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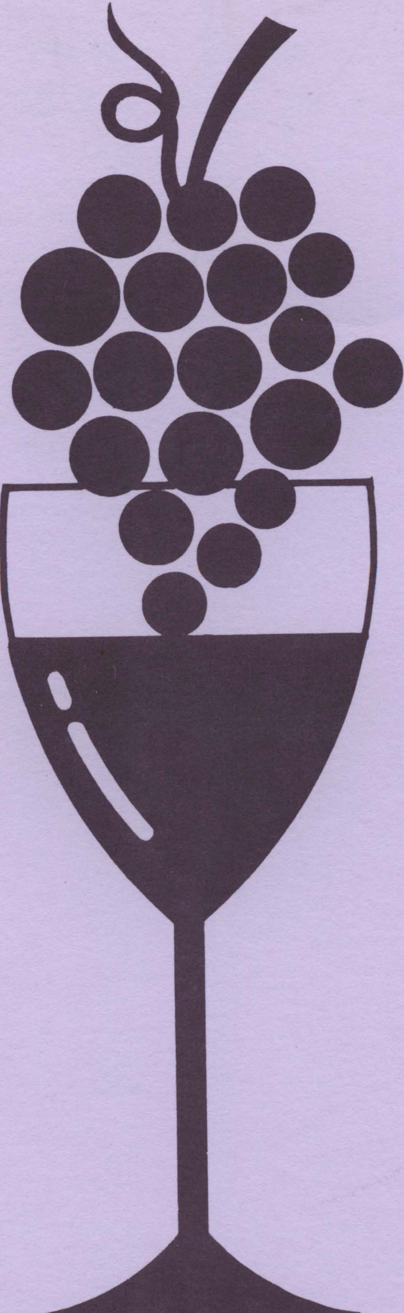

An Econometric Model of the U.S. Wine Industry

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AN ECONOMETRIC MODEL OF THE U.S. WINE INDUSTRY

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FOREWORD

This document summarizes an economic model of the U.S. wine industry. In the past 20 years, the wine industry has undergone sweeping changes. It is important for the public to recognize that a wine variety of factors influence the markets for wine and grapes, and that a knowledge of these factors can be important to ascertaining future trends in the industry.

The purpose of this publication is not to advocate particular policies, but rather to summarize the factors influencing wine and grape prices and quantities in recent years, including the effects of increased wine imports on the domestic industry. This publication should be useful to those individuals primarily interested in the broader domestic and international dimensions of the U.S. wine and grape industries.

INTRODUCTION

Over the last 20 years the U.S. wine industry has undergone dramatic changes. In the 1960's and early 1970's the industry was characterized by rapid growth in demand for wine combined with rising grape prices. Since the mid 1970's, growth in demand for U.S. wine has slowed as the growth in real consumer income has declined and as wine imports have made strong inroads into the domestic market. While growth in demand was declining, grape supplies continued to increase as new acreage planted in response to the initial wine boom reached bearing age. The effect has been a 60% drop for real grape prices (wine varieties) between 1972 and 1983.

This report presents an econometric model of the U.S. wine industry. The model describes the behavior of 32 endogenous variables in the markets for wine and grapes between 1947 and 1983. The model extends previous work by Wohlgenant (1978, 1982) to include equations for wine import demand and long-run supply response of grapes. The econometric model was developed primarily to quantify the effects of increased wine imports but also may be used to quantify the effects of changes in other variables including income, population, and wine processing costs.

DESCRIPTION OF THE STRUCTURAL MODEL

The econometric model contains four blocks of equations: (a) consumption of domestic and imported wines, domestic wine prices, and production and inventories of domestic wine; (b) demand and supply of grapes crushed for wine production and grapes dried for raisins; (c) demand and supply of grapes sold for fresh use and grapes sold for canned use; and (d) acreage, yield, and production of grapes.

There are three main types of grapes which have alternative uses. Raisin grapes (mainly Thompson Seedless) can be dried, crushed, sold for fresh consumption, or sold for canning. Table grapes (e.g., Tokay) can be sold for fresh consumption or for crushing. The most heterogenous category, wine grapes, includes such distinctive varietals as Cabernet Sauvignon and Chenin Blanc. These varietals are used almost exclusively for wine production, although a small portion finds its way into the fresh market. Separate demand and supply equations were estimated for each grape type by market outlet.

For taxation purposes, wines are classified as: still wine less than 14% alcohol by volume (mainly table wine), still wine over 14% alcohol by volume (mainly dessert wine and vermouth), and sparkling wine. Commercially, the most important wine is table wine which accounts for about 80% of all wine shipments. While there have been significant compositional changes over time, generally favoring table wine and sparkling wine, necessary price data were not available to estimate separate behavioral equations by product type. Thus only aggregate behavioral equations for all wine were estimated. In order to avoid aggregation bias, where possible, prices and quantities of individual components were used to develop index numbers for aggregate prices and quantities.[1]

Demand for wine was modeled by two equations: total demand for wine (domestic plus imports), and the ratio of domestic to imported wine consumption. The first equation relates per capita total wine consumption to an index of domestic and imported wine prices, per capita real income, and lagged per capita total wine consumption. Lagged consumption was included to account for dynamics in wine consumption resulting from habit persistence, exposure to new wine products, advertising, etc. Plots of the data indicated an abrupt increase in demand beginning in 1970. This shift probably was associated with the introduction of "pop wines" and increased promotional effort by the wine industry. This effect was modeled with a dummy variable which takes the value 1 for 1970 and beyond, but zero otherwise. Plots of the data also suggested a curvilinear relationship between per capita wine consumption and price, so a double log (constant elasticity) functional form was used for this equation.

The second wine demand equation relates the ratio of domestic to imported wine consumption to the ratio of domestic to imported wine prices and to the lagged quantity ratio. This specification assumes approximate validity of the two-stage consumer budgeting process whereby domestic and imported wines constitute a weakly separable group.[2] In the first stage, the consumer allocates expenditures between wine (both domestic and imports) and all other goods. In the second stage, expenditures on wine are allocated between domestic and imported wines. With similar income elasticities for domestic and imported wines, this is equivalent to specifying that the ratio of quantities consumed is determined by the price ratio of the two types of wine. This specification is typical of models employed in international trade to predict commodity trade flows between different countries (Johnson, Grennes, and Thursby, 1979). The advantage of this type of model is that it overcomes the effects of extreme multicollinearity from introducing prices of goods with similar quality as separate regressors in a demand equation. The lagged quantity ratio was included in the model to account for dynamics in shifting consumption from one wine type to the other. As in the case of total demand, graphical analysis of the data indicated a log linear specification would be more appropriate for this specification. Graphical analysis also suggested an abrupt upward shift in this demand relationship for the years 1981 and beyond, so a dummy variable was used to account for this shift. It is not clear what caused this shift; however, introduction of wine coolers by the domestic wine industry is a possibility.

In both demand specifications, prices rather than quantities are assumed to be predetermined. Justification for this specification is towfold: domestic wine prices are determined mainly by lagged (endogenous) grape prices, and U.S. consumers face an essentially horizontal supply curve for imported wine. The reason wine prices lag changes in grape prices is because of the length of time required for wine processing and aging. Inventory-to-shipment ratios for wine historically have averaged between 1 and 1.5, suggesting current year supply is mainly from inventories. Wine prices also are influenced by other input prices (bottle prices, wage rates, etc.), but these prices are largely determined by forces exogenous to the industry. Prices for imported wines also are determined mainly by forces exogenous to the domestic industry. The main reason is that imports into the United States account for a small share of production and consumption in the major exporting countries.[3]

The behavioral equation explaining wine production was derived from a decision model of a representative producer who chooses the quantity of output to minimize the sum of expected production costs and expected inventory holding costs, given expected demand and beginning-of-the-period inventories. This results in a behavioral equation relating the quantity of wine produced to expected grape prices, expected demand for wine, and beginning inventories. Expected grape prices are assumed to be determined solely on the basis of current grape prices; expected wine demand is assumed to be based solely on lagged wine shipments. Time series analysis indicated that, aside from a linear time trend, expected grape prices could be explained by current-year prices and expected wine demand could be predicted by the level of wine shipments in the previous year. The final behavioral equation for wine production therefore relates the quantity of output to current-year grape prices, lagged wine shipments, beginning inventories, and a linear time trend. Given the quantity of output and wine shipments, ending inventories are predicted by the identity relating the change in wine stocks to the difference between production and consumption.

Eight separate equations are used to explain derived demand for grapes. Prices of grapes crushed (raisin, table, and wine grapes) are specified as functions of the quantities crushed, lagged wine shipments, beginning wine inventories, and a linear time trend. Relative quantities crushed reflect substitution among the three grape types in wine production. Lagged wine shipments and inventories, which are determinants of expected production, take into account the impact of demand and supply conditions in the wine market (Wohlgenant, 1982).

Demand for raisins was modeled by two equations: farm-level demand and inventory demand for raisins. The price of raisin grapes dried (the farm price for raisins) is specified as a function of the per capita quantity dried, per capita beginning inventories of raisins, per capita income, and lagged price of raisin grapes dried. Beginning inventories were converted to a fresh weight basis and were added to the current-year quantity of raisin grapes dried. Demand for the raw product consists of demand for current and future use; thus beginning inventories and lagged price, which are determinants of inventory demand, are included in the farm-level demand specification for raisins.

Ending inventories of raisins, on a per capita basis, are related to per capita total supply of raisins (current-year production plus beginning inventories), current-year farm price of raisins, the rate of change in the farm price of raisins from the previous year, and a linear time trend. The rate of change in price is included in the specification to account for the speculative motive for inventory holding. Other things being equal, a larger supply of raisins, a lower current-year price, and a higher rate of price change each would be expected to lead to an increase in ending inventories. This inventory specification is intended to reflect the combined motives of raisin packers and the Raisin Administrative Committee, who are permitted to allocate supplies between domestic and export markets and other noncompetitive outlets under the provisions of a Federal Marketing Order.

Demand equations for grapes sold for fresh and canned use are based on the static theory of demand. Fresh prices for raisin grapes and table grapes are related to per capita quantities sold for fresh use and per capita income. Canned price for raisin grapes is specified as a function of the per capita quantity canned and per capita income. Graphical analysis of the data indicated curvilinear relationships between prices and quantities for fresh market and canned market demand, so double log functional forms were used for these demand specifications. Fresh prices for wine grapes have moved closely over time with prices on the crushed outlet, so fresh price on this outlet was estimated directly as a function of the crush price for wine grapes.

There are two types of supply decisions to model: market allocation of predetermined grape supply, and long-run supply response of grapes. A key consideration in formulating market allocation equations is the information available to firms at the time decisions are made. Cultural practices and contractual arrangements dictate that fresh market and canned market allocation decisions be made early in the year prior to determination of prices on other market outlets. This suggests that expected, rather than actual, prices on other outlets influence these market allocations. These short-run price expectations are modeled simply as prices prevailing in the previous year. Thus the proportion of the grape supply allocated to a given outlet depends on the current-year price on that outlet and lagged prices on other outlets. Lagged quantity ratios also were included in the market allocation equations for raisin grapes to account for rigidities due to prior contractual commitments.

In contrast to fresh market and canned market allocations, decisions on quantities to dry and to crush can be delayed until late in the season when the decision to dry must be made. Drying occurs in a very short period of time and yield is highly variable from year to year depending on weather conditions at the time drying occurs. Thus the decision to dry is based on expected, rather than the actual, dried price. This short-run price expectation is approximated by the price prevailing in the previous year. Therefore, quantities allocated for drying and crushing, as proportions of net supply of raisin grapes (total production less quantities allocated for fresh and canned use), depend on the current-year crushed price and lagged dried price.

Supply response for each grape type is described by two equations: one equation predicting bearing acreage and the other equation predicting yield. Grapes are a perennial crop with production extending over a considerable number of years. An additional consideration is a fixed gestation period of 3 to 4 years between planting and the flow of production. The equations used to explain acreage adjustment are similar to those proposed by French and Matthews (1971). The main difference is that removals are assumed simply to be proportional to beginning bearing acreage. This simplification seemed reasonable because the productive capacity of vines changes very little as the vines become older. Given this simplification, bearing acreage for each grape type is related to lagged bearing acreage, price expectations formed 3 years ago, and a time trend to account for technological change. Price expectations were modeled by unrestricted distributed lags of prices from 4 to 6 years ago.

Yields are influenced mainly by weather and technological change. With rapidly changing acreage, as in the case of wine varieties, average industry yields also can be influenced by the proportion of new bearing acreage. For this reason, the yield relationship suggested by French and Matthews (p. 486) was employed. This specification relates average industry yield to the change in bearing acreage from 3 years ago and to a linear time trend.

ECONOMETRIC RESULTS

In this section, econometric estimates of the structural model are presented. The model consists of 25 behavioral equations and 16 identities which describe the behavior over time of 32 endogenous variables. Individual equations and definitions of the variables used in the model are summarized in the Exhibit 1. The method of estimation and years covered by estimation are indicated in parenthesis by each behavioral equation.[4] Values in parentheses below the estimated parameters are standard errors of the coefficients. All price data were deflated by the consumer price index to remove the effects of inflation. Data for the wine variables were obtained from various publications and reports provided by the Wine Institute, U.S. Bureau of Labor Statistics, and U.S. Department of Commerce. Grape demand and supply relationships relate only to California, which accounts for about 90% of all grape varieties suitable for wine production. Grape price and quantity data were obtained from various published reports provided by the California Crop and Livestock Reporting Service and the Raisin Administrative Committee.

Together, Equations 1 and 2 predict changes in per capita consumption of domestic and imported wine in response to changes in wine prices and per capita income. All parameter estimates have the expected signs and are of reasonable magnitudes. Price and income elasticities of aggregate demand for wine are given directly by the coefficients of the price and income variables in Equation 1; the elasticity of substitution between domestic and imported wine is given directly as the negative of the coefficient of the price variable in Equation 2. These two equations can be combined to produce short-run estimates of own- and cross-price elasticities. For domestic wine, the own-price elasticity is -0.64 and the cross-price elasticity with respect to imported wine is 0.13. For imported wine, own- and cross-price elasticities of -1.05 and 0.54, respectively are indicated. In both demand relationships, significant lagged quantity variables are indicated. This suggests that changes in current-year prices and income affect future wine consumption.[5]

Equation 3 predicts shipments of California wine into all markets (domestic plus exports) as a share of shipments of domestically produced wine entering distribution channels in the United States. Graphical analysis indicated a U-shaped relationship with respect to time, so linear and squared trend variables were included in this specification.

Equation 4 provides the linkage between domestic wine prices and crush grape prices. This price spread depends on wine processing and distribution costs, the most significant of which are wine bottle costs. These costs were proxied by the Bureau of Labor Statistics Producer Price index for glass containers (SIC 1380) since time-series data were not available for wine bottle prices. A linear time trend also was included in the specification to account for increases in wine producing capacity and technological change. Wine prices were regressed on lagged rather than current-year grape prices because of time lags in wine processing. Different lagged specifications were tested and a simple average of grape prices for the previous 2 years was performed. While the estimate obtained might appear too small, it is statistically significant and entirely consistent with prior expectations. Theory suggests that, in the long run, the elasticity of wine price with respect to grape prices should be equal to the cost share of grapes in wine production. At the sample means, this elasticity equals 0.07. This is entirely consistent with the data. On average, 1 ton of grapes yields 170 gallons of wine. With 12, 4/5 qt. bottles per case and an average (sample mean) price for grapes of $60 per ton, this would imply a farm equivalent of the wholesale value for grapes of about $0.84 per case. With an average price for wine of $12 per case, this would suggest an average cost share value of about 0.07.

Wine output, crush demand for grapes, and demand and supply of raisins are simultaneously determined by Equations 5-8. Equations for wine production, demand for raisins, and crush supply of raisin type grapes were estimated by 2SLS. The crush demand equations were estimated by 3SLS with symmetry imposed on the grape quantity variables. This restriction was suggested by theory. It was tested and not rejected statistically. All parameters have the expected signs. As hypothesized, wine production and crush grape prices are positively related to lagged wine shipments and negatively related to beginning wine inventories. Wine output is negatively related to crush grape prices and negative price flexibilities are indicated for the three types of grapes used in wine production (estimated mean price flexibilities of -0.61, -0.26, and -0.99 for raisin, table, and wine type grapes, respectively). The signs and magnitudes of the cross-quantity parameters in the crush demand equations indicate that raisin and table grapes are close substitutes, but that wine grapes are complementary with raisin and table grapes.

Equations 9, 10, and 11 predict the farm-level price for raisins, ending inventories of raisins, and the proportion of the supply of raisin grapes crushed, respectively. All parameter estimates have the expected signs and are of reasonable magnitudes. A negative mean short-run price flexibility of -0.91 is indicated for the farm-level demand for raisins. The mean short-run supply elasticity for raisin grapes crushed is 0.40 and the mean cross-price elasticity with respect to (lagged) raisin price is -0.20. Given this supply equation, the proportion of the supply of raisin grapes dried can be predicted as one minus the proportion of the supply allocated for crushing.

Equations 12 through 17 predict prices and quantities of raisin and table type grapes allocated for fresh and canned use. All the variables are hypothesized to be jointly determined. With the exception of fresh market demand and fresh allocation of raisin type grapes, these equations were estimated by 2SLS. Fresh market demand relationships were estimated by 3SLS with symmetry imposed at the sample mean relative budget shares of the two grape types. This restriction was suggested by theory, which indicates that the ratio of any two cross flexibilities is approximately equal to the reciprocal ratio of budget shares for the two commodities (Houck, 1966). Inclusion of the current-year price variable in the fresh allocation equation for raisin type grapes led to a negative but insignificant coefficient estimate. Efforts to overcome this inconsistency proved unsuccessful, so the proportion of raisin type grapes allocated for fresh use was predicted simply by the lagged dried price and lagged quantity ratio (Equation 18). Overall, the parameter estimates of these equations have the correct signs and are of reasonable magnitudes.

Equations 19 through 25 predict bearing acreages and average industry yields of the three grape types. Note that the acreage equations for raisin and table type grapes are expressed in first-differences rather than levels. This was done in order to make these two data series stationary. Price changes in the current year do not influence acreage changes until 4 years from now due to a 3-year gestation period between new plantings and bearing age, and lagged price expectations. Lagged price variables through year t-6 were included in each equation. Additional price lags also were tested but were found to contribute little to the variation in bearing acreage. Short-run mean acreage elasticities (for year t-4) of 0.04, 0.02, and 0.20 for raisin, table, and wine type grapes, respectively, are indicated. Thus, the acreage response equations suggest extremely long lags in response to any sustained price changes.

MODEL VALIDATION

Having estimated an econometric model of the wine industry, the next step is to see how well the model predicts actual values of the endogenous variables (Exhibit 1c). For each time period (1963-83), the estimated model is solved for the 32 endogenous variables (given actual values for the exogenous variables and lagged endogenous variables). The predictive performance of the model is evaluated through visual comparison of actual with predicted values (Figures 1-32), and through evaluation of different goodness of fit statistics (Table 1). In the figures, solid lines are actual values of the endogenous variables while dashed lines are simulated values of the variables. The four evaluation statistics presented in Table 1 are: root mean square error (RMSE), root mean square percentage error (RMS%E), Theil's decomposition coefficient (U_d), and Theil's inequality coefficient (U_1). For RMSE, RMS%E, and U_1, the smaller the value, the better the fit. Values for U_1 and U_d range between 0 and 1. A value of 0 for U_1 would mean a perfect forecast, while a value of 1 for U_d would mean completely unbiased forecasts (Kost, 1980).

Overall, graphical comparisons of actual with predicted values and estimated evaluation statistics for the U.S. wine model indicate a highly satisfactory fit to the observed data. Graphical analysis reveals that predicted values generally follow the same pattern as actual values. The RMSE and RMS%E statistics are low except for IRNS and DPWGF. With the exception of QRGCA, Theil's decomposition coefficient (U_d) ranges between 0.67 and 1, suggesting relatively unbiased forecasts for the major quantity and price variables of the model. Theil's inequality coefficient (U_1) is close to zero in all cases, indicating close approximation of predicted values with actual values. The smallest forecast errors occur in wine quantities and price, quantities and prices for grapes crushed and dried, and bearing acreages for the three grape types. Since these are the key variables linking wine imports to grape prices and quantities, this suggests that the model can provide accurate estimates of the impact of wine imports on the domestic industry.

IMPACT OF WINE IMPORTS

In this section, the U.S. wine model is used to estimate the effects of increased wine imports on prices and quantities of the domestic industry for the most recent five years, 1979-83. Since imports affect grape prices and quantities only after a 1-year lag, quantitative estimates are provided for the years 1978-83. Over this period, imports increased approximately 70% from a volume of 78.367 million gallons in 1977 to 133.065 million gallons in 1983.

The effects of increased imports are quantified by comparing the historically simulated time paths of the variables with the simulated values when the volume of imports is held constant at its 1977 level. The present analysis is concerned with the impact of import quantities rather than prices. Thus, prior to conducting the simulations, the estimated import demand relation (Exhibit 1A, Equation 2) was inverted to obtain a price dependent specification. The policy question posed is: What would have been the expected levels of prices and quantities for U.S. wine and grapes if import supply had been restricted to the volume in 1977?

In the simulations, grape acreages and yields were fixed at their historical levels until 1983, since this is the first year that a change in wine imports in 1978 would have an impact on bearing acreages and yields. Changes in acreages and production for 1983, resulting from a change in imports in 1978, were calculated by the estimated relations in Exhibit 1A.[6] The estimated yield relationships for raisin and table type grapes (Exhibit 1A, Equations 23 and 24) indicate that changes in bearing acreage have small and insignificant effects on yields. Thus yields for these two grape types were assumed to be exogenously determined in the simulations. All simulations are dynamic in that they take into account feedback effects from changes in lagged endogenous variables.

Historically simulated values for the major variables of the model are exhibited in Table 2. Table 3 shows the cumulative effects attributable solely to an increase in imports beginning in 1978. For example, a reduction of domestic wine shipments by 15.012 million gallons in 1983 (SWD for 1983) is the reduction in shipments for that year attributable to the increase in imports from 1978 to 1983. All effects take into account simultaneous relationships and lagged adjustments resulting from changed imports. Table 5 expresses the cumulative effects from Table 3 as percentage changes from the historically simulated values in Table 2. All effects have the expected signs. Increased imports reduced wine shipments, increased wine inventories (until 1983), reduced wine and grape prices, reduced utilization of grapes for crushing, increased utilization of grapes on other outlets, and finally, in 1983, reduced acreage and production of grapes. However, the timing and relative magnitudes of the effects differ depending on the particular market in question. The main factors leading to these differences are highlighted below.

In 1978, increased wine imports of 15.098 million gallons reduced domestic wine shipments by 7.781 million gallons and increased wine inventories by 6.806 million gallons. Aside from the impact on California's share of the domestic market (a decrease of 6.806 million gallons, Exhibit 1A, Equation 3), these are the only effects initially. In 1979, reduced wine shipments and increased inventories (from an increase in imports in 1978) caused crush demand for grapes to decrease, which led to a decrease in crush prices for the three grape types and shifted utilization of raisin type grapes to the dried outlet. In turn, this increased supply of raisin type grapes for drying reduced the dried price, and increased raisin inventories. The impact of wine imports in 1978 on domestic wine prices does not show up until 1980. This is because domestic wine prices react to lagged rather than current year prices (Exhibit 1A, Equation 4). Likewise, because of lagged supply response in the fresh and canned markets (Table 1, Equations 15-17), price and quantity changes on these outlets first show up in 1980. Finally, because of a 4-year lag between changes in grape prices and bearing acreages (Exhibit 1A, Equations 20-22), increased imports in 1978, which first decreased grape prices in 1979, did not reduce total grape supplies until 1983.

As indicated previously, effects in other years reflect the combined influence of imports in the current year and increased imports from previous years. For example, increased wine inventories of 5.974 million gallons in 1979 is the net effect of increased wine inventories of 6.806 million gallons in 1978, reduced wine shipments of 8.836 million gallons in 1979, and reduced wine production of 9.668 million gallons in 1979. This decrease in wine production resulted from a combination of decreased wine shipments, increased inventories, and decreased grape prices from the increase in imports in 1978 (Exhibit 1A, Equation 5). The increased responsiveness of wine production over time to changes in imports explains why the impact on inventories diminishes and eventually becomes negative in 1983.

The fact that increased wine imports both reduce wine shipments and increase wine inventories is the key to understanding why crush grape prices are affected so drastically by increased wine imports (Table 4). Decreased wine shipments in the previous year (through increased wine imports) simultaneously reduce current crushing requirements through increased inventories, and reduce crush demand for future use through a decrease in expectations of future wine demand. This combination of reduced demand for current and future crushing requirements is reflected in the large and significant coefficients for lagged wine shipments and lagged wine inventories in the crush price (Exhibit 1A, Equations 6-8).

The market for raisins is adversely affected by wine imports as well since raisins are the main alternative outlet for raisin-type grapes. The results indicate that increased imports lead to some shift in utilization of grapes to the fresh and canned markets and, therefore, reduce price on these outlets. But these effects are small in comparison to the impact of imports on the crush and dried markets. Thus, in addition to strong effects of wine imports on crush demand for grapes, limited supply flexibility between crush/dry use and fresh/canned use is another factor contributing to large price reductions in the crush and dried markets. The final contributing factor to large price reductions in response to increased wine imports is the highly inelastic nature of acreage response for grapes, which results from a combination of biological lags and lagged price expectations.

The amounts by which increased wine imports have reduced average and total returns of grape producers are shown in Table 5 and 6. These effects were computed in the same manner as those shown in Table 3. Average returns for each grape type are total returns from sales on all outlets divided by total utilized production (Exhibit 1A, Equations 34-36). These reduced returns were converted to 1984 real dollars by multiplying each value by 3.111, which is the amount by which the general price level has risen since 1967 as shown by the consumer price index. Also, after the study was initiated, grape data for 1984 became available, allowing estimated reduced returns for 1984 to be included in these tables.

The results in Tables 5 and 6 are broadly consistent with the findings thus far. Increased imports have the greatest impact on wine type grapes, as expected. Also, reduced returns for raisin-type grapes have shown a tendency to widen over time as utilization has shifted from crushing to drying and eventually to other market outlets. Reduced average returns in 1979 and 1980, attributable to increased imports in 1978 and 1979, had small effects on total grape supplies and, therefore, price reductions in 1983 and 1984. Reduced grape supplies in 1983 from reduced grape prices in 1979 are shown in Table 3. Reduced grape supplies in 1984, attributable to reduced grape prices in 1979 and 1980, were estimated as 6,000, 1,000, and 42,000 tons for raisin, table, and wine type grapes, respectively.

Total producer revenue reduction attributable to increased wine imports is substantial. For all three grape types the estimated loss in total revenue for the 6 years is $1.1 billion from an increase in total wine imports of 54.7 million gallons from 1978 through 1983. In 1984 alone, increased imports reduced total producer returns by an estimated $204.4 million. This was more than 27% of 1984 actual total revenue of $751.6 million.

CONCLUSIONS

Increased wine imports since 1978 have had significant impacts on segments of the U.S. wine industry. Increased wine imports have sharply reduced the growth in domestic wine sales, and reduced average and total returns to grape producers. The effects have been greatest in the crush and dried markets for grapes. This is because increased wine imports simultaneously reduce current and future crushing requirements through a decrease in expectations of future wine demand. In turn, reduced producer prices for crushing have resulted in a shift in supply of raisin-type grapes mainly to raisins, which has led to price decreases on this outlet as well. With long lags in supply response of grapes, producers can be expected to experience continued price declines into the future if wine imports continue to grow at the present rate.

The model presented in this report can be used to quantify effects of changes in other variables of the model related to demand for wine, costs of producing wine, and supply response of grapes. For example, the model could easily be adapted to simulate the impact of increased grape supplies resulting from increased plantings in other regions of the country. The import case is especially interesting, however, because of current concern about the effects of imports on the economic welfare of segments of the U.S. wine industry.

EXHIBIT 1. ESTIMATED EXONOMETRIC MODEL OF U.S. WINE INDUSTRY

A. Behavioral Equations

1. Total Demand for Wine (OLS, 1963-1982)

$$\ln(SWT/POP)_t = \underset{(0.750)}{1.800} + \underset{(0.035)}{0.123}\ D1 - \underset{(0.157)}{0.510}\ \ln DPW_t$$

$$+\underset{(0.209)}{0.404}\ \ln PDY_t + \underset{(0.095)}{0.556}\ \ln(SWT/POP)_{t-1},$$

$$R^2 = 0.99, \quad DW = 2.57, \quad DH = -1.41.$$

2. Ratio of Domestic to Imported Wine (GLS, 1964-1982)

$$\ln(SWD/MW)_t = \underset{(0.370)}{0.918} + \underset{(0.128)}{0.332}\ D2 - \underset{(0.334)}{1.184}\ \ln(DPWD/DPMW)_t$$

$$+\underset{(0.173)}{0.580}\ \ln(SWD/MW)_{t-1},$$

$$R^2 = 0.89, \quad r = \underset{(0.201)}{0.520}.$$

3. California Share of Domestic Wine (OLS, 1947-1982)

$$(SW/SWD)_t = \underset{(0.008)}{0.793} + \underset{(0.029\times10^{-2})}{0.168\times10^{-2}}\ T + \underset{(0.002\times10^{-2})}{0.028\times10^{-2}}\ (T-22)^2,$$

$$R^2 = 0.80, \quad DW = 1.57.$$

4. Domestic Wine Price (GLS, 1949-1982)

$$DPWD_t = \underset{(18.850)}{89.946} + \underset{(0.058)}{0.119}\ [.5(DPGC_{t-1} + DPGC_{t-2})]$$

$$+\underset{(0.185)}{0.235}\ DIBC_t - \underset{(0.247)}{1.048}\ T,$$

$$R^2 = 0.39, \quad r = \underset{(0.102)}{0.798}.$$

5. Wine Production (2SLS, 1950-1982)

$$QW_t = \underset{(11.239)}{-6.476} - \underset{(0.364)}{1.165}\, DPGC_t + \underset{(0.402)}{2.486}\, SW_{t-1}$$

$$-\underset{(0.246)}{0.860}\, IW_{t-1} - \underset{(1.011)}{0.703}\, T.$$

6. Crush Demand for Raisin Type Grapes (3SLS, 1950-1983)

$$DPRGC_t = \underset{(9.262)}{58.680} - \underset{(0.012)}{0.045}\, QRGC_t - \underset{(0.009)}{0.033}\, QTGC_t + \underset{(0.010)}{0.008}\, QWGC_t$$

$$+\underset{(0.145)}{0.809}\, SW_{t-1} - \underset{(0.107)}{0.585}\, IW_{t-1} - \underset{(0.546)}{0.675}\, T.$$

7. Crush Demand for Table Type Grapes (3SLS, 1950-1983)

$$DPTGC_t = \underset{(7.370)}{44.179} - \underset{(0.009)}{0.033}\, QRGC_t - \underset{(0.010)}{0.042}\, QTGC_t + \underset{(0.008)}{0.001}\, QWGC_t$$

$$+\underset{(0.122)}{0.742}\, SW_{t-1} - \underset{(0.084)}{0.476}\, IW_{t-1} - \underset{(0.447)}{0.601}\, T.$$

8. Crush Demand for Wine Type Grapes (3SLS, 1950-1983)

$$DPWGC_t = \underset{(10.151)}{-1.906} + \underset{(0.010)}{0.008}\, QRGC_t + \underset{(0.008)}{0.001}\, QTGC_t - \underset{(0.017)}{0.089}\, QWGC_t$$

$$+\underset{(0.222)}{1.437}\, SW_{t-1} - \underset{(0.138)}{0.501}\, IW_{t-1} - \underset{(0.804)}{1.129}\, T.$$

9. Farm Level Demand for Raisins (2SLS, 1950-1983)

$$DPRGD_t = \underset{(15.143)}{50.454} - \underset{(1.853)}{10.550}\, PQRNS_t + \underset{(6.537)}{20.456}\, PDY_t$$

$$+\underset{(0.124)}{0.523}\, DPRGD_{t-1}.$$

10. Inventory Demand for Raisins (2SLS, 1950-1983)

$$PIRNS_t = \underset{(0.875)}{-0.604} + \underset{(0.121)}{0.220}\, PQRNS_t$$

$$-\underset{(0.006)}{0.010}\, DPRGD_t + \underset{(0.007)}{0.017}\, (DPRGD_t - DPRGD_{t-1}) + \underset{(0.015)}{0.049}\, T.$$

11. Crush Allocation of Raisin Type Grapes (2SLS, 1950-1983)

$$(QRGC/NQRG)_t = \underset{(0.070)}{0.314} + \underset{(0.145x10^{-2})}{0.329x10^{-2}} DPRGC_t$$

$$\underset{(0.084x10^{-2})}{-0.111x10^{-2}} DPRGD_{t-1} + \underset{(0.206x10^{-2})}{0.065x10^{-2}} T.$$

12. Fresh Market Demand for Raisin Type Grapes (3SLS, 1948-1983)

$$lnDPRGF_t = \underset{(0.306)}{4.113} - \underset{(0.153)}{0.947} ln(QRGF/POP)_t$$

$$\underset{(0.196)}{-0.353} ln(QTGF/POP)_t + \underset{(0.315)}{0.840} lnPDY_t$$

13. Fresh Market Demand for Table Type Grapes (3SLS, 1948-1983)

$$lnDPTGF_t = \underset{(0.378)}{4.059} - \underset{(0.158)}{0.285} ln(QRGF/POP)_t$$

$$\underset{(0.248)}{-0.847} ln(QTGF/POP)_t + \underset{(0.387)}{0.983} lnPDY_t.$$

14. Canned Market Demand for Raisin Type Grapes (2SLS, 1948-1983)

$$lnDPRGCA_t = \underset{(0.464)}{4.975} - \underset{(0.167)}{0.363} ln(QRGCA/POP)_t + \underset{(0.165)}{0.523} lnPDY_t$$

15. Fresh Allocation of Raisin Type Grapes (OLS, 1948-1983)

$$(QRGF/QRG)_t = \underset{(0.020)}{0.089} - \underset{(0.011x10^{-2})}{0.033x10^{-2}} DPRGD_{t-1}$$

$$\underset{(0.142)}{+0.381} (QRGF/QRG)_{t-1},$$

$R^2 = 0.44$, DW = 1.95.

16. Fresh Allocation of Table Type Grapes (2SLS, 1948-1983)

$$(QTGF/QTG)_t = \underset{(0.036)}{0.458} + \underset{(0.031x10^{-2})}{0.060x10^{-2}} DPTGF_t$$

$$\underset{(0.095x10^{-2})}{-0.062x10^{-2}} DPTGC_{t-1} - \underset{(0.195x10^{-2})}{0.195x10^{-2}} T.$$

17. Canned Allocation of Raisin Type Grapes (2SLS, 1948-1983)

$$(QRGCA/QRG)_t = \underset{(0.500\times10^{-2})}{0.662\times10^{-2}} + \underset{(0.009\times10^{-2})}{0.027\times10^{-2}}\, DPRGCA_t$$

$$-\underset{(0.009\times10^{-2})}{0.036\times10^{-2}}\, DPRGC_{t-1} + \underset{(0.138)}{0.603}\, (QRGCA/QRG)_{t-1}$$

18. Fresh Market Price for Wine Type Grapes (OLS, 1947-1983)

$$DPWGF_t = \underset{(7.310)}{-19.348} + \underset{(0.109)}{1.568}\, DPWGC_t - \underset{(0.295)}{0.651}\, T,$$

$R^2 = 0.88$, $DW = 1.43$

19. Crush Allocation of Wine Type Grapes (OLS, 1947-1983)

$$QWGC_t = \underset{(3.651)}{-72.499} + \underset{(0.006)}{0.952}\, QWG_t + \underset{(0.283)}{2.427}\, T,$$

$R^2 = 0.99$, $DW = 1.68$.

20. Bearing Acreage of Raisin Type Grapes (GLS, 1954-1982)

$$(ARG_t - ARG_{t-1}) = \underset{(1.963)}{0.866} + \underset{(0.058)}{0.135}\, (DPRG_{t-4} - DPRG_{t-5})$$

$$+\underset{(0.067)}{0.062}\, (DPRG_{t-5} - DPRG_{t-6})$$

$$+\underset{(0.056)}{0.004}\, (DPRG_{t-6} - DPRG_{t-7}),$$

$R^2 = 0.20$, $r = \underset{(0.155)}{0.550}$.

21. Bearing Acreage of Table Type Grapes (GLS, 1954-1982)

$$(ATG_t - ATG_{t-1}) = \underset{(0.639)}{-0.667} + \underset{(0.015)}{0.015}\,(DPTG_{t-4} - DPTG_{t-5})$$

$$+\underset{(0.018)}{0.036}\,(DPTG_{t-5} - DPTG_{t-6})$$

$$-\underset{(0.015)}{0.005}\,(DPTG_{t-6} - DPTG_{t-7}),$$

$$R^2 = 0.28, \quad r = \underset{(0.166)}{0.453}.$$

22. Bearing Acreage of Wine Type Grapes (GLS, 1953-1982)

$$AWG_t = \underset{(18.103)}{-17.361} + \underset{(0.167)}{0.456}\,DPWG_{t-4} + \underset{(0.172)}{0.180}\,DPWG_{t-5}$$

$$+\underset{(0.146)}{0.185}\,DPWG_{t-6} + \underset{(0.168)}{0.521}\,AWG_{t-1} + \underset{(1.268)}{1.930}\,T,$$

$$R^2 = 0.88, \quad r = \underset{(0.159)}{0.544}.$$

23. Yield of Raisin Type Grapes (OLS, 1950-1982)

$$YRG_t = \underset{(0.496)}{6.904} + \underset{(0.017)}{0.019}\,(ARG_t - ARG_{t-3}) + \underset{(0.023)}{0.058}\,T,$$

$$R^2 = 0.24, \quad DW = 2.77.$$

24. Yield of Table Type Grapes (OLS, 1950-1982)

$$YTG_t = \underset{(0.477)}{6.783} + \underset{(0.041)}{0.054}\,(ATG_t - ATG_{t-3}) + \underset{(0.021)}{0.006}\,T,$$

$$R^2 = 0.06, \quad DW = 2.41.$$

25. Yield of Wine Type Grapes (OLS, 1950-1982)

$$YWG_t = \underset{(0.259)}{3.273} - \underset{(0.003)}{0.008}\,(AWG_t - AWG_{t-3}) + \underset{(0.013)}{0.098}\,T,$$

$$R^2 = 0.67, \quad DW = 2.11.$$

B. IDENTITIES

26. $\ln SWT_t = 0.8 \ln SWD_t + 0.2 \ln MW_t,$

27. $\ln DPW_t = 0.8 \ln DPWD_t + 0.2 \ln DPMW_t,$

28. $DPGC_t = (DPRGC_t \cdot QRGC_t + DPTGC_t \cdot QTGC_t + DPWGC_t \cdot QWGC_t)/(QRGC_t + QTGC_t + QWGC_t),$

29. $IW_t = IW_{t-1} + QW_t - SW_t,$

30. $NQRG_t = QRG_t - QRGF_t - QRGCA_t,$

31. $QRG_t = ARG_t \cdot YRG_t,$

32. $QTG_t = ARG_t \cdot YTG_t,$

33. $QWG_t = AWG_t \cdot YWG_t,$

34. $DPRG_t = (DPRGC_t \cdot QRGC_t + DPRGD_t \cdot QRGD_t + DPRGF_t \cdot QRGF_t + DPRGCA_t \cdot QRGCA_t)/(QRGC_t + QRGD_t + QRGF_t + QRGCA_t),$

35. $DPTG_t = (DPTGC_t \cdot QTGC_t + DPTGF_t \cdot QTGF_t)/(QTGC_t + QTGF_t),$

36. $DPWG_t = (DPWGC_t \cdot QWGC_t + DPWGF_t \cdot QWGF_t)/(QWGC_t + QWGF_t),$

37. $QRG_t = QRGC_t + QRGD_t + QRGF_t + QRGCA_t,$

38. $QTG_t = QTGC_t + QTGF_t,$

39. $QWG_t = QWGC_t + QWGF_t$

40. $PQRNS_t = (QRGD_t + IRNS_{t-1})/POP_t,$

41. $PIRNS_t = (IRNS/POP_t).$

C. ENDOGENOUS VARIABLES[a]

SWD = quantity of U.S. produced wine sold in the U.S. (mil. gal.),

SW = quantity of California produced wine sold in all markets (mil. gal.),

MW = quantity of imported wine sold in the U.S. (mil. gal.),

DPWD[b] = deflated index of wholesale prices of domestic wines (1967 = 100),

QW = production of California wine (mil. gal.),

IW = June 30 inventories of California produced wine (mil. gal.),

DPRGC = deflated crush price of raisin type grapes ($/ton),

DPTGC = deflated crush price of table type grapes ($/ton),

DPWGC = deflated crush price of wine type grapes ($/ton),

DPRGD = deflated dried price of raisin type grapes, fresh basis ($/ton),

QRGC = quantity of raisin type grapes crushed (1000 tons),

QTGC = quantity of table type grapes crushed (1000 tons),

QWGC = quantity of wine type grapes crushed (1000 tons),

QRGD = quantity of raisin type grapes dried, fresh basis (1000 tons),

DPRGF = deflated fresh price of raisin type grapes ($/ton),

DPTGF = deflated fresh price of table type grapes ($/ton),

DPWGF = deflated fresh price of wine type grapes ($/ton),

DPRGCA = deflated canned price of raisin type grapes ($/ton),

QRGF = quantity of raisin type grapes sold for fresh use (1000 tons),

QTGF = quantity of table type grapes sold for fresh use (1000 tons),

QWGF = quantity of wine type grapes sold for fresh use (1000 tons),

QRGCA = quantity of raisin type grapes canned (1000 tons),

ARG = bearing acreage of raisin type grapes (1000 acres),

ATG = bearing acreage of table type grapes (1000 acres),

AWG = bearing acreage of wine type grapes (1000 acres),

YRG = yield of raisin type grapes (tons/acre),

YTG = yield of table type grapes (tons/acre),

YWG = yield of wine type grapes (tons/acre),

QRG = production of raisin type grapes (1000 tons),

QTG = production of table type grapes (1000 tons),

QWG = production of wine type grapes (1000 tons),

IRNS[c] = August 31 inventories of raisins, fresh basis (1000 tons).

D. EXOGENOUS VARIABLES[a]

PDY = per capita deflated total personal consumption expenditures ($1000/person),

DPMW = deflated wholesale price of imported table wine under $4/gal. (1967 = 100),

POP = July 1 civilian population (mil.),

D1 = zero-one dummy variable (D1 = 0 prior to 1970; D1 = 1 from 1970),

D2 = zero-one dummy variable (D2 = 0 prior to 1981; D2 = 1 from 1981),

T = linear time trend (1947 = 1, 1948 = 2, etc.),

DIBC = deflated index of wholesale bottle prices (1967 = 100).

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[a]All variables except DPWD, PDY, DPMW, and DIBC on crop year basis, July 1 through June 30; other variables on calendar year basis.

[b]Variable DPWD constructed as geometric weighted average of deflated indexes for wholesale table wine and dessert wine prices; i.e., $\ln DPWD = 0.6 \ln DPTW + 0.4 \ln DPDW$, where DPTW is deflated index of wholesale prices of table wine and DPDW is deflated index of wholesale prices of dessert wine; weights are sample mean relative expenditure shares of table and dessert wine.

[c]For 1962 and beyond, free plus reserve tonnage as designated by Federal Marketing Order for raisins; prior to 1962, packers' stocks only.

Table 1. Summary of Goodness of Fit Statistics for Endogenous Variables of the Model -- Simulation, 1963-83

Endogenous Variable	Mean	RMSE	RMS%E	U_d	U_1
SWD	280.351	8.856	0.029	0.98	0.0001
MW	59.123	4.981	0.064	1.00	0.0010
SW	240.426	8.289	0.031	0.93	0.0001
DPWD	95.72	2.44	0.026	1.00	0.0003
QW	258.588	20.684	0.079	0.96	0.0003
IW	260.615	19.678	0.079	0.95	0.0003
DPRGC	49	11	0.232	0.74	0.0042
DPTGC	48	10	0.226	0.84	0.0042
DPWGC	88	19	0.212	0.89	0.0022
DPRGD	81	16	0.208	0.96	0.0025
QRGC	762	185	0.317	0.99	0.0003
QTGC	258	66	0.272	0.89	0.0008
QWGC	1101	127	0.155	0.97	0.0001
QRGD	1095	221	0.311	0.95	0.0002
IRNS	280	115	1.885	0.67	0.0021
DPRGF	164	42	0.288	0.95	0.0016
DPTGF	165	44	0.348	0.67	0.0018
DPRGCA	76	12	0.160	0.70	0.0019
QRGF	200	38	0.210	0.78	0.0010
QTGF	221	41	0.197	0.73	0.0008
QRGCA	54	9	0.195	0.58	0.0035

Table 1 cont.

Endogenous Variable	Mean	RMSE	RMS%E	U_d	U_1
DPWGF	103	34	0.431	0.84	0.0033
QWGF	63	12	0.201	0.98	0.0028
ARG	245.775	3.775	0.015	1.00	0.0001
ATG	70.664	1.789	0.025	0.99	0.0004
AWG	195.504	9.134	0.055	0.79	0.0003
YRG	8.528	1.263	0.169	0.72	0.0175
YTG	6.826	1.066	0.168	0.91	0.0233
YWG	5.663	0.658	0.125	0.99	0.0206
QRG	2111	312	0.170	0.71	0.0001
QTG	483	79	0.179	0.89	0.0003
QWG	1165	129	0.152	0.97	0.0001

Table 2. Historically Simulated Values for Selected Endogenous Variables of the Model, 1978-1983[a]

Endogenous Variable	1978	1979	1980	1981	1982	1983
SWD	353.341	368.678	371.589	387.214	398.550	421.016
IW	349.927	379.752	426.121	431.469	468.358	468.583
DPWD	89.35	88.94	87.81	87.02	86.44	84.12
DPRGC	65	53	45	35	34	26
DPTGC	63	54	48	40	38	35
DPWGC	86	82	74	73	65	88
DPRGD	117	102	81	90	72	69
DPRGF	251	191	156	213	136	152
DPTGF	223	204	186	205	149	173
QRGC	647	789	890	564	800	713
QTGC	199	219	227	218	319	269
QRGD	834	1287	1510	998	1496	1358
IRNS	257	292	382	398	457	518
QRGF	143	191	232	168	249	241
QTGF	194	198	201	202	263	235
QRG[b]	1670	2320	2692	1779	2624	2391
QTG[b]	393	417	428	420	582	504
QWG[b]	1706	1821	2004	1794	2152	1880

[a]Dynamic simulation beginning in 1978 using actual values for exogenous variables including actual import volumes of 93.465, 95.865, 107.841, 118.656, 128.279, and 133.065 million gallons for 1978-1983, respectively.

[b]Actual utilized production.

Table 3. Cumulative Impact of Increased Wine Imports on Selected Endogenous Variables of the Model, 1978 - 83[a]

Endogenous Variable	Year 1978	1979	1980	1981	1982	1983
SWD	-7.781	-10.017	-13.481	-15.829	-15.842	-15.012
IW	6.806	5.974	5.235	4.307	0.607	-4.349
DPWD	0	0	-0.65	-1.38	-1.71	-2.05
DPRGC[b]	0	-7	-8	-10	-10	-9
DPTGC[b]	0	-7	-7	-10	-10	-9
DPWGC[b]	0	-13	-16	-20	-24	-19
DPRGD[b]	0	-3	-4	-5	-6	-6
DPRGF[b]	0	0	-2	-4	-3	-5
DPTGF[b]	0	0	-2	-2	-2	-3
QRGC	0	-50	-57	-51	-75	-59
QTGC	0	0	-1	-1	-3	-3
QRGD	0	49	50	42	57	36
IRNS	0	29	74	20	25	27
QRGF	0	0	2	2	6	6
QTGF	0	0	1	1	3	3
QRG	0	0	0	0	0	-3
QTG	0	0	0	0	0	0[c]
QWG	0	0	0	0	0	-24

[a]Each entry in the table shows the cumulative effect attributable to an increase in imports beginning in 1978.

[b]Price effects rounded to the nearest dollar. These price impacts are in 1967 dollars; multiply by 3 to find impacts in current dollars.

[c]Less than 500 tons.

Table 4. Cumulative Impact of Increased Wine Imports on Selected Endogenous Variables, 1978 - 83[a] (Expressed as Percentage Changes from Historically Simulated Values)

Endogenous Variable	Year 1978	1979	1980	1981	1982	1983
SWD	-2.20	-2.72	-3.63	-4.09	-3.97	-3.57
IW	1.94	1.44	1.23	1.00	0.13	-0.93
DPWD	0	0	-0.73	-1.59	-1.99	-2.44
DPRGC	0	-13.71	-17.21	-30.28	-31.52	-36.30
DPTGC	0	-12.31	-14.99	-24.12	-26.23	-25.54
DPWGC	0	-16.60	-21.36	-27.86	-35.52	-22.18
DPRGD	0	-2.29	-4.83	-5.21	-8.35	-8.60
DPRGF	0	0	-1.10	-1.85	-2.57	-2.90
DPTGF	0	0	-0.84	-1.05	-1.54	-1.55
QRGC	0	-6.29	-6.48	-8.91	-9.33	-8.25
QTGC	0	0	-0.60	-0.61	-0.84	-0.93
QRGD	0	3.86	3.34	4.23	3.84	2.72
IRNS	0	2.40	3.95	4.97	5.49	5.21
QRGF	0	0	0.90	1.68	2.27	2.64
QTGF	0	0	0.68	0.66	1.02	0.91
QRG	0	0	0	0	0	-0.14
QTG	0	0	0	0	0	-0.08
QWG	0	0	0	0	0	-1.26

Note: Each entry in the table shows the cumulative effect from Table 3 expressed a a percentage of the corresponding entry in Table 2. Percentages computed directly from Tables 2 and 3 may not be exactly equal to values in Table 4 due to rounding.

Table 5. Impact of Increase in Total Wine Imports, 1978-83, on Average Producer Returns for 1979-84 (Expressed in 1984 Real Dollars)

	Reduction in Average Returns ($/ton)					
Grape Type	1979	1980	1981	1982	1983	1984
Raisin	9	13	16	21	21	21
Table	11	12	18	21	21	18
Wine	45	49	69	80	79	68

Table 6. Impact of Increase in Total Wine Imports, 1978-83, on Total Producer Returns for 1979-84 (Expressed in 1984 Real Dollars)

	Reduction in Total Returns ($1000)					
Grape Type	1979	1980	1981	1982	1983	1984
Raisin	20,880	34,996	28,464	55,104	50,880	48,291
Table	4,587	5,136	7,560	12,222	10,584	8,757
Wine	81,945	98,196	148,488	172,160	157,345	147,336
Total	107,412	138,328	184,512	239,486	218,809	204,384

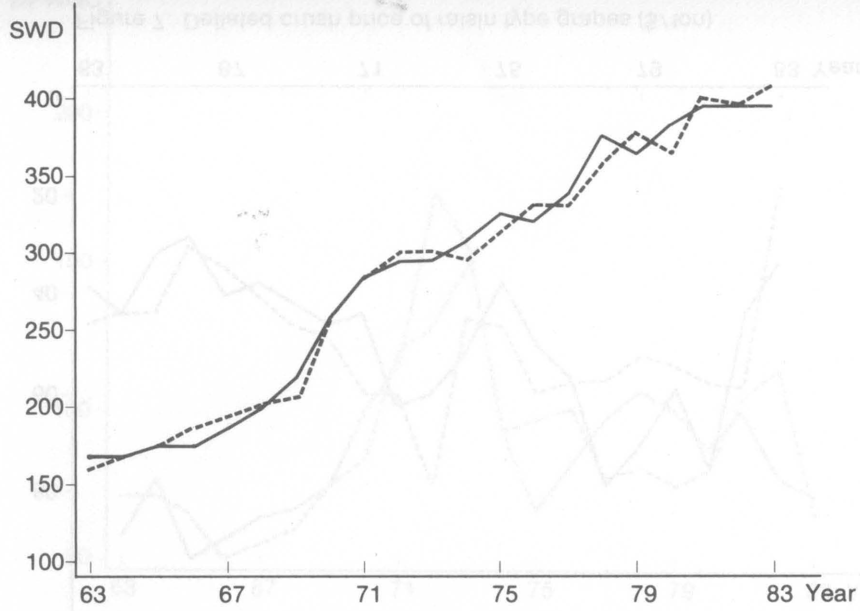

Figure 1. Quantity of U.S. produced wine sold in the U.S. (mil. gal.)

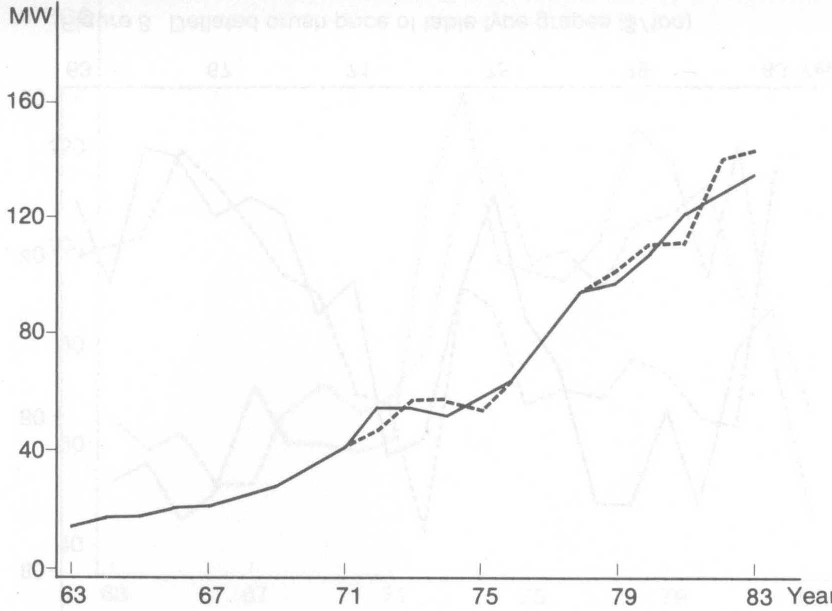

Figure 2. Quantity of imported wine sold in the U.S. (mil. gal.)

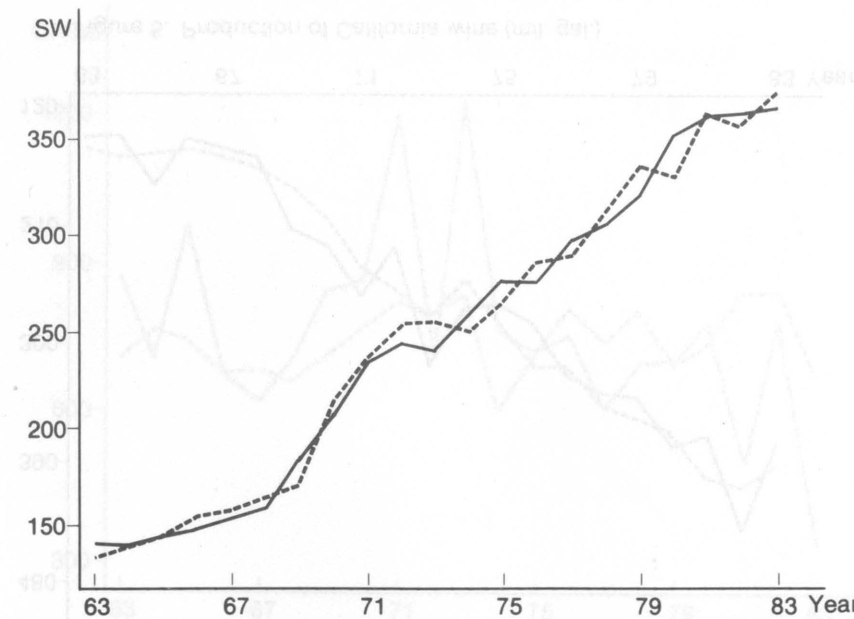

Figure 3. Quantity of California produced wine sold in all markets (mil. gal.)

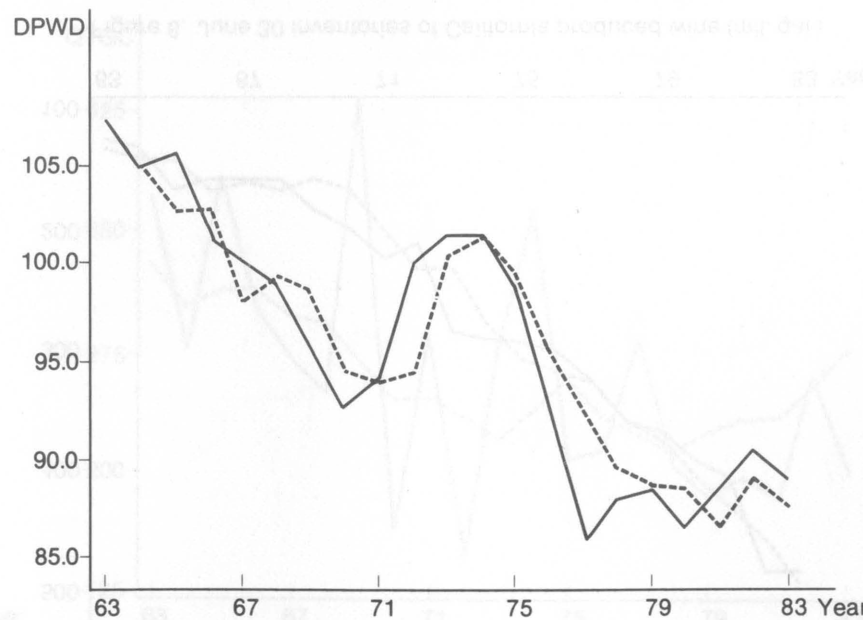

Figure 4. Deflated index of wholesale prices of domestic wines (1967=100)

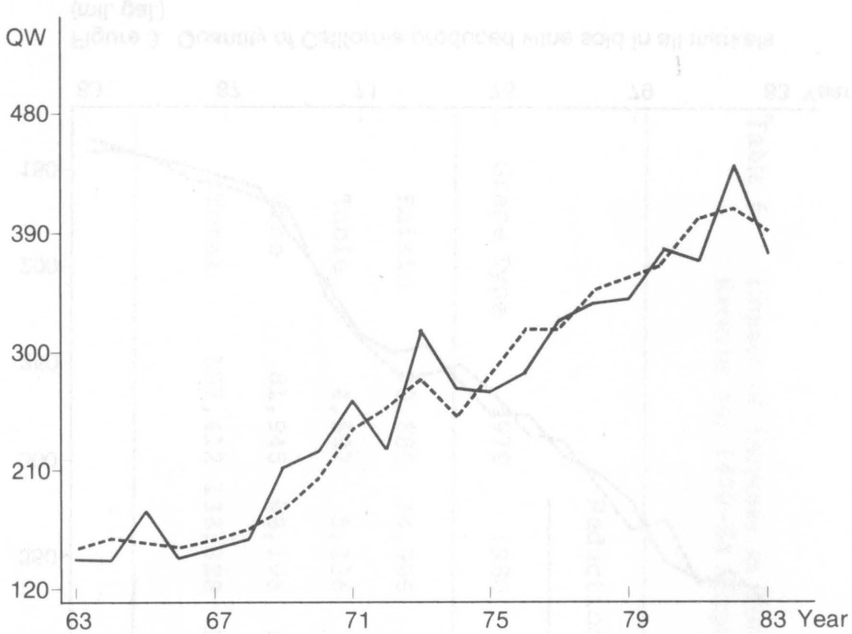

Figure 5. Production of California wine (mil. gal.)

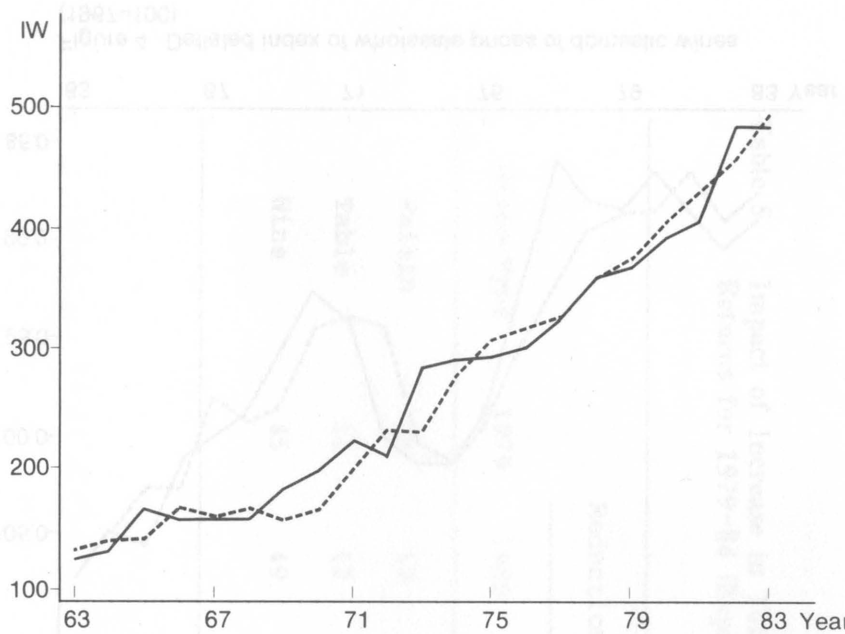

Figure 6. June 30 inventories of California produced wine (mil. gal.)

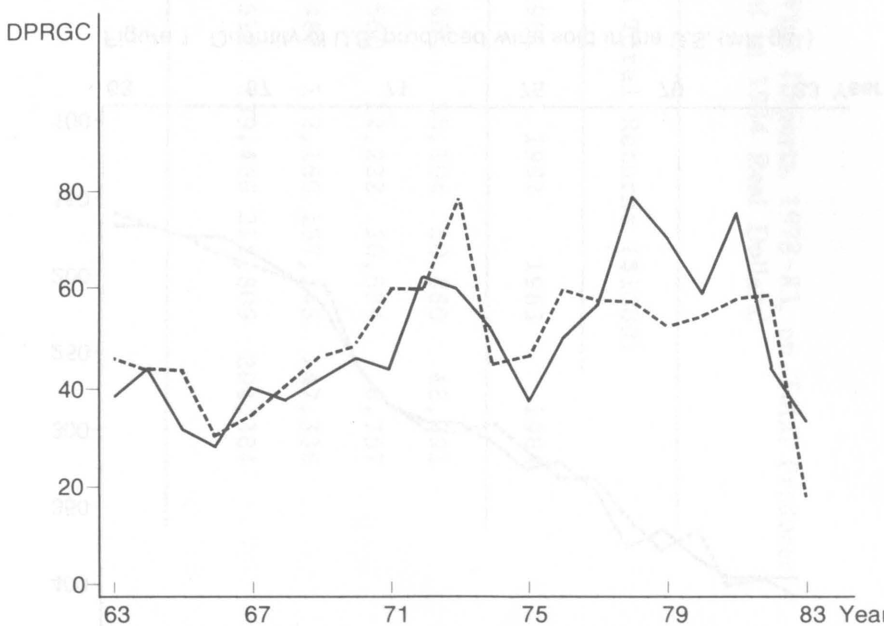

Figure 7. Deflated crush price of raisin type grapes ($/ton)

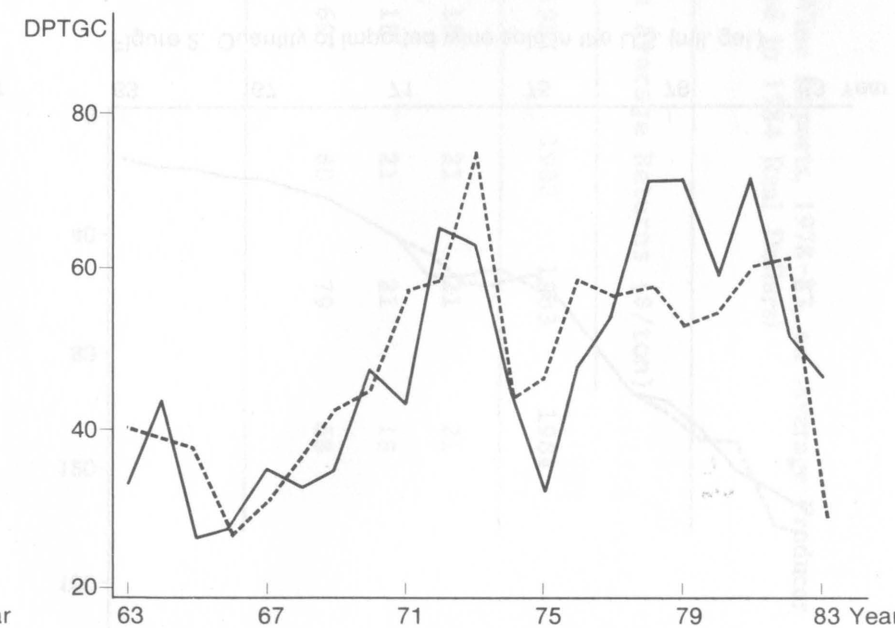

Figure 8. Deflated crush price of table type grapes ($/ton)

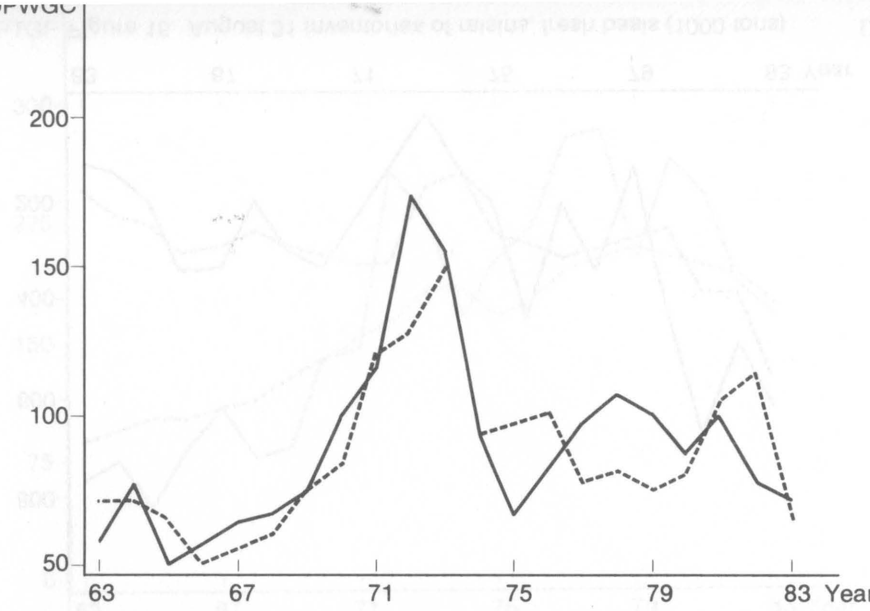

Figure 9. Deflated crush price of wine type grapes ($/ton)

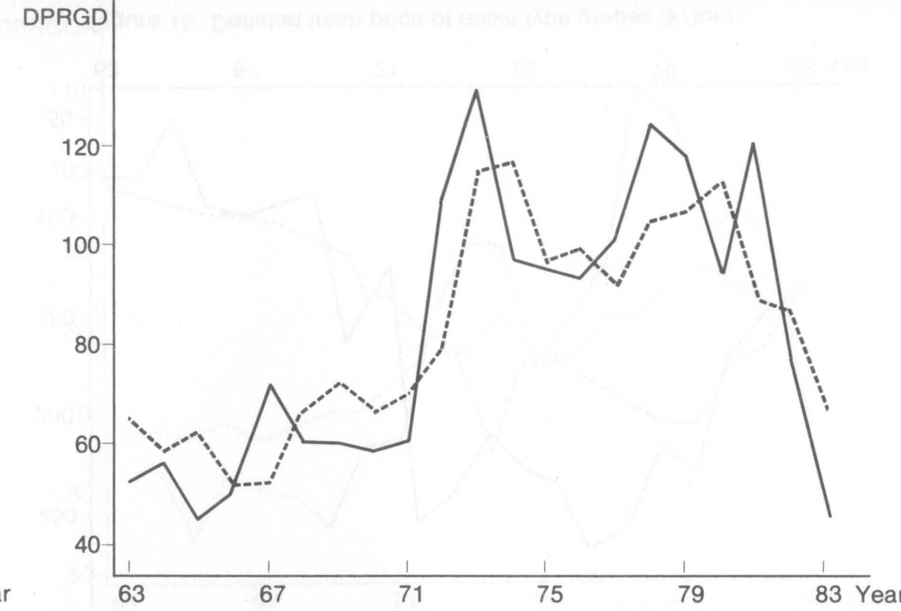

Figure 10. Deflated dried price of raisin type grapes, fresh basis ($/ton)

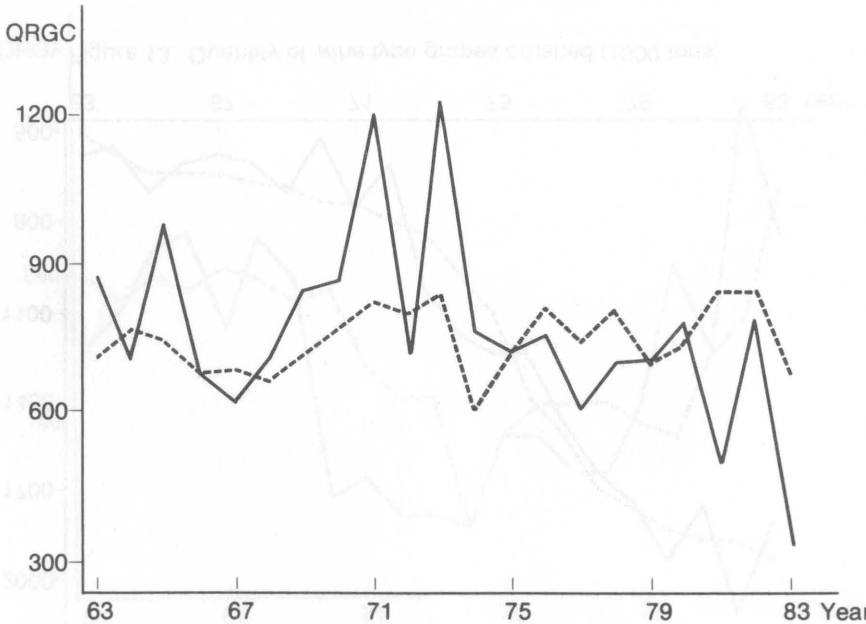

Figure 11. Quantity of raisin type grapes crushed (1000 tons)

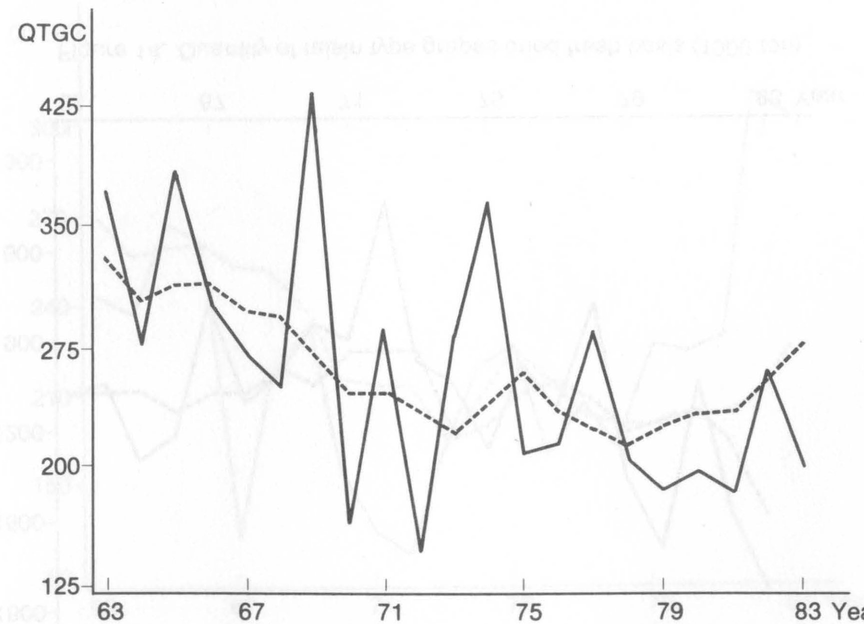

Figure 12. Quantity of table type grapes crushed (1000 tons)

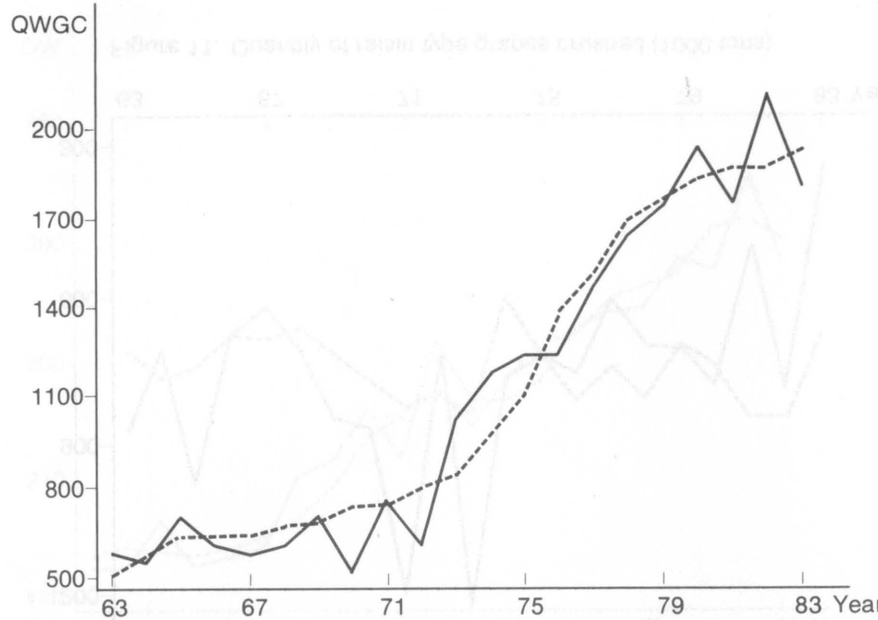

Figure 13. Quantity of wine type grapes crushed (1000 tons)

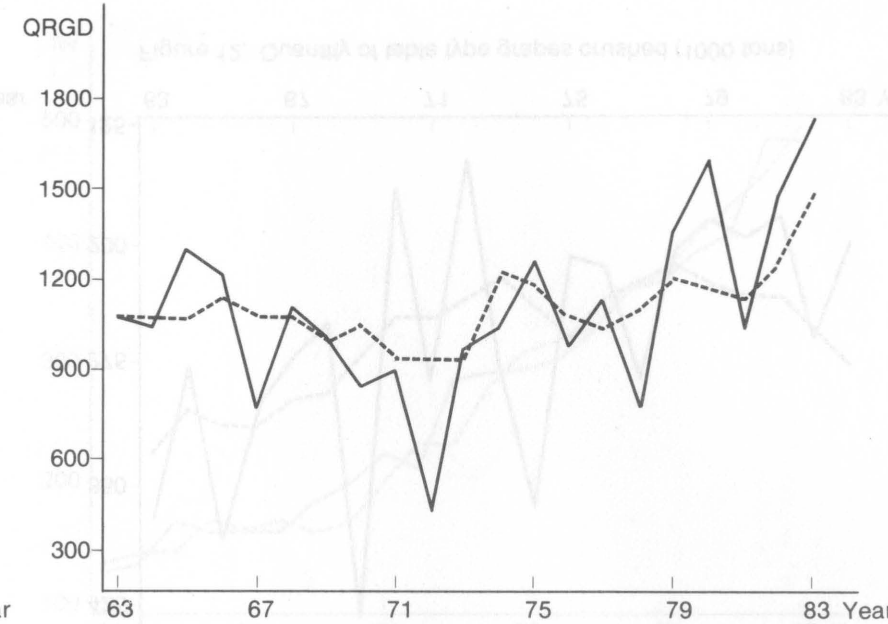

Figure 14. Quantity of raisin type grapes dried fresh basis (1000 ton)

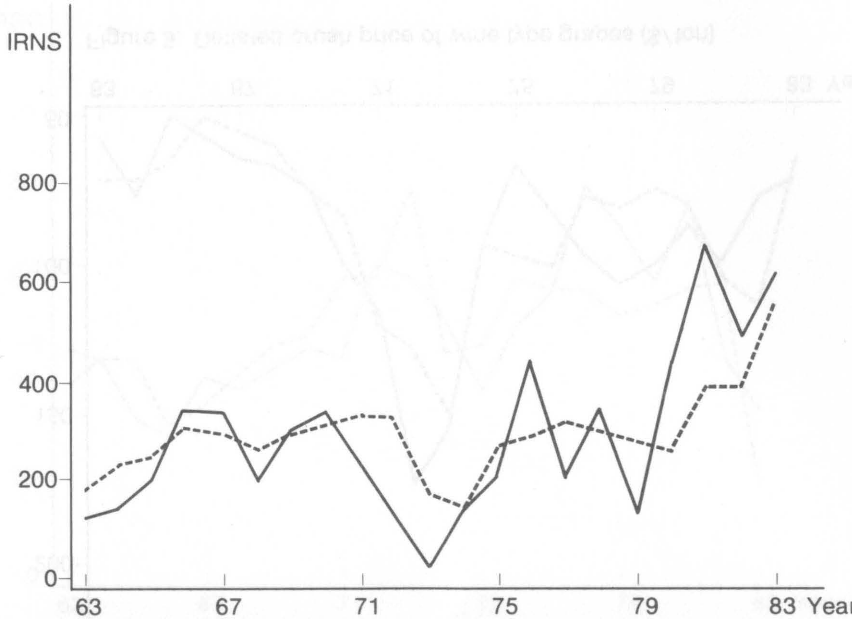

Figure 15. August 31 inventories of raisins, fresh basis (1000 tons)

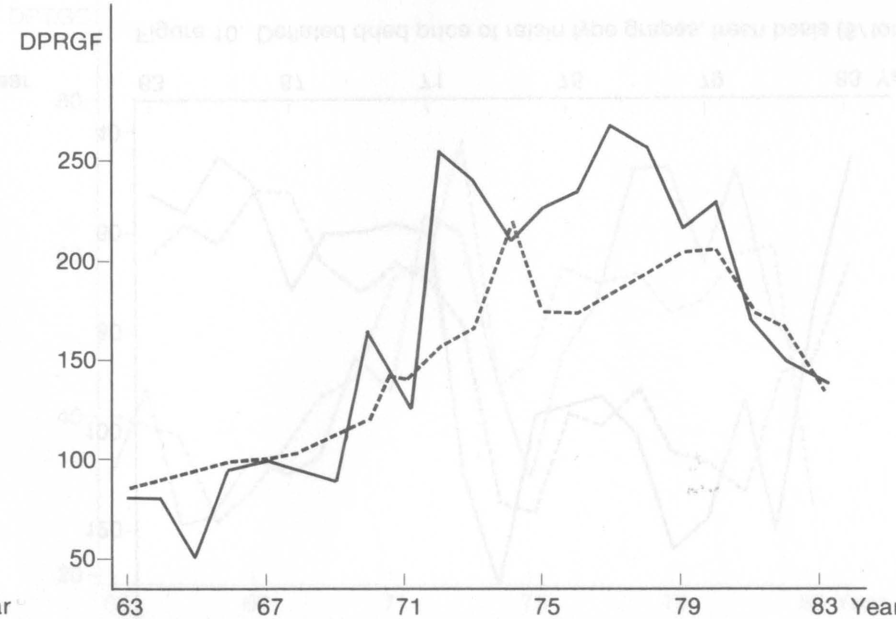

Figure 16. Deflated fresh price of raisin type grapes ($/ton)

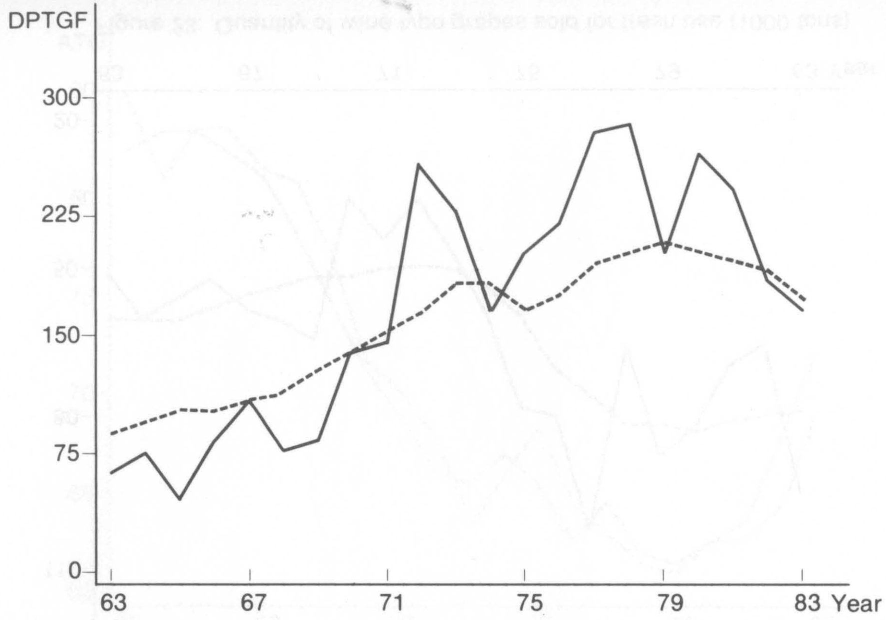

Figure 17. Deflated fresh price of table type grapes ($/ton)

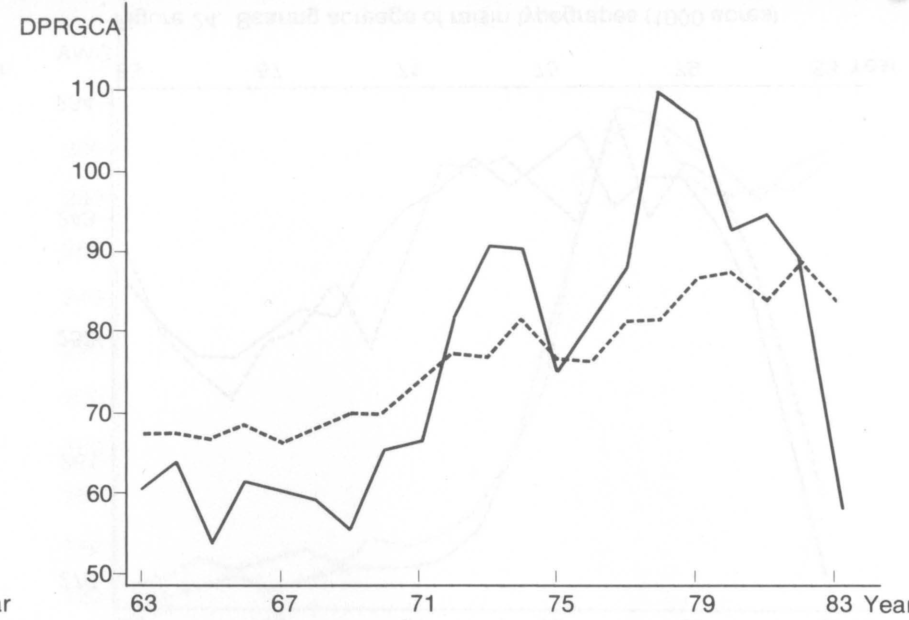

Figure 18. Deflated canned price of raisin type grapes ($/ton)

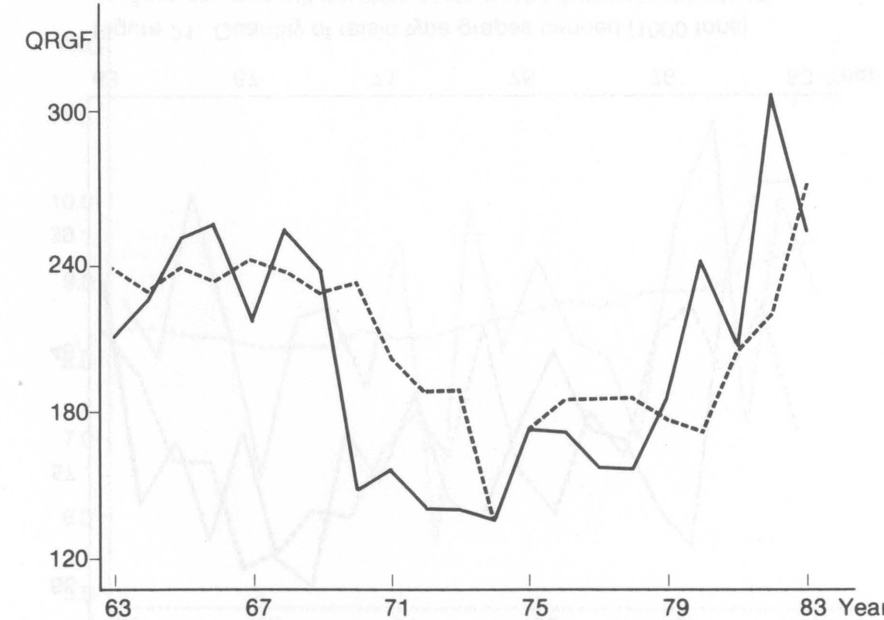

Figure 19. Quantity of raisin type grapes sold for fresh use (1000 tons)

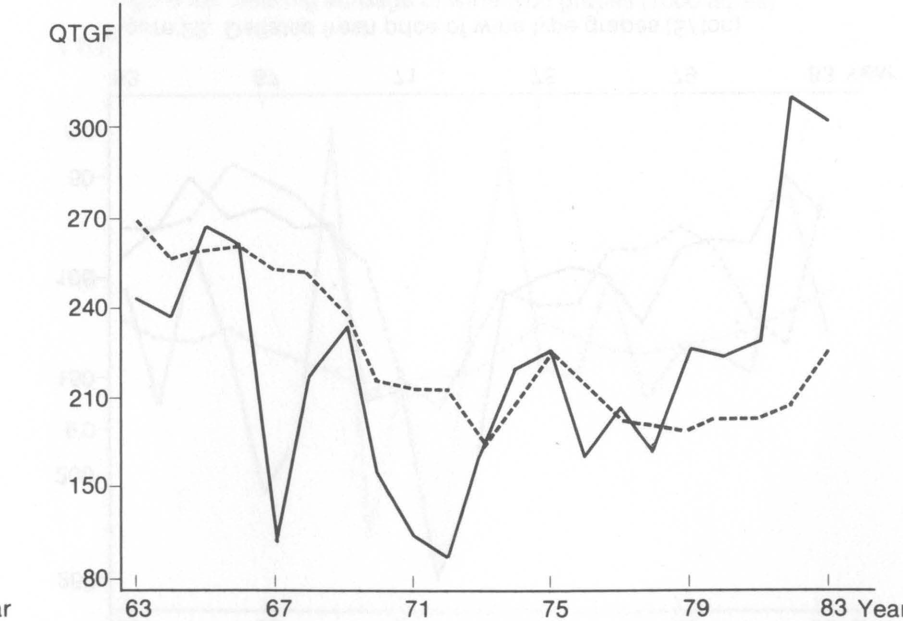

Figure 20. Quantity of table of type grapes sold for fresh use (1000 tons)

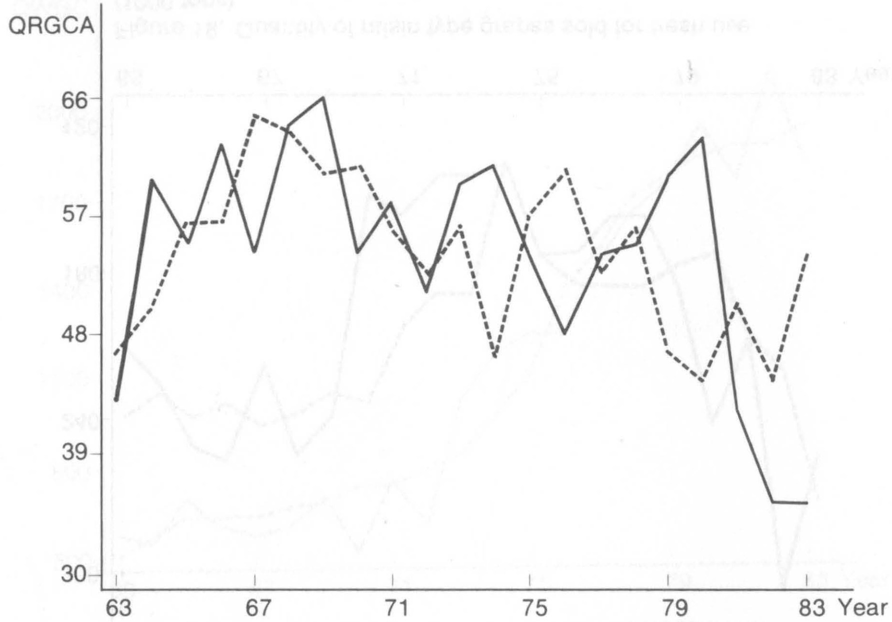

Figure 21. Quantity of raisin type grapes canned (1000 tons)

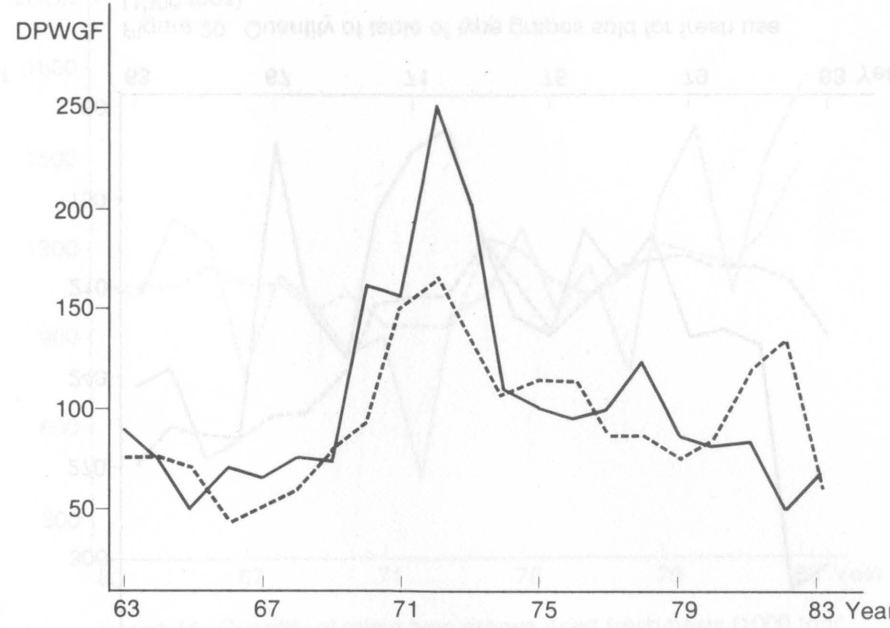

Figure 22. Deflated fresh price of wine type grapes ($/ton)

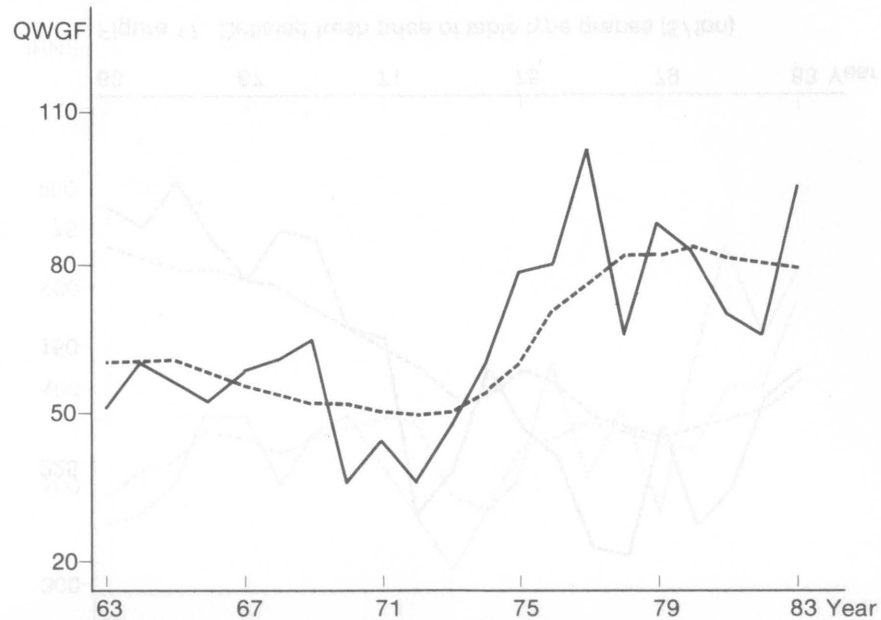

Figure 23. Quantity of wine type grapes sold for fresh use (1000 tons)

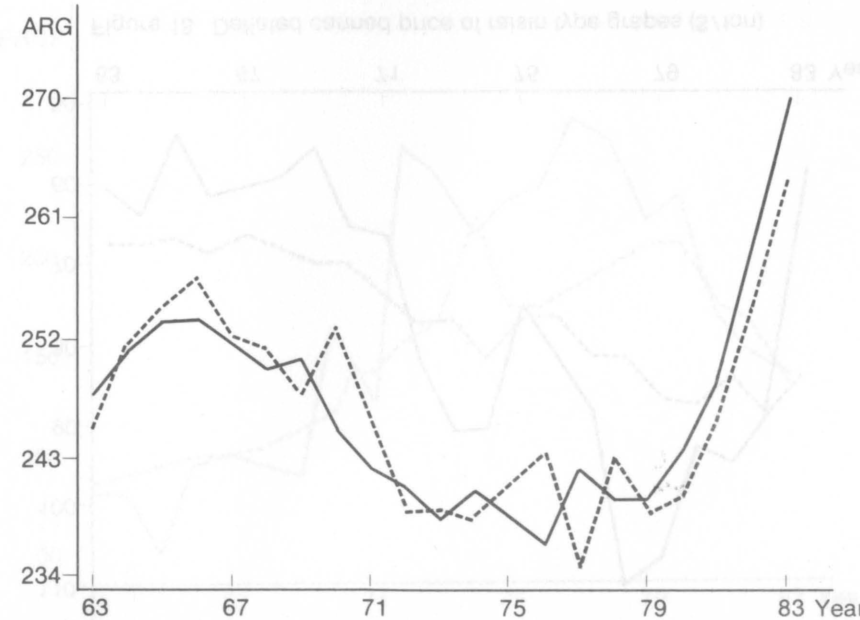

Figure 24. Bearing acreage of raisin typegrapes (1000 acres)

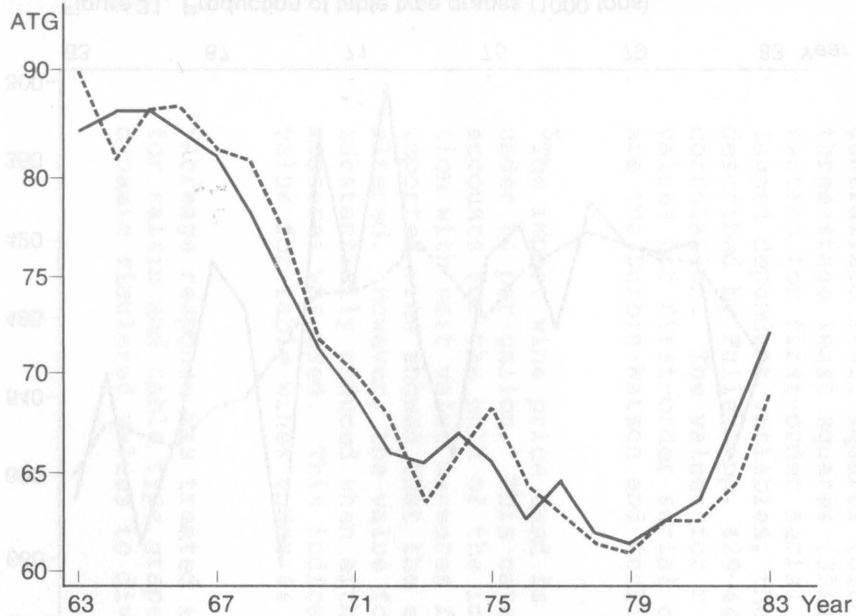

Figure 25. Bearing acreage of table type grapes (1000 acres)

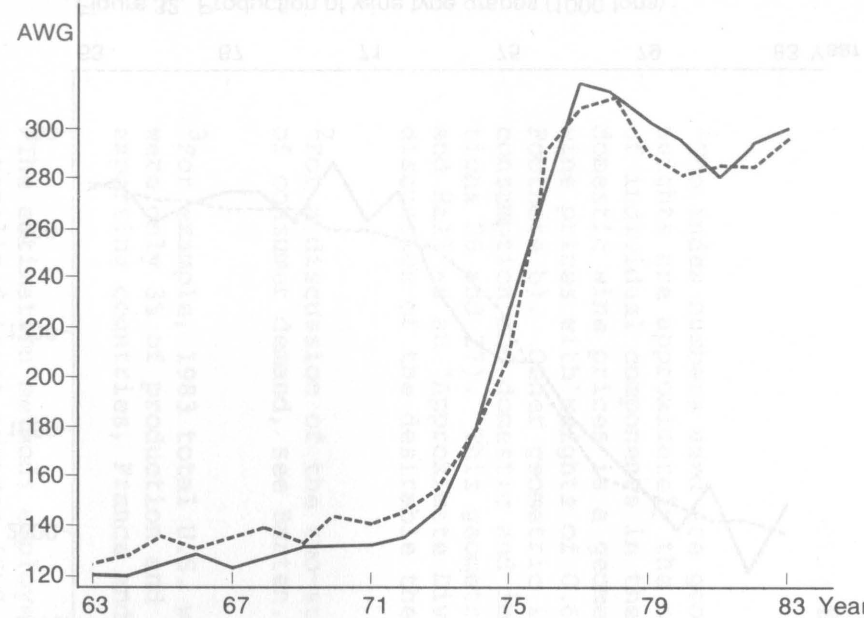

Figure 26. Bearing acreage of wine type grapes (1000 acres)

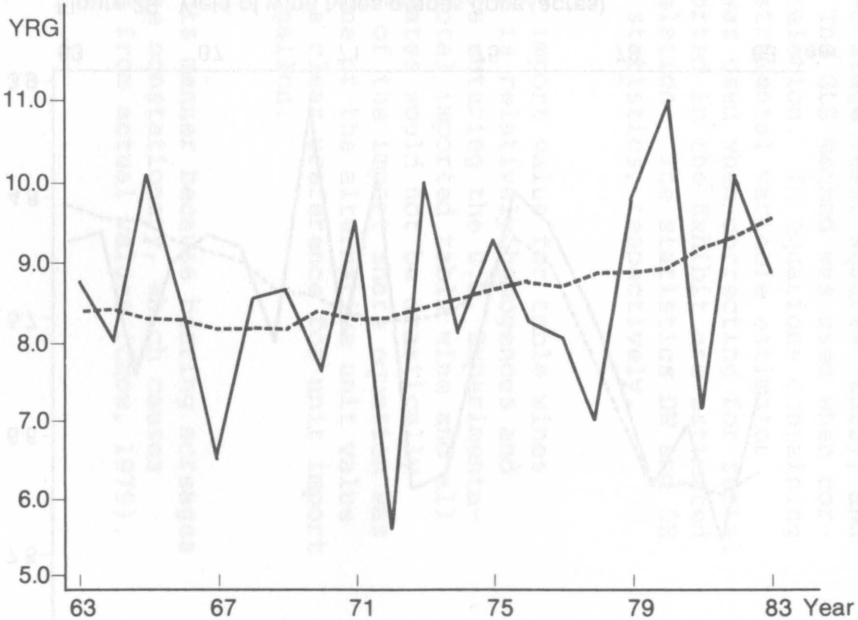

Figure 27. Yield of raisin type grapes (tons/acre)

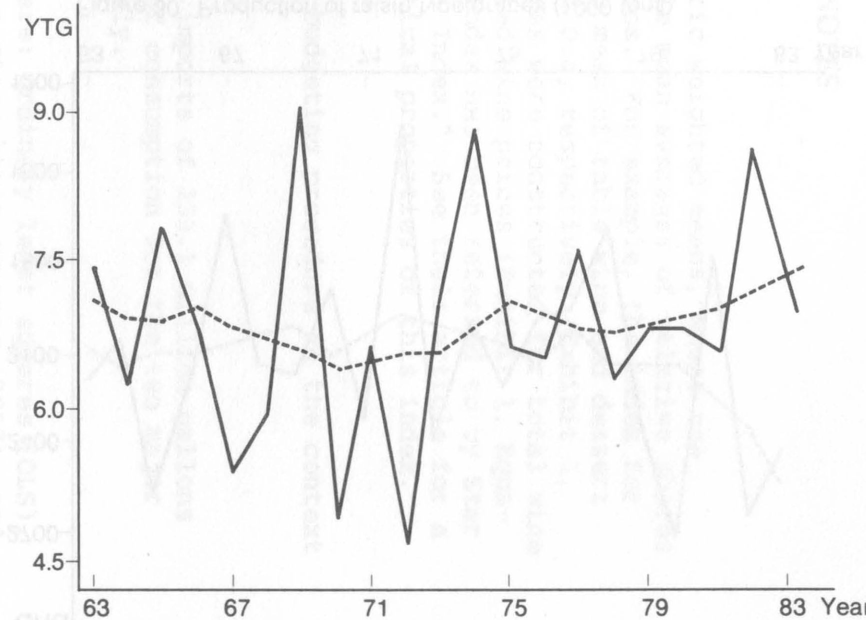

Figure 28. Yield of table type grapes (tons/acre)

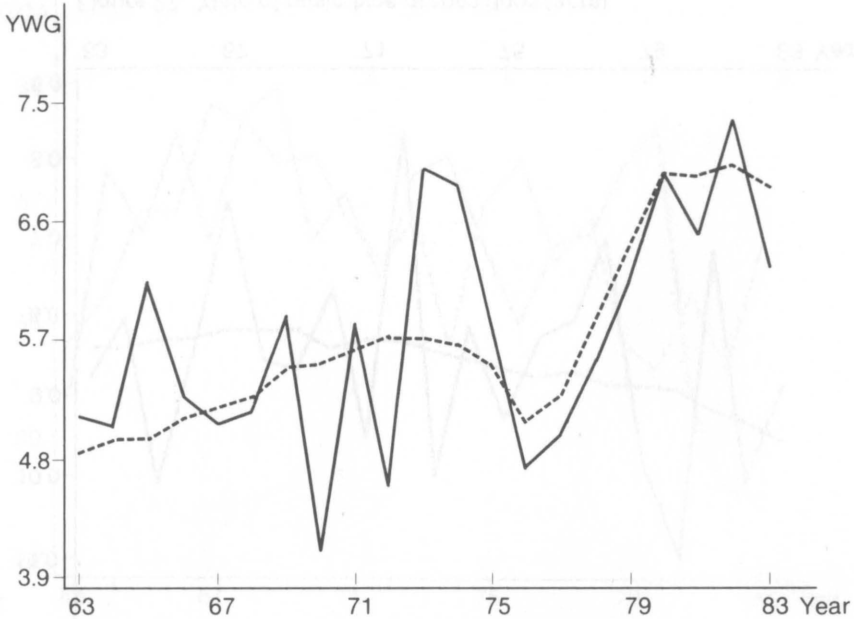

Figure 29. Yield of wine types grapes (tons/acres)

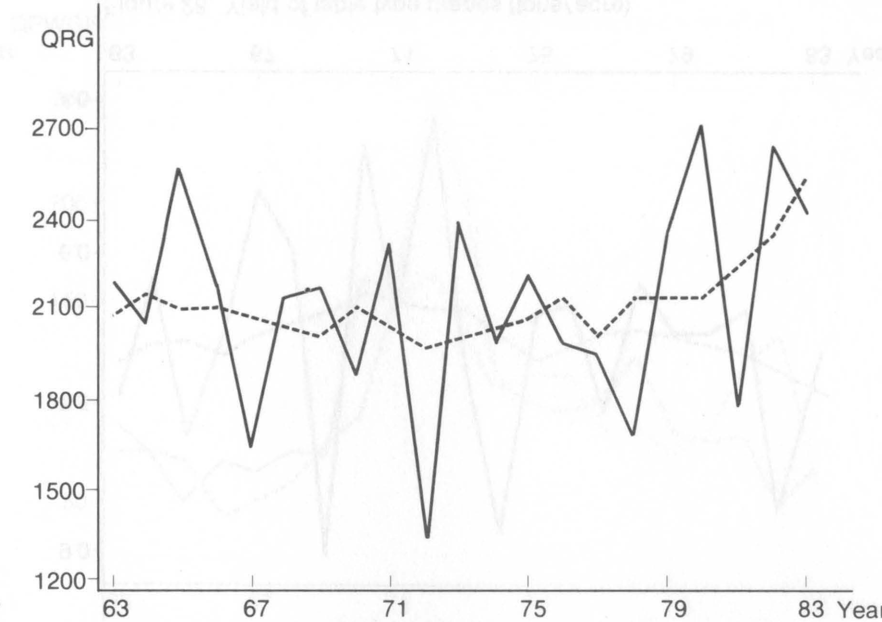

Figure 30. Production of raisin type grapes (1000 tons)

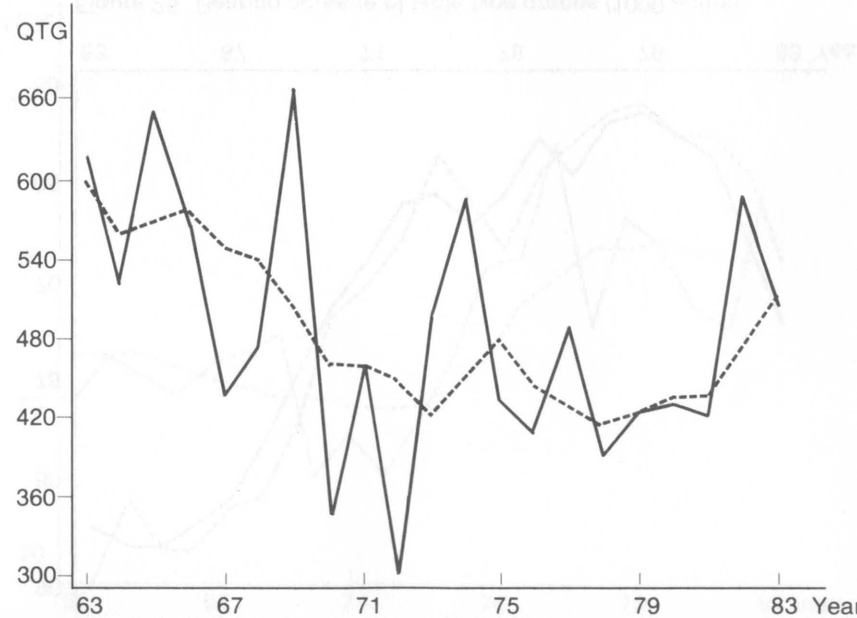

Figure 31. Production of table type grapes (1000 tons)

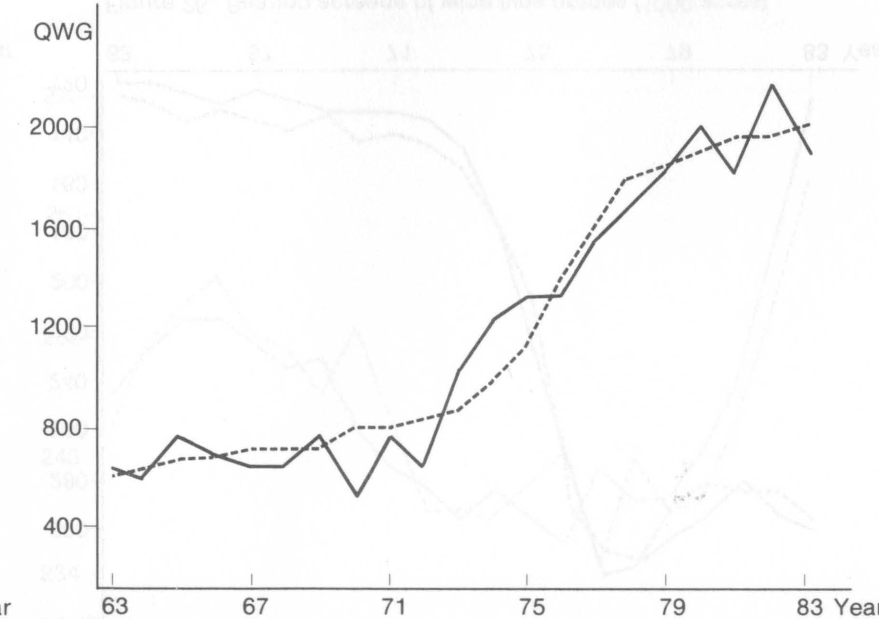

Figure 32. Production of wine type grapes (1000 tons)

ENDNOTES

[1]The index numbers used are geometric weighted means, where the weights are approximately the sample mean averages of relative shares of individual components in the index. For example, the index for domestic wine prices is a geometric mean of table wine and dessert wine prices with weights of 0.6 and 0.4, respectively (Exhibit 1, Footnote b). Other geometric indexes were constructed for total wine consumption and domestic and imported wine prices (Exhibit 1, Equations 26 and 27). This geometric index has been referred to by Star and Hall as an "Approximate Divisia Index." See their article for a discussion of the desirable theoretical properties of this index.

[2]For a discussion of the two-stage budgeting procedure in the context of consumer demand, see Barten.

[3]For example, 1983 total U.S. wine imports of 133.1 million gallons were only 3% of production and 5% of consumption for the two major exporting countries, France and Italy.

[4]The estimation methods employed were: ordinary least squares (OLS), generalized least squares (GLS), two-stage least squares (2SLS), and three-stage least squares (3SLS). The GLS method was used when correcting for first-order serial correlation. In equations containing lagged dependent variables, the instrumental variable estimator described by Fuller (pp. 429-446) was used when correcting for serial correlation. The values for r reported in the Exhibit are estimated values for first-order serial correlation. The statistics DW and DH are the Durbin-Watson and Durbin-H statistics, respectively.

[5]The import wine price used is unit import value for table wines under $4 per gallon. This category is relatively homogenous and accounts for the bulk of the imports entering the U.S. Experimentation with unit value measures for total imported table wine and all imported wine showed that the estimates would not be drastically altered. However, the value for R^2 of the import share equation was substantially reduced when either one of the alternative unit value measures was used. This indicates a clear preference for unit import value for table wines under $4 per gallon.

[6]Acreage response was treated in this manner because bearing acreages for raisin and table type grapes are nonstationary, which causes dynamic simulated values to diverge from actual values (Chow, 1975).

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