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An Econometric Analysis of the California Raisin Industry

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1. INTRODUCTION

Natural Thompson seedless raisins (NTS) are an important California specialty crop. This naturally sun-dried product is unique on world markets. Distinctive features of this industry include:

- Raisin grapes are a perennial crop, so production in any year depends on decisions made in earlier years.
- The Thompson seedless grape is utilized in three major outlets: fresh, crush, and dried.[1] This flexibility has made it a popular grape for California growers for over a century.
- The sun-drying method of producing NTS involves considerable weather risk. Although salvage techniques are improving, rain on the laid-out raisins can severely reduce their value, particularly if cool weather follows the rain. Occasionally, extremely short crops result (as in 1978), with very high prices for those NTS that are salable.
- Unprocessed NTS raisins are storable for one to two years with no special treatment other than fumigation. This storability introduces the possibility of stock holding either by growers or packers.
- Nearly all NTS are produced within a 75 mile radius of the city of Fresno, making possible the effective implementation of certain provisions of a marketing order. (For a discussion of the economic and sociological conditions essential for accomplishing marketing order program objectives, see Farrell, 1966)
- Since 1949, the California raisin industry has operated under a federal marketing order, implementing several provisions authorized under the Agricultural Marketing Agreement Act of 1937, including volume control in an attempt to stabilize prices and enhance grower returns.
- Twenty percent or more of the NTS crop is exported. The role of exports has changed over the last two decades from being a "noncompetitive outlet" for NTS diverted from the domestic market to one of crucial commercial importance to the industry.
- There are 21 processor-packers in the state's raisin industry, including one large cooperative, Sun-Maid, which represented about 40 percent of the growers in the early 1980s and generally about one-half of the tonnage. Since 1967, another 40 percent of the growers has belonged to a grower-bargaining cooperative, the Raisin Bargaining Association (RBA). Thus, although individual growers may be competitive price takers, above the farm level the structure is imperfectly competitive.

In recent years the industry has experienced some severe economic shocks. In 1983, the largest NTS crop of all time was delivered to packers: 347,943 short, sweatbox tons. This compares with deliveries of 74,410 tons in 1978, 263,108 tons in 1979, 254,657 tons in 1980, 224,463 tons in 1981, and 205,700 tons in 1982 (Raisin Administrative Committee). The direct reason for this unprecedentedly large raisin crop was the wineries' dramatically reduced demand for Thompsons for crushing. The Thompson seedless share which had been running 20 to 25 percent of the total crush fell to 12 percent in 1983 as wineries failed to renew contracts

1. A small portion of the crop (from 1 to 2 percent) is canned, mostly in fruit cocktail.

with Thompson growers.[2]

Grower's average returns for raisins were cut in half in 1983, $590 per short ton, down from an average of $1204 for the previous four years (California Crop and Livestock Reporting Service, CCLRS, 1984). Associated with reduced grower returns was a sharp drop in vineyard values: California's raisin grape vineyards fell from $10,840 per acre in 1982 to $6850 in 1984 (U.S. Department of Agriculture, 1984).

The raisin industry made several responses to this crisis situation of the early 1980s, including (a) an export incentive plan (EIP) whereby the export price was greatly reduced to be more competitive with raisins from other producing countries on foreign markets; (b) a self-help plan, the raisin incentive disposal, whereby growers volunteer to abort their crop by spur pruning, spraying, or vine removal, and then receive certificates for the previous year's reserve tonnage to sell to packers; (c) an inventory adjustment plan in 1984 (only) whereby packers were given reserve tonnage at $100 per ton to blend with free tonnage already held, to lower the domestic price; and (d) the RBA's acceptance in 1984 of a field price of $700 per ton—a little more than half its level of the previous several years.

Large price-depressing NTS supplies continued through the mid-1980s, but with sharply lower prices, new product development, and very successful product promotion, sales increased at home and abroad and the industry has begun to recover. In September 1988, the manager of the California Raisin Advisory Board remarked "Raisin sales have increased 50 percent in the last five years, doing especially well in institutional/industrial (prepared foods) and overseas markets" (Nef, 1988).

There have been several descriptive marketing studies of the early California raisin industry (Howard, circa 1920; Shear and Howe, 1931; Watson, 1940; Nelsen, 1950). And Townshend-Zellner (1961, 1962, 1964) analyzed the first ten years of the federal raisin marketing order—from 1949 through 1959. However, there has never been a detailed quantitative analysis incorporating the unique features of the NTS industry.

This study constructs a dynamic econometric model of the California raisin industry which accounts for the interactions and feedback effects among sectors of the industry: growers' raisin grape vine planting and removal decisions; growers' allocation of the grape crop among alternative uses; RAC's division of the NTS crop into free and reserve tonnage; RBA's bargaining process with packers for the free tonnage price; RAC's determination of reserve sales, especially exports; packer-processor f.o.b. price-establishment behavior; and domestic and foreign NTS demand. No econometric model can fully reflect all of the complexities of the economic processes it attempts to measure. The empirically estimated relationships focus on the major raisin price and quantity variables and the primary demand and supply shifting variables. The influences of omitted variables enter the model as unexplained random disturbances. Hence the

2. The San Joaquin Valley bearing wine grape acreage doubled over the decade of the 1970s; yields there under irrigation were higher than in the traditional wine-growing regions of the state, magnifying the impact of the increased acreage on total production. Further, much of this new acreage was in wine varieties directly competing with Thompsons for blending in generic wines: French Colombard, Chenin Blanc, and Chardonnay. And in 1983, the law was changed to require that 75 percent of a varietal wine be made from grapes of that variety—up from 51 percent—further reducing the demand for Thompsons for blending.

The strong dollar in the early 1980s made foreign wines cheaper to U.S. consumers; U.S. consumption of foreign wine increased from 8 percent of the total wine consumed to 25 percent in 1983 (Sun-Maid Growers, 1984). While some imported wine is of premium quality, much of it is in direct price competition with California jug wines in which the Thompson seedless has been an important ingredient.

economic relationships measured are in the form of expected values within probability distributions of actual values. In this context and with these limitations, the model is utilized to evaluate the dynamic effects of changes in exogenous variables such as cost of production or exchange rates, and the probable effects of changes in marketing order programs such as price blending to reduce export prices.

Section 2 presents a description of the industry, including (1) raisin grape and NTS production; (2) a brief review of U.S. raisin marketing problems, policies, and programs; (3) the institutional setting of the industry; and (4) NTS on world markets. Section 3 constructs a theoretical framework for the industry model. Section 4 specifies the model empirically and presents the econometric estimates. Section 5 constructs a dynamic simulation model from the econometric results and various identities and linking relationships. Section 6 uses the model to analyze policy issues and to evaluate the dynamic effects of changes in important exogenous factors.

2. DESCRIPTION OF THE CALIFORNIA RAISIN INDUSTRY

Production

California's grapes are classified into three groups according to their most significant, but not exclusive use: table grapes, wine grapes and raisin grapes. Table grapes represent about 10 percent of the state's grape acreage, wine grapes about one-half, and raisin grapes, 40 percent (CCLRS, *California Grape Acreage*, 1985). The share in wine grapes increased dramatically in the late 1970s (Figure 1).

Raisin grapes are the most versatile of the three types. Besides the portion of the crop that is dried (the 1963-83 average is 52 percent), a large share is crushed (36 percent average), from 10 to 11 percent is sold fresh, and from 1 to 2 percent is canned (mostly in fruit cocktail). Partly because of this versatility, the raisin grape has been popular with growers. Since the mid-1960s, bearing acreage remained relatively steady at around 250,000 acres; then favorable returns in the late 1970s encouraged plantings with a subsequent increase in bearing acreage in the 1980s (Figure 1).

Not all raisin grape growers have the option to sell on the fresh market. For those raisin producers who do choose to sell to the fresh market, the decision must be made in the spring when the trellis structure must be changed to protect the fruit from the sun.

Figure 1A. Bearing Grape Acreage

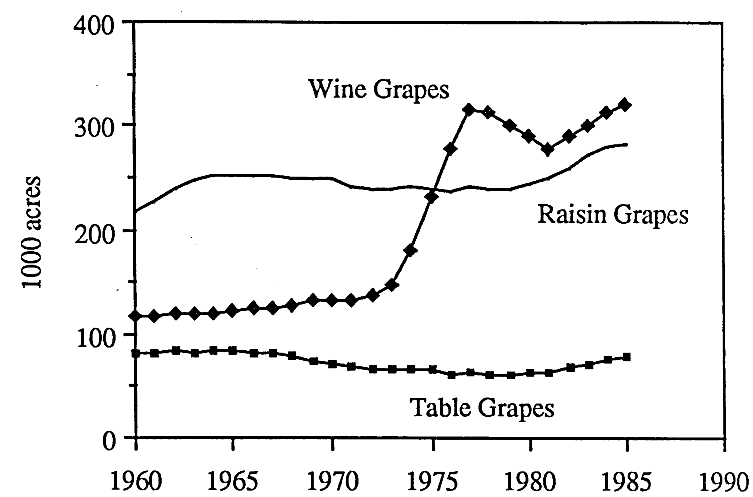
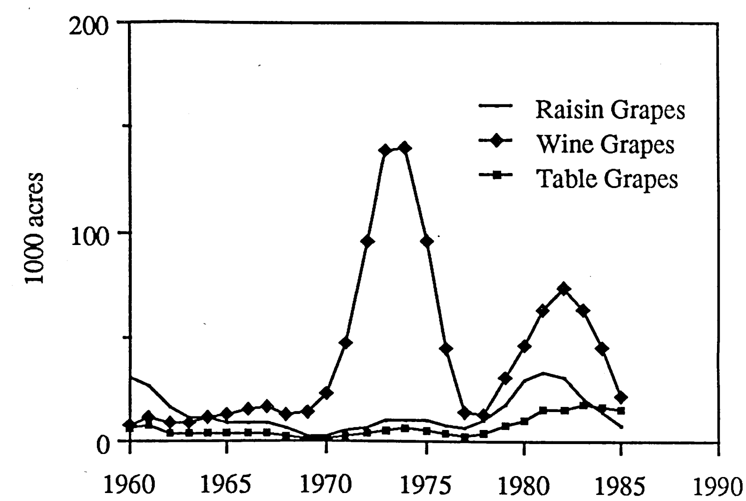


Figure 1B. Nonbearing Grape Acreage



This costly procedure discourages frequent switching between the fresh and drying alternatives. (In this report, therefore, the quantity of raisin grapes to fresh sales is treated as exogenous, as is the small amount that is canned. Only the allocation between drying and selling for crush is modeled.)

Over 95 percent of California's raisin grape acreage is in Thompson seedless,[3] a thin-skinned white grape with high fruit-sugar content. Of the portion of the Thompson crop that is dried, most is used for natural Thompson seedless raisins (NTS), i.e., naturally dried in the sun. About 10 percent of the crop is artificially dehydrated for golden seedless or sulfur-dipped seedless raisins.

The drying outlet for raisin grapes requires a higher sugar-acid ratio in the grape than does the crush outlet (Renaud, 1966). The ratio improves as the grapes mature, but the time to a raisin-quality ratio depends on the weather (number of degree days).[4] Then, the NTS tonnage from grapes laid in the sun depends on the sugar content, the temperature during the sun-drying period (the temperature must be warm, but not so hot that the raisins dry too fast), whether or not it rains on the raisins, and if it rains, what kind of weather follows the rain. Thus, NTS producers face a tradeoff between letting the grapes mature more, raising their sugar content but reducing the chances of a rain-free sun-drying period.[5]

When determining the best time to harvest, growers must be sure enough labor is available. Bunches are cut by hand and laid on paper trays between the rows on carefully prepared ground; after several days they are turned by hand. When three-fourths dry, they are rolled in the paper into "biscuits" to cure. During this curing period, further drying takes place and the remaining moisture content is spread evenly through the raisins.

According to industry sources, most NTS producers make raisins year after year, but some part of the industry makes the allocation decision between drying and selling for crush. These growers must weigh the current winery offer against a yet unknown raisin price at the end of the sun-drying period (Renaud, 1966).[6]

Raisin Marketing: A Historical Review

Marketing problems in the California raisin industry are not new. Howard (circa 1920) describes the turbulent history of raisin marketing in the late 1800s leading to the formation of a large marketing cooperative, the California Associated Raisin Company (later Sun-Maid), in 1912: "Twenty years of bitter struggle, ceaseless agitation, failure, discouragement, associations, pools, raisin exchanges and forced combinations..." (p. 1).

3. Muscats, a larger grape than the Thompson and with seeds, once represented about 15 percent of the state's raisin-grape acreage; its share has declined to about 3 percent (Nuckton and Johnston, 1985); most of the muscat crop is crushed. The Black Corinth, less than 1 percent of the acreage, is native to Greece and produces the Zante Currant, a small, black, seedless raisin used in baking fruitcakes, specialty breads and mincemeat (Crouse, 1977). There is also minor acreage in several other raisin-grape varieties—Canner, Fiesta, and Sultana. (The Thompson seedless is known as Sultana in Europe; the California Sultana is a smaller grape.)

4. For grapes, the number of days that the average temperature is above 50°F. times average temperature less 50, e.g., ten days averaging 60° is 100 degree days.

5. One rain on the laid-out raisins can severely cut their value; a second rain can mean nearly complete loss, particularly if cool weather follows the rain. Rain and cool weather also cause the sugar content of grapes still on the vine to drop, reducing their value as raisins.

6. While many traditional NTS producers seldom sell to crush, newer producers may be more likely to do so. For example, when the next generation takes over a raisin operation, more consideration may be given to the crush alternative. Also, newer raisin-grape vineyards on the West Side of the San Joaquin Valley, that were planted after the State Water Project deliveries began, are apparently more likely to use the crush outlet.

Cooperation was seen as a remedy for the strong tendency for growers to "stampede"—to rush to sell their crop as soon as it was dried, with the result that the entire output was dumped on the market at once (p. 25). Campaigns were eventually successful: By the 1920s Sun-Maid controlled from 85 to 95 percent of the industry. However, in 1923 Sun-Maid was charged with violation of the Sherman Anti-Trust Act and reorganized (Nelsen, 1950). Sun-Maid relinquished its near-monopoly control, retaining about 35 to 40 percent of the growers; a share it maintains to this day. Marketing problems persisted. Shear and Howe (1931) wrote of the 1920s:

> Within a decade California raisin production has nearly doubled. As a consequence the industry has experienced drastic price declines. Production averaged about 285,000 tons during the years 1926, 1927, and 1928, or over 100,000 tons more than the average at the close of the War.
>
> In spite of the greater decline in prices and the diversion of considerable tonnage into byproducts (alcohol, syrup, and stockfeed), the September 1 raisin carryover in the state has been in the neighborhood of 100,000 tons for the last four years. Prices have not been low enough since 1920 to move all of the available supply for any crop year into consumption.

Shear and Howe's objective was to help the industry make better judgments about the price at which any given tonnage may be expected to sell during the crop year. From free hand regressions between domestic sales and f.o.b. rail prices, they found that the domestic demand for raisins was inelastic, varying from about 0.3 to 0.4. They concluded that (pp. 74-5): "Large crops of raisins are, therefore, extremely serious, since prices must be set very low in order to move them into consumption and growers receive very much less for large crops than from small ones."

Watson (1940) examined various raisin marketing control programs of the 1930s. The problem with most attempts was their voluntary nature. Writing about the California Raisin Pool of 1930:

> Prices were much increased by the Raisin Pool and by the short crop in 1931, but growers became restless as it became plain that the producers remaining outside the Pool were getting the benefits of the effort without paying their share of the cost, and the Pool ceased operation in 1932.

Two types of surplus were seen in the raisin industry: (1) seasonal surplus which requires a "merchandizing pool" that prorates sales over the season and (2) annual surplus carried over from one year to the next, representing an excess of production over what is normally sold. The California Agricultural Prorate Act of 1933, amended several times, set up machinery whereby a majority could compel the rest to cooperate in disposing of either type of surplus (Watson, p. 11). There was a strong campaign and prorate was implemented in 1938, but there was considerable opposition to disposing of annual surplus that was not to be marketed in any form that would directly compete with "free tonnage."

Nelsen (1950) pointed to the difference between chronic surplus which "must eventually be reduced by removing vines" and episodic surplus with the need for some sort of regulation of shipments to promote "orderly" marketing. Nelsen examined the various market control schemes for the industry between 1930 and 1950. During 10 of these 20 years, there was some sort of control program operating, each an attempt to deal with surplus of one type or the other. The final program of the six that Nelsen studied established a federal marketing order under the Agricultural Marketing Agreement Act of 1937. The program was called the "dual plan of 1949" in that it created two pools: a reserve pool from which raisins could come to commercial trade channels later in the marketing season (prorate) *and* a surplus pool from which raisins would be disposed of in noncompetitive outlets.

At the time the federal marketing order was enacted soon after the close of World War II, the California raisin industry was in a serious state of overproduction due to the curtailment of the wartime raisin-buying program for distribution to armed forces and in Europe.[7] The marketing order established in 1949 is essentially the same as the order currently in effect, though some provisions have been altered as needs changed.

Townshend-Zellner (TZ 1961, 1964) who analyzed the first 10 years of the operation of the marketing order wrote that it had improved the position of raisin producers and "created an industry organization that is stable, enduring, and capable of progressive development and adaption" (1964, p.1). The industry moved from (1) a high-cost program of massive government subsidies to a long-term, two-price (domestic-export) program, (2) from a program operated entirely by the government to a self-help program, and (3) from an unregulated and unorganized market structure to regulated marketing in accordance with new rules (p. 1).

The common conception among economists is that increased economic profits from such market control programs are only temporary because they attract new (less efficient) producers to enter (see for example, Farrell, 1966; Berck and Perloff, 1985). The additional output is thought to drive down prices and economic profits are soon dissipated for all in the industry. However, TZ observed that in spite of the fact that the gross return to raisin producers had been raised substantially relative to those in the crush outlet, the tonnage dried actually decreased. TZ offered several reasons for this seemingly perverse supply response. It could be that most entry occurred after TZ's study (see the increase in bearing raisin grape acreage in the early 1960s in Figure 1). Or it could be that the geographical limits on the area ideal for sun-dried raisin production discourage entry.[8]

Pritchard (1964) of the U.S. Department of Agriculture also studied the federal raisin marketing order and concurred with TZ that valuable economic benefits had accrued to raisin producers from the order and that packers also benefited from wider gross margins. Pritchard made several recommendations for revision of and simplification of the order's provisions (p. v):

- Establish the free tonnage allocation each year in *actual* tons, rather than on a percentage basis, based on packers' free tonnage sales in recent years.
- Establish this free tonnage by about August 1st rather than waiting until October when the crop is delivered.
- Abolish the two-pool system; allow the surplus pool to simply be the difference between deliveries and free tonnage.

7. During World War II there was a law that no Thompson seedless grape could be crushed for wine; raisins were needed for the war effort. The government bought 300,000 tons of raisins annually.

8. All NTS are produced within a 75 mile radius of Fresno. Areas both further south and further north have a higher probability of early fall storms that can ruin a laid-out raisin crop.

These recommendations were adopted by the federal marketing order's Raisin Administrative Committee (RAC). In 1967 the two-pool system was abolished. All NTS not declared as free tonnage become part of one reserve pool.

The Institutional Setting of the Industry

The California raisin industry has a number of important institutions, including federal and state marketing orders, a large grower-processor cooperative, and a growers' cooperative bargaining association.

The Federal Marketing Order

The volume control provision of the federal marketing order combines prorate and surplus control in an attempt to handle both seasonal and interseasonal surplus. About August 1st, the RAC meets to decide on the amount of the upcoming crop to declare as free tonnage. Only free tonnage can be marketed on the domestic market. The RAC administers the reserve tonnage which is delivered to packers' doors but still owned by growers.[9] Besides the initially declared free tonnage, packers may buy additional tonnage for free use from the reserve, according to certain rules that attempt to prorate shipments during the marketing year. The RAC attempts to dispose of the rest (surplus disposal).

Until 1977, most of the reserve pool was exported at prices considerably lower than those on the domestic market. Other uses of the reserve include the school lunch program, P.L. 480 exports, sales to wineries for distilling purposes, charities, cattle feed, and other government purchases. In 1977 and after, because of favorable markets abroad, exports were considered free tonnage shipments. Accordingly, the initial free tonnage was set somewhat higher.

Besides volume control, the RAC also administers quality control and inspection provisions.

The State Marketing Order

The raisin industry is also under a state marketing order which implements research and product promotion. The generic advertising campaign sponsored by the Raisin Advisory Board has been particularly active in the mid-1980s. The state order also provides for volume control, but this provision has never been implemented.

Sun-Maid Growers

Sun-Maid is a large grower-processor cooperative representing 40 percent of the growers in the early 1980s and over one-half of the tonnage. Member patronage returns are from both the farm and wholesale levels. While Sun-Maid is the industry leader, it must abide by the marketing order provisions. Sun-Maid representatives sit on the RAC and vote as a block for their members.

In 1980, Sun-Maid joined with other processor cooperatives—Diamond Walnut, Valley Fig, and Sunsweet Prunes—to form a large marketing cooperative, Sun-Diamond. Together they enjoy economies in nationwide transportation and promotion.

The Raisin Bargaining Association

Organized in 1967, the Raisin Bargaining Association (RBA) is a cooperative which bargains with packers for the field price of the RAC-declared free tonnage. Given the structure of the industry, the bargaining process essentially establishes a floor for the field price for all growers even though only about 40 percent belong to RBA.

Additional packer purchases from the reserve pool for free tonnage shipments must be at the bargained-for free tonnage price—or more, to cover interest and storage as the marketing season progresses.

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9. Reserve tonnage remains in sweatbox containers in the packers' yards, covered with tarps and fumigated periodically.

NTS on World Markets

California ranks first in world raisin production, drying 304.2 thousand metric tons in 1984, 314.7 in 1985, and 205.8 (preliminary) in 1986 (Federal-State Market News Service, MNS, Dec. 12, 1986). The next largest producers in 1986 were Turkey with 100 thousand tons and Greece with 73 thousand. In addition, Greece produces and exports substantial tonnage of currants. Australia, Iran, Afghanistan, and South Africa are also major raisin producers.

California ranked third in tonnage in world trade of raisins and currants in 1985 with a 16 percent share (U.N. Food and Agriculture Organization, FAO, 1985). Counting currant exports, Greece ranked first with about 23 percent of the total, followed by Turkey with 21 percent. Australia had almost a 15 percent share; Afghanistan, 12 percent; South Africa, 5 percent.

