demand that each production area faces, the quantities of the product supplied by the other producing areas must be subtracted from the total demand. This spatial demand, essentially a residual to any region, is known as excess demand for that region. For linear functions, the excess demand curve may be illustrated graphically (assuming zero transportation costs):

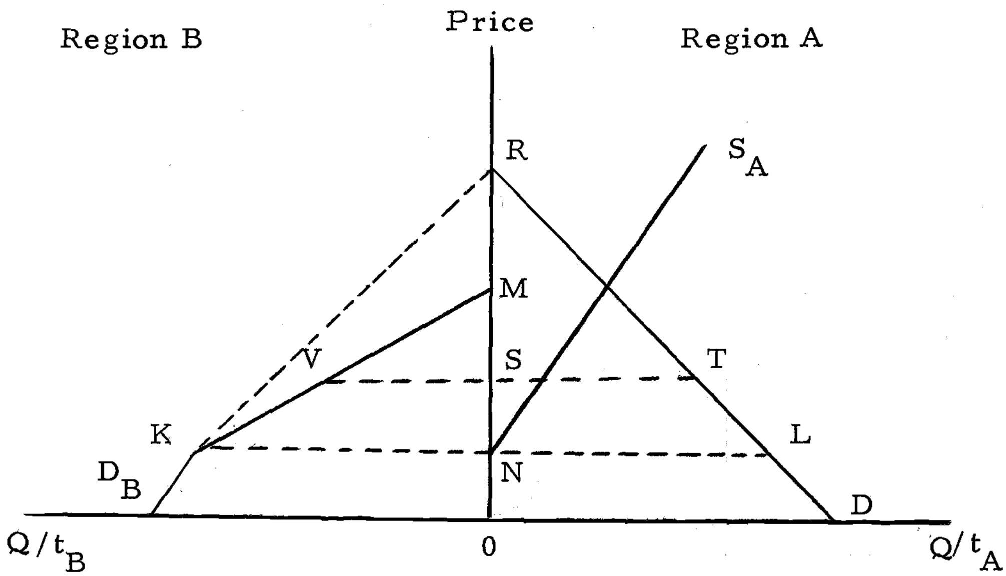

Figure 11. An excess demand curve

In the "back-to-back" diagram of Figure 11, total demand is represented by D. The quantity of the product supplied by the production region A at each price is represented by S_A. The curve D_B is the excess demand facing the production region B. The curve D_B is derived by plotting in the quadrant of region B the horizontal differences between the total demand curve D and the supply of region A, S_A.

The elasticity of the aggregate demand curve is smaller than the elasticity of the excess demand curve at a given price. This is shown by means of the Figure 11. For prices above ON (i. e., when region A is supplying a positive quantity)

$$\left| E_{D_B} \right| > \left| E_D \right| .$$

Consider price OS:

$$E_D = \left| \frac{dQ}{dP} \cdot \frac{P}{Q} \right| = \frac{ST}{SR} \cdot \frac{OS}{ST} = \frac{OS}{SR}$$

$$E_{D_B} = \left| \frac{dQ}{dP} \cdot \frac{P}{Q} \right| = \frac{SV}{SM} \cdot \frac{OS}{SV} = \frac{OS}{SM}$$

But SM < SR. Therefore, $\frac{OS}{SM} > \frac{OS}{SR}$ and hence $\left| E_{D_B} \right| > \left| E_D \right|$.

It has been shown previously that the Pacific Coast demand for fresh Bartlett pears is more inelastic than the total Medford demand. These demand curves, then, can be represented by the demand curves in Figure 11.

The slope of the total demand curve D is greater than the slope of the excess demand curve above K. This is shown in Figure 11. The line connecting the points K and R, KR, is equal in length to the line RL, since KRL is an isosceles triangle. Hence, $\widehat{NKM}$ is smaller than $\widehat{NKR}$, since the latter angle contains the former. Thus, the slope of the total demand curve D is greater than that of the excess demand curve KM.

The slope of the excess demand curve depends upon the slope of the spatial supply curve S_A. With a given demand curve, the greater the gradient of the spatial supply curve, the greater the slope of the excess demand curve becomes. Figure 12 shows two supply curves S_1 and S_2, where S_1 has a greater slope than S_2.

D_1 and D_2 are the corresponding excess demand curves. If the supply curve S_2 is shifted parallel to its position to the point I, where the supply curve S_1 intersects the aggregate demand curve, the excess demand curve D_2' will be parallel to the excess demand curve D_2. The angle $\widehat{KMN}$ is greater than the angle $\widehat{KLN}$ as exterior angle of the triangle KLM. Thus, D_1 has a greater slope than the excess demand curve D_2.

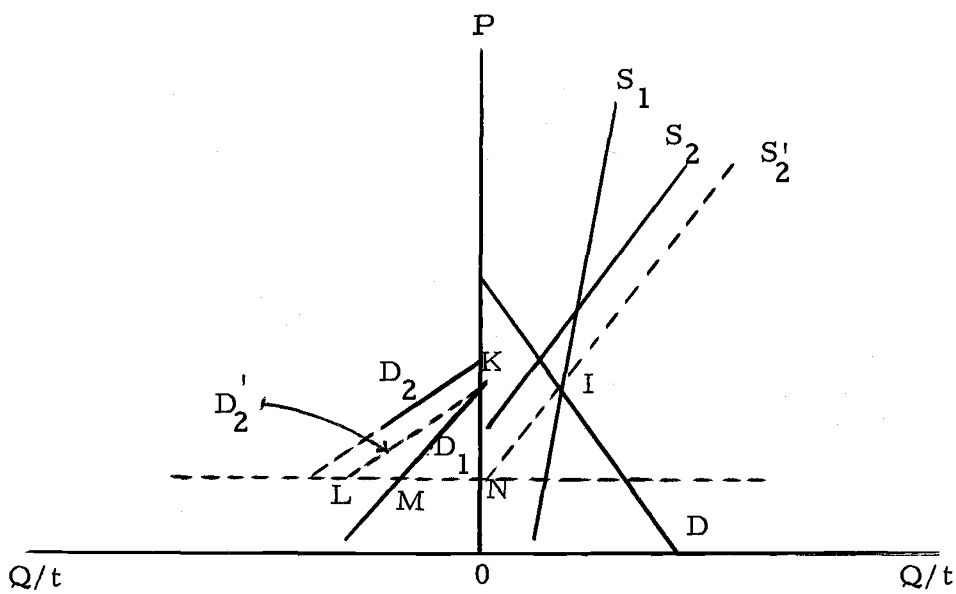

Figure 12. The slope of an excess demand curve

California has a larger number of production areas, and its total production is 10 to 15 times greater than the Bartlett pear production of Medford. Moreover, there is not a completely separate and definite shipping pattern for the two regions. Although California precedes Medford in shipping dates, both are in the market for a significant part of the marketing season of Bartlett pears. Thus, at the time of the entrance of Medford into the market, California is in the peak of its fresh pear shipments. In other words, the California supply curve shifts to the right of its position at the beginning of the season. Hence, the slope of the Medford excess demand curve becomes less pronounced. However, as the season progresses California shipments diminish. The California supply curve shifts to the left of its original position. Hence, the Medford excess demand curve becomes steeper than before.

The shifts of the California supply curve and the corresponding Medford excess demand curves are shown in Figure 13 by the curves S^c_o, S^c_1, and S^c_2 and D^m_0, D^m_1 and D^m_2. When California shipments are large (supply curve S^c_1), the Medford excess demand curve is almost perfectly elastic ((demand curve D^m_1); when California shipments diminish (supply curve S^c_2), the Medford excess demand curve becomes steeper (demand curve D^m_2). This behavior of the demand curve D^m may explain why the Medford quantity variable becomes statistically significant and shifts during the years with long marketing seasons. Similarly, the appearance of winter varieties makes the Medford demand curve elastic again.

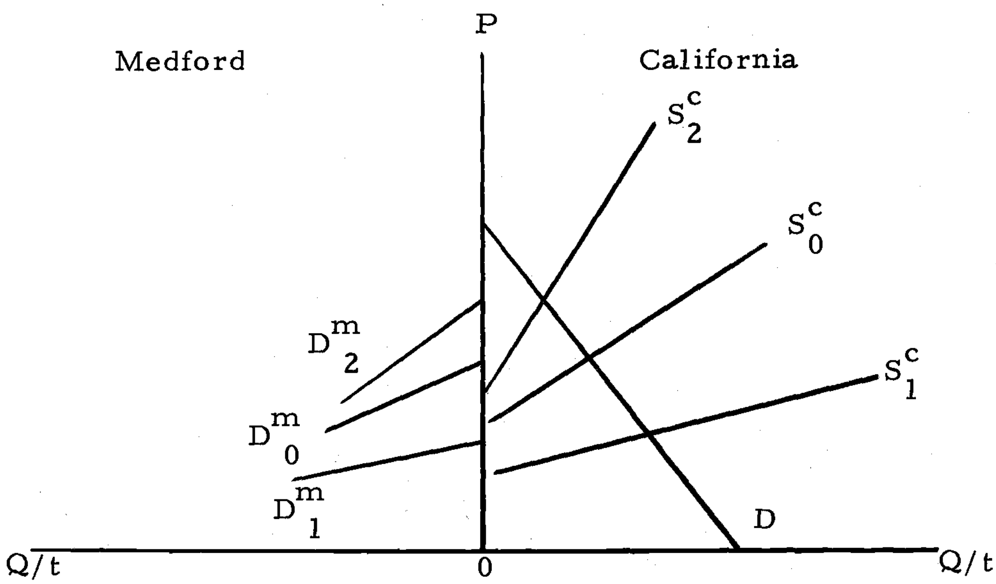

Figure 13. The shape of the Medford demand curve

The above hypothesis about the within-season shape of the Medford demand curve can be verified by California or Pacific Coast f.o.b. fresh price-quantity relations. However, the unavailability of data, at present, prevents the investigation of this hypothesis. This subject may become the task of further research.

How can price changes at Medford be explained? For most of the marketing season (excess demand curve D^m_1) the level of prices at Medford is determined by California pear prices.

During this period, price changes represent fluctuations along a horizontal demand curve. These fluctuations may stem from marketing and financial considerations, trade relations, quality of pears and other factors discussed in Chapter I. The structure of the Medford fresh market, where almost all of the growers market their pears through one or more of 11 packer-shippers, is strong evidence in favor of this argument. For the rest of the marketing season until winter pears appear in the market (excess demand curve D^m_2), price changes result from price-quantity relationships as well as from qualitative factors. Hence, in the former cases, quantitative analysis alone can not explain price changes. An analysis also of the price policies of the participants in the fresh market is necessary.

VI SYNOPSIS AND CONCLUSIONS

The purpose of the present study has been to identify important explanatory variables in the demand functions for Pacific Coast Bartlett pears, to explore alternative specifications underlying the behavior of such demand functions, and to estimate the parameters of these functions. In particular, the study has focused attention on intraseasonal variations in these demand functions in order to identify how changes in the magnitudes of important explanatory variables affect the price and consumption pattern within each marketing season.

The study has applied estimation methods on models appropriate to such demand analyses, for which relevant data, especially for intraseasonal analyses, are often not available in intraseasonal form. The results were expected to provide demand estimates needed for better scheduling of storage and distribution patterns in order to improve total returns to growers.

The overall market for Bartlett pears can be broken into two major component markets on the basis of utilization: 1) the fresh market, and 2) the processing market. On the basis of percentage of the crop utilized, the processing market is the most important outlet for Bartlett pears. Canning is the dominant processing use.

Fresh per capita consumption has decreased substantially. At the same time, the processing market has experienced a substantial increase. However, the technological improvements, the convenient aspects and the marketing developments which have been concentrated in large part in the processing market have not succeeded in reversing the decline in the per capita consumption of Bartlett pears.

The Bartlett exports have undergone considerable variations in quantities and shifts in sale destinations. The export quantities varying from year to year, never regained the pre-war export levels. The formation of the European Economic Community and the development of Commonwealth countries as pear producers are among factors that deprived the United States of additional markets for pears.

The market for processing pears is characterized by several large canners on the buying side, and many small growers, most of whom commit their production to bargaining associations for price negotiations. Pears for the fresh market are sometimes sold by growers to wholesale packer-shippers for a cash price at the time of delivery. In many production areas, however, a more common arrangement is that of fresh sales on a commission basis, or through cooperative organizations. In the Medford region of Oregon, almost all of the growers market their pears through one or more of 11 packer-shippers.

Pears differ by grade, quality and size. Information is lacking with regard to the price differentials. Undoubtedly, trade position, quantity bought, promptness of payment and location of buyer influence the pricing of the same grade, quality and size of pears. The information available on how pear prices are made refers to the processing market only. Discussions and interviews with industry and Extension Service representatives reveal that growers and processors negotiate pear prices but not quantities. Accordingly, the established prices are in effect during the entire marketing season for pears that meet the specifications set. However, both growers and processors attempt to enter into contracts based on supply and demand expectations, and thus indirectly determine the quantities to be sold.

Since pears are categorized by size and quality, it was decided to see if there existed any systematic relationship between pear sizes and pear prices. The results obtained show that prices of various sizes are related linearly, and that the use of weighted average prices of pears is an appropriate index for the present study. On the basis of these results, however, one can not conclude that separate demand and/or supply functions do not exist for each size.

A period of several years is required to raise a pear tree to full production, and pear production has become a more specialized operation. Hence, the total crop of Bartlett pears available for harvest during any given year is not the result of any decision made that year. In addition, no storage of fresh Bartlett pears takes place between years although some storage does occur within years. For purposes of economic analysis, the annual quantity of Bartlett pears supplied may be regarded as a predetermined variable. However, the allocation of the annual pear production to final uses can not, a priori, be regarded as predetermined.

A statistical analysis of annual data for the years 1954-1966 indicates that 86.5 percent of the variation in the percent of Pacific Coast Bartlett pear production entering the processing market, could be explained by variations in the Pacific Coast pear production, beginning stocks of canned Bartlett pears, and a linear trend variable. The estimated coefficients were significantly different from zero at the one percent level. The equation indicates a tendency for the percent of pears being processed to increase over a period of time, but also it shows that years with high production and/or high canner stock levels may experience a reallocation from the processing to the fresh markets. When actual quantities of all United States Bartlett pears processed annually and sold domestically were regressed against total United States farm marketings, net of exports, annual stocks of processed pears, and the ratio of the average annual processing to fresh returns to growers, almost 98 percent of the variation in the dependent variable could be explained by the independent variables. The coefficient of the ratio variable was not significantly different from zero at the ten percent level, suggesting that one could treat the processing supply as independent of current relative prices in the fresh and processing markets. Therefore, the total annual volume of Bartlett pears sold to the fresh market has been treated as an exogenous variable in the intraseasonal models.

The aggregate demand analysis for fresh and processing Bartlett pears was included in the study because of an interest in exploring the nature of the annual demand facing all regions producing Bartlett pears. The Pacific Coast fresh and processing demand functions were estimated by the two-stage least-squares method. The results obtained indicate that the fresh demand for Bartlett pears is more elastic than the corresponding processing demand.

The intraseasonal demand analysis for fresh Bartlett pears was performed for the Medford area, by two alternative specifications on the model of the Bartlett pear market. In the first model, it was assumed that each bi-weekly supply function was perfectly inelastic and that the supply quantity was determined by factors other than the current price of fresh Bartlett pears. The bi-weekly demand functions were estimated by the ordinary least-squares method. In the second model, it was assumed that growers set prices on the basis of the market prices they had most recently observed and of their total holdings of Bartlett pears. A price predicting equation was then estimated by ordinary least-squares and the resulting predicted prices were used in estimating the parameters of the demand functions.

The marketing seasons were divided into two-week subperiods by using data on domestic sales for the years 1947-1967. A demand equation was estimated for each of the first five subperiods. The results of this analysis were unsatisfactory, with none of the estimated coefficients being consistently and significantly different from zero. The price flexibilities showed no seasonal pattern. The period 1959-1967 was analysed separately. The Medford data were analysed by grade and size of Bartlett pears. Independent variables expressing Medford and California quantities were retained. Disposable personal income and annual quantities of peaches sold fresh, which had been included in the first analysis, were omitted. A variable indicative of size distribution of pears was included. The results obtained showed the same characteristics. However, the value of the coefficients representing quantities of California pears showed a systematic variation. This pattern leads to the hypothesis that the California quantity variable is a very important factor in determining the Medford demand.

A single equation was specified in which the observations were indexed by year and by subperiod number. Medford and California quantities were the independent variables. Dummy variables were employed to permit shifts in the estimated equation for the various subperiods. The California quantity was the only statistically significant variable. Shifts in the level of the demand function took place only in the third subperiod. In order to permit the level as well as the slope of the demand function to shift, terms indicating the product of Medford and California quantities were introduced in the previously specified equation. The coefficients of Medford and California quantity variables were significant at the ten percent level. With the exception of the dummy variable corresponding to the third subperiod, none of the dummy or the product variables had a statistically significant coefficient at the ten percent level. This finding lends little support to the hypothesis that the derived curve facing Medford sellers shifted in response to conditions in the California market except for the third subperiod.

The data were stratified according to the length of the marketing season to which they pertained. During the 1947-1967 period, the marketing season for Medford sellers ranged from four to seven subperiods in duration. A marketing period with a length of exactly six subperiods was the most common, and provided the only case in which the shift variables had statistically significant coefficients. The analysis indicates that the California influence in the determination of the Medford demand may also depend upon the length of Medford's marketing season.

In the second model, one supply equation was estimated for each subperiod. The predicted prices were used in estimating the parameters of the demand equation for each subperiod. The prices of California and Yakima Bartlett pears, and the price of California peaches, and disposable personal income were the other independent variables. The results of this analysis were also unsatisfactory.

As in the first model, a single equation was specified and observations were indexed both by year and by subperiod number. Dummy variables were employed to permit shifts in the estimated equations for the various subperiods. The regression coefficient of the Medford price variable was significant at the two-and-a-half percent level. The California price coefficient was not significantly different from zero at the ten percent level. The coefficients on all but the first dummy variables were significantly different from zero at the ten percent level.

For purposes of comparison with the results of the first model, a separate analysis was conducted for those years in which the length of the Medford marketing season was equal. However, based on the results obtained when the first hypothesis was investigated, only years with five and six subperiods were subjected to statistical analysis. Yakima pear and California peach prices were omitted in view of their statistical insignificance in the subperiod analysis. The analysis of both sets of data indicated that shifts in the demand function took place in all subperiods. At the ten percent level of significance, the California price variable was statistically insignificant in the five subperiod analysis.

The statistical insignificance of the California price variable in most cases of model two can not support the hypothesis about its importance in explaining the shifts in the Medford demand function. However, the observed unimportance of this variable can be attributed to its high correlation with the Medford price variable.

The results obtained from the investigation of the two hypotheses show that the Medford demand function changes level within season. This finding is more pronounced in the marketing-season analysis. The marketing-season analysis of the price takers' hypothesis indicated that changes in the slope of the demand curve also took place. These results suggest that there is, in fact, a seasonal pattern to the derived demand facing the sellers of fresh Bartlett pears from the Medford district. The elasticity of the Medford demand curve changes in response to the shifts of the California supply curve and possibly the appearance of the winter varieties. The two hypotheses yielded consistent results.

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APPENDIX

Appendix Table 1. Bartlett Pears: Medford Data Used in Size Analysis.

Week	Domestic f.o.b. sales					Ratio of extra fancy to all grades	Ratio of large and small to total extra fancy
	Average price extra fancy	All grades	Extra fancy				
			Total	Medium size	Large and small sizes		
		(Standard box)					
1964							
9-18	$3.651	16,014	16,014	8,450	7,564	1.000	0.472
9-25	3.751	19,782	19,782	16,515	3,267	1.000	0.165
10-2	3.619	32,916	31,966	17,770	14,196	0.971	0.444
10-9	3.829	78,105	50,491	38,656	11,835	0.646	0.234
10-16	3.998	60,582	55,219	47,223	7,996	0.911	0.145
10-23	4.132	35,390	32,660	25,975	6,685	0.923	0.205
10-30	4.194	22,571	19,435	16,295	3,140	0.861	0.161
11-6	4.185	41,258	32,772	30,466	2,306	0.794	0.070
11-13	4.247	8,816	6,710	5,510	1,200	0.761	0.179
11-20	4.299	2,056	2,056	--	2,056	1.000	1.000
1965							
8-20	6.460	11,200	11,200	7,488	3,712	1.000	0.331
8-27	6.380	20,248	20,248	13,912	6,336	1.000	0.313
9-3	6.490	22,729	22,729	17,993	4,736	1.000	0.208
9-10	6.290	56,674	56,674	25,445	31,229	1.000	0.551
9-17	6.510	66,402	63,706	50,490	13,216	0.959	0.207
9-24	6.670	46,707	44.851	28,028	16,823	0.960	0.375

Continued

Appendix Table 1--Continued.

Week	Domestic f.o.b. sales					Ratio of extra fancy to all grades	Ratio of large and small to total extra fancy
	Average price extra fancy	All grades	Extra fancy				
			Total	Medium size	Large and small sizes		
	(Standard box)						
10-1	$6.830	5,944	4,448	4,248	200	0.748	0.045
10-8	6.800	8,466	7,070	5,140	1,930	0.835	0.273
10-15	7.330	4,865	4,415	2,048	2,367	0.907	0.536
1966							
8-12	4.148	3,054	3,054	2,613	441	1.000	0.144
8-19	3.859	15,756	13,575	3,801	9,774	0.861	0.720
8-26	4.079	8,305	8,305	6,182	2,123	1.000	0.255
9-2	4.233	64,862	64,862	39,526	25,336	1.000	0.390
9-11	4.185	51,436	51,322	25,129	26,193	0.998	0.510
9-16	4,704	18,103	18,103	11,708	6,395	1.000	0.353
9-23	4.564	43,744	43,444	28,250	15,194	0.993	0.350
9-30	4.729	35,044	35,044	23,573	11,471	1.000	0.327
10-7	4.660	48,606	48,606	25,861	22,745	1.000	0.468
10-14	5.017	27,841	25,985	14,048	11,937	0.933	0.459
10-21	4.769	15,202	15,202	6,134	9,068	1.000	0.596
10-28	3.987	10,231	10,231	1,462	8,769	1.000	0.857

Source: Daily sales reports, Rogue Valley Marketing Association.

Appendix Table 2. Extra Fancy Bartlett Pears, Medford Data Used in Size Analysis.

Week	Domestic f. o. b. average price		Domestic f. o. b. sales		Ratio of 135L to 150L	
	135L	150L	135L	150L	Prices	Quantities
	(Standard box)		(Standard box)			
1964						
9-18	$3.744	$3.770	5,048	2,892	0.993	1.745
9-25	3.800	3.750	6,624	6,304	1.013	1.051
10-2	3.750	3.836	6,414	5,368	0.977	1.195
10-9	3.963	3.761	16,582	10,664	1.054	1.555
10-16	4.166	3.979	5,162	29,961	1.047	0.172
10-23	4.258	4.059	6,143	15,670	1.049	0.392
10-30	4.323	4.117	6,672	8,345	1.050	0.799
11-6	4.283	4.109	13,808	11,282	1.042	1.224
11-13	4.194	4.199	3,356	2,154	0.999	1.558
1965						
8-20	6.500	6.500	1,024	1,984	1.000	0.516
8-27	--	6.500	--	3,648	--	--
9-3	6.500	6.500	2,752	2,976	1.000	0.925
9-10	6.500	6.400	1,521	18,631	1.016	0.082
9-17	6.540	6.510	4,973	30,560	1.005	0.163
9-24	6.750	6.620	1,216	21,379	1.020	0.057
10-1	7.000	6.820	400	3,848	1.026	0.104

Continued

Appendix Table 2--Continued.

Week	Domestic f. o. b. average price		Domestic f. o. b. sales		Ratio of 135L to 150 L	
	135L	150L	135L	150L	Prices	Quantities
	(Standard box)		(Standard box)			
1966						
8-26	$4.366	$4.000	3,443	1,971	1.091	1.747
9-2	4.452	4.358	32,790	6,436	1.021	5.095
9-9	4.564	4.438	12,317	12,812	1.028	0.961
9-16	4.940	4.750	10,326	1,228	1.040	8.409
9-23	4.950	4.887	14,765	10,107	1.013	1.461
9-30	5.036	5.000	17,798	2,390	1.007	7.447
10-7	5.132	5.199	14,950	7,929	0.987	1.885
10-14	5.487	5.280	6,772	5,502	1.039	1.231

Source: Daily sales reports, Rogue Valley Marketing Association.

Appendix Table 3. Extra Fancy Bartlett Pears, Medford Data Used in Size Analysis

Week	Domestic f. o. b. average price		
	Large	Medium	Small
		(Standard box)	
1964			
9-18	$3.850	$3.748	$3.505
9-25	3.850	3.764	3.500
10-2	3.850	3.737	3.305
10-9	3.965	3.825	3.580
10-16	4.064	4.007	3.549
10-23	4.336	4.111	3.688
10-30	4.420	4.198	4.000
11-6	4.459	4.182	4.000
11-13	4.483	4.196	--
11-20	4.750	--	4.250
1965			
8-20	6.500	6.434	--
8-27	6.188	6.481	6.146
9-3	6.500	6.483	6.500
9-10	6.316	6.423	6.471
9-17	6.353	6.532	6.570
9-24	6.711	6.672	6.633
10-1	6.750	6.837	--
10-8	6.086	7.065	--
10-15	7.750	6.600	8.000
1966			
8-12	--	4.173	4.000
8-19	--	4.224	3.717
8-26	--	4.204	3.717
9-2	--	4.435	3.917
9-11	--	4.500	3.883
9-16	--	4.919	4.312
9-23	--	4.913	3.914
9-30	5.000	5.010	4.034
10-7	5.121	5.117	3.942
10-14	5.420	5.394	4.357

Continued

Appendix Table 3--Continued.

Week	Domestic f.o.b. average price		
	Large	Medium	Small
		(Standard box)	
10-21	$5.165	$5.419	$4.121
10-28	5.250	4.944	3.790

Source: Daily sales reports, Rogue Valley Marketing Association.

Appendix Table 4. Bartlett Pears: Data Used in Aggregate Supply Analysis.

Year	Pacific Coast processed production	Pacific Coast production	Total U.S. farm mktgs.	Total U.S. processed	Beginning stocks	Total exports	Processed exports	Ratio of processing to fresh returns to growers
	(%)	(Thousand tons, fresh basis)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1954	74.0	493.0	516.2	376.8	46.3	35.1	25.4	0.87226
1955	75.0	491.5	513.4	389.4	66.1	43.2	36.9	0.82775
1956	75.0	512.5	541.8	405.8	68.3	37.1	29.3	0.95255
1957	70.0	512.5	523.5	356.0	94.0	49.8	34.1	0.81048
1958	73.0	447.0	483.4	340.4	90.0	36.5	24.8	1.05318
1959	75.0	490.5	520.3	372.7	78.7	45.9	29.7	0.76846
1960	76.5	424.2	451.1	336.6	88.4	38.8	29.7	0.77391
1961	75.5	450.8	479.7	356.7	90.9	47.0	39.3	0.89990
1962	72.6	499.8	526.1	378.1	105.5	53.4	43.4	1.05190
1963	79.8	290.0	317.4	248.3	91.8	37.7	34.3	0.97095
1964	78.3	511.7	547.0	419.0	40.8	52.0	44.1	1.31043
1965	83.5	288.2	314.1	256.6	105.4	41.2	36.7	0.98404
1966	76.5	513.0	525.4	391.2	72.2	52.7	40.1	0.98490

Sources: Column (1): U.S. Dept. of Agriculture, Agricultural Marketing Service-Washington State Department of Agriculture. Marketing Northwestern pears. Season summaries.
Columns (2) to (7): O.S.U. Cooperative Extension Service, Oregon commodity data sheet for the years 1958, 1961, 1965, and 1968.
Column (8): computed from columns (1) and (2), Table 6.

Appendix Table 5. Bartlett Pears Data Used in Aggregate Demand Analysis.

Year	Pacific Coast sales		Canners beginning stocks total U.S.	U.S. exports		Index of quantities of competing fruits 1947-1949=100		Index of labor cost in food and kindred products
	Fresh	Total		Fresh	Canned	Fresh	Canning	
	(Thousand tons, fresh basis)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1947	168.2	484.1	5.7	15.0	11.3	118.0	104.4	94.8
1948	94.3	357.4	20.7	16.3	11.1	95.4	108.6	101.1
1949	166.5	452.2	21.7	9.8	7.0	99.2	95.9	103.9
1950	118.3	421.3	12.8	2.8	6.8	87.7	91.1	108.7
1951	106.3	439.2	16.2	6.2	8.8	91.6	116.6	119.0
1952	153.6	464.1	45.0	6.3	9.3	88.5	95.2	126.6
1953	118.6	400.1	38.9	5.9	9.4	87.7	108.8	134.0
1954	121.5	486.8	23.2	7.4	9.8	83.1	91.1	137.1
1955	116.1	482.5	41.8	8.5	13.2	77.8	111.1	144.3
1956	122.3	501.7	45.5	9.4	20.5	77.8	119.1	153.6
1957	135.9	491.9	70.0	8.9	21.5	82.4	99.6	156.4
1958	124.0	441.5	65.5	9.8	19.6	85.1	94.7	161.0
1959	122.8	484.6	55.0	10.2	18.5	85.8	117.4	170.1
1960	97.0	419.6	60.6	11.9	18.8	76.6	113.5	176.9
1961	107.5	443.7	67.6	12.0	21.1	78.2	113.2	180.9
1962	133.4	492.3	81.6	9.3	24.4	68.3	117.9	185.9
1963	56.7	284.3	61.3	9.9	29.2	69.4	117.8	189.7
1964	108.7	507.0	17.3	7.7	28.1	69.3	113.8	195.2
1965	46.2	285.6	74.8	6.4	29.2	69.5	110.4	201.4

Continued

Appendix Table 5--Continued.

Year	Pacific Coast sales		Canners beginning stocks total U.S.	U.S. exports		Index of quantities of competing fruits 1947-1949=100		Index of labor cost in food and kindred products
	Fresh	Total		Fresh	Canned	Fresh	Canning	
	(Thousand tons, fresh basis)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1966	116.3	493.8	50.2	7.2	29.9	59.5	118.3	212.1
1967	41.9	264.1	63.7	8.6	28.3	47.7	94.2	221.8

Sources: Columns 1 and 2: U.S. Dept. of Agriculture. Agricultural Marketing Service-Washington State Department of Agriculture. Marketing Northwestern pears. Season summaries.
Columns 3 to 5: O.S.U. Cooperative Extension Service. Oregon commodity data sheet, Bartlett pears, annual.
Columns 6 and 7: 1947-1961, Ricks, 1964, p. 205. 1962-1967: U.S. Dept. of Agriculture. Statistical Reporting Service. Fruits, noncitrus, by states. Production, use, value. Statistical Bulletin No. 407, Part I: FrNt 2-1: (5-67), (5-68), (5-69). Part II: FrNt 2-1: (7-67), (7-68).
Column 8: U.S. Dept. of Commerce. Statistical abstract of the United States.

Appendix Table 6. Bartlett Pears. Data Used in Aggregate Demand Analysis.

Year	Pacific Coast sales Returns to growers		Estimated quantities	
	Fresh	Canning	Fresh	Processed
	(Tons, fresh basis)		(Thousand tons)	
	(1)	(2)	(3)	(4)
1947	80.30	74.00	164.5	319.4
1948	102.45	115.00	101.0	255.7
1949	32.80	31.00	144.7	308.6
1950	87.90	81.50	121.4	299.6
1951	100.10	98.70	118.6	320.3
1952	59.60	46.00	142.8	322.4
1953	78.10	63.80	108.7	291.9
1954	82.20	71.70	130.9	252.4
1955	83.60	69.20	122.7	360.8
1956	82.20	78.30	119.6	382.2
1957	74.40	60.30	142.5	349.7
1958	77.10	81.20	130.9	311.3
1959	79.90	61.40	131.0	353.3
1960	103.50	80.10	101.6	318.2
1961	100.90	90.80	113.6	330.0
1962	65.58	68.90	120.2	371.6
1963	120.55	117.00	40.8	242.7
1964	75.70	99.20	110.5	397.6
1965	150.44	148.00	59.3	224.9
1966	86.10	84.80	109.8	383.5
1967	210.22	180.00	39.8	225.0

Sources: Columns 1 and 2: 1947-1962, Ricks, 1964, p. 201. 1963-1967, U.S. Dept. of Agriculture. Agricultural Marketing Service-Washington State Dept. of Agriculture. Marketing Northwestern pears. Seasonal summaries. Colums 3 and 4: Predicted quantities.

Appendix Table 7. Bartlett Pears: Medford f.o.b. Fresh Price Data (Domestic).

Year	Subperiod 1	2	3	4	5	6	7
	(Dollars per standard box)						
1947	3.26	3.86	4.44	4.78	4.05	--	--
1948	4.07	3.65	3.68	3.37	--	--	--
1949	2.19	2.32	2.77	2.65	2.87	--	--
1950	4.02	4.28	4.32	4.07	--	--	--
1951	4.10	3.77	4.15	3.94	3.91	4.47	--
1952	3.20	3.09	3.35	3.84	4.40	--	--
1953	4.10	4.10	4.09	3.62	3.49	2.95	--
1954	4.22	4.68	5.06	5.05	--	--	--
1955	3.98	4.02	4.16	4.00	3.77	3.39	--
1956	4.19	4.02	3.98	4.25	4.87	4,35	--
1957	3.62	3.55	4.03	4.31	4.48	4,49	--
1958	4.08	4.14	4.21	4.04	3.96	3.78	3.25
1959	3.82	4.18	4.50	4.50	4.19		--
1961	4.36	4.38	4.65	4.60	4.62	4.57	4.57
1963	5.35	5.31	5.65	5.74	5.41	--	--
1964	3.69	3.67	3.89	4.15	4.24	4.30	4.75
1965	6.41	6.35	6.58	6.96	7.37	--	--
1966	3.87	4.21	4.32	4.64	4.80	4.45	--
1967	7.40	7.47	7.20	7.13	7.28	6.45	--

Source: Daily sales reports, Rogue Valley Marketing Association.

Appendix Table 8. Bartlett Pears: Medford f.o.b. Fresh Sales Data (Domestic).

Year	Subperiod 1	2	3	4	5	6	7
	(Standard boxes)						
1947	7,680	147,450	184,320	76,032	7,680	--	--
1948	58,368	163,671	106,368	6,137	--	--	--
1949	29,952	219,272	195,072	87,552	8,601	--	--
1950	26,312	109,420	80,736	15,960	--	--	--
1951	3,840	11,892	23,040	27,350	113,442	3,840	--
1952	4,608	44,503	240,550	182,718	768	--	--
1953	25,096	251,024	123,281	94,513	28,776	1,694	--
1954	73,637	113,124	52,837	1,536	--	--	--
1955	43,776	170,640	231,457	100,513	64,865	4,608	--
1956	9,984	66,965	176,998	237,571	67,643	768	--
1957	768	23,840	171,153	202,252	103,112	36,064	--
1958	13,056	21,440	18,956	54,333	134,127	143,203	23,761
1959	13,280	85,142	138,423	82,640	16,476	--	--
1961	6,848	29,467	89,211	110,072	125,104	24,074	4,157
1963	3,384	19,544	25,772	13,762	892	--	--
1964	17,742	52,698	138,687	57,961	50,074	2,056	185
1965	31,448	79,403	113,109	14,410	4,865	--	--
1966	18,810	73,167	69,539	78,788	76,447	25,433	--
1967	11,728	41,019	48,608	38,140	19,017	5,632	--

Source: Daily sales reports, Rogue Valley Marketing Association.

Appendix Table 9. Bartlett Pears: Ratio of Medium Sizes to Total Quantities (Domestic).

Year	Subperiod 1	2	3	4	5
1959	0.5408	0.5362	0.4594	0.4394	0.4743
1961	0.8595	0.4972	0.5123	0.5240	0.5299
1963	0.5863	0.1295	0.2839	0.5104	0.1121
1964	0.5737	0.4872	0.7194	0.8085	0.7555
1965	0.6805	0.5470	0.7188	0.6515	0.4210
1966	0.3583	0.6247	0.5314	0.6615	0.5463
1967	0.6396	0.7124	0.7140	0.7237	0.8855

Source: Daily sales report, Rogue Valley Marketing Association.

Appendix Table 10. Bartlett Pears: Medford f.o.b. Fresh Price Data

Year	Subperiod						
	1	2	3	4	5	6	7
	(Dollars per standard box)						
1947	3.26	3.84	4.43	4.77	4.05	--	--
1948	4.07	3.61	3.63	3.37	--	--	--
1949	2.19	2.36	2.81	2.67	2.87	--	--
1950	4.02	4.25	4.32	4.05	--	--	--
1951	3.78	3.76	4.15	3.92	3.90	4.47	--
1952	3.09	3.06	3.33	3.82	4.40	--	--
1953	4.03	4.08	4.10	3.63	3.49	3.14	--
1954	4.20	4.68	5.06	5.05	--	--	--
1955	3.96	3.97	4.13	4.00	3.75	3.39	--
1956	3.91	3.93	3.97	4.22	4.85	4.35	--
1957	3.62	3.51	4.02	4.30	4.48	4.45	--
1958	4.00	3.92	4.08	4.00	3.93	3.77	3.14
1959	3.50	4.00	4.49	4.49	4.19	--	--
1961	4.21	4.25	4.52	4.54	4.59	4.48	4.09
1963	5.35	5.31	5.60	5.73	5.41	--	--
1964	3.67	3.66	3.87	4.14	4.22	4.30	4.75
1965	6.42	6.35	6.58	6.93	7.37	--	--
1966	3.72	4.19	4.31	4.61	4.78	4.95	--
1967	7.40	7.47	7.14	7.05	7.16	6.13	--

Source: Daily sales reports, Rogue Valley Marketing Association.

Appendix Table 11. Bartlett Pears: Medford f.o.b. Fresh Sales Data.

Year	Subperiod						
	1	2	3	4	5	6	7
			(Standard boxes)				
1947	7,680	153,668	188,160	76,800	7,680	--	--
1948	58,368	170,583	110,208	6,137	--	--	--
1949	29,952	226,184	201,216	89,088	8,601	--	--
1950	26,312	116,332	86,880	17,496	--	--	--
1951	7,730	15,732	23,040	28,502	114,978	3,840	--
1952	6,150	57,105	255,910	190,590	768	--	--
1953	32,008	266,384	126,377	95,441	28,776	2,622	--
1954	79,045	114,660	52,837	1,536	--	--	--
1955	44,544	180,853	238,378	100,513	66,301	4,608	--
1956	16,184	87,712	185,514	250,378	68,861	768	--
1957	1,536	48,503	179,593	208,396	103.880	40,744	--
1958	19,967	40,256	22,933	62,645	145,803	145,123	27,001
1959	33,232	116,890	144,747	89,214	16,476	--	--
1961	17,376	42,439	115,010	120,973	128,656	27,015	8,037
1963	3,384	19,544	26,700	13,762	892	--	--
1964	19,598	56,250	147,469	60,803	55,282	2,056	185
1965	37,592	81,739	119,589	18,472	4,865	--	--
1966	26,506	75,681	74,318	82,800	81,916	31,142	--
1967	11,728	41,819	51,700	42,813	22,048	7,798	--

Source: Daily sales reports, Rogue Valley Marketing Association.

Appendix Table 12. Bartlett Pears: California Auction Price Data.

Year	Subperiod 0	1	2	3	4	5	6	7
	(Dollars per standard box)							
1947	3.57	4.02	4.51	5.64	6.17	5.03		
1948	6.31	5.38	5.35	5.20	4.22			
1949	3.06	3.17	3.63	4.36	4.10	4.75		
1950	4.33	4.86	5.40	5.82	5.40			
1951	5.49	5.67	4.42	4.52	4.25	4.71	5.84	
1952	3.76	4.19	4.18	4.89	5.32	5.89		
1953	4.96	5.47	5.45	4.82	4.92	4.90	3.90	
1954	4.63	5.48	5.79	6.90	6.09			
1955	5.58	5.11	5.22	5.85	5.57	5.87	5.94	
1956	4.64	4.92	5.05	5.16	5.36	6.19	6.14	
1957	5.03	4.61	4.88	5.27	5.75	6.11	5.82	
1958	5.54	5.86	5.01	4.78	4.92	4.98	5.25	4.66
1959	4.59	4.93	5.70	6.03	6.54	6.80		
1961	6.65	5.96	5.70	6.04	5.60	5.77	5.75	5.55
1963	6.29	6.68	7.51	7.35	7.07	6.89		
1964	5.60	4.91	5.17	5.51	5.37	5.12	5.39	--
1965	8.13	8.02	7.52	7.98	8.70	10.59		
1966	5.12	5.66	5.42	6.49	6.13	6.46	7.00	
1967	9.13	7.92	8.87	9.03	8.87	7.87	9.61	

Source: Federal-State Market News Service, U. S. D. A. -California Dept. of Agriculture. Pears. Annual summaries.

Appendix Table 13. Bartlett Pears: California Auction Sales Data.

Year	Subperiod 1	2	3	4	5	6	7
	(Standard boxes)						
1947	338, 665	300, 085	171, 228	68, 836	35, 712		
1948	163, 448	121, 681	106, 420	44, 533			
1949	398, 114	249, 460	157, 831	57, 849	2, 986		
1950	243, 142	204, 530	157, 202	73, 807			
1951	188, 173	293, 886	256, 080	287, 879	153, 845	31, 285	
1952	284, 184	269, 708	230, 569	137, 042	27, 368		
1953	181, 203	174, 495	158, 577	102, 119	54, 194	8, 827	
1954	178, 777	149, 376	66, 919	37, 161			
1955	218, 137	137, 699	96, 823	55, 158	18, 711	5, 610	
1956	213, 304	180, 360	174, 608	119, 536	64, 894	17, 773	
1957	214, 439	186, 414	143, 589	116, 526	114, 482	67, 845	
1958	136, 766	179, 930	160, 708	142, 880	123, 320	70, 210	15, 692
1959	128, 840	133, 968	115, 927	85, 215	36, 597		
1961	110, 177	96, 902	89, 630	96, 063	63, 809	16, 583	1, 487
1963	31, 340	21, 325	22, 833	13, 432	5, 120		
1964	76, 444	74, 783	55, 998	37, 412	12, 787	710	--
1965	25, 747	20, 061	16, 204	5, 982	490		
1966	77, 499	65, 351	36, 454	26, 859	22, 252	11, 444	
1967	5, 796	12, 070	11, 260	7, 374	7, 250	1, 680	

Source: Federal-State Market News Service. U. S. D. A. -California Dept. of Agriculture. Pears. Annual summaries.

Appendix Table 14. California Peaches: Auction Price Data.

Year	Subperiod						
	1	2	3	4	5	6	7
	(Dollars per standard box)						
1947	2.17	1.96	1.68	1.97	2.05		
1948	2.03	2.86	2.57	1.49			
1949	1.78	1.62	1.64	1.44	1.65		
1950	1.78	1.67	3.17	2.25			
1951	2.36	2.53	2.27	3.07	2.62	3.52	
1952	1.70	2.14	2.47	2.14	2.81		
1953	1.77	2.35	2.43	2.50	2.74	2.52	
1954	2.71	2.08	1.63	--			
1955	1.70	2.18	2.34	2.56	1.12	1.88	
1956	2.17	2.44	2.40	2.12	3.97	--	
1957	1.77	1.86	2.06	2.37	2.62	2.68	
1958	1.70	2.22	2.77	3.07	2.98	--	--
1959	2.40	1.88	2.54	2.60			
1961	1.88	2.34	2.50	2.15	1.41	0.20	--
1963	2.73	2.17	2.24	--			
1964	2.67	1.93	1.77	1.98	1.28	--	--
1965	1.85	2.40	2.22	2.59	1.67		
1966	2.05	2.81	3.03	2.73	3.37	3.58	
1967	2.89	3.38	3.14	2.90	1.35	--	

Source: Federal-State Market News Service. U.S.D.A.-California Dept. of Agriculture. Peaches. Annual summaries.

Appendix Table 15. California Peaches: Auction Sales Data.

Year	Subperiod						
	1	2	3	4	5	6	7
				(Standard boxes)			
1947	33,563	36,114	19,214	22,072	7,902		
1948	25,407	9,140	4,825	1,795			
1949	64,503	38,984	44,136	27,666	10,390		
1950	107,611	30,611	4,570	8,590			
1951	125,269	80,735	23,727	19,605	12,468	5,860	
1952	142,853	22,475	23,964	21,863	3,530		
1953	130,558	54,755	39,675	14,685	4,170	505	
1954	9,434	37,033	10,774	--			
1955	242,971	26,217	10,379	8,169	3,618	2,710	
1956	114,652	15,743	21,487	10,080	750	--	
1957	140,923	126,079	21,311	13,999	9,225	1,255	
1958	78,224	44,635	1,718	6,772	1,592	--	--
1959	43,084	23,956	18,204	6,233			
1961	52,187	12,259	9,355	15,177	7,052	275	--
1963	8,760	35,041	16,179	--			
1964	9,016	50,045	39,619	13,947	1,551	--	--
1965	33,031	16,349	41,510	5,228	2,721		
1966	47,245	10,329	3,667	23,413	5,445	2,270	
1967	18,984	4,438	11,624	8,841	2,565	--	

Source: Federal-State Market News Service. U.S.D.A.-California Dept. of Agriculture. Peaches. Annual summaries.

Appendix Table 16. Bartlett Pears: Yakima f.o.b. Fresh Price Data.

Year	Subperiod 1	2	3	4	5	6	7
	(Dollars per standard box)						
1947	3.14	3.39	3.76	5.15	--	--	2.30
1949	2.17	2.15	2.00	3.75	--	--	--
1950	4.05	3.93	3.95	--	--	--	--
1951	4.00	3.11	3.24	3.52	2.84	--	--
1952	2.45	2.43	2.68	2.70	--	--	--
1953	3.38	3.28	3.31	3.68	--	--	--
1954	3.27	3.79	3.86	4.86	--	--	--
1955	3.28	3.44	3.44	3.70	3.71	4.16	3.98
1956	3.78	3.61	3.88	4.26	4.44	4.65	4.41
1957	3.38	3.20	3.37	3.60	3.97	4.08	--
1958	3.84	3.70	3.51	3.58	3.73	3.73	3.58
1959	3.24	3.50	3.92	4.08	3.58	4.06	3.30
1961	3.56	3.90	3.98	4.00	3.91	4.30	3.70
1963	4.78	4.72	4.82	4.70	5.71	2.00	--
1964	3.40	3.33	3.66	3.34	3.00	2.30	--
1965	--	5.77	5.72	5.82	--	--	--
1966	--	3.58	3.74	3.81	3.77	3.02	--
1967	6.99	7.03	6.82	6.43	6.64	5.53	--

Source: Daily sales reports, United Marketers, Inc.

Appendix Table 17. Bartlett Pears: Yakima f.o.b. Fresh Sales Data.

Year	Subperiod 1	2	3	4	5	6	7
	(Standard boxes)						
1947	340	9,253	2,460	414	--	--	--
1949	15,854	30,580	756	200	--	--	--
1950	3,235	14,989	6,635	--	--	--	--
1951	756	8,567	10,897	1,762	6,459	--	--
1952	7,919	21,619	14,166	327	--	--	--
1953	56,312	53,408	20,345	561	--	--	--
1954	70,734	48,816	3,791	1,004	--	--	--
1955	33,604	192,167	79,482	20,793	13,477	2,361	1,352
1956	15,797	23,472	32,471	68,388	43,496	10,334	1,272
1957	1,155	23,612	50,599	77,452	43,743	5,146	--
1958	33,111	27,554	41,545	38,351	45,123	28,686	15,506
1959	12,292	66,648	77,903	51,600	33,726	1,787	796
1961	430	6,167	28,775	23,070	17,565	8,828	3,357
1963	65,322	93,400	27,267	4,819	2,414	10	
1964	57,949	61,138	28,530	23,989	12,063	2,956	--
1965	--	13,394	13,329	3,873	--	--	--
1966	--	7,302	56,892	42,963	26,679	9,396	--
1967	38,025	48,900	30,972	26,717	9,627	3,552	--

Source: Daily sales reports, United Marketers, Inc.

Appendix Table 18. Disposable Personal Income, Wholesale Price Index, Population and Peaches Sold Fresh, 1947-1967

Year	U.S. disposable personal income current prices	Wholesale price index, all commodities (1957-1959=100)	U.S. population	U.S. peaches sold fresh
	(Billion dollars)		(1,000 persons)	(Thousand standard boxes)
1947	170.1	81.2	144,083	38,899
1948	189.3	87.9	146,730	29,937
1949	189.7	83.5	149,304	31,657
1950	207.7	86.8	151,868	22,023
1951	227.5	96.7	153,982	26,652
1952	238.7	94.0	156,393	31,122
1953	252.5	92.7	158,956	30,634
1954	256.9	92.9	161,884	31,034
1955	274.4	93.2	165,069	19,955
1956	292.9	96.2	168,088	29,878
1957	308.8	99.0	171,187	28,920
1958	317.9	100.4	174,149	36,363
1959	337.1	100.6	177,135	34,446
1960	350.0	100.7	179,992	35,046
1961	364.4	100.3	183,057	35,950
1962	385.2	100.6	185,890	30,731
1963	404.6	100.3	188,658	29,346
1964	438.0	100.5	191,372	23,125
1965	472.1	102.5	193,815	27,327
1966	508.7	105.9	195,936	24,931
1967	544.7	106.1	197,863	19,504

Continued

Appendix Table 18--Continued.

Source: U.S. Dept. of Commerce. Bureau of Census. Statistical abstract of United States, 1968.
Column 1: p. 313
Column 2: p. 341
Column 3: p. 5
U.S. Dept. of Agriculture, Statistical Reporting Service. Fruits, noncitrus, by state. Production, use, value
Column 4.