The U.S. product is unique in world trade. Except for a few thousand tons from South Africa and recently some from Mexico, the only natural sun-dried raisin is the California NTS. While the Sultana grape, the most important grape everywhere for raisins, is identical to the Thompson seedless, the NTS drying process is different from that used, for example, in Greece or Turkey. Most raisins in these countries are dipped in sulfur right after harvest to shorten the time required for drying. Once dipped they may either be dried in the sun or artificially dehydrated. The resulting product is softer and lighter in color than NTS. Consumers worldwide view NTS and other raisins as close substitutes, but as distinct products.

World trade in raisins (and currants) has grown gradually from an average of 270,000 metric tons in the 1950s to over 400,000 metric tons in the 1980s (U.S. Department of Agriculture, Foreign Agricultural Service, FAS, 1984; and FAO, 1985). The European Economic Community (EEC) is the largest importer of raisins with Greece and Turkey providing about 60 percent of its supply. Since Greece's entry to the EEC in 1981, an increasing portion of Greek raisin exports has been directed to the EEC. Among non-EEC European countries, Sweden and Norway are the most important importers of California's NTS.

The Soviet Union and Eastern Europe comprise the second largest importing block with Afghanistan providing most of the supply (FAS, 1984). Before Greece joined the EEC, a large portion of Greek raisins went to the eastern block. The United States does not export raisins to this area of the world.

The United States has consistently been the leading supplier to Japan, and Japan has and continues to be the largest single-country importer of U.S. raisins. Exports to other Pacific nations, particularly to Taiwan and Korea, have increased, stimulated recently by FAS's Targeted Export Assistance program created by the 1985 farm bill.

Canada is another important customer for U.S. raisins; however, Australia provides nearly one-half of Canada's raisin imports; the United States, only about one-third (FAS, 1984). The RAC considers Canada as part of the domestic market.

3. FRAMEWORK FOR THE CALIFORNIA RAISIN MODEL

Introduction

The model of the California raisin industry at the farm and f.o.b. levels involves four structural blocks of behavioral equations reflecting distinct levels of decision making. See Figure 2.

I. The first block models growers' raisin grape vine planting and removal decisions and the resulting bearing acreage and raisin grape production.

II. The second block explains growers' allocation of raisin grape production between drying and crushing after the quantities to the fresh and canning outlets have been subtracted out exogenously. Most of the allocation to dry is for Natural Thompson seedless raisins (NTS).

III. The third block considers (1) the Raisin Administrative Committee's (RAC) allocation of NTS between free tonnage and the reserve pool and (2) growers' bargaining, through the Raisin Bargaining Association, with packers for the field price for free tonnage.

IV. The final large block consists of (1) packer-processor f.o.b. price-establishment behavior, (2) domestic demand for packaged and bulk NTS, (3) RAC's determination of the growers' price for NTS exports, (4) the resulting f.o.b. export price, and (5) demand for NTS by major importers.

The model is block recursive, with a number of feedback loops. For example, production in block I is predetermined with respect to the allocation decisions in blocks II and III and the pricing decisions in block IV. The associated returns to growers influence their vine planting (and removal) decisions which later affect production, and so on.

I. Raisin Grape Producers' Supply Response

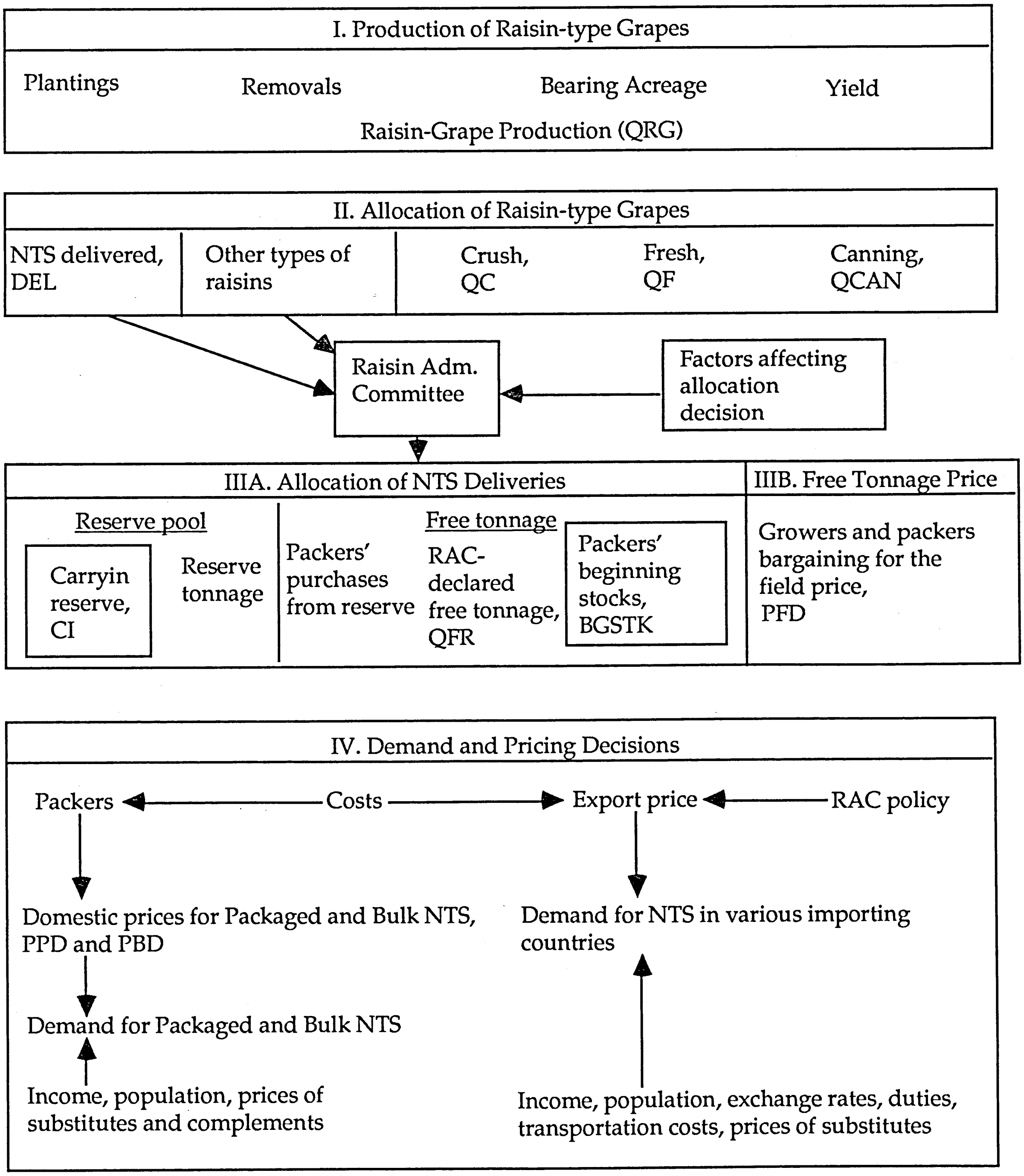
The annual output of raisin grapes is determined by the raisin grape acreage and yields which are mainly influenced by random natural factors and the age distribution of vines. The acreage and age composition are determined by the past history of plantings and removals. Hence, to model supply response we need to model planting and removal decisions. The theoretical framework formulated and elaborated by French and Matthews (1971), Minami, French, and King (1979), and French, King, and Minami (FKM, 1985) serves as the basis for specifying the planting and removal functions for raisin grapes.

Plantings

In FKM's model, new plantings were determined by expected returns for the commodity over its expected life, expected future returns for alternative crops, the existing total area in the crop (less removals from the previous year's acreage), and a variable to account for changes in perceived risk. Expected long-run returns were expressed as functions of past average price and cost experience and a measure of potential future competing production from existing acreage.[10]

10. The FKM model assumes rational behavior in the sense that growers project future economic conditions, but not in the strict sense of Muth's (1961) rational expectations model. Muth's model assumes expectations to be consistent with the equilibrium predictions of the supply-demand structure of the industry. But this requires growers to forecast over long periods both the supply-demand structure and the variables which cause it to shift. The FKM model assumes less sophisticated processing of economic information in making long-run decisions.

Figure 2. The California Raisin Industry



Since raisin grapes may be dried, crushed, or sold fresh, expected future returns are based on past returns from all three outlets. Potential future production of a perennial crop is related to the current age distribution of plants. If most of the existing acreage is relatively young, the potential future production is high; if much of the existing acreage is old and likely to be removed soon, potential future production is reduced. Detailed data pertaining to ages of vineyards are not available. However, the ratio of nonbearing to bearing acreage, which is computable, provides a rough indicator of age distribution, with a larger ratio indicating the existence of more young acreage.

With these considerations, the planting function is specified generally as:

(1) $PLANT_t = f(RR_t, RC_t, RF_t, RA_t, VRET_t, PNB_t, TNA_t, GPL_t)$

where PLANT is new plantings; RR, RC, and RF are past average net returns for raisin grapes dried, crushed, and sold fresh; RA is a measure of past average returns to alternative crops; VRET is the variance of past returns as a measure of risk; PNB is the proportion of total acres classed as nonbearing; TNA is total net acres in year t-1 (total acres less removals after harvest), entered as a measure of the effect of industry size on plantings; and GPL is a general price level measure. The specific measures of the return and risk variables are discussed with the presentation of empirical estimates in Section 4.

Removals

Removal rates are determined mainly by expectations concerning the productivity of the vines, which varies with age, and by natural factors such as diseases. FKM found that for cling peaches, removals are also affected by current returns (which influence expectations a year ahead). If they are high, removals may be delayed; if low, they may be accelerated.

The removal model for raisin grape vines differs from the FKM model in two important ways. First, data pertaining to removals by age class are not available for grapes so the model deals only with aggregate removals. Second, raisin grape vines, given proper cultural attention, enjoy considerable longevity in productivity, so annual removals may be relatively small and thus less affected by variations in returns. Further, the relevant profit expectation may pertain to a relatively short period and hence may be based on a different information set than plantings.

With these considerations, removals are expressed as:

(2) $RMVL_t = f(RR_t', RC_t', RF_t', RA_t', BA, GPL_t)$

where RMVL is the acreage removed after harvest in t, BA is bearing acres, and the primes (′) on the average return measures are to reflect the possibility that because removals have immediate market effects, they may be influenced by different average returns than are plantings. Removals from nonbearing acreage are assumed negligible.

Bearing Acreage and Raisin Grape Production

Bearing acreage in year t is defined as:

$$BA_t = BA_{t-1} + a \bullet PLANT_{t-k} - RMVL_{t-1}$$

where BA is bearing acreage, a is a number less than but close to 1.0 to account for any plantings removed prior to reaching bearing age, PLANT is new plantings, and k is three since it takes three years for raisin grapes to reach bearing age. Total production of raisin grapes (QRG_t) is given by the identity:

$$QRG_t = BA_t \bullet YIELD_t.$$

(In the stochastic model, the disturbance terms for QRG will be multiplicative and complex.)

II. Growers' Allocation Between Drying and Selling for Crush

As noted previously, raisin grape production may be dried for raisins, crushed for wine, or sold fresh. A switch to fresh from raisin production is a costly procedure involving retrellising the vines. Although long-term expectations may cause some acreage to shift over to fresh production (if other conditions such as soil and location are right), fresh market tonnage (QF) will be treated as exogenous and subtracted from QRG, as will the small amount that goes to the cannery outlet (QCAN). Thus, Q, the raisin-grape tonnage to be allocated between making raisins and selling to the winery for crush is given by the identity:

$Q_t = QRG_t - QF_t - QCAN_t$.

At the time when Q is to be allocated between drying and crushing, the current winery price offers for raisin grapes are known. The desired quantity dried, QR^d may be based largely on growers' expected net returns to raisins later in t (RR^e) and *current* net returns to the crush outlet (RC), where the net returns are, in both cases, the respective prices less harvesting and handling costs. Thus, the desired quantity allocated to raisins may be specified as:

$$(3a)\ QR^d_t = f(RR^e_t, RC_t, Q_t, GPL_t)$$

where GPL is a price level measure.

In a perfectly competitive market, growers would allocate between dry and crush until the expected net raisin return, RR^e, equals the current net crush return. However, there may be quality differences between grapes going to the two outlets so observed prices may never be equated. Further, contracts with raisin packers and with wineries affect the aggregate outcome as do habit, inertia, and other frictions. The relationship between the desired quantity laid to raisins, QR^d, and the actual quantity, QR, is therefore formulated as a partial adjustment model (Nerlove, 1958). That is, the aggregate quantity dried in year t, QR_t, equals the quantity dried the previous year, QR_{t-1}, plus some portion of the difference between the desired quantity dried in t and actual quantity dried in t-1:

$$(3b)\ QR_t = QR_{t-1} + a \bullet (QR^d_t - QR_{t-1}).$$

Substituting for QR^d_t from (3a) into (3b) yields:

$$(3c)\ QR_t = (1-a) \bullet QR_{t-1} + a \bullet f(RR^e_t, RC_t, Q_t, GPL_t).$$

On a hypothesis similar to that used in the plantings and removals functions, that the experience of net returns-to-raisins in the recent past (RR″) is closely related to the unobservable expectations variable (RR^e), the allocation decision may be specified using (3c) as:

$$\textbf{(3)}\ QR_t = f(RR''_t, RC_t, Q_t, QR_{t-1}, GPL_t).$$

The quantity crushed (QC) is determined residually as an identity:

$$QC_t = Q_t - QR_t.$$

The current net return to raisin grapes on the crush market, RC, depends on the quantity of raisin grapes going to crush in year t (QC), and numerous other factors affecting the wine market (Z), to be discussed more fully with the empirical analysis in Section 4.

$$\textbf{(4)}\ RC_t = f(QC_t, Z_t, GPL_t).$$

The tonnage of raisins produced from QR depends on various stochastic factors, including the maturity of the grapes at the time of the decision, i.e., their sugar content, and, for the sun-dried raisins, the weather during the drying period. Also, not all raisins are NTS. The relationship between the wet tonnage allocated for raisins, QR, and NTS delivered at packers' doors, DEL, is specified as:

$$DEL_t = \Pi_t \bullet (QR_t / DR_t)$$

where Π is the proportion of the total raisin crop that is NTS and DR is the drying ratio. Historically, about 85 percent of the total raisin crop has been NTS; the balance consists of Muscats, Zante Currants, other raisin-grape varieties, and other Thompson seedless raisins, e.g., goldens and dipped. The historic drying ratio averages about 4.0 with variations due to stochastic factors.

III. Allocation of NTS Between Free and Reserve Tonnage and Grower-Packer Bargaining for the Free Tonnage Price

Free Tonnage

The RAC determines how much of NTS deliveries in year t, DEL, is to be declared free tonnage (QFR), and how much is to be set aside as reserve tonnage. The marketing order section 989.54 lists the factors that should be reviewed by the RAC in establishing the marketing policy for the year to submit to the Secretary of Agriculture. These are: (1) the estimated tonnage held by producers, handlers and the RAC at the beginning of the crop year, (2) the expected general quality and any needed modifications in the minimum grade standards, (3) the estimated tonnage of standard and off-grade raisins that will be produced, (4) the estimated trade demand for raisins in free tonnage outlets, (5) the estimated desirable carryout at the end of the year for free tonnage and, if applicable, for reserve tonnage, (6) the estimated market requirements for raisins outside free tonnage outlets, considering the world raisin supply and demand situation, (7) current prices being received and the probable general level of prices to be received for raisins by producers and handlers, (8) the trend and level of consumer income, and (9) any other pertinent factors bearing on the marketing of such raisins including the supply and demand of varietal types.

Since the mid-1970s the RAC has used a plan whereby QFR equals 90 percent of the previous year's shipments in free tonnage outlets plus an adjustment factor based on (1) free tonnage in packers' hands and (2) the "desired free tonnage carryout."[11] While this sounds as if QFR could be calculated by formula, either the adjustment factor and/or the 90 percent apparently varies substantially according to items (1) through (9) above. Hence, it is necessary to formulate a stochastic equation to model RAC behavior.

Factors important in setting QFR should be the previous year's free tonnage shipments and f.o.b.prices, ($FSHIP_{t-1}$) and ($PFOB_{t-1}$), respectively; the crop size (DEL_t); and stocks, including the beginning free tonnage in packers' hands (BGSTK) and the size of the carryin reserve, still owned by growers, administered by the RAC (CI).

With all other factors constant, increased shipments in t-1 would call for more free tonnage, as would higher f.o.b. prices; if shipments increase with constant price, a shift in demand is indicated (and vice versa), so a larger QFR would be established. Beginning stocks reported by packers (BGSTK) would be expected to have an inverse relationship with QFR; that is, the more free tonnage stocks that packers already hold, the less they want to buy; further, if it is known that packers are holding considerable free tonnage as stocks, the RAC will tend to declare a lower initial free tonnage percentage. Other supply, however, i.e., DEL and CI, would be expected to have a positive relationship with QFR. If the crop is large, the RAC might want to have a larger tonnage declared free to be purchased by packers.

In the mid-1970s the export situation became very favorable, partly due to a weakening dollar. As a result, in 1977, the RAC changed its policy from treating exports largely as distress sales from the reserve pool at reduced prices (except in short-crop years) to regarding them as free tonnage to be sold in commercial trade channels equivalent to the domestic market. To model this shift, a variable (X) was created which has a value of zero from 1963-76; thereafter it equals lagged total exports (QXT_{t-1}). This assumes not only

11. This desired free tonnage carryout was set at 20,000 short sweatbox tons from 1963-1975 except for the short-crop year 1972 when it was lowered to 15,000 tons. After 1976 all exports were considered free tonnage; accordingly, the desired free tonnage carryout was raised to 35,000 tons.

that the level of free tonnage (QFR) increases under the new policy, but also it varies with the volume of exports.

The free tonnage equation (QFR) is specified as:

$$(5)\ QFR_t=f(FSHIP_{t-1}, PFOB_{t-1}, DEL_t, BGSTK_t, CI_t, X_t, GPL_t)$$

where the variable are defined above, and GPL is a general price level measure.

Free Tonnage Price

If raisins were purchased under competitive conditions, farmers would face packers' derived demand for the raw product, and the free tonnage price (PF) would be determined by the intersection of QFR and this demand curve. But with California raisins, the growers' bargaining association bargains with packers for PF; this bargaining process effectively determines the free tonnage price for the entire industry.[12] The bargaining situation implies imperfect competition on both the buyers' and sellers' sides, so as in the case of a bilateral monopoly, price is determined only within some range, not by the intersection of supply and demand. However, the bargaining range itself may vary with supply and demand factors, and the location of price within the range depends on the relative bargaining strength of the parties involved and their bargaining strategies.

French (1987) developed a model to predict the price outcome of bargaining for processed fruit and vegetables, which he applied to the cling peach industry. He noted that the price-predicting equation includes "essentially the same variables as would be included under the assumption of perfect competition" (p. 26). Following French, the free tonnage price predicting equation is specified as:

$$(6)\ PF_t=f(PFOB_{t-1}, PC_{t-1}, QFR_t, (SUPPLY_t\text{-}QFR_t), POP_t, X_t, GPL_t)$$

where PF is the free tonnage price; PFOB is the f.o.b. price; PC is packers' nonfruit processing cost; QFR is free tonnage; SUPPLY - QFR is all other supply;[13] POP is population; X is the same variable as is used in (5) to reflect the RAC's change in export policy; and GPL is a general price level measure. Lagged prices and costs reflect the previous year's profit experience of packers. Increased price and reduced cost are likely to increase processor raw product demand. Increased supply in the form of larger free tonnage (QFR) and other supply (SUPPLY-QFR) may be expected to reduce PF, but the effect of free tonnage supplies on PF may differ from the effect of other supplies—hence they enter as separate variables. Population enters as an indicator of a change in the size of the market, with quantities expressed as ratios to population. Since shipments to Canada are considered part of the domestic market by the RAC, the population variable, POP, includes the U.S. and Canadian populations. The variable, X, defined previously, is a reflection of increased demand for exports. It would therefore be expected to relate positively to the negotiated free tonnage price.

Stocks

Stocks in packers' hands at the beginning of the marketing year are the total free tonnage supply in the previous year minus free tonnage shipments in the previous year:

$$BGSTK_t=QFR_{t-1}+BGSTK_{t-1}\text{-}FSHIP_{t-1}.$$

---

12. Final returns to Sun-Maid members depend on patronage refunds based on profits from processing and wholesale shipments. However, the initial Sun-Maid price to members for free tonnage apparently is influenced by the bargained-for price, PF.

13. Total supply is deliveries plus both types of stocks: SUPPLY=DEL+BGSTK+CI.

For reasons not entirely clear, the total beginning stocks *reported* by packers in year t has differed from the accounting identity values calculated by subtracting free tonnage sales in t-1 from the free tonnage supply in t-1. Factors thought to cause these discrepancies include (1) the possibility of counting some stocks committed for shipment as stocks on hand, (2) variations in packer accounting practices, (3) occasional inclusion (during short-crop years) of non-NTS raisins in reported shipments, and (4) a shift in the crop year in 1975 from September 1-August 31 to August 1-July 31, yet continuing to record packers' reported beginning stocks as of September 1st. Whatever the reasons, it is *reported* rather than calculated stocks that are observed and used by packers in planning price strategies. Reported beginning stocks are related to the unobservable actual stocks by regressing on reported stocks, the variables that enter the stock identity:

(7) $BGSTK_t = f(QFR_{t-1}, BGSTK_{t-1}, FSHIP_{t-1})$

where, for convenience, $BGSTK_t$ hereafter refers to *reported* stocks. QFR_{t-1} is lagged free tonnage, $BGSTK_{t-1}$ is lagged reported beginning stocks, and $FSHIP_{t-1}$ is lagged free tonnage shipments.

The quantity carried in as grower-owned reserve, CI_t, is determined residually from supply and utilization of the reserve pool in t-1: the reserve supply (deliveries plus growers' carryin minus packers' free tonnage purchases) minus reserve tonnage exports (QXR) and all other uses of the reserve pool in year t-1 (OTHER):

$$CI_t = DEL_{t-1} + CI_{t-1} - QFR_{t-1} - QXR_{t-1} - OTHER_{t-1}.$$

Other uses of the reserve pool include sales to wineries for alcohol manufacture, PL-480 exports, government purchases for the school lunch and other programs, sales for feed, shrinkage, etc. The rules followed in determining the quantity of raisins exported from reserve tonnage, QXR, have varied over time with changes in RAC policy. The method of approximating the RAC decisions is described with the presentation of the complete industry simulation model.

IV. Domestic and Foreign Demand for NTS and Pricing Decisions

Raisin packer-processors face demand functions for their products derived from the retail sales level and ultimately from individual consumers' demand. Consumers at home and abroad purchase NTS for direct consumption and home baking or in various ready-made products, especially bakery goods and cereals. Accordingly, at the packer-processor level the homogeneous farm-level product is differentiated by marketing outlets. The two main forms are consumer retail packages and bulk pack; the three main markets are domestic packaged sales, domestic industrial uses (i.e., bakers, cereal manufacturers, confectioners), and foreign sales which can be separated into individual demand functions by the major raisin importing countries.

The 21-packer California raisin industry is dominated by Sun-Maid, a large cooperative which in the early 1980s represented 40 percent of the growers and handled about half of the total sales.[14] Sales are to a large number of domestic and foreign consumers. It seems reasonable, therefore, to assume some sort of oligopolistic behavior, such as price leadership, rather than price taking. Packers attempt to establish prices so as to cover their costs and return them the largest margin they can reasonably expect, given the current supply and demand situation and their knowledge of past relationships.

14. In 1980, Sun-Maid sales were 47 percent of total industry sales, including exports; in 1981, 50 percent; in 1982, 52 percent; and in 1983, 44 percent (Sun-Diamond annual reports and RAC *Marketing Policy* reports).

Quantities not sold at the set price are carried over as inventory to the next season.

A few quotations from the American Institute of Food Distribution, *Food Institute Report* lend support to the price-setting hypothesis:

> September 11, 1976: "No new pricing as yet reported on Naturals and there is not expected to be any until the grower bargaining assocation announces a raw fruit price agreement with packers."
>
> October 23, 1976: "Such variations (in price) seem to be caused by the uncertainty on what packers' costs will be, including reconditioning, handling, and how much tonnage will actually be received."
>
> October 8, 1977: "Some packers are waiting to see how actual tonnage materializes before naming prices."
>
> September 8, 1979: "A lot of activity was reported on the West Coast this week as packers began formulating pricing for the new crop."
>
> October 4, 1986: "As a result of higher field prices, packers are expected to open around 63¢-65¢ for Selects, 64¢-66¢ for Midgets and 66¢-68¢ per pound for Goldens, in 30-lb. cartons, f.o.b. West Coast."

Price setting and the oligopolistic market of the raisin industry does not necessarily mean that prices are set far above competitive levels, i.e., above those levels that just cover costs plus a normal return on operations and management. The price-establishment approach makes sense because raisin packers have a great deal of information in advance of setting prices. They know what they'll initially have to pay for free tonnage raisins (PF) and that further purchases (from the reserve pool) during the season can only be at a higher price. Processing is relatively simple for NTS in that a homogeneous raw product is washed, destemmed, and either packaged in retail packages or bulk pack, so costs are well understood. And packers have the option of carrying stocks over if they set the price too high to move the total supply of free tonnage. Supply conditions are well known. The marketing order generates and disseminates detailed information including carryin reserve stocks in growers' hands and beginning stocks in packers' hands. The RAC gives periodic crop estimates as the crop year progresses, then the entire year's production is delivered (reserve and free tonnage) at the packers' doors.

Packers' Price Establishment Behavior

The packers' price-setting process is hypothesized to be directed mainly at domestic market free tonnage sales. Packers establish f.o.b. prices for NTS sold in retail packages (PP) and for bulk pack (PB). Following the general approach of French and King (1986) for canned cling peaches, the packer price for packaged NTS (PP) is expressed as a function of the cost of raw product purchases from growers for free tonnage use (PF), the nonfruit processing cost (PC), including labor, packaging materials, administration, energy, overhead, etc.; and a targeted profit margin for the packaged market (MARG1). That is:

(8a) $PP_t = f(PF_t, PC_t, MARG1_t)$.

MARG1 is not an observable variable. However, it is hypothesized to vary with demand factors, the general price level, and available supplies. If the delivered crop or the carryover are large relative to current demand, a smaller margin might be anticipated. But if shipments are moving well relative to supply, packers may increase their f.o.b. price to better their margin. Hence, MARG1 may be replaced by observable demand and supply indicators to obtain:

(8) $PP_t = f(PF_t, PC_t, QPKG_t, SUPPLY_t, POP_t, GPL_t)$

where PP is the f.o.b. price for retail pack, QPKG represents the current movement (demand) in the packaged market, and SUPPLY includes DEL, BGSTK, and CI. Population (POP) is entered because the size of both shipments and supplies should be considered relative to the size of the market (i.e., in per capita values). The general price level (GPL) is included to reflect inflation effects. All variables on the right except QPKG are predetermined or exogenous with respect to PP. PF and SUPPLY are related, as indicated by equation (6). However, the degree of association is not excessively high. In the empirical analysis, the problem is further reduced by expressing QPKG and SUPPLY as a ratio.

The bulk price setting equation (PB) is specified similarly:

(9) $PB_t = f(PF_t, PCB_t, QBLK_t, SUPPLY_t, POPt, GPL_t)$

where PCB is nonfruit processing cost for bulk pack (PC>PCB), QBLK is bulk sales on the domestic market, and the other variables are as noted for retail pack.

Domestic Demand for NTS

The domestic demand system consists of two equations: one for demand for packaged NTS; the other for bulk pack:

(10) $QPKG_t = f(PP_t, PSUB_t, PCOMP_t, EU_t, POP_t, GPL_t)$

(11) $QBLKt = f(PB_t, PSUB_t, PCOMP_t, EU_t, POP_t, GPL_t)$

where QPKG and QBLK are NTS sales in the United States and Canada in the packaged and bulk outlets, respectively, specified as functions of their prices (PP and PB, respectively); substitutes and complements (PSUB, PCOMP), explained more fully with the empirical estimation results; the U.S. and Canadian population (POP); U.S. consumer expenditures (EU); and a measure of the general price level (GPL).

Conceptually, the bulk price, PB, should be in the packaged NTS demand equation (10) and the packaged price, PP, in the bulk demand equation (11) because consumers can choose between buying commercial products using raisins or buying raisins to make the products. However, the correlation between them is very high (r=.97) so it is not possible to account for their separate effects empirically. For purposes of this study, this is not a serious problem since the close positive correlation should hold in the future due to the fact that both prices are influenced by the same variables.

The RAC's Price Establishment for Exports from the Reserve Pool

Until the mid-1970s exports were a secondary market, somewhat residual to domestic sales with shipments largely from the reserve pool.[15] From 1963 through 1976, except in the short-crop years 1972 and 1973, the RAC set the prices received by growers, PR, for these exported reserve pool NTS considerably below the free tonnage price, PF. To model the RAC pricing policy, we define a variable PGX which is the RAC's target price for export returns to growers. PGX is a weighted average of export sales

15. In the 1963 crop year, 77 percent of NTS exports were from the reserve pool; in 1964, 91 percent; in 1965, 91 percent; in 1966, 92 percent; in 1967, 94 percent; in 1968, 1969, and 1970, 96 percent; in 1971, 94 percent; in 1974, 61 percent; in 1975, 89 percent; and in 1976, 71 percent (RAC, *Marketing Policy* reports, various issues).

from the reserve at PR and sales for export at PF, the free tonnage price. It may be represented as:

$$PGX_t = s \bullet PR_t + (1-s_t) \bullet PF_t$$

where s is the share of NTS exports coming from the reserve pool. In the short crop years, 1972 and 1973, growers received the free tonnage price for all NTS exports, so s=0 and PGX=PF.

From 1977 to 1980, because export conditions were favorable, the RAC changed its export policy: All NTS exports were considered free tonnage shipments after 1977. Packers, therefore, would have to purchase raisins at the free tonnage price, so PGX=PF for 1977-80.

In 1981-83, the RAC adopted the Export Incentive Plan (EIP) which blended free tonnage NTS with varying percentages of reserve tonnage. The export price was blended down by offering packers reserve tonnage at $100 per short sweatbox ton to mix with free tonnage already in packers' hands. The object of EIP was to make U.S. raisins more competitive in foreign markets with those from other sources; so by lowering the price growers received for NTS exports, the f.o.b. price could also be lowered on world markets. The price of $100 for NTS from the reserve pool stayed constant, but the composition of the reserve-free blend varied. For example, EIP began in November 1981 on a basis of one-fourth to three-fourths ratio of reserve to free tonnage. Even when there was no reserve pool in 1982-3, EIP continued by offering packers $100 tonnage promised from the 1983 pool, taken from reserve carryin stocks. For more details on the blending proportions, see Appendix F. For the EIP years, PR was $100 per short sweatbox ton (about $120 per packed weight metric ton), so PGX is defined as:

$$PGX_t = s_t \bullet 120 + (1-s_t) \bullet PF_t.$$

During EIP, the proportion of total exports from the reserve pool, s, was varied during the marketing year; in the model, s is the average for the year.[16]

The RAC, with an eye to the world market, is hypothesized to meet competitors' prices in export markets. Key factors, therefore, in explaining the price growers get for NTS exports (PGX) are the prices of raisins from other producing countries landed in major importing countries, e.g., the price of Greek raisins in the United Kingdom (PGR)—expressed in nominal U.S. dollars in London—and on the size of supply relative to the size of the (domestic) market in year t. Hence, PGX is predicted by:

(12) $PGX_t = f(PGR, SUPPLY_t, POP_t)$.

The Proportion of Total Exports From the Reserve Pool, s

The share of total exports from the reserve pool (s) is defined as:

$$s_t = QXR_t / QXT_t$$

where QXR is the quantity of total exports that come from the reserve pool and QXT is total exports. Whenever all exports are free tonnage (i.e., 1972, 1973 and 1977-80) s=0; but for those years (before EIP) when s≠0, an equation is needed to predict s. The share from the reserve pool in t would be expected to be larger, the greater are total exports in t. But if no exports came from the reserve pool in t-1, the share in t would be expected to be somewhat smaller; a dummy variable can be used to capture this effect. The share of total exports from the reserve pool in those non-EIP years when s≠0, i.e., 1963-71 and 1974-76, is predicted by:

(13) $s_t = f(QXT_t, D_t)$

where D is a dummy variable equal to 1 when s in t-1 was zero; equal to zero, otherwise.

16. The average proportions (s) were: 1981, .24; 1982, .45; 1983, .64; 1984, .37; 1985, .26.

When EIP was in effect, after 1981, s was determined by solving equation (12) and PGX=s•(120)+(1-s)•PF for s—where 120 is the price paid to growers for reserve pool raisins ($100) converted to dollars per packed weight metric ton.

The f.o.b. Export Price

There are no data series available for f.o.b. export prices for the years when exports were sold below domestic price levels. Because most exports are in bulk,[17] we approximate the export price (PX) by adding the packer margin for bulk sales (the bulk f.o.b. price, PB, minus the free tonnage price, PF) to PGX. That is:

$$PX_t=PGX_t+(PB_t-PF_t).$$

Note that whenever PF=PGX, PX=PB.

As a check on the accuracy of this calculated f.o.b. export price, costs to ship raisins to London were added to PX and the result compared with Federal-State Market News Service (MNS) data on prices of U.S. NTS landed in London. MNS data are reported in U.S. dollars on a weekly basis, though some years the quotes are sparse and in 1978 no quotes were given. The available MNS weekly quotes were averaged on a crop-year basis. Sun–Maid provided a time series of representative costs to deliver raisins in London. The line item "freight-insurance-duty" (FID) was added to PX to give an estimated landed price in U.S. dollars:

$$PXUK_t=PX_t+FID_t.$$

PXUK compared very favorably with the MNS data, lending confidence in the construction of PX (see Figure 3.1 in Nuckton, 1986).

Export Demand for NTS

U.S. packers face an export demand function which is an aggregate of demand functions of importing countries including: the United Kingdom (UK), West Germany (WG), the Netherlands-Belgium (NB), Norway-Sweden-Denmark (NSD), Japan (J), and others. Demand was expressed in per capita terms, dividing the quantity shipped to importing country or group of countries I, Q(I), by the population, POP(I): QC(I)=Q(I)/POP(I). The Netherlands (N) is considered representative of the NB group in prices and income; Sweden, of the NSD group. Besides the United States, exporters include Greece, Turkey, Australia, and others. Using the Greek price as a substitute for U.S. NTS in the European equations and the Australian price in Japan, per capita demand for U.S. NTS by five major importing countries or groups of countries may be expressed as:

(14) $QCUK_t=f(PUUK_t, PGUK_t, ECUK_t, CPIUK_t);$

(15) $QCWG_t=f(PUWG_t, PGWG_t, ECWG_t, CPIWG_t);$

(16) $QCNB_t=f(PUN_t, PGN_t, ECN_t, CPIN_t);$

(17) $QCNSD_t=f(PUS_t, PGS_t, ECS_t, CPIS_t);$

(18) $QCJ_t=f(PUJ_t, PAJ_t, ECJ_t, CPIJ_t).$

PU(I) is the U.S. NTS price in importing country I; PG(I) is the Greek price in European country I; PAJ, the Australian price in Japan; EC(I) and CPI(I) are per capita income and the consumer price index in I.

The expected signs of own-price coefficients are negative; those on substitute prices, positive. However, the anticipated signs for the income coefficients in equations (14) through (18) are ambiguous. As real incomes rise, more bakery products using raisins are demanded which would be indicated by a positive sign. But over time technological improvements in fruit varieties and in transportation and storage have meant

17. Between 1979-80 and 1983-4, 70 percent of exports were in bulk or bags (RAC, "Accumulated Report of the Raisin Industry Shipments," *Final Report*, various issues).

that a greater variety of fruits is available to consumers everywhere. Rising real income over time may capture a substitution of other fruits for NTS; so the sign could be negative.

Summing over the five major importers and the quantity exported to the rest of the world (QROW) equals the aggregate quantity exported from the United States (QXT):

$$QXT_t = \Sigma^5 QU(I)_t + QROW_t.$$

U.S. NTS Prices in Importing Countries, I

Because no consistent price series are available for U.S. raisin prices landed in importing countries, approximate prices were constructed by expanding PX to reflect shipping costs, duties, exchange rates, and price levels. Following closely the specification of Bushnell and King (1986), the U.S. price in country I, PU(I), is:

$$PU(I)_t = [PX_t + TU(I)_t] \bullet D(I)_t \bullet ER(I)U_t / CPI(I)_t$$

where PX is the U.S. NTS f.o.b. export price, TU(I) is the transportation from the United States to country I, D(I) is the import duty (expressed as, for example 1.07 for a 7 percent duty); ER(I)U is the I-to-U.S. exchange rate, and CPI(I) is country I's consumer price index. Other European prices are calculated using the London-landed price, PXUK, as a base; details are given in Section 4.

A complete model would include supply equations from all exporting countries, transfer costs, and separate importing country demand equations for raisins from other than U.S. sources. This type of modeling effort, however, is beyond this research effort, mostly because of data availability. The only practical approach is to treat supply prices from other-than-U.S. source countries as exogenous, realizing that bias and inconsistency may thereby be introduced to parameter estimates of the econometric model. The possible distortions are believed not to be severe. However, conclusions based on the estimation results must, therefore, be tempered by an awareness of possible simultaneity bias.

The model is summarized in Table 1.

Table 1. Summary of the California Raisin Industry Model—Equations to be estimated, (1) through (18), Various Identities Needed and Definitions of Variables Used.

I. Production of Raisin-type Grapes

(1) $PLANT_t = f(RR_t, RC_t, RF_t, RA_t, VRET_t, PNB_t, TNA_t, GPL_t)$

(2) $RMVL_t = f(RR'_t, RC'_t, RF'_t, RA'_t, BA_{t-1}, GPL_t)$

$BA_t = BA_{t-1} + a \bullet PLANT_{t-k} - RMVL_{t-1}$
(a accounts for any new plantings removed)

$QRG_t = BA_t \bullet YIELD_t$

II. Allocation of Raisin-type Grapes

$Q_t = QRG_t - QF_t - QCAN_t$

(3) $QR_t = f(RR''_t, RC_t, Q_t, QR_{t-1}, GPL_t)$

$QC_t = Q_t - QR_t$

(4) $RC_t = f(QC_t, Z_t, GPL_t)$

Natural Thompson Seedless Deliveries

$DEL_t = \Pi_t \bullet (QR_t / DR_t)$

III. Allocation of NTS Deliveries

Free Tonnage

(5) $QFR_t = f(FSHIP_{t-1}, PFOB_{t-1}, DEL_t, BGSTK_t, CI_t, X_t, GPL_t)$

Free Tonnage Price

(6) $PF_t = f(PFOB_{t-1}, PC_{t-1}, QFR_t, (SUPPLY_t - QFR_t), POP_t, X_t, GPL_t)$

Stocks

(7) $BGSTK_t = f(QFR_{t-1}, BGSTK_{t-1}, FSHIP_{t-1})$

$CI_t = DEL_{t-1} + CI_{t-1} - QFR_{t-1} - QXR_{t-1} - OTHER_{t-1}$

IV. Demand and Pricing Decisions

Domestic Demand and f.o.b. Pricing

(8) $PP_t = f(PF_t, PC_t, QPKG_t, SUPPLY_t, POP_t, GPL_t)$

(9) $PB_t = f(PF_t, PCB_t, QBLK_t, SUPPLY_t, POP_t, GPL_t)$

(10) $QPKG_t = f(PP_t, PSUB_t, PCOMP_t, EU_t, POP_t, GPL_t)$

(11) $QBLK_t = f(PB_t, PSUB_t, PCOMP_t, EU_t, POP_t, GPL_t)$

The Export Sector

(12) $PGX_t=f(PGR_t, SUPPLY_t, POP_t)$

(13) $s_t=f(QXT_t, D_t)$

Under the Export Incentive Plan, (13) is replaced and s is determined by:

$s=(PGX_t-PF_t)/(120-PF_t)$.

$PX_t=PGX_t + (PB_t-PF_t)$

Import Demand

(14) $QCUK_t=f(PUUK_t, PGUK_t, ECUK_t, CPIUK_t)$

(15) $QCWG_t=f(PUWG_t, PGWG_t, ECWG_t, CPIWG_t)$

(16) $QCNB_t=f(PUN_t, PGN_t, ECN_t, CPIN_t)$

(17) $QCNSD_t=f(PUS_t, PGS_t, ECS_t, CPIS_t)$

(18) $QCJ_t=f(PUJ_t, PAJ_t, ECJ_t, CPIJ_t)$

Total exports

$QXT_t=\Sigma^5 QU(I)_t+QROW_t$

U.S. NTS Prices in Importing Countries

$PU(I)_t=[PX_t+TU(I)_t]\bullet D(I)_t\bullet ER(I)U_t/CPI(I)_t$

Definitions of Variables Used

(The variables are explained more explicitly in Section 4 and their units are given.)

PLANT:	acres in raisin grapes planted in t
RMVL:	acres removed after harvest in t-1
BA:	bearing acres in raisin grapes
TNA:	total net acres, total acres in t-1 minus removals
PNB:	nonbearing acres divided by total acres in raisin grapes
QRG:	raisin-grape production
QF:	quantity of QRG sold fresh
QCAN:	quantity of QRG canned
Q:	the net quantity to be allocated between dried and crush
QR:	quantity of QRG dried
QC:	quantity of QRG crushed
RR:	past average returns to NTS
RC:	raisin grape returns to crush
Z:	various factors affecting the wine market
RF:	past average returns to fresh
RA:	past average returns to alternative crops
VRET:	the variance of past returns as a measure of risk
QWG:	quantity of wine grapes available
DR:	drying ratio, wet-to-dry
Π	proportion of QR that is NTS
DEL:	NTS production, deliveries
QFR:	the free tonnage quantity
BGSTK:	packers' beginning stocks
CI:	growers' carryin reserve
QXR:	NTS exports from the reserve pool
OTHER:	other uses of the reserve pool
SUPPLY:	$DEL_t+BGSTK_t+CI_t$
PF:	the free tonnage price
FSHIP:	the previous year's shipments in the domestic market
PFOB:	the previous year's f.o.b. prices received
X:	a variable to reflect the RAC's policy change with exports in 1977 and after
PC,PCB:	processing costs for packaged and bulk pack NTS, respectively
QPKG:	packaged NTS domestic shipments
QBLK:	bulk NTS domestic shipments
PP:	packaged NTS f.o.b. price
PB:	bulk NTS f.o.b. price
$PSUB_t$:	NTS substitute prices
$PCOMP_t$:	NTS complement prices
EU_t:	U.S. consumption expenditures
POP_t:	U.S. and Canadian population
GPL_t:	a measure of the general price level
QCU(I):	per capita U.S. quantity imported by country I, I=the United Kingdom (UK), West Germany (WG), the Netherlands-Belgium (NB), Norway-Sweden-Denmark (NSD), and Japan (J)
PGX:	the price growers receive for exported NTS—a weighted average of PF and the grower price from the reserve pool, PR
QXT:	total U.S. NTS exports
s:	the share of total exports that come from the reserve pool
D:	a dummy variable; D=1, if $s_{t-1}=0$; D=0, otherwise
PX:	the NTS f.o.b. export price
PGR:	the price of Greek raisins in the United Kingdom, representing the price from all other source countries in equation (12)
PU(I):	price of U.S. NTS in importing country I, , I=UK, WG, N, and S.
PG(I):	price of Greek raisins for importing countries I, I=UK, WG, N, and S.
PAJ:	price of Australian raisins in Japan
EC(I):	per capita consumption expenditures in importing country I
CPI(I):	a measure of the general price level or cost of living in country I
TU(I):	transportation costs U.S. to country I
D(I):	duty charged on raisins by country I
ER(I)U:	the I-to-U.S. exchange rate
QROW:	NTS exports to the rest of the world

4. ECONOMETRIC ESTIMATION OF THE CALIFORNIA RAISIN MODEL

Introduction

Section 3 developed a general conceptual framework for a model at the farm and wholesale levels of the industry. This section explains more fully the variable measures, specifies the equation forms, and presents the econometric estimates. The period of analysis is from 1963-64 through 1983-84 (21 observations) with lagged variables extending back before 1963. (While a longer series would have been preferable, data on export shipments to major importing countries were only available since 1963.) U.S. price and cost variables were deflated by the gross national product price deflator (GNPD); foreign country monetary variables were deflated by the consumer price index (CPI) of the respective countries. (Deflated variables are denoted by a "D" following their symbols; for example, the free tonnage price, PF, becomes PFD when deflated for estimation in equation (6).)

I. Production of Raisin-type Grapes

(An explanation of variables used and data sources is given in Appendix A.)

Plantings Equation Estimation Results

Recall that the theoretical specification of the plantings function, equation (1) in Table 1, expresses plantings as a function of past average net returns to grapes dried, crushed, and sold fresh; net returns to alternative crops; a measure of risk; the proportion of vines that are nonbearing; and the total industry acreage, net of removals. However, not all of these variables were retained in the final empirically estimated equation. The future profit expectation turned out to be dominated by the average returns to drying (NTS), with no significant relationship revealed for crush or fresh market returns. Also, as has been the experience in other perennial crop studies, the possible effects of variation in returns to alternative crops could not be measured. This appears to be due to the wide range of alternative crop possibilities whose individual effects are difficult to identify and whose aggregate effects tend to cancel or remain stable. A trend variable, introduced to account for possible systematic changes in overall returns to alternative crops, proved to be nonsignificant. Hence, the effects of returns to alternative crops appears as part of the random disturbance term.

Variances of past returns over several different periods were introduced in an attempt to capture possible effects of changing risk perception. None of these measures proved to be statistically significant, suggesting that while risk perception may be important in planting decisions, it may not have changed significantly over the period of the data set.

With these considerations, the final empirical plantings function expresses plantings relative to total net acres as a quadratic function of a three year average of a weighted average of grower prices received for domestic and export NTS sales, less a measure of grower cost per ton.[18] The final estimation results, by ordinary least squares (OLS) are:

$$\text{(1)}\quad PPLT_t = \underset{(3.11)}{.01121} + \underset{(0.62)}{.000171}\,RRD3 + \underset{(1.33)}{.0000047}\,RRD3^2$$

$$R^2 = .73 \qquad DW = 1.62$$

where PPLT=PLANT/TNA,[19] RRD3 is the

18. The regression was also estimated using two- and four-year average returns; the three year average gave the best fit.

19. $TNA_t=TA_{t-1}$- RMVL and $TA_t=BA_t+PLANT_t+PLANT_{t-1}+PLANT_{t-2}$ andBA_t=bearing acreage in year t.

three year average of grower prices less costs, ending in t-1;[20] t-statistics are in parentheses.

The quadratic form of the function is similar to that used by FKM (1985) in their study of cling peach plantings. They argued that PPLT could be expected to be an increasing function of the level of net returns because as returns increase, not only do existing growers expand plantings, but new growers are attracted to the industry. Note that the statistical significance of $\partial PPLT/\partial RRD3$ is actually greater than suggested by the t-ratios of 0.62 and 1.33 because of the intercorrelation between RRD3 and $RRD3^2$. If RRD3 is deleted, the estimated relationship is:

$$PPLT = \underset{(6.39)}{.0131} + \underset{(6.99)}{.0000069}\, RRD3^2$$
$$R^2 = .70 \qquad DW = 1.76.$$

If $RRD3^2$ is deleted, the estimated relationship is:

$$PPLT = \underset{(2.98)}{.0079} + \underset{(6.64)}{.00052}\, RRD3$$
$$R^2 = .72 \qquad DW = 1.20.$$

In equation (1), the derivative of PPLT with respect to the three-year lagged average return, RRD3, is:

$$\partial PPLT/\partial RRD3 = .000171 + .0000094 \bullet RRD3.$$

Evaluating the derivative at the 1963-83 mean of RRD3, \$24.76, gives .0004037 (the elasticity is .48). (Note that RRD3 ranges between -\$28 and \$80; see Appendix Table A.4.) For a \$10 increase in the average net raisin grape return per short wet ton, planting as a proportion of total net acreage has increased about 0.04 percent. Or, to evaluate the derivative in terms of change in acres planted in response to changed average net returns, equation (1) must be multiplied through by total net acres (TNA):

$$PLANT = .01121 \bullet TNA + .000171 \bullet RRD3 \bullet TNA + .0000047 \bullet RRD3^2 \bullet TNA.$$

Then:

$$\partial PLANT/\partial RRD3 = .000171 \bullet TNA + .0000094 \bullet RRD3 \bullet TNA.$$

Using the 1963-83 mean value of TNA, 258,776 acres, a \$10 increase in average net raisin returns would mean an increase of a little more than 1040 acres planted.

Removal Equation Estimation Results

As in the case of plantings, returns to raisin grapes crushed and sold fresh and returns to alternative crops proved to be statistically nonsignificant predictors of removals. The removal function, estimated by OLS, expressed with removals in t-1 as a

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20. $RRD3 = (RNETD_{t-1} + RNETD_{t-2} + RNETD_{t-3})/3$, and

$$RNETD = \{[PFD \bullet (QPKG+QBLK) + (PGX/GNPD) \bullet QXT]/(QPKG+QBLK+QXT)\} \bullet (CF/4.5 \bullet 1.10231) - GCRD.$$

RRD3 is a three-year weighted average of lagged returns for domestic and export NTS shipments less grower costs, expressed in terms of deflated dollars per short, wet ton (RNETD). Gross returns per *dried* metric ton equals the deflated grower price for free tonnage (PFD) times packer domestic shipments to the packaged and bulk NTS markets (QPKG+QBLK) plus the deflated price growers receive for NTS to be exported (PGX/GNPD) times total export shipments (QXT), divided by total shipments (QPKG+QBLK+QXT). This gross return is converted from a dried metric ton, packed weight basis to a wet short ton basis by multiplying it by the factor that converts packed weight to sweatbox (dry) tons (CF) divided by the average drying ratio (4.5), multiplied by 1.10231 to convert metric to short tons. Gross returns per short wet ton less deflated grower cost per short wet ton for producing raisins (GCRD) gives the deflated net returns variable (RNETD).

Note that RNETD is based on tonnage sold by packers rather than that purchased by packers from growers; thus it is an approximation of growers' returns.

proportion of bearing acreage in t–1 is:[21]

$$\text{(2)}\quad PRMVL_t = .0186 - .000176\ RRD2. \quad \underset{(7.92)}{} \quad \underset{(-2.35)}{}$$

(7.92) (-2.35)

$R^2 = .25$ $DW = 1.54$

where $PRMVL=RMVL_{t-1}/BA_{t-1}$ and RRD2 is a two year average of grower deflated net returns ($RRD2 = (RNETD_{t-1} + RNET_{t-2})/2$. As noted in the theoretical discussion, the time horizon for expected returns relating to removals seems likely to be shorter than for plantings. A two-year average of net returns, rather than a three-year average as in the plantings equation, proved to be a better predictor of removals.

Although the coefficient for RRD2 is clearly statistically significant (the t-statistic=-2.35), the equation explains only a small proportion of the variance in removals, suggesting that removals are mainly determined by noneconomic factors such as disease, weather or reduced productivity due to aging.

The derivative of PRMVL with respect to the two-year lagged average returns is:

$$\partial PRMVL/\partial RRD2=-.000176.$$

(At the means of the variables, the elasticity is .30.) A \$10 decrease in the average net return, RRD2, would increase removals somewhat, resulting in a increased percentage of bearing acreage removed of 0.18 percent. Multiplying through by bearing acreage, BA, at its mean value, 248,001 acres, translates to a 436-acre increase in acres removed.

Bearing Acreage and Raisin Grape Production

Recall that bearing acres in year t was defined in Section 3 as:

$$BA_t=BA_{t-1}+a\bullet PLANT_{t-3}-RMVL_t$$

where BA is bearing acreage, PLANT is acreage planted in t-3 that is beginning to bear in t, and RMVL is acreage removed after harvest in t–1 (reported in t). During the interim between t-3 when planted and t when the acre begins to bear there is some proportion of plantings that is removed because of, for example, diseased plants or changed plans. Data are not available for removals of young acreage, but it seems likely that the amount is very small. Therefore, the proportion a is assumed equal to 1, as an approximation. Raisin grape production then is determined by:

$$QRG_t=BA_t\bullet YIELD_t$$

where raisin grape YIELD is considered exogenous to the model.

II. Growers' Allocation Between Drying and Selling for Crush

(An explanation of variables used and data sources is given in Appendix B.)

The allocation of raisin grapes not sold for fresh or canning use (Q) between drying and crushing is determined by equations (3) and (4) in Table 1.

In equation (3), the quantity allocated to dry, QR, was specified as a function of Q; the expected NTS returns based on past returns (RR"); the lagged quantity dried, QR_{t-1}; and the *current* net deflated crush return, RC. A three-year average of net grower returns to NTS was the best predictor of QR, so RR"=RRD3, the same variable that was used in the plantings equation (1).

In the empirical analysis equations (3) and (4) can be expressed linearly as follows:

21. RMVL is defined as acreage removed after harvest in t-1; Equation (2) was fitted to 1963-83 data. Alternatively, RMV_t could have been defined as removals in t, and the equation fitted for 1962-82 with RRD1 as the explanatory variable, where $RRD1=(RNETD_t+RNETD_{t-1})/2$.

$$(3.1)\ QR_t = b_{10} + b_{11} Q_t + b_{12} RRD3_t + b_{13} CRDNET_t + b_{14} QR_{t-1} + \varepsilon 1_t;$$

$$(4.1)\ CRD_t = b_{20} + b_{21} QC_t + b_{22} Z_t + \varepsilon 2_t;$$

and

$$(4.2)\ CRDNET_t = CRD_t - GCWGD_t.$$

CRDNET is the deflated net return for raisin grapes crushed, CRD is the deflated price for raisin grapes crushed, and GCWGD is the deflated cost of wine grape production in the San Joaquin Valley, used here as a proxy for costs of producing raisin grapes for crush, and the ε_{it} are unexplained disturbance terms. CRDNET and CRD replace RC in equations (3) and (4), respectively. These values are deflated, accounting for the general price level variable, GPL, used in (3) and (4) in Table 1. Z accounts for factors in the wine market affecting the price of raisin grapes crushed. Along with the identity, QC = Q - QR, equations (3.1), (4.1), and (4.2) form a simultaneous system where QR, QC, CRD, and CRDNET are the endogenous variables.

The variable Z encompasses a number of factors that are difficult to measure or to account for without including additional equations pertaining to the wine industry. Since these factors are not of direct interest in this study, other than to account for their aggregate effects on the price of raisin grapes crushed, equation (4.1) was not estimated directly. An estimate of b_{21} was obtained from an econometric study of the wine industry by Wohlgenant (1985).[22] With the value of b_{21} = -.000045 inserted, (4.1) can be rewritten in first differences (to eliminate b_{20}) as:

$$(4)\ CRD_t = CRD_{t-1} - .000045\ \Delta QC_t + b_{22} \Delta Z_t + \Delta \varepsilon 2_t.$$

Since the variable Z (and therefore ΔZ) could not be measured, $b_{22}\Delta Z$ becomes part of the unexplained disturbances of the model. In simulation projections with the model, ΔZ is set to zero. For purposes of historical tracking simulations, we define a variable, WINE where

$$WINE_t = \Delta\ CRD_t + .000045\ \Delta\ QC_t = b_{22}\ \Delta\ Z_t + \Delta\ \varepsilon 2_t.$$

The historically observed values of WINE are treated as (known) exogenous variables in all historical simulations. In one-period-ahead predictions, the values of CRD are therefore predicted without error. However, this is not necessarily the case with dynamic simulations where sequentially predicted values of the equation's endogenous variables are used.

Without some measure of the relationship between the crush return (CRD) and the quantity crushed (QC), the model could allocate increasing amounts of raisin grapes to crush without affecting the price. The procedure allows the model to be used, even though the entire wine market is not modeled in this research effort.

The parameters of (3.1) were estimated by an instrumental variable procedure where the instruments are the predetermined variables in (3.1), (4.1), and (4.2), excluding Z— Q_t, $RRD3_t$, QC_{t-1}, QR_{t-1}, $GCWGD_t$, CRD_{t-1} and a constant. The estimation results are:

22. As part of Wohlgenant's system estimated by three- stage least squares, the deflated price of California raisin-type grapes was fitted for 1950- 83 as a linear function of: quantities of raisin–, wine-, and table-type grapes to crush; sales of California-produced wine in t-1; June 30 inventories of California wine in t-1; and a trend. The slope coefficient associated with the quantity of raisin-type grapes was -.045 where quantity was in 1000 short tons.

$$(3)\ QR_t = -449{,}438.8 + 0.6073\ Q_t + 2{,}178.9\ RRD3 - 4{,}791.4\ CRDNET_t + 0.2623\ QR_{t-1}.$$
$$\qquad (-1.60) \quad (4.95) \quad (1.81) \quad (-1.99) \quad (2.06)$$

$R^2 = .89$ Durbin h = .638.[23]

The coefficients of equation (3) indicate that for a $1 increase in the average raisin return, RRD3, *ceteris paribus*, 2179 more tons of grapes would be dried (and 2179 fewer crushed). And if the crush offer increased by $1 per ton, 4791 more tons would be crushed (and 4791 fewer would be dried).

The Proportion of Raisin Grapes Dried that is NTS

The quantity of raisin grapes allocated to be dried in t, QR, becomes the quantity of NTS delivered to packers' doors (DEL) by applying the historic drying ratio, DR, and the historic proportion dried that is NTS, Π. DEL is converted to packed-weight metric tons by applying: (1) the short-to-metric ton factor of 1.10231; and (2) the factor (CF) to convert from a sweatbox ton to a packed weight basis:

$$DEL_t = \Pi_t \bullet (QR_t / DR_t) \bullet (CF_t / 1.10231).$$

III. Allocation of NTS between Free and Reserve Pool Tonnage, the Free Tonnage Price, and Free and Reserve Stocks

(An explanation of variables used and data sources is given in Appendix C.)

Free Tonnage and Free Tonnage Price

Free tonnage, equation (5) in Table 1, was specified as a function of free tonnage shipments and f.o.b. prices of the recent past, various supply factors, and the shift variable, X, representing RAC's policy change in 1977 and after to consider all exports as free tonnage. Besides the initial free tonnage set by the RAC, packers bid for additional free tonnage as the marketing year progresses. For this they must pay the free tonnage price plus interest and storage. Thus, the dependent variable, QFR, is defined to include not only the RAC's initially declared free tonnage, but also the additional purchases packers make during year t for free tonnage uses.

Shipments and f.o.b. prices in t-1 were used as explanatory variables in (5), that is, FSHIP in Table 1 becomes:

$$FSHIP_{t-1} = (QPKG + QBLK)_{t-1}$$

where QPKG and QBLK are packaged and bulk NTS domestic market shipments, respectively; and PFOB and GPL in Table 1 are replaced by PD, an average of the deflated NTS packaged price (PPD) and bulk price (PBD) in dollars per metric ton, weighted by their respective shipments:

$$PD_{t-1} = (PPD \bullet QPKG + PBD \bullet QBLK) / QPKG + QBLK)_{t-1}.$$

As noted previously, the shift variable, X, is defined as:

$$X = 0,\ 1963\text{-}76;\ X = (QX + QROW)_{t-1},\ 1977\text{-}83$$

where QX is the sum of exports to major importing countries being modeled, i.e., the United Kingdom, West Germany, the Netherlands-Belgium, Scandinavia, and Japan; QROW is exports to the rest of the world.

The dependent variable in equation (6) is defined as a weighted average of the initial, bargained-for field price and prices paid for additional reserve tonnage purchased for free use during the marketing year. The result is converted to deflated dollars per packed-weight metric ton (PFD).

23. The Durbin h test is stictly valid for large samples; our sample is 21 observations. However, in a large sample, say n>30, h is tested as a standard normal deviate; thus if h>1.645, reject the null hypothesis of zero autocorrelation, at the 5 percent level; see Johnston, 1984, p. 318.

The free tonnage price was specified as a function of lagged f.o.b. prices and processing costs; QFR; other supply, SUPPLY-QFR; and the shift variable, X. Empirically, a net price variable was specified in deflated dollars to replace $PFOB_{t-1}$ and PC_{t-1} in (6):

$$PNETD=((PPD-PCD)\bullet QPKG+(PBD-PCBD)\bullet QBLK)/(QPKG+QBLK)$$

where QPKG and PPD are NTS packaged domestic shipments and f.o.b. prices, QBLK and PBD are bulk shipments and prices, and PCD and PBCD are the respective processing costs for packaged and bulk pack NTS.

The free tonnage quantity, QFR, and other supply, SUPPLY-QFR, were put in per capita terms by dividing by the U.S. plus Canadian populations.

QFR enters recursively in the free tonnage price equation (6), but because of the likely contemporaneous correlation of the error terms, equations (5) and (6) were estimated as a block by seemingly unrelated regression (SUR); results are presented below.

Free tonnage:

$$(5)\quad \underset{(-0.76)}{QFR_t=-34{,}531.3} \underset{(2.98)}{+39.84\,PD_{t-1}} + \underset{(2.02)}{0.78(QPKG+QBLK)_{t-1}} - \underset{(-4.05)}{1.92BGSTK_t} \underset{(6.38)}{+0.40(DEL+CI)_t} \underset{(3.89)}{+1.59\,X}$$

$R^2 = .85$ DW= 2.02.

Free tonnage price:

$$(6)\quad PFD_t=\underset{(7.77)}{890.52}\underset{(4.15)}{+0.43PNETD_{t-1}} - \underset{(-4.94)}{1.00(QFR/POP)_t} - \underset{(-1.40)}{0.19[(SUPPLY-QFR)/POP]_t} \underset{(4.67)}{+\ .0064\,X.}$$

$R^2 = .79$ DW = 2.07.

A \$10 increase in past f.o.b. prices has encouraged the RAC to boost the free tonnage allocation by almost 400 metric tons, while a 100 metric ton increase in past shipments has been associated with a 78 ton increase, according to the results in equation (5). As expected, beginning free tonnage stocks work against a high allocation; in fact, for every additional ton held by packers, the free tonnage allocation would be cut by almost two. But an additional ton delivered or carried over in the reserve pool would lead to an increased free tonnage allocation of 0.4 ton. The X variable captures the fact that with the RAC policy change, more free tonnage was needed to meet export demand.

A \$10 increase in lagged packers' net prices has been associated with a \$4.30 increase in the bargained-for free tonnage price. The amount of free tonnage (in per capita terms) is an important negative influence on its price, while additions to other supply, softens the price. Again the sign on the shift variable is as expected; the policy change reflected positive market conditions, and better field prices resulted.

Stocks

Packers' Beginning Stock Prediction

(An explanation of variables used and data sources is given in Appendix D.)

Recall that reported beginning stocks (BGSTK) are inconsistent with stocks calculated according to the stock change identity. Instead, BGSTK was estimated as a linear function of the same variables that would be found in the identity: free supply, i.e., free tonnage purchased (QFR) and BGSTK, in t-1; and free tonnage shipments in t-1. Total free tonnage marketings, QMF, however, include not only shipments to the domestic packaged and bulk markets but also free tonnage exports (QXF):

$$QMF_{t-1}=(QPKG+QBLK+QXF)_{t-1} \text{ or } (FSHIP+QXF)_{t-1}$$

Equation (7) was estimated by OLS:

$$(7)\quad BGSTK_t = \underset{(-1.32)}{-8{,}487.07} + \underset{(8.87)}{0.69}\, QFR_{t-1} +$$

$$\underset{(9.21)}{0.71}\, BGSTK_{t-1} - \underset{(-4.73)}{0.58}\, QMF_{t-1}.$$

$R^2 = .95$ Durbin h = 1.09.[24]

Growers' Carryin Reserve

Unlike packers' beginning stocks, RAC's accounting does balance and so that identity specified in Table 1 may be used in the model.

IV. Domestic and Foreign Demand for NTS and Pricing Decisions

(An explanation of variables used and data sources is given in Appendixes E and F.)

This large block of the model consists of packers' price-establishment behavior, equations (8) and (9), domestic demand, equations (10) and (11), the export sector, equations (12) through (18), and a number of identities.and technical relationships. Thus, the demand and pricing system includes both the domestic marketing sector and the export sector. Theoretically these two blocks should be considered as a simultaneous system; however, the number of predetermined and exogenous variables (47) exceeds the number of observations (21).

One procedure for handling the undersized sample problem, suggested by Theil (section 10.8), is to divide the system into subblocks. By treating the (undeflated) bulk price (PB, equation (10)) as predetermined with respect to the export component—PB is dominantly influenced by variables within the domestic block—the system separates into two parts: (1) a simultaneous set of domestic demand and pricing equations, estimated by three-stage least squares, and (2) a set of foreign demand functions, estimated by SUR to account for possible contemporaneous correlation of the disturbance terms.

Packer Price Establishment Behavior and Domestic Demand

Section 3 suggested that packers establish their f.o.b. prices for packaged NTS (PPD) and bulk pack (PBD) to cover their costs and return them a margin, with the anticipated target margin varying according to the supply and demand situation in year t. Raisin costs (PFD) and nonfruit processing costs were added together, i.e., (PFD+PCD) in the packaged price-setting equation (8) and (PFD+PCBD) in the bulk price-setting equation (9). Supply and demand factors specified for equations (8) and (9) were expressed as ratios. The ratio of packaged NTS shipments to total supply was entered in equation (8) and the ratio of bulk NTS shipments to supply in equation (9):

QPS=QPKG/SUPPLY;
QBS=QBLK/SUPPLY.

The deflated f.o.b. prices in the domestic demand equations are PPD and PBD, for the packaged and bulk NTS markets, respectively.

Substitutes for packaged raisins include various types of snack food and other dried fruits. A price index for cookies and crackers seemed an appropriate measure for a snack-food raisin substitute (PSUBD). In the bulk demand equation the price index for cereal and bakery products was selected as a shift variable though the anticipated sign for its coefficient is not unambiguous. The index contains 12 product types only some of which use raisins. But the sweet yeast goods, cookie, and cereal components may serve as a proxy for a complement price in the bulk f.o.b. demand equation (PCOMPD). Only one index was used in each equation: PSUBD in the packaged NTS demand (10) and PCOMPD in bulk demand (11).

24. The Durbin h test is only valid for large samples; i.e., > 30 (see footnote 23 and Johnston, p.318).

Because domestic shipments are also to Canada,[25] QPKG and QBLK in equations (10) and (11) were specified in per capita terms dividing by the U.S. plus the Canadian populations (POP) yielding NTS in grams per capita (QCPKG and QCBLK). Deflated U.S. per capita personal expenditures was used as representative of income for both countries (ECUD).

Equations (8), (9), (10) and (11) were estimated as a simultaneous system by three stage least squares:

Domestic f.o.b. price for NTS packaged shipments:

$$(8) \quad PPD_t = \underset{(5.11)}{-458.29} + \underset{(21.06)}{1.33}\,(PCD+PFD)_t + \underset{(3.99)}{1{,}148.32}\,QPS_t$$

$R^2 = .96 \quad DW = 1.60.$

Domestic per capita demand for packaged NTS:

$$(9) \quad QCPKG_t = \underset{(3.05)}{102.93} - \underset{(-6.31)}{0.077}\,PPD_t + \underset{(5.17)}{1.61}\,PSUBD_t - \underset{(-0.42)}{0.0047}\,ECUD_t$$

$R^2 = .72 \quad DW = 2.88.$

Domestic f.o.b. price for NTS bulk shipments:

$$(10) \quad PBD_t = \underset{(-7.51)}{-607.10} + \underset{(20.19)}{1.12}\,(PCBD+PFD)_t + \underset{(6.17)}{1{,}620.33}\,QBS_t$$

$R^2 = .96 \quad DW = 2.25.$

Domestic per capita demand for bulk NTS:

$$(11) \quad QCBLK_t = \underset{(3.78)}{289.57} - \underset{(-4.32)}{0.73}\,PBD_t - \underset{(-1.00)}{0.53}\,PCOMPD_t + \underset{(1.92)}{0.024}\,ECUD_t$$

$R^2 = .50 \quad DW = 1.29.$

The Durbin-Watson values are in the inconclusive range at the 5 percent level of significance except for equation (10) where the null hypothesis of no autocorrelation is not rejected.

In the price setting equations, the strongly significant coefficients on the cost variables indicate how much packers may increase prices with cost increases. For a $1 per ton increase in costs, packers have raised PPD $1.33; PBD, $1.16.[26] The coefficient values above 1.0 may indicate that our somewhat crude measure of processing costs may not include all factors involved in processor decisions. (See details on PCD and PCBD in Appendix E.)

While the ratio variables, QPS and QBS, are unitless, their coefficients may be interpreted by taking the partial derivatives first with respect to shipments and then with respect to supply and evaluating the result at the means of the variables:

$$\partial PPD/\partial QPKG = 1{,}148/SUPPLY = .0054;$$

$$\partial PBD/\partial QBLK = 1{,}620/SUPPLY = .0076;$$

$$\partial PPD/\partial SUPPLY = -1{,}148 \bullet (QPKG)/(SUPPLY)^2 = -.0014;$$

$$\partial PBD/\partial SUPPLY = -1{,}620 \bullet (QBLK)/(SUPPLY)^2 = -.0021.$$

Evaluating the derivatives at the 1963-83 means of the variables—SUPPLY, 212,857

25. U.S. raisins are duty free in Canada.

26. Both coefficients are statistically different from 1 by the t-test: (1.33-1)/.06 =5.5 and (1.12-1)/.06 =2.0 where the .06s are their respective standard errors.

metric tons; QPKG, 54,362 metric tons; and QBLK, 58,563 metric tons—means that, *ceteris paribus*, if shipments should increase by 100 metric tons relative to supply, packers would set PPD about 54 cents higher and PBD about 76 cents higher, per metric ton. But if supply should increase 100 metric tons relative to shipments, packers would lower the packaged price about 14 cents and the bulk price about 21 cents per metric ton.

Both demand equations have strong inverse price relationships. As either PPD or PBD increase $100 per metric ton, per capita sales would decrease about 7 grams in the respective outlets. Multiplying this per capita quantity by the U.S. and Canadian populations, 260 million in 1983, implies a decrease of more than 1800 metric tons in the packaged and bulk outlets, respectively. Demand in both markets is inelastic, figured at the 1983 values of the variables:

$$(\partial QCPKG/\partial PPD) \bullet PPD/QCPKG = -.077 \bullet 1028/231 = -.34;$$

$$(\partial QCBLK/\partial PBD) \bullet PBD/QCBLK = -.073 \bullet 794/275 = -.21.$$

The elasticities figured at the means of the variables are -.33 and -.24, respectively. The 1963 elasticities (using the predicted values of QCPKG and QCBLK) are -.18 and -.15, respectively; for 1983, -.32 and -.24, respectively.

The Export Sector

The export sector includes stochastic equations to predict the average return received by growers for NTS exports (PGX), equation (12); the share of total exports that comes from the reserve pool in years when exports are not all free tonnage (s), equation (13); and demand equations for U.S. NTS in major importing countries, equations (14) through (18). Equation (12) for PGX was estimated together with the demand equations by SUR; results are reported below. Equation (13) pertains only to non-EIP years when a large share of exports came from the reserve pool, i.e., 1963-71 and 1974-76. The OLS estimate of the equation is:

$$(13)^{27}\ s = \underset{(4.82)}{.44669} + \underset{(5.05)}{.9357}\,QXT - \underset{(-6.34)}{.2097}\,D$$

DW (adjusted for gaps) = 1.27
$R^2 = .89$.

U.S. NTS Prices Landed in Importing Countries

Recall that PX was defined as the RAC target price (PGX) plus the packer-grower margin for bulk pack NTS (PB - PF) and that freight-insurance-duty for shipping raisins to London is FID. Thus the U.S. NTS price in London in U.S. dollars is: PX+FID. The UK-US exchange rate (ERUKU) was applied to PXUK to convert from dollars to pounds and the result was deflated by the U.K. consumer price index (CPIUK), yielding the landed, duty-paid, deflated price of U.S. NTS in British pounds:

$$PUUKD=((PX+FID) \bullet ERUKU)/CPIUK.$$

To get the U.S. NTS price in other European importing countries, the U.K. duty (DUK) was removed from FID in the identity above, the difference in transportation between US-UK and the United States and country I was added (TUK(I)), country I's duty (D(I)) (where D(I) is expressed as the ad valorem duty in percent plus 1) and the country I-to-U.S. exchange rate (ER(I)U) was applied; the result was deflated by the CPI in country I. The resulting prices are in deflated marks for West Germany, in deflated guilders for the Netherlands, and in deflated kronor for Sweden:

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27. D=1 in 1963 and 1974 because $s_{t-1}=0$; D=0 otherwise. The Durbin lower value for n = 15, and two explanatory variables is 0.95 at the 95 percent confidence level; here n = 12, so the test is in the inconclusive range.

PUWGD=((PX+FID/DUK+TUKWG)•
DWG•ERWGU)/CPIWG;

PUND=((PX+FID/DUK+TUKN)•
DN•ERNU)/CPIN;

PUSD=((PX+FID/DUK+TUKS)•
ERSU)/CPIS.

For the U.S. NTS price in Japan, transportation U.S.-to-Japan (TUJ) was added to PX, and the duty (DJ), exchange rate (ERJU), and the CPI for Japan were applied:

PUJD=((PX+TUJ)•DJ•ERJU)/CPIJ.

Substitute Prices

The Federal-State Market News Service (MNS) price for Greek raisins landed in London was used as the base price of a NTS substitute in equations (13) through (16). PGR in U.S. nominal dollars was converted to deflated British pounds by applying the UK duty on raisins for appropriate years (since 1974, Greek raisins have entered the United Kingdom duty free), the US-UK exchange rate, and CPIUK.

For the prices of Greek raisins landed in other European countries, the U.K. duty was removed (when appropriate) from the MNS reported dollar price, the difference in transportation was added (TUK(I)), and country I's duty, exchange rate, and CPI were applied, yielding PGWGD in deflated marks, PGND in deflated guilders, and PGSD in deflated kronor. The deflated Australian price in Japanese yen was used as a substitute for California NTS in the Japanese import demand equation (PAJD). As noted in Section 3, these substitute prices will be treated as exogenous, recognizing that they really are not. For more details about the construction of these prices see Appendix F.

Per capita personal consumption expenditures in representative country I's currency were deflated by the CPI in I, yielding EC(I)D.

Estimation Results

The econometric results of the SUR estimation of equations (12) and (14) through (18) are:

Growers' price for NTS exports:

(12) $PGX=196.3+1.01\ PGR_t -$
(1.29) (15.4)

$0.29\ (SUPPLY/POP)_t$
(-2.29)

$R^2 = .92$ DW=2.13.

United Kingdom:

(14) $QCUK_t=525.56-0.318\ PUUKD_t+$
(7.22) (-3.11)

$0.196\ PGUKD_t-0.655\ ECUKD_t$
(1.03) (-5.30)

$R^2 = .54$ DW=2.04.

West Germany:

(15) $QCWG_t=13.70-0.0168\ PUWGD_t+$
(0.78) (-3.31)

$0.0153\ PGWGD_t+0069\ ECWGD_t$
(1.66) (3.57)

$R^2 = .59$ DW=1.87.

Netherlands-Belgium:

(16) $QCNB_t=13.06-0.0336\ PUND_t+$
(0.65) (-4.58)

$0.0204\ PGND_t+0.0166\ ECND_t$
(1.65) (6.01)

$R^2 = .74$ DW=1.83.

Scandinavia:

(17) $QCNSD_t=815.99-0.0786\ PUSD_t+$
(6.38) (-3.58)

$0.085\ PGSD_t-0.0291\ ECSD_t$
(2.34) (-2.46)

$R^2 = .67$ DW=2.48.

Japan:

$$(18)\ QCJ_t = 252.52 - 0.00058\ PUJD_t + 0.00024\ PAJD_t - 0.00010\ ECJD_t$$
$$\quad\ (6.22)\qquad (-6.86)\qquad\qquad (1.66)\qquad\qquad (-1.64)$$

$$R^2 = .67 \qquad DW = 1.96.$$

All Durbin Watson values either do not reject the hypothesis of no first-order autoregressive errors at the 5 percent level, or are in the inconclusive range (equation 17).

The PGX equation indicates that the RAC almost matches the movements in the Greek price one-for-one in targeting the average price growers receive for NTS exports during the marketing year. But as per capita supply increases, the price decreases slightly.

All five demand equations have strong inverse own-price relationships. Figured at the 1963-83 means of the variables, the price elasticities of demand are -.75, for the United Kingdom; -.82, for West Germany; -.1.1 for the Netherlands-Belgium; -.58 for Scandinavia; and -.80 for Japan. Because of the linear specification, the elasticity estimates vary each year with the variation in prices and quantities.

The signs of the coefficients on income, as expected, are mixed. Those associated with EC(I)D are negative in the United Kingdom, Scandinavia, and Japan equations. This result indicates that as incomes rise more fresh fruits may be replacing raisins in the diet. On the other hand, in the West Germany and Netherlands-Belgium equations, the income coefficients are strongly positive, suggesting a positive association between income and bakery products using raisins, such as sweet rolls and cookies.

The coefficients on the substitute prices are all of the correct sign, though some are not statistically significant, probably due to collinearity with the U.S. price.

Econometric Predictions for 1984 and 1985 using Equations (1)-(3), (5)–(12), and (14)-(18)

Given the overall favorable statistical results, it appears that the econometric model is an acceptable representation of the structure of the California raisin industry. The estimated behavioral equations may be used to make conditional short-run predictions. For example, if past prices and shipments are known and current supply in terms of deliveries and stocks are known, then the RAC's determination of the free tonnage quantity may be predicted with equation (6).

Once an econometric model has been estimated for a certain time period, it is of some interest to update the data and see how well the equations predict later values of the endogenous variables. This exercise is not to check on the validity of the historic model, for this was established in the original statistical tests on the model. Rather, it is a way to see if there have been structural changes in parts of the industry since the econometric estimates were made.

Exogenous variables were updated through 1985 and the equations were used to predict the endogenous variables for 1984 and 1985 (except for equations: (1) plantings, for which the adjusted plantings data are not yet available (see Appendix A); (2) removals, which had low explanatory power; (4) the crush return, which was not estimated; and (13) the share of total exports from the reserve, which was only estimated for part of the period). Salkever's (1976)[28]

28. By Salkever's (1976) method, a zero-one dummy variable is entered for each year being forecasted and the equation rerun. The coefficients will be identical to those for the original time series. The standard error of the coefficient on the dummy variable is the standard error of the forecast for the dependent variable for each respective year. Note that Salkever's method applies basically to OLS. When applied to 3SLS, the forecast errors are for the structural equations and the standard errors of forecast reported are approximations.

method was used to compute the standard error of forecast for each structural equation for 1984 and for 1985. Predicted and actual values for 16 endogenous variables for 1984 and 1985, the deviations between the predicted and actual values, and their respective SE_f are reported in Table 2. These are not forecasts of the reduced forms, but they are useful in looking for evidence of structural change that may have taken place since the econometric estimation period, 1963-83.

Most predicted values are well within two SE_f of the actual values in 1984 and 1985. Exceptions include packers' reported beginning stocks (BGSTK) which was overpredicted in 1984, but very close to actual in 1985; and several of the per captita demand predictions. The domestic bulk quantity (QCBLK), the quantity demanded in the United Kingdom (QCUK), and that in West Germany were underpredicted both years, and the per capita quantity demanded in Norway-Sweden-Denmark (QCNSD) was underpredicted in 1985. These underpredictions of demand suggest the possibility of a structural change in the mid-1980s. An explanation of what may lie behind these underpredictions follows.

On the domestic market, with sharply lower NTS prices in 1984, bakers and cereal manufacturers increased their use of NTS in many products. Cereal manufacturers began to advertise their increased use of raisins. Evidently, the percentage increase in use exceeded the percentage decrease in price, as their advertising and increased use led to further increases in raisin use in the highly competitive cereal industry.

In the United Kingdom, NTS shipments increased dramatically in the mid-1980s: In 1982, only 2,207 metric tons were imported; by 1983, imports were up to 4,578, due partly to the EIP; but in 1984, 6,776 metric tons were shipped and in 1985, 10,969 tons. The increase continued, for in 1986, 14,175 metric tons were shipped to the United Kingdom. (See Appendix Table F.1.) There are a number of explanations for this dramatic reversal of what had been a steadily declining trend in U.K. NTS imports:

- The dollar weakened substantially against many major currencies.[29] However, the exchange rate change is accounted for in equation (14).
- The minimum import price (MIP) of the EEC effectively kept low-cost Turkish raisins (another important substitute) off the EEC market in some years. In 1986 the MIP was considered a "great opportunity for California raisins." (Federal-State Market News Service, MNS, May 30, 1986).
- Both the Greek and Turkish crops were below normal and of poor quality in 1984, increasing EEC demand for U.S. raisins. The 1985 crops were adequate but left small year-end stocks (MNS, Jan. 17, 1986). Incidently, in 1986, the Greek and Turkish crops were down again and the quality was poor (MNS, Dec. 12, 1986).
- There were considerable funds expended in overseas promotion from the U.S. Department of Agriculture, the California Department of Food and Agriculture, and the state marketing order board, the Raisin Advisory Board. Part of the USDA funds were from the Target Export Assistance for special promotion activities as provided in the 1985 farm bill. "U.S. raisin exports to the United Kingdom have risen dramatically over the past three years,

29. The U.K.-U.S. exchange rate fell from .811 in 1984 to .683 in 1985. This would have made U.S. raisins cheaper in the United Kingdom; accordingly the EIP blend percentage was relaxed from about .37 in 1984 to about .26 in 1985 on a crop-year average, allowing the effective export price to increase. The annual average of the MNS weekly price quotes of NTS landed in the United Kingdom was about $1200 per metric ton in 1984 and $1400 in 1985, but the UK (nominal) price was about 973 pounds sterling in 1984 and 956 in 1985.

owing to an effective California Raisin Advisory Board advertising campaign and competitive pricing of the California product." (MNS, Dec. 5, 1985)

Many of these same factors explain the increases in West Germany and in Norway-Sweden-Denmark, i.e., the underpredictions of equations (15) and (17).

Table 2. Predicted and Actual Values of Endogenous Variables, Equations (3), (5)-(12), and (14)-(18); Deviations Between Predicted and Actual Values; and Standard Errors of Forecast (SE_f), 1984-1985.

Variable	Eq.#	Pred.	Act.	Dev.	Dev/Act	SE_f
1984:						
QR (1000)	(3)	1,642	1,390	252	.18	179
QFR	(5)	214,901	235,405	-20,504	.09	17,554
BGSTK	(6)	69,329	51,684	17,645	.34	5,589
PFD	(7)	471	383	88	.23	124
PPD	(8)	620	665	-45	.07	83
PBD	(9)	465	544	-79	.15	69
QCPKG	(10)	275	284	-9	.03	20
QCBLK	(11)	281	344	-63	.18	25
PGX	(12)	661	597	64	.11	149
QCUK	(14)	45	120	-75	.63	32
QCWG	(15)	61	111	-50	.45	11
QCNB	(16)	92	84	8	.10	14
QCNSD	(17)	398	464	-66	.14	78
QCJ	(18)	155	183	-28	.15	28
1985:						
QR (1000)	(3)	1,530	1,543	-13	.01	172
QFR	(5)	191,676	206,681	-15,005	.07	19,349
BGSTK	(6)	74,152	78,162	-4,010	.05	5,327
PFD	(7)	512	400	112	.31	130
PPD	(8)	602	687	-85	.12	84
PBD	(9)	497	560	-63	.11	68
QCPKG	(10)	279	264	15	.06	20
QCBLK	(11)	283	381	-98	.26	26
PGX	(12)	757	727	30	.04	153
QCUK	(14)	36	194	-157	.81	33
QCWG	(15)	64	105	-40	.38	11
QCNB	(16)	100	118	-18	.15	14
QCNSD	(17)	389	591	-202	.34	81
QCJ	(18)	166	182	-16	.09	28

5. THE COMPLETE DYNAMIC MODEL

Model Solution

To predict the full effect of any change in an exogenous variable or of an endogenous policy shift and to allow changes in one period to feed back and generate further changes in subsequent periods, the model needs to be solved as a dynamic system. The model, however, while linear in the parameters of each behavioral equation, is nonlinear in the variables, so it is not possible to develop a structural analysis of the complete system by mathematical solutions.[30] Instead a computer simulation procedure was used.

The complete model, with all equations and identities arranged in sequence for computer simulation, is presented in Table 3. For this purpose, the simultaneous equation blocks are replaced by their reduced form solutions as noted in the table. For example, the per capita packaged NTS quantity, QCPKG, is computed by first computing the packaged price, PPD from the reduced form equation, then sequentially entering this predicted price into the quantity-dependent demand equation.

An initial solution (for year t) is obtained by reading in the exogenous variables and the actual values of lagged endogenous variables as required. The equations in Table 3 sequentially generate predictions of all the current (year t) endogenous variables. The system then is advanced to t + 1 with the predicted endogenous variable for year t entering as lagged endogenous variable in t + 1 and so on up to t + k.

30. One procedure in such cases is to linearize the nonlinear equations by Taylor-series approximations around fixed values. However, this may involve considerable deviation from the original model.

Table 3. Solution Procedures for the California Raisin Industry Model Using Behavioral Equations (1) through (18), Linking Identities and Other Technical Relationships (i) through (xxiv), and Definitions of Variables.

- Read in all values of exogenous variables and the initial period values of lagged endogenous variables.
- Compute first period values of the endogenous variables in the following sequence:

Two-year moving average of growers' past net NTS returns, deflated dollars per wet short ton (st):

(i) $RRD2_t = (RNETD_{t-1} + RNETD_{t-2})/2.$

Proportion of bearing acreage removed after the previous year's harvest:

(2) $PRMV_{t-1} = .0186 - .000176\, RRD2_{t-1}.$

Raisin grape removals after the previous year's harvest, acres:

(ii) $RMVL_{t-1} = PRMV_{t-1} \bullet BA_{t-1}.$

Bearing raisin grape acreage change, acres:

(iii) $BA_t = BA_{t-1} + PLANT_{t-3} - RMVL_{t-1}.$

Three-year moving average of growers' past net NTS returns, deflated dollars per wet st:

(iv) $RRD3_t = (RNETD_{t-1} + RNETD_{t-2} + RNETD_{t-3})/3.$

Raisin grape plantings relative to total net acreage:

(1) $PPLT_t = .01121 + .00017\ RRD3_t + .0000047\ RRD3^2_t$.

Total net acreage, total acreage in t-1 minus removals, acres:

(v) $TNA_t = TA_{t-1} - RMVL_{t-1}$.

New raisin grape vine plantings, acres:

(vi) $PLANT_t = PPLT_t \bullet TNA_t$.

Total acreage, bearing and nonbearing, acres:

(vii) $TA_t = BA_t + PLANT_t + PLANT_{t-1} + PLANT_{t-2}$.

Raisin grape production, wet st:

(viii) $QRG_t = BA_t \bullet YIELD_t$.

Raisin grape production net of the quantity to the fresh and canned markets, wet st:

(ix) $Q_t = QRG_t - QF_t - QCAN_t$.

Quantity of raisin grapes allocated to be dried for raisins, wet st (reduced form equation):

(3) $QR_t = -364{,}300 + 0.677\ Q_t + 1792\ RRD3 + .216\ QR_{t-1} - 3942\ CRD_{t-1} - 177\ QC_{t-1} + 3942\ \ GCWGD_t$.

Quantity of raisin grapes allocated to the crush outlet, wet st:

(x) $QC_t = Q_t - QR_t$.

Crush return, deflated dollars per wet st:

(4) $CRD_t = -.000045\ (QC_t - QC_{t-1}) + CRD_{t-1} + WINE_t$.

Net crush return, deflated dollars per wet st:

(xi) $CRDNET_t = CRD_t - GCWGD_t$.

(Because (3) is in reduced form, identity (xi) is not used in the simulation runs; (xi) is included here for completeness; see part II of Section 4 which explains the econometric estimation of the allocation decision.)

NTS delivered to packers' doors, packed weight metric tons (pwmt):

(xii) $DEL_t = \Pi \bullet (QR/DR)_t \bullet (CF_t/1.10231)$.

Beginning free tonnage stocks in packers' hands, pwmt:

(6) $BGSTK_t = -8{,}487.07 + 0.69\ QFR_{t-1} + 0.71\ BGSTK_{t-1} - 0.58\ QMF_{t-1}$.

(Restriction: $BGSTK \geq 0$.)

Carryin reserve tonnage, owned by growers, administered by the RAC, pwmt:

(xiii) $CI_t = RES_{t-1} - s_{t-1} \bullet QXT_{t-1} - OTHER_{t-1}$.

(Restriction: $CI \geq 0$.)

The initial free tonnage quantity set by the RAC plus packer purchases from the reserve pool for free use, pwmt:

(5) $QFR_t = -34{,}531.36 + 39.84\ PD_{t-1} + 0.78\ (QPKG + QBLK)_{t-1} - 1.92\ BGSTK_t + 0.40\ (DEL + CI)_t + 1.59\ X.$

[Restriction: $QFR \leq (DEL + CI)$.]

Reserve supply remaining after packers' free tonnage purchases, pwmt:

(xiv) $RES_t = DEL_t + CI_t - QFR_t.$

Uses of the reserve pool other than sales to packers and exports, pwmt:

(xv) $OTHER_t = .10 \bullet RES_t.$

(Other uses include sales to the government for the school lunch and other programs or for PL-480 shipments, to wineries for alcohol manufacture, to feedlots for cattle feed; charity; and shrinkage. For 1963-83, other uses averaged 10 percent of RES.)

Total supply, pwmt:

(xvi) $SUPPLY_t = DEL_t + BGSTK_t + CI_t.$

The weighted average of the grower-packer bargained-for free tonnage price and the cost of subsequent packer purchases for free use, deflated dollars per pwmt:

(7) $PFD_t = 890.52 + 0.43\ PNETD_{t-1} - 1.00\ (QFR/POP)_t - 0.19\ [(SUPPLY - QFR)/POP]_t + .0064\ X.$

The f.o.b. price of packaged NTS, deflated dollars per metric ton (reduced form):

(8) $PPD_t = -458\ [SUPPLY/(SUPPLY+89\ POP)]_t + 1.327\ (PCD + PFD)_t \bullet [SUPPLY/(SUPPLY+89POP)]_t + [(118{,}197 + 1849\ PSUBD - 5.4\ ECUD) \bullet POP/(SUPPLY + 89\ POP)]_t.$

Per capita NTS packaged shipments to the United States and Canada, grams:

(10) $QCPKG_t = 102.93 - 0.077\ PPD_t + 1.61\ PSUBD_t - 0.0047\ ECUD_t.$

NTS packaged shipments to the United States and Canada, pwmt:

(xvii) $QPKG_t = QCPKG_t \bullet POP_t.$

The f.o.b. price of bulk NTS, deflated dollars per metric ton (reduced form):

(9) $PBD_t = -607\ [SUPPLY/(SUPPLY+118\ POP)]_t + 1.22\ (PCBD + PFD)_t \bullet [SUPPLY/(SUPPLY+118POP)]_t + [(469{,}199 - 865.6\ PCOMPD + 33.5\ ECUD) \bullet POP/(SUPPLY+118\ POP)]_t.$

Per capita NTS bulk shipments to the United States and Canada, grams:

(11) $QCBLK_t = 289.57 - 0.73\ PBD_t + 0.53\ PCOMPD_t + 0.024\ ECUD_t.$

NTS bulk shipments to the United States and Canada, pwmt:

(xviii) $QBLK_t = QCBLK_t \bullet POP_t.$

Weighted average price growers receive for NTS that are exported, nominal dollars per pwmt:

(12) $PGX_t = 196.25 + 1.007\ PGR_t - 0.291\ (SUPPLY/POP)_t.$

(Restrictions: For 1964-76 and 1981-85, if PGX>.86•PFD•GNPD, then set PGX=.86•PFD•GNPD, where .86 is the largest historic ratio of PGX/PF except when the ratio equals 1; and if CI<3000 and

DEL<100,000, then set PGX=PFD•GNPD.) Note that between 1977-80, equation (12) is replaced by: PGX=PFD•GNPD.

The computed f.o.b. export price for NTS, nominal dollars per pwmt:
(xix) $PX_t = PGX_t + [(PBD_t \bullet GNPD_t) - (PFD_t \bullet GNPD_t)$.

The price of U.S. NTS in the United Kingdom, deflated pounds per pwmt:
(xx) $PUUKD_t = [((PX+FID) \bullet ERUKU)/CPIUK]_t$.

The price of U.S. NTS in West Germany, deflated marks per pwmt:
(xxi) $PUWGD_t = [((PX+FID/DUK+TUKWG) \bullet DWG \bullet ERWGU)/CPIWG]_t$.

The price of U.S. NTS in the Netherlands, deflated guilders per pwmt:
(xxii) $PUND_t = [((PX+FID/DUK+TUKN) \bullet DN \bullet ERNU)/CPIN]_t$.

The price of U.S. NTS in Sweden, deflated kronor per pwmt:
(xxiii) $PUSD_t = [((PX+FID/DUK+TUKS) \bullet ERSU)/CPIS]_t$.

The price of U.S. NTS in Japan, deflated yen per pwmt:
(xxiv) $PUJD_t = [((PX+TUJ) \bullet DJ \bullet ERJU)/CPIJ]_t$.

Per capita NTS shipments to the United Kingdom, grams:
(14) $QCUK_t = 525.56 - 0.32\ PUUKD_t + 0.20\ PGUKD_t - 0.66\ ECUKD_t$.
(Restriction: $QCUK \geq 0$.)

Per capita NTS shipments to West Germany, grams:
(15) $QCWG_t = 13.70 - 0.017\ PUWGD_t + 0.0153\ PGWGD_t + .007\ ECWGD_t$.

Per capita NTS shipments to the Netherlands-Belgium, grams:
(16) $QCNB_t = 13.06 - 0.036\ PUND_t + 0.020\ PGND_t + 0.017\ ECND_t$.

Per capita NTS shipments to Norway-Sweden-Denmark, grams:
(17) $QCNSD_t = 816.0 - 0.079\ PUSD_t + 0.086\ PGSD_t - 0.029\ ECSD_t$.

Per capita NTS shipments to Japan, grams:
(18) $QCJ_t = 252.54 - 0.00058\ PUJD_t + 0.00024\ PAJD_t - 0.0001\ ECJD_t$.

Exports to major importing countries, pwmt:
(xxv) $QX_t = (QCUK \bullet POPUK + QCWG \bullet POPWG + QCNB \bullet POPNB + QCNSD \bullet POPNSD + QCJ \bullet POPJ)_t$.

Exports to the rest of the world, pwmt:
(xxvi) $QROW_t = .39 \bullet QX_t$.
(For 1963-83, QROW/QX was .39.)

Total NTS exports, pwmt:
(xxvii) $QXT_t = QX_t + QROW_t$.

A quasi-dummy variable to represent the RAC policy change with respect to exports in 1977 and after:

(xxviii) X=0, 1963-76; X= QXT_{t-1}, 1977-83.

The share of total exports that come from the reserve pool:

(13) $s = 0.4467 + .000009 \bullet QXT_t - 0.21 \bullet D_t$.

D=1 if $s_{t-1} \leq .1$; D=0, otherwise.

(Restrictions: For 1963-76, if QXT>40,000, use (13)—otherwise set s=0; and if s>0.96, set s=0.96.) For 1977-80, s=0.

During the EIP, the following identity replaces (13):

(13a) $s = (PGX_t - PFD_t \bullet GNPD_t)/(120 - PFD_t \bullet GNPD_t)$

where $120/pwmt is the cost of reserve pool NTS.

NTS reserve tonnage exports, pwmt:

(xxix) $QXR_t = s_t \bullet QXT_t$.

NTS free tonnage exports, pwmt:

(xxx) $QXF_t = QXT_t - QXR_t$.

Total NTS free tonnage marketings, pwmt:

(xxxi) $QMF_t = QPKG_t + QBLK_t + QXF_t$.

Growers' net NTS average returns:

(xxxii) $RNETD_t = \{[PFD_t(QPKG_t + QBLK_t) + (PGX_t/GNPD_t) \bullet QXT_t]/ [(QPKG_t + QBLK_t + QXT_t) \bullet (CF_t/4.5 \bullet 1.10231)]\} - GCRD_t$.

RNETD is calculated from packaged and bulk domestic sales at the deflated free tonnage price for NTS and from exports at the deflated price growers receive for NTS for exports, converted from a dollars per pwmt basis to dollars per wet st (4.5 is the average drying ratio and 1.10231 is the ratio of one metric to one short ton).

A weighted average of packaged and bulk NTS domestic f.o.b. prices, deflated dollars per pwmt:

(xxxiii) $PD_t = (PPD_t \bullet QPKG_t + PBD_t \bullet QBLK_t)/QPKG_t + QBLK_t)$.

PD net of the packaged and bulk processing costs, PCD and PCBD, respectively, deflated dollars per pwmt:

(xxxiv) $PNETD_t = ((PPD_t - PCD_t) \bullet QPKG_t + (PBD_t - PCBD_t) \bullet QBLK_t)/(QPKG_t + QBLK_t)$.

- Advance t one period. Repeat process with predicted values of endogenous variables in t–1 entering as appropriate in period t's equations.
- Continue for period desired.

Definitions of 47 Exogenous Variables:[31]

YIELD Raisin grape yield, short tons per acre.

31. Plus the four variables representing the Greek price landed in the United Kingdom, West Germany, the Netherlands, and Sweden, PGUKD, PGWGD, PGND, and PGSD, respectively. These variables are based on PGR; see Appendix F for a full explanation.

GCRD:	Growers' costs for raisin production, dollars per short wet ton.
CF:	Factor to convert sweatbox raisin tonnage to a packed weight basis, i.e., stemmer loss; CF is about 0.90 but varies from 0.89 to 0.94.
QF:	Quantity of raisin grapes allocated to the fresh market, short, wet tons.
QCAN:	Quantity of raisin grapes allocated to the canned outlet, short, wet tons.
GCWGD:	Growers' costs for wine grape production, dollars per short, wet ton.
WINE:	A proxy for factors affecting the wine market. (WINE is calculated as $\Delta CRD + .000045 \bullet \Delta QC$.)
Π:	Proportion of dried raisin grapes that is NTS.
DR:	Drying ratio, QR to dried QR. (The 1963-83 average is 4.4; Cooperative Extension cost sheets use 4.5.)
POP:	U.S. plus Canadian populations, millions.
GNPD:	The gross national product implicit price deflator, 1970-71=1.00 used as a deflator of U.S. prices, costs, and income.
PCD:	Nonfruit processor costs for packaged NTS, deflated dollars per metric ton.
PCBD:	Nonfruit processor costs for bulk NTS, deflated dollars per metric ton.
PSUBD:	Index (1966-67=100) of prices for cookies and crackers as an NTS substitute, deflated.
ECUD:	U.S. per capita personal consumption expenditures, deflated dollars.
PCOMPD:	Index (1966-67=100) of prices for cereal and bakery products as an NTS complement, deflated.
PGR:	The price of Greek raisins landed in London, nominal dollars per metric ton.
POP(I):	Population of importing country I, millions; I=UK, WG, NB, NSD, and J.
FID:	Freight-insurance-duty charged on raisins shipped from the United States to London, nominal dollars per metric ton.
ER(I)U:	The country I-to-U.S. exchange rate, I=UK, WG, N, S, and J.
CPI(I):	The consumer price index in importing country I, used as a price and income deflator, I=UK, WG, N, S, and J.
PG(I)D:	The price of Greek raisins landed in European importing country (I), in I's currency; deflated pounds, marks, guilders, and kronor, respectively for I=UK, WG, N, and S.
PAJD:	The price of Australian raisins landed in Japan, deflated yen per metric ton.
EC(I)D:	Per capita personal consumption expenditure in importing country I's currency, deflated pounds, marks, guilders, kronor, and yen, respectively, for UK, WG, N, S, and J.
T(I,J):	The difference in transportation costs of U.S. NTS between UK-WG, UK-N, and UK-S, nominal dollars per metric ton.
TUJ:	Transportation costs to ship U.S. raisins to Japan.
D(I):	Importing country I's duty on raisin imports, expressed as a percentage of value, divided by 100, plus 1; I=UK, WG, N, and J (raisins are duty free in Sweden).

Model Validation

The validity of the model as a representation of the raisin industry and a tool for policy analysis is determined by the appropriateness of the theoretical specifications, the equation forms selected and the statistical properties of the estimated equations. In this regard, the behavioral specifications appear logically sound and are supported by coefficient estimates that have signs consistent with the theoretical expectations, most coefficients are large relative to their standard errors and the specifications concerning structural disturbances are generally supported by the test statistics. We need also to be concerned about the model's behavior as a dynamic system—in particular how it tracks over the historical period, its stability properties, and how it predicts out of the sample.

Table 4 presents measures of the model's performance in predicting changes in key endogenous variables one period ahead. The predictions are for year t, given the values of the exogenous variables, the stocks carried in, and the known (t - 1 and before) values of the other endogenous variables. For the simultaneous components of the model, the predictions are from reduced form solutions of the structural equations. The mean absolute error (MAE) and the root mean square error (RMSE) are compared to the means and ranges of actual values of key endogenous variables.[32]

Table 4 also presents accuracy measures for the model's performance when only the exogenous variables and the initial values of lagged endogenous variables (1963 and earlier) are read in; the disturbances in each equation are set to zero. The predictions following the first year use predicted values of lagged endogenous variables rather than the actual values. The results of these dynamic deterministic predictions of the model over the period 1964-85 are compared with actual values.

This comparison of historical deterministic sequential predictions of dynamic models with actual values has been a common practice (Kost, 1980). The procedure, however, provides only a limited indication of the closeness of future projections. A historical fit can be close simply because of some exogenous factors such as, for example, trend. Further, the dynamic model residuals will be autocorrelated and heteroskedastic, even though the structural equations were not (see Howrey and Kelejian,1969; Hendry and Richard, 1982; and Peters and Freedman,1985). As a result, predictions may tend to remain above (or below) their historical values for extended periods and the differences may tend to widen. This problem is accentuated with nonlinear models such as this one. Therefore, as expected, the overall fit is less close than for the one-period ahead predictions in Table 4.

Because the disturbances are set to zero in this deterministic simulation, it is possible that *predicted* levels of shipments exceed supply, resulting in a negative prediction of stocks—packers' beginning free tonnage stocks (BGSTK) and/or growers' carryin reserve (CI). Therefore, BGSTK and CI were constrained to be greater than or equal to zero. In the historic run of the model (1964-85), the BGSTK and CI constraints were binding in years when actual stocks were very low or zero—during or just after short-crop years. Another constraint became binding in 1978: The predicted free tonnage quantity was set to never exceed available supplies—deliveries plus carryin reserve, i.e., $QFR \leq (DEL+CI)$.

32. The MAE is the mean of the absolute value of the differences between the actual and predicted values over the time series, and the RMSE is the square root of the mean of the squared differences between the predicted and actual values.

Table 4. Goodness-of-Fit Measures for Key Endogenous Variables for One-Period Ahead and Dynamic Simulation Predictions, 1964-83.

Variable	Symbol	Mean	Range	One-Period Ahead: MAE[a]	One-Period Ahead: MAE/mean	One-Period Ahead: RMSE[b]	One-Period Ahead: RMSE/mean	Dynamic Simulation: MAE[a]	Dynamic Simulation: MAE/mean	Dynamic Simulation: RMSE[b]	Dynamic Simulation: RMSE/mean
Plantings/total net acres	PPLT	0.0207	.004—.060	.0062	.30	0.007	.34	.0060	.29	0.007	.34
Removals/bearing $acres_{t-1}$	PRMVL	0.0149	0—.040	.0057	.38	0.007	.47	.0056	.38	0.007	.47
Bearing acreage, 1,000 acres	BA	252	237—296	.9	.004	1.5	.006	4.7	.02	5.5	.02
Allocation to dry, 1,000 short tons	QR	1,096	436—1,733	100	.09	121	.11	112	.10	141	.13
Packers' reported beginning stocks, mt	BGSTK	25,898	1,233—69,761	3,157	.12	3,892	.12	9,297	.36	12,591	.49
Free tonnage, 1,000 mt	QFR	135	62—201	13	.10	16	.12	15	.11	20	.15
Free tonnage price (field price), $/mt	PFD	634	357—1,228	91.8	.14	110	.17	83.3	.13	124	.20
Packaged f.o.b. price, $/mt	PPD	1,031	592—2,247	129.8	.13	156	.13	135.4	.13	178	.17
Per capita packaged quantity, grams	QCPKG	231	148—276	12.4	.05	16	.07	13.4	.06	17	.07
Bulk f.o.b. price, $/mt	PBD	827	462—1,962	142.2	.17	177	.21	128.7	.16	187	.23
Per capita bulk quantity, grams	QCBLK	248	176—289	17.4	.07	22	.09	21.7	.09	27	.11
Ave. grower price for exports, $/mt	PGX	706	222—1,928	93.9	.13	141	.20	93.5	.13	153	.22
Per capita sales:											
United Kingdom, grams	QCUK	104	10—196	24.4	.23	29	.28	27.7	.27	34	.33
West Germany, grams	QCWG	44	25—79	10.4	.24	13	.30	11.2	.25	14	.32
Netherlands-Belgium, grams	QCNB	63	29—107	16.2	.26	18	.29	15.2	.24	18	.29
Norway-Sweden-Denmark	QCNSD	422	138—568	57.0	.14	76	.18	70.9	.17	100	.24
Japan	QCJ	142	18—193	19.6	.14	29	.20	23.7	.17	40	.28
Share of reserve to total exports, 1964-71 and 1974-76	s	0.88	0.61—0.96	0.04	.05	0.05	.06	0.12	.14	0.24	.27

a. mean absolute error.

b. root-mean-square error.

Long-Run Equilibrium Values

A dynamic model should have the property that starting with some initial values of endogenous variables and fixed values of all exogenous variables, over time the endogenous variables should all approach stationary equilibruium values. To determine the stability of the model, the values of exogenous variables were set at their 1985 values and the model was run forward in time for 60 periods. Lagged endogenous variables were read in at their actual values for 1985 and earlier. Certain exogenous variables were read in at their historic means (1963-83) rather than their 1985 values: YIELD; DR, the drying ratio; and Π, the proportion of raisin grapes dried that is NTS. The WINE term in equation (4) which projects the crush return was set to zero. The approximated long-run stationary equilibrium values are reported in Table 5 together with the historic means of the variables (1963-85), reported simply to show that the projected values are "reasonable." The values are not forecasts.

Table 5. Base-Run Equilibrium Values (BREV) for Key Endogenous Variables and Their 1963-85 Mean Values.

Variable	Symbol	Mean	BREV
Plantings, acres	PLANT	5075	3876
Removals, acres	RMVL	4107	3876
Raisin grape production, short tons	QRG	2,133,339	2,095,338
Deliveries, metric tons (packed weight)	DEL	178,381	201,560
Quantity allocated to dry for raisins, short tons	QR	1,126,734	1,303,383
Packers' beginning stocks, metric tons	BGSTK	28,937	63,272
Free tonnage, metric tons	QFR	142,375	163,546
Free tonnage price, deflated $/metric ton	PFD	603	866
Packaged f.o.b. price, deflated $/metric ton	PPD	981	1,254
Per capita packaged quantity, grams	QCPKG	236	235
Bulk f.o.b. price, deflated $/metric ton	PBD	790	971
Per capita bulk quantity, grams	QCBLK	259	252
Price growers receive for exports, $/metric ton	PGX	702	863
Per capita sales, United Kingdom, grams	QCUK	111	36
Per capita sales, West Germany, grams	QCWG	50	65
Per capita sales, Netherlands-Belgium, grams	QCNB	66	100
Per capita sales,			

Deterministic versus Stochastic Simulation

Because of the nonlinear structure of the model, some of the error components are complex multiplicative rather than additive values. Howrey and Kelejian (1969) have suggested stochastic simulation as a means of accounting for such error processes. Stochastic simulation involves generating a set of disturbances for the coefficients and the equation errors from the estimated variance-covariances of the model and an assumed distribution form for each future period, and making repeated simulation runs—perhaps 50 to 100 replications. Model forecasts then would be obtained as means of the replication values, with error variances computed for each prediction (see Pindyck and Rubinfeld, 1981).

The choice of simulation procedure (stochastic vs. deterministic) is influenced to a considerable extent by the intended use of the model. If the emphasis is on forecasting, the stochastic simulation procedure may well be worth the added cost. Here, the interest is in comparing dynamic model predictions for alternative scenarios pertaining to market policies or to changes in values of single exogenous variables, with all other variables constant. It seems likely that the deterministic results will not differ greatly from the means of repeated comparisons when random disturbances are included. Hence, the simulation analysis here is based on the less costly deterministic solution procedure.

6. SIMULATION ANALYSIS

This section presents the results of several simulation experiments, using the model. These experiments evaluate the dynamic effects of RAC policies, such as the export incentive plan (EIP) initiated in 1981, and changes in important exogenous variables such as exchange rates, tariffs, foreign competition, population growth, and cost-reducing technology at the farm level. The procedure is first to establish a "base run" in which all exogenous variables are held constant, initial values of lagged endogenous variables are read in, and the model allowed to generate predictions of the endogenous variables over a 24-year period.[33] Then, a particular aspect of the model is changed. For example, the value of a single exogenous variable is changed, and the model is again allowed to generate predictions of the endogenous variables over the same 24-year period. The deviations of the model predictions from those of the base run provide estimates of the dynamic effects of the change of interest. Differences in model predictions between alternative runs are also compared.

The Base Run

In the base run, most exogenous variables, including the general price level, are held at their 1981 levels.[34] Variables such as raisin grape yield, the drying ratio, and the proportion of raisins that is NTS, are held at their 1963-83 mean levels. The export incentive plan (EIP) is assumed to be in effect. The various factors affecting the wine market and influencing the raisin grape crush price[35] are held constant at zero in the simulation projections. Values of exogenous variables used in the simulations are reported in Table 6. The model was projected ahead 24 periods from 1981; however, intermediate values are also reported. In several of the simulation run comparisons, the nearer term may be of more interest. Predicted values for selected years are reported in Table 7. Note that these values are not predictions of future values, i.e., forecasts. Instead, they provide the base for comparison with alternative runs of the model.[36] Note also that by the years 20 to 25, all variables approach stationary values with plantings very close to removals. Hence, the system is clearly stable.

33. In the simulations, we use "periods" rather than "crop years" to emphasize the fact that we are not making predictions about particular years in the future.

34. For convenience, the initial year of the export incentive plan, 1981, was chosen.

35. $WINE_t$ in equation 4 = $\Delta CRD_t + .000045 \Delta QC_t = b_{22}\, \Delta Z_t + \varepsilon 2_t$.

36. Because it is possible that results would differ if raisin-grape yield were allowed to vary over time, a 25-year historic yield pattern was used in an alternative base run. Differences between simulation experiment results using alternative base runs were considered similar enough to proceed with the constant-yield base run in which YIELD is held at its 1963-83 mean.

Table 6. Values of Exogenous Variables for the Simulation Runs, 1981 Values or the 1963-83 Means as Noted; for Definitions of Variables, see Table 3, pages 39-40.

YIELD(mean)	8.51	ERSU	5.80
GCRD	119.77	ERJU	238
CF	.925	CPIUK[a]	4.21
QF	204,000	CPIWG[a]	1.79
QCAN	42,000	CPIN[a]	2.23
GCWGD	110.08	CPIS[a]	2.82
DR(mean)	4.423	CPIJ[a]	2.51
P(mean)	.836	PGUKD	140
POP	255.56	PGWGD	1434
GNPDa	2.0149	PGND	1273
PCD	293.22	PGSD	2186
PCBD	261.80	PAJD	145,467
PSUBD	154.01	ECUKD	637.54
ECUD	4,132	ECWGD	7961
PCOMPD	126.56	ECND	6734
PGR	1073.65	ECSD	12,830
POPUK	56.3	ECJD	491,649
POPWG	61.7	TUKWG	14
POPNB	24.05	TUKN	14
POPNSD	17.54	TUKS	-11
POPJ	117.6	TUJ	106
FID	211.64	DUK	1.04
ERUKU	0.55	DWG	1.036
ERWGU	2.36	DN	1.036
ERNU	2.61	DJ	1.031

[a]GNPD = 1.0 in 1971-72; CPI(I) = 1.0 in 1970.

Analysis of the Effects of the Export Incentive Plan and Changes in Exchange Rates

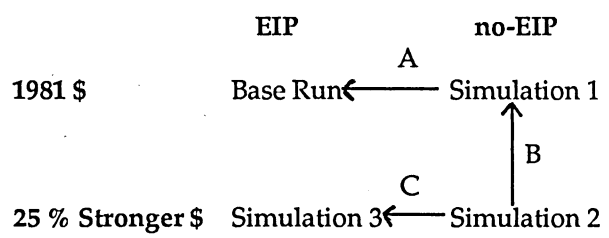
In the early 1980s, partly due to a strengthening dollar against European currencies, an export incentive plan (EIP) was initiated to help keep U.S. raisins at more competitive levels abroad. Three simulation experiments are performed to analyze the effects of EIP and of the stronger dollar:

A. The first analysis focuses on the effects of EIP with exchange rates held at 1981 levels. The base run (under EIP and 1981 exchange rates) is compared with Simulation 1 in which there is no EIP but exchange rates are held at 1981.

B. The second analysis looks at the effects of changes in exchange rates *without* EIP in effect. Simulation 2 under a 25 percent stronger dollar and no EIP is compared with Simulation 1 (1981 exchange rates and no EIP).

C. The third analysis considers the effects of EIP under a 25 percent stronger dollar. Simulation 3 (a 25 percent stronger dollar with EIP in effect) is compared to Simulation 2 in which the dollar is also 25 percent stronger but EIP is not in effect.

In summary, we perform the following analyses:



Simulation 1: Without the Export Incentive Plan (Analysis A)

The base run holds exchange rates constant at 1981 levels and is under the EIP. Simulation 1 holds exchange rates at 1981, but eliminates the EIP. However, the reserve pool provisions of the marketing order remain in effect. Without EIP, growers receive the free-tonnage price for all exported NTS (PGX=PF), and the f.o.b. export price equals the domestic bulk price (PX=PB). It follows that the portion of exports from the reserve pool is zero, s=0 in (13a) in Table 3. Deviations of Simulation 1 predictions from the EIP base run values are given in Table 8.

Table 7. Base Run: Predicted Values of Key Endogenous Variables, Initial Period (1981) and for 24 Periods Ahead.

	1	2	3	4	5	10	15	20	25
Production									
Plantings, acres, PLANT	12,180	4,892	4,041	3,310	3,681	2,965	3,198	3,830	4,224
Removals, acres, RMVL	2,958	4,098	4,684	4,634	4,859	5,139	4,611	4,059	3,868
Bearing acreage, 1000 acres, BA	249	257	269	276	276	269	259	254	254
Production, 1000 short tons (st), QRG	2,118	2,190	2,285	2,350	2,350	2,285	2,206	2,162	2,158
Allocation to dry, 1000 st, QR	1,364	1,278	1,308	1,339	1,357	1,285	1,231	1,214	1,219
Deliveries, 1000 packed weight mt, DEL	216	203	207	212	215	204	195	192	193
Prices, deflated $ per packed weight mt									
f.o.b. packaged price, PPD	1,037	1,252	1,133	1,208	1,106	1,100	1,199	1,286	1,308
f.o.b. bulk price, PBD	764	941	837	895	805	798	890	970	988
f.o.b. export price, PX/GNPD	584	585	558	545	521	513	557	585	590
Free tonnage price, PFD	646	822	735	800	726	724	789	850	865
Growers' price for exports, PGX/GNPD	466	465	456	451	442	439	455	465	467
Shipments in 1000 packed weight mt									
Domestic shipments, QPKG+QBLK	129	121	125	123	126	127	123	120	119
Total exports, QXT	52	52	53	53	54	55	53	52	51
The proportion of exports from the reserve pool, s	.31	.47	.41	.47	.43	.43	.46	.49	.49
Supply and stocks, 1000 packed weight mt									
Free tonnage, QFR	209	140	190	154	184	170	166	161	160
Packers' reported free tonnage stocks, BGSTK	42	70	52	70	60	68	64	62	62
Growers' carryin reserve, CI	39	26	55	43	65	74	58	44	41
Total supply, DEL+BGSTK+CI	297	299	315	325	341	346	317	299	296
Grower' net returns, deflated $ per wet st									
RNETD[a]	-8.9	13.6	1.9	9.7	-.34	-.81	8.7	17.1	19.2
Revenue, 1,000,000, deflated $									
Growers' export revenue, GXREVD[b]	24.1	24.1	24.1	24.0	24.0	23.9	24.0	24.0	24.0
Growers' total revenue, GTREVD[c]	135.9	116.7	141.2	125.1	135.1	124.2	132.5	138.2	140.1
Packers' export revenue, PXREVD[d]	60.9	60.9	59.4	58.5	56.9	56.4	59.2	60.9	61.2
Packers' total revenue, PTREVD[e]	146.0	162.8	152.8	158.0	149.0	148.2	157.8	165.3	166.9

[a] RNETD is the basis for the average past returns variables, RRD3 and RRD2, used in equations (1), (2), and (3); see identity (xxxii) in Table 3.

[b] GXREVD=(PGX/GNPD)•QXT/1,000,000.

[c] GTREVD=[PFD•QFR+s•(120/GNPD)•(QXT)]/1,000,000 where 120 is the amount paid for reserve pool raisins under the export incentive plan, in pwmt.

[d] PXREVD=[(PX/GNPD)•(QXT)]/1,000,000.

[e] PTREVD=[(PPD•QPKG+PBD•QBLK+(PX/GNPD)•QXT]/1,000,000.

Table 8. Effects of Eliminating the Export Incentive Program: Changes in Predicted Values of Key Endogenous Variables, Simulation 1 (S1) versus the Base Run (BR), Absolute and Percentage Changes S1 - BR, Initial Period (1981), Yearly Averages of Periods 2—5, 6—15, and 16—25.

	Initial period	2nd-5th	6th-15th	16th-25th
Production				
Plantings, acres, PLANT	0	49 (1.2%)	-464 (5.2%)	-587 (15.3%)
Removals, acres, RMVL	0	186 (4.0%)	575 (11.6%)	44 (1.1%)
Bearing acreage, 1000 acres, BA	0	.18 (0.0%)	-6.15 (2.3%)	-12.68 (5.0%)
Production, 1000 short tons (st), QRG	0	1.50 (0.0%)	-52.40 (2.3%)	-107.93 (5.0%)
Allocation to dry, 1000 st, QR	0	.65 (0.0%)	-77.69 (6.0%)	-105.11 (8.6%)
Deliveries, 1000 packed weight metric tons (pwmt), DEL	0	.11 (0.0%)	-12.32 (6.0%)	-16.67 (8.6%)
Prices, deflated $ per pwmt				
f.o.b. packaged price, PPD	0	-231 (19.7%)	-184 (16.4%)	-160 (12.5%)
f.o.b. bulk price, PBD	0	-200 (23.0%)	-150 (18.3%)	-124 (12.8%)
f.o.b. export price, PX/GNPD	180 (38.6%)	117 (21.2%)	147 (28.2%)	257 (44.2%)
Free tonnage price, PFD	0	-174 (22.6%)	-152 (20.5%)	-142 (16.8%)
Price growers receive for NTS exports, PGX/GNPD	180 (30.8%)	143 (31.5%)	145 (32.8%)	239 (51.4%)
Shipments in 1000 pwmt				
Domestic shipments, QPKG+QBLK	0	8.3 (6.7%)	6.4 (5.1%)	5.5 (4.5%)
Total exports, QXT	-7.2 (13.9%)	-4.7 (8.8%)	-5.9 (10.9%)	-10.3 (19.8%)
Supply and stocks, 1000 pwmt				
Free tonnage, QFR	0	16.8 (10.0%)	14.8 (8.7%)	10.2 (6.3%)
Packers' reported free tonnage stocks, BGSTK	0	-8.0 (12.6%)	-12.0 (18.0%)	-15.2 (24.3%)
Growers' carryin reserve, CI	0	31.2 (66.0%)	17.2 (24.7%)	12.3 (27.3%)
Total supply, DEL+BGSTK+CI	0	23.4 (7.3%)	-7.1 (2.1%)	-19.6 (6.5%)
Growers' net returns, deflated $ per wet st				
RNETD[a]	9.6 (108.7%)	-14.8 (238.3%)	-11.6 (776.0%)	-5.1 (31.1%)
Revenue, 1,000,000, deflated $				
Growers' export revenue, GXREVD[b]	4.7 (19.3%)	4.4 (18.2%)	4.3 (18.0%)	5.1 (21.3%)
Growers' total revenue, GTREVD[c]	-.94 (0.7%)	-21.7 (16.8%)	-18.7 (14.7%)	-17.3 (12.6%)
Packers' export revenue, PXREVD[d]	7.7 (12.6%)	5.3 (9.0%)	7.8 (13.7%)	9.4 (15.5%)
Packers' total revenue, PTREVD[e]	3.8 (2.6%)	-17.7 (11.4%)	-12.0 (7.9%)	-6.9 (4.2%)

a. RNETD is the basis for the average past returns variables, RRD3 and RRD2, used in equations (1), (2), and (3); see identity (xxxii) in Table 3. The base run values for RNETD are -$8.85 in 1981; $6.21 for 2nd-5th periods; $1.50 for 6th-15th periods; $16.50 for 16th-25th periods.

b, GXREVD=(PGX/GNPD)•QXT/1,000,000.

c. GTREVD=[PFD•QFR+s•(120/GNPD)•(QXT)]/1,000,000 where 120 is the amount paid for reserve pool raisins under the export incentive plan, in pwmt; s=0 in simulation 1.

d. PXREVD=[(PX/GNPD)•(QXT)]/1,000,000.

e. PTREVD=[(PPD•QPKG+PBD•QBLK+(PX/GNPD)•QXT]/1,000000.

In the initial period of no export blending, setting PGX and PX equal to PF and PB, respectively, results in an increase of $180 (deflated) per packed weight metric ton in each price, a 38.6 percent increase over the base run. Consequently, exports drop 7,179 metric tons (13.9 percent) from the base level. Growers' export revenue is 19 percent greater, for they are being paid more for NTS for export; but their total revenue is somewhat less since the free tonnage quantity has not changed and they are no longer getting the extra $120 per ton under EIP for NTS from the reserve pool. Their net return is up $9.62 per wet short ton in the initial period. Given the relatively inelastic demand curves in importing countries, packers' export revenue (PXREVD) rises over 12 percent above base, with the higher PX and smaller QXT; their total revenue increases almost 3 percent.

In the following four periods, although exports are down, all exports must come from free tonnage, since without EIP, the portion of exports from the reserve pool is s=0. The free tonnage quantity, QFR, averages 10 percent higher than in the base run to account for increased free tonnage exports. Because no exports are from the reserve pool, growers' carryin stocks (reserve pool) are up 66 percent above base; supply is up over 23 percent. With more free tonnage to bargain for and with increased supply, the free tonnage price drops $174 (22.6 percent). Higher levels of supply and a substantially lower free tonnage price mean that packers set lower f.o.b. prices (PPD is down 20 percent; PBD, 23 percent), with the result that domestic sales increase 6.7 percent above base.

Although growers receive more per ton for NTS exports without EIP, their overall net returns are lower; RNETD is $14.80 per ton less per year than in the base run These lower returns lead to lower plantings under the no-EIP scenario and to increased removals during the 6th-15th periods, resulting in a 2.3 percent drop in bearing acreage and raisin grape production. Lower net grower returns also mean that less is allocated to be dried, with QR and DEL both 6 percent below base. As production falls, the supply buildup is reversed and the free tonnage and f.o.b. prices begin to recover—that is, their differences from the base run grow gradually smaller. However, the price recovery process is slow. Even in the 16th-25th periods, PFD is still almost 17 percent below base; PPD and PBD, over 12 percent. Revenues for growers and packers correspondingly remain below base. And growers' net return is still on average 31 percent below its base run level ($16.50 per short wet ton), meaning that reduced plantings and increased removals will continue beyond the 25th period.

Thus, it appears that EIP may have benefited both growers and packers, increasing their gross total revenues an average of 17 percent and 11 percent, respectively, in the first four periods after 1981; almost 15 percent and 8 percent, respectively, for the subsequent 10 periods. If EIP were to be maintained permanently, the model projections show revenues remaining 13 and 4 percent, respectively, higher in the base run than in the alternative no-EIP experiment through 25th period.

Without EIP, export revenues increase for both growers and packers, but higher export prices reduce quantities sold abroad, causing reserve stocks and total supply to build up. Also, without EIP, all exports are from free tonnage (s=0), requiring a larger amount to be allocated as free tonnage. But this increase and the increased supply, depresses the free tonnage price. With a larger supply and a lower free tonnage price, packers set lower f.o.b. prices. Domestic consumers benefit from the elimination of EIP in that somewhat more is sold at much lower prices; however, foreign consumers pay more and get less.

Simulation 2: A 25 Percent Increase in Exchange Rates (Stronger Dollar) without the Export Incentive Plan (Analysis B)

To simulate the impact of a stronger dollar on the industry, exchange rates for the five major importing countries were increased from their 1981 levels by 25 percent:

$$ER(I)U(1981) \bullet 1.25$$

where I=the United Kingdom, West Germany, the Netherlands, Sweden, and Japan.[37] This raises the import prices in identities (xxi) through (xxiv) in Table 3. It is assumed that the Greek price measured in drachma and the exchange rate between Greece and European importing countries remain constant. Therefore, the variable PGUKD in equation (14), for example, does not differ from its 1981 value in Table 6.

Because there is no export price blending, PGX=PF, PX=PB, and s=0, as in Simulation 1. Table 9 compares the strong dollar predictions of Simulation 2 with those of Simulation 1 in which exchange rates are held at their 1981 levels.

In the initial period, exports decrease by 18.9 percent from Simulation 1 levels, as prices in importing countries are higher due to the strong dollar. Accordingly, growers' and packers' export revenues increase above Simulation 1 levels, as does packers' total revenue. Growers' net returns and total revenue do not change in the initial period as there has not yet been a change in the free tonnage level or in its price. Stocks in the second period would be higher to reflect the decrease in export shipments.

In the 2nd-5th periods, stocks begin to build over Simulation 1 levels, with packers' beginning stocks up 1.3 percent and growers' carryin reserve up 8.4 percent. The larger supply depresses f.o.b. and free tonnage prices about 7 to 8 percent, increasing domestic shipments slightly. The decrease in the bulk price (and the export price) moderates the price increases in importing countries, narrowing the difference in exports between the runs to about 10 percent. The lower free tonnage price depresses growers' net return per short wet ton over $8 below that of Simulation 1. Plantings decrease and removals increase over 4 percent, respectively, decreasing production about 1 percent in the 6th-15th periods. Allocation to raisins and NTS deliveries also decrease in the 6th-15th periods, reversing the supply buildup over Simulation 1 and causing a moderation in the price differences, with f.o.b. prices 3 to 4 percent below Simulation 1 and the free tonnage price, about 5 percent below. The difference in growers' net returns also narrows somewhat, but is still about $5 below Simulation 1 in the 6th-15th and 16th-25th periods.

Growers respond by planting over 11 percent less acreage, removing 3 percent more, and allocating about 5 percent less to raisins in the 16th-25th periods. As a result, stocks and supply levels are well below those in Simulation 1 in spite of an over 20 percent reduction in exports, so price differences moderate further.

Beyond the 25th period, prices may well equilibrate as supply diminishes. Even though prices abroad would still be higher than in Simulation 1 and exports lower, supply response from reduced returns eventually would bring about a price recovery.

Growers' and packers' revenues are well below their Simulation 1 levels in all periods, due to lower prices and reduced exports. With the inelastic demand on the domestic market, lower prices bring about only a slight increase in shipments. Domestic consumers are the only ones who gain in the strong dollar scenario, and theirs is a modest one. Consumers abroad would pay more for a reduced tonnage exported.

A 25 percent weaker dollar assumption yields simulation results similar to those in Table 9, but with opposite signs.

37. An alternative would be to spread the change over two to three years and then hold the new level. The final equilibrium results would be the same, but the interim values might differ considerably.

Table 9. Effects of a Strong Dollar: Changes in Predicted Values of Key Endogenous Variables without EIP, Simulation 2 (S2) versus Simulation 1 (S1), Absolute and Percentage Changes S2 - S1, Initial Period (1981), Yearly Averages of Periods 2—5, 6—15, and 16—25.

	Initial period	2nd-5th	6th-15th	16th-25th
Production				
Plantings, acres, PLANT	0	-184 (4.6%)	-20 (0.7%)	-374 (11.5%)
Removals, acres, RMVL	0	226 (4.8%)	237 (4.3%)	128 (3.1%)
Bearing acreage, 1000 acres, BA	0	-398 (0.1%)	-2.9 (1.0%)	-5.9 (2.4%)
Production, 1000 short tons (st), QRG	0	-3.4 (0.1%)	-24.5 (1.0%)	-50.3 (2.4%)
Allocation to dry, 1000 st, QR	0	-10.4 (0.8%)	-35.2 (2.9%)	-54.9 (4.9%)
Deliveries, 1000 packed weight metric tons (pwmt), DEL	0	-1.6 (0.8%)	-5.6 (2.9%)	8.7 (4.9%)
Prices, deflated $ per pwmt				
f.o.b. packaged price, PPD	0	-63 (6.6%)	-33 (3.5%)	-22 (2.0%)
f.o.b. bulk price, PBD =				
f.o.b. export price, PX/GNPD	0	-54 (8.0%)	-26 (3.9%)	-13 (1.5%)
Free tonnage price, PFD =				
Price growers receive for NTS exports, PGX/GNPD	0	-48 (8.0%)	-30 (5.1%)	-26 (3.7%)
Shipments in 1000 pwmt				
Domestic shipments, QPKG+QBLK	0	2.2 (1.7%)	1.1 (0.8%)	.68 (0.5%)
Total exports, QXT	-8.4 (18.9%)	-4.8 (9.9%)	-6.2 (12.8%)	-8.5 (20.5%)
Supply and stocks, 1000 pwmt				
Free tonnage, QFR	0	-4.3 (2.3%)	-5.5 (3.0%)	-8.5 (5.0%)
Packers' reported free tonnage stocks, BGSTK	0	.74 (1.3%)	-2.6 (4.9%)	-4.0 (8.5%)
Growers' carryin reserve, CI	0	6.6 (8.4%)	3.2 (49.8%)	-1.7 (2.9%)
Total supply, DEL+BGSTK+CI	0	5.7 (1.6%)	-5.1 (1.5%)	-11.1 (3.9%)
Growers' net returns, deflated $ per wet st				
RNETD[a]	0	-8.9 (104%)	-5.6 (54.9%)	-4.9 (43.3%)
Revenue, 1,000,000, deflated $				
Growers' export revenue, GXREVD[b]	-5.44 (18.9%)	-5.1 (17.8%)	-4.9 (17.4%)	-6.9 (23.6%)
Growers' total revenue, GTREVD[c]	0	-11.1 (10.3%)	-8.7 (8.0%)	-10.3 (8.5%)
Packers' export revenue, PXREVD[d]	-13.0 (18.9%)	-11.5 (17.9%)	-10.7 (16.4%)	-15.4 (21.9%)
Packers' total revenue, PTREVD[e]	-6.4 (4.3%)	-11.7 (8.5%)	-8.3 (6.0%)	-9.2 (5.8%)

a. RNETD is the basis for the average past returns variables, RRD3 and RRD2, used in equations (1), (2), and (3); see identity (xxxii) in Table 3. Simulation 1 values for RNETD are -$8.55 for 2nd-5th periods; -$10.14 for 6th-15th periods; $-11.37 for 16th-25th periods.

b. GXREVD=(PGX/GNPD)•QXT/1,000,000.

c.GTREVD=[PFD•QFR+s•(120/GNPD)•(QXT)]/1,000,000 where 120 is the amount paid for reserve pool raisins under the export incentive plan, in pwmt; s=0 in simulations 1 and 2.

d. PXREVD=[(PX/GNPD)•(QXT)]/1,000,000.

e. PTREVD=[(PPD•QPKG+PBD•QBLK+(PX/GNPD)•QXT]/1,000000.

Simulation 3: Evaluation of the Effect of the Export Incentive Plan under a 25 Percent Increase in Exchange Rates (Analysis C)

In 1981, when the dollar began to strengthen against European currencies (though not much against the yen), the EIP was initiated to keep U.S. raisins priced at more competitive levels abroad. Analysis C is parallel to analysis A, but under a stronger dollar. That is, like the Base Run, Simulation 3 is under EIP, but with exchange rates 25 percent higher. Simulation 3 is compared with Simulation 2, a no-EIP scenario, also at 25 percent higher exchange rates. Of interest is whether the conclusions from analysis A will be sustained under the change in exogenous exchange rates.

The Base Run (under EIP) was altered to reflect higher exchange rates. The exchange rates in the five importing countries were increased by 25 percent, as in Simulation 2, raising the U.S. price in equations (14)-(18). In addition, the exogenous Greek price in U.S. dollars, PGR, used as an explanatory variable in equation (12), was lowered to reflect the higher exchange rate.[38] Recall that equation (12) predicted PGX, the growers' NTS export price under EIP.

In Table 10, we compare the no-EIP, strong dollar scenario, Simulation 2, with Simulation 3, an EIP base, also with a strong dollar assumption. This comparison will indicate the effectiveness of EIP in the face of a strengthening dollar.

In the initial period, no-EIP in Simulation 2 raises growers' price for NTS exports, PGX, over 80 percent above its EIP level in Simulation 3, due to growers' receiving the free tonnage price rather than the blend price for exports. Similarly the f.o.b. export price, PX, is about 60 percent above its EIP level, because without EIP in Simulation 2, PX=PB, the domestic bulk price. As a result of a higher f.o.b. export price, PX, exports decrease 28.4 percent. Growers' net returns (RNETD) and export revenue (GXREVD) increase because, even though less is being exported, their export price is higher without EIP.

With decreased export shipments growers' carryin reserve increases over 100 percent during the 2nd-5th periods; supply increases over 10 percent. More is allocated to free tonnage, QFR, to accomodate the increase *free tonnage* export sales without EIP. With supply levels considerably above the EIP base in Simulation 3, domestic f.o.b. and free tonnage prices decrease markedly: Packaged and bulk f.o.b. prices are down 33 and 32 percent, respectively, below their EIP levels; the free tonnage price, 32 percent. With lower prices, domestic shipments increase about 10 percent.

With lower free tonnage prices under Simulation 2 without EIP, growers' net returns are down some $23 per short wet ton. As a result, in the 6th-15th periods, plantings decrease 17 percent; removals increase over 18 percent; and the allocation to raisins is almost 9 percent below Simulation 3 no-EIP base values. This decreased production reverses the supply build up even though growers' carryin is still well above its EIP level. Lower supplies begin to moderate the differences in f.o.b. and free tonnage prices and in grower net returns between the simulations. However, the positive effects of EIP on these prices, returns, and revenues extend well beyond the 25th period.

Domestic consumers pay considerably higher prices for NTS in all periods for less tonnage under EIP. Foreign consumers benefit from the export price blending program which helps compensate for the effect of a strong dollar.

Results of this analysis (Table 10) are

38. Recall that the deflated Greek price landed in London, PGUKD, was calculated from PGR, for use in the UK import demand equation (14) as follows: PGUKD=(PGR•ERUKU)/CPIUK. We can solve this for PGR and alter the exchange rate, giving the relevant PGR to use in equation (12) in Simulation 3: PGR=[PGUKD/(ERUKU•1.25)]•CPIUK.

Table 10. Effects of the Export Incentive Plan under a Strong Dollar: Changes in Predicted Values of Key Endogenous Variables Without and With EIP, Simulation Experiment 2 (SE2) versus Simulation Experiment 3 (Absolute and Percentage Changes from SE2), Initial Period (1981), Yearly Averages of Periods 2 through 5, 6 through 15, and 16 through 25.

	Initial period	2nd-5th	6th-15th	16th-25th
Production				
Plantings, acres, PLANT	0	-7 (0.2%)	555 (21.1%)	878 (30.5%)
Removals, acres, RMVL	0	-329 (6.6%)	-899 (15.5%)	-113 (2.7%)
Bearing acreage, 1000 acres, BA	0	-.09 (0.0%)	8.6 (3.3%)	19.0 (8.0%)
Production, 1000 short tons (st), QRG	0	.75 (0.0%)	73.6 (3.3%)	161.6 (8.0%)
Allocation to dry, 1000 st, QR	0	3.8 (0.3%)	113.3 (9.7%)	160.9 (15.2%)
Deliveries, 1000 packed weight metric tons (pwmt), DEL	0	0.6 (0.3%)	18.0 (9.7%)	25.5 (15.2%)
Prices, deflated $ per pwmt				
f.o.b. packaged price, PPD	0	344 (39.0%)	294 (32.4%)	223 (20.3%)
f.o.b. bulk price, PBD	0	297 (48.2%)	241 (37.3%)	171 (20.6%)
f.o.b. export price, PX/GNPD	-287 (37.6%)	-163 (26.5%)	-219 (34.0%)	-350 (42.3%)
Free tonnage price, PFD	0	260 (47.4%)	240 (43.0%)	201 (29.7%)
Price growers receive for NTS exports, PGX/GNPD	-287 (44.4%)	-200 (36.4%)	-220 (39.4%)	-319 (47.1%)
Shipments in pwmt				
Domestic shipments, 1000, QPKG+QBLK	0	-12.3 (9.2%)	-10.3 (7.7%)	-7.6 (6.0%)
Total exports, 1000, QXT	14.3 (39.7%)	8.1 (18.7%)	10.9 (26.0%)	17.4 (52.9%)
The proportion of exports from the reserve pool, s	.48 (up from 0)	.61 (up from 0)	.62 (up from 0)	.64 (up from 0)
Supply and stocks, 1000 pwmt				
Free tonnage, QFR	0	-21.7 (12.1%)	-19.2 (10.7%)	-9.0 (5.5%)
Packers' reported free tonnage stocks, BGSTK	0	9.9 (17.8%)	17.5 (33.8%)	21.5 (49.6%)
Growers' carryin reserve, CI	0	-44.2 (51.9%)	-29.0 (32.2%)	-17.2 (29.2%)
Total supply, DEL+BGSTK+CI	0	-33.6 (9.6%)	6.5 (2.0%)	29.8 (11.0%)
Growers' net returns, deflated $ per wet st				
RNETD[a]	-15.1 (down from $.77)	23.0 (132.1%)	19.0 (121.0.4%)	-8.6 (132.6%)
Revenue, 1,000,000, deflated $				
Growers' export revenue, GXREVD[b]	-5.2 (23.3%)	-5.3 (22.9%)	-5.4 (23.1%)	-4.3 (19.1%)
Growers' total revenue, GTREVD[c]	1.5 (1.1%)	32.1 (33.2%)	30.0 (30.0%)	26.8 (24.3%)
Packers' export revenue, PXREVD[d]	-7.1 (12.8%)	-5.6 (10.6%)	-8.8 (16.2%)	-6.3 (11.6%)
Packers' total revenue, PTREVD[e]	-3.6 (2.5%)	27.4 (21.7%)	20.5 (15.7%)	12.7 (8.6%)

a. RNETD is the basis for the average past returns variables, RRD3 and RRD2, used in equations (1), (2), and (3); see identity (xxxii) in Table 3. Simulation Experiment 2 values for RNETD are $.77 in the initial period, -$17.40 for 2nd-5th,-$15.70 for 6th-15th periods; $6.45 for 16th-25th periods.

b. GXREVD=(PGX/GNPD)•QXT/1,000,000.

c. GTREVD=[PFD•QFR+s•(120/GNPD)•(QXT)]/1,000,000 where 120 is the amount paid for reserve pool raisins under the export incentive plan, in pwmt; s=0 in simulation 2.

d. PXREVD=[(PX/GNPD)•(QXT)]/1,000,000.

e. PTREVD=[(PPD•QPKG+PBD•QBLK+(PX/GNPD)•QXT]/1,000000.

of the same general magnitude as analysis A (Table 8, 1981 exchange rates). The model in both cases suggests that the export incentive plan provided improved returns for growers.

Evaluation of the Effects of Tariffs

Major importing countries' tariffs on raisins are not high and have been decreasing. (In the mid-1980s, a 3 percent tariff was imposed on U.S. raisins by European Economic Community countries; 2 percent by Japan (see Appendix Table F.7). Sweden charges no duty on raisins.) However, because there is considerable discussion about the need and desirability of lowering trade barriers on agricultural commodities in the next GATT round, it is of some interest to run the model without tariffs and compare the results with the base run.

Simulation 4: The Effect of Eliminating All Tariffs

In Simulation 4, identity (xx) in Table 3, the British price, becomes:

$$PUUKD_t = \{[((PX+FID)/DUK) \bullet ERUKU]/CPIUK\}_t$$

where the f.o.b. export price plus freight-insurance-duty (FID) is divided by DUK to remove the effect of the UK duty. The other duty variables, DWG, DN, and DJ, are set to equal 1 in identities (xxi), (xxii), (xxiii), and (xxv). The change effects approximately a 3 percent price decrease in the United Kingdom, Germany, the Netherlands, and Japan. Average differences between Simulation 4 and the base run are reported in Table 11.

Without duties, exports and growers' and packers' export revenues increase 1.3 percent in the initial period. Exports continue to be about 1 percent above base in all periods considered. As exports increase, somewhat more tonnage is drawn from the reserve pool so that growers' carryin reserve decreases 2.6 percent in the 2nd-5th periods, lowering supply a fraction of a percent, raising f.o.b. and free tonnage prices a few dollars. By the 16th-25th periods, however, all of these slight changes have been narrowed to a negligible difference from their base values. Somewhat more grower and packer revenues are derived from exports in all periods considered, but the differences in their respective total revenues are 1 percent or less.

Thus, elimination of tariffs against U.S. raisins by these major importing countries would likely have a very small effect on the industry. However, since the early 1980s, Pacific Rim nations other than Japan have become important importers. In 1986-87, Korea imported 4,055 metric tons of NTS, and Taiwan, 2,990 metric tons, despite substantial tariffs. Korea has a 50 to 80 percent ad valorem tariff on raisins, adjustable according to the level of imports; Taiwan's ad valorem tariff on raisins amounts to 40 to 50 percent (UC Agricultural Issues Center, 1987, Appendix A). Trade barrier reductions in these countries could have considerable impact on these countries' demand for U.S. raisins, on U.S. exports, and on the California industry.

Effects of Growth in the U.S. and Canadian Population

Although not a staple in the diet, California NTS are used by most U.S. and Canadian households as a snack and in home baking, and are consumed in purchased bakery products and cereals. Therefore, one source of increased demand for NTS is growth in population, and the increase in demand would depend partly on the rate of population growth.

The U.S. Bureau of the Census (1984) reported low, medium, and high projections of the U.S. population through 2080. The medium and high series were interpolated between data points, multiplied by 1.079 to reflect the fact that the projected figure for 1985 was lower than the actual, and then multiplied by 1.105 to include Canada, on the assumption that the Canadian growth

Table 11. Effects of Eliminating all Tariffs: Changes in Predicted Values of Key Endogenous Variables, Simulation 4 (S4) versus the Base Run (BR), Absolute and Percentage Changes S4 - BR, Initial Period (1981), Yearly Averages of Periods 2—5, 6—15, and 16—25.

	Initial period	2nd-5th	6th-15th	16th-25th
Production				
Plantings, acres, PLANT	0	10 (0.3%)	51 (1.6%)	20 (0.5%)
Removals, acres, RMVL	0	-14 (0.3%)	-33 (0.7%)	12 (0.3%)
Bearing acreage, 1000 acres, BA	0	.02 (0.0%)	.50 (0.2%)	.94 (0.4%)
Production, 1000 short tons (st), QRG	0	.1 (0.0%)	4.2 (0.2%)	8.0 (0.4%)
Allocation to dry, 1000 st, QR	0	.38 (0.0%)	5.5 (0.4%)	7.1 (0.6%)
Deliveries, 1000 packed weight metric tons (pwmt), DEL	0	.06 (0.0%)	.90 (0.4%)	1.1 (0.6%)
Prices, deflated $ per pwmt				
f.o.b. packaged price, PPD	0	9 (0.8%)	8 (0.7%)	2 (0.1%)
f.o.b. bulk price, PBD	0	8 (0.9%)	7 (0.8%)	.62 (0.1%)
f.o.b. export price, PX/GNPD	0	2 (0.3%)	-.66 (0.1%)	-3 (0.5%)
Free tonnage price, PFD	0	7 (0.9%)	7 (0.9%)	3 (0.3%)
Price growers receive for NTS exports, PGX/GNPD	0	0.61 (0.1%)	-.34 (0.1%)	-1 (0.3%)
Shipments in pwmt				
Domestic shipments, 1000, QPKG+QBLK	0	-.32 (0.2%)	-.29 (0.2%)	-.05 (0.0%)
Total exports, 1000, QXT	.68 (1.3%)	.57 (1.0%)	.64 (1.2%)	.80 (1.5%)
The proportion of exports from the reserve pool, s	.0	.005 (1.1%)	.006 (1.4%)	.003 (0.6%)
Supply and stocks, 1000 pwmt				
Free tonnage, QFR	0	.07 (0.1%)	.07 (0.0%)	.47 (0.3%)
Packers' reported free tonnage stocks, BGSTK	0	.23 (0.4%)	.54 (0.8%)	.70 (1.1%)
Growers' carryin reserve, CI	0	-1.4 (2.6%)	-.80 (1.1%)	.24 (0.52%)
Total supply, DEL+BGSTK+CI	0	-1.0 (0.3%)	.61 (0.2%)	2.1 (0.7%)
Growers' net returns, deflated $ per wet st				
RNETD[a]	-.09 (1.0%)	.73 (11.8%)	.71 (48%)	.03 (0.3%)
Revenue, 1,000,000, deflated $				
Growers' export revenue, GXREVD[b]	.31 (1.3%)	.29 (1.2%)	.26 (1.1%)	.31 (1.3%)
Growers' total revenue, GTREVD[c]	.01 (0.0%)	1.3 (1.0%)	1.3 (1.0%)	.85 (0.6%)
Packers' export revenue, PXREVD[d]	.80 (1.3%)	.83 (1.4%)	.61 (1.1%)	.60 (0.1%)
Packers' total revenue, PTREVD[e]	.40 (0.3%)	1.1 (0.7%)	.96 (0.6%)	.39 (0.2%)

a. RNETD is the basis for the average past returns variables, RRD3 and RRD2, used in equations (1), (2), and (3); see identity (xxxii) in Table 3. RNETD decreases slightly in the initial period as exports increase, as more weight is given to lower-prices sales in the weighted average. Base run values for RNETD are -$8.85 in the initial period, $6.21 for 2nd-5th, $1.50 for 6th-15th periods, $16.50 for 16th-25th periods.

b. GXREVD=(PGX/GNPD)•QXT/1,000,000.

c. GTREVD=[PFD•QFR+s•(120/GNPD)•(QXT)]/1,000,000 where 120 is the amount paid for reserve pool raisins under the export incentive plan, in pwmt.

d. PXREVD=[(PX/GNPD)•(QXT)]/1,000,000.

e. PTREVD=[(PPD•QPKG+PBD•QBLK+(PX/GNPD)•QXT]/1,000000.

rate would be the same as that for the United States. The two series used are reported in Table 12. From 1981 through 1985, actual population figures were used; see POP in Appendix Table C.1. The average medium projection growth rate is 0.76 percent per year; the high, 1.15 percent.

Recall that the variable POP, the U.S. and Canadian populations, is used in the model in the free tonnage price equation (7), the two f.o.b. price setting equations (8) and (9), and the growers' NTS price for exports, PGX, equation (12). In these equations the impact of supply on prices is seen relative to the size of the market, i.e. on a per capita basis. Domestic demand for packaged and bulk NTS is also on a per capita basis.

In the base run, POP was held constant at its 1981 level. In the next two experiments, we consider the effects of medium and high population projections and compare their respective effects on demand for NTS. Expenditures (ECUD) in the demand equations (10) and (11) are also on a per capita basis. In the experiments we hold ECUD constant at its 1981 level, assuming that income just keeps pace with population growth.

Simulation 5: Effects of a Medium Population Growth Rate

In Table 13, model predictions using the medium population projections are compared with the base run which held population constant at its 1981 level. In the 2nd-5th period, using actual population data for 1982 through 1985, domestic shipments increase 1.4 percent to accommodate the growth in population. With all other exogenous variables held constant at the same level as in the base run, all prices and growers' net returns increase. Exports decline a small amount to accomodate the increase in domestic demand. In response to more favorable returns, more grapes are allocated to raisin production, new vines are planted, and fewer are removed. By the 6th-15th period, raisin grape production is up 1.5 percent; NTS deliveries, 4 percent. Domestic shipments continue to increase an average of 5.6 percent per year, exports continue to decline, and prices improve. The higher production outpaces the increased shipments, so stocks begin to build up, with supply averaging 2.7 percent above base.

With very favorable returns through the 15th year, growers continue to plant and allocate to raisins. During the 16th-25th periods, raisin grape production is up 7 percent above base; NTS deliveries to packers are up 12.6 percent. The amount allocated to free tonnage increases10.7 percent to accommodate the 14.6 percent increase in domestic shipments and in response to better f.o.b. prices. This increase and the 17 percent per year increase in supply moderates the difference above base in the free tonnage price which in turn slows the growth

Table 12. Projected Population Growth Rates for the United States and Canada, 1986 through 2005.

	Medium	High
1986	268.2	268.2
1987	270.7	272.1
1988	273.1	275.2
1989	275.6	278.3
1990	278.1	281.5
1991	280.3	284.6
1992	282.5	287.7
1993	284.7	290.8
1994	286.9	293.9
1995	289.1	297.0
1996	291.0	300.0
1997	292.8	302.9
1998	294.7	305.9
1999	296.6	308.9
2000	298.4	311.8
2001	300.1	315.0
2002	301.8	318.1
2003	303.5	321.3
2004	305.2	324.4
2005	306.9	327.6

Table 13. Effects of a Medium Population Growth Rate: Changes in Predicted Values of Key Endogenous Variables, Simulation 5 (S5) versus the Base Run (BR), Absolute and Percentage Changes S5 - BR, Initial Period (1981), Yearly Averages of Periods 2—5, 6—15, and 16—25.

	2nd-5th	6th-15th	16th-25th
Production			
Plantings, acres, PLANT	66 (1.7%)	720 (23.2%)	1416 (40.0%)
Removals, acres, RMVL	-59 (1.3%)	-464 (9.3%)	-260 (6.4%)
Bearing acreage, 1000 acres, BA	.10 (0.0%)	4.0 (1.5%)	17.8 (7.0%)
Production, 1000 short tons (st), QRG	.78 (0.0%)	34.3 (1.5%)	151.3 (7.0%)
Allocation to dry, 1000 st, QR	2.3 (0.2%)	50.8 (4.0%)	153.4 (12.6%)
Deliveries, 1000 packed weight metric tons (pwmt), DEL	.38 (0.2%)	8.1 (4.0%)	24.3 (12.6%)
Prices, deflated $ per pwmt			
f.o.b. packaged price, PPD	30 (2.6%)	112 (9.9%)	72 (5.6%)
f.o.b. bulk price, PBD	27 (3.2%)	99 (12.1%)	59 (6.1%)
f.o.b. export price, PX/GNPD	12 (2.1%)	30 (5.7%)	1.6 (0.3%)
free tonnage price, PFD	20 (2.6%)	80 (10.8%)	58 (6.9%)
Price growers receive for NTS exports, PGX/GNPD	4 (0.9%)	11 (2.5%)	0.2 (0.0%)
Shipments, pwmt			
Domestic shipments, 1000, QPKG+QBLK	1.7 (1.4%)	7.0 (5.6%)	17.5 (14.6%)
Total exports, 1000, QXT	-.46 (0.9%)	-1.2 (2.2%)	-0.7 (0.1%)
The proportion of exports from the reserve pool, s	.01 (2.2%)	.04 (10.2%)	0.4 (7.3%)
Supply and stocks, 1000 pwmt			
Free tonnage, QFR	.73 (0.4%)	5.1 (3.0%)	17.3 (10.7%)
Packers' reported free tonnage stocks, BGSTK	.01 (0.0%)	2.3 (3.5%)	7.9 (12.7%)
Growers' carryin reserve, CI	-.80 (1.7%)	1.2 (1.8%)	18.7 (41.6%)
Total supply, DEL+BGSTK+CI	.41 (1.3%)	9.2 (2.7%)	50.9 (17.0%)
Growers' net returns, deflated $ per wet st			
RNETD[a]	3.2 (51.0%)	12.2 (800.0%)	9.86 (59.7%)
Revenue, 1,000,000, deflated $			
Growers' export revenue, GXREVD[b]	.02 (0.0%)	.06 (0.2%)	-.02 (0.0%)
Growers' total revenue, GTREVD[c]	4.1 (3.2%)	18.0 (14.2%)	25.1 (18.2%)
Packers' export revenue, PXREVD[d]	.73 (1.2%)	2.0 (3.4%)	0.1 (0.2%)
Packers' total revenue, PTREVD[e]	5.7 (3.6%)	21.9 (14.5%)	28.6 (17.4%)

a. RNETD is the basis for the average past returns variables, RRD3 and RRD2, used in equations (1), (2), and (3); see identity (xxxii) in Table 3. The base run values for RNETD are $6.21 in the 2nd-5th, $1.50 in the 6th-15th, and $16.50 in the 16th-25th periods.

b. GXREVD=(PGX/GNPD)•QXT/1,000,000.

c. GTREVD=[PFD•QFR+s•(120/GNPD)•(QXT)]/1,000,000 where 120 is the amount paid for reserve pool raisins under the export incentive plan, in pwmt.

d. PXREVD=[(PX/GNPD)•(QXT)]/1,000,000.

e. PTREVD=[(PPD•QPKG+PBD•QBLK+(PX/GNPD)•QXT]/1,000000.

in f.o.b. prices. With increased supplies, the small difference in export levels narrows so that about the same amount is exported as in the base run.

Revenues to growers and packers are well above the base run in all periods.

Simulation 6: Effects of a High Population Growth Rate

Actual population data were used through 1985 in both the medium and high population growth experiments, so results for the 2nd-5th periods for both are reported in the first column of Table 13. In Table 14, model predictions using the high population growth rate for the 6th-25th periods are compared with the base run (first two columns) and with the medium growth rate (3rd and 4th columns). Domestic shipments are up 0.9 percent more than in the medium run in the 6th-15th period; 3.6 percent more in the 16th-25th periods. Prices and returns are higher, as are plantings, production and supply. After the 15th period, differences in prices from the base run begin to moderate, but they remain substantially above the medium run predictions. Net grower returns to raisin grape production remain $14.40 per short ton above a base of $1.50, and $4.50 above the average predicted value in Simulation 5 using the medium population growth projection.

Summary, Effects of Population Growth

The basic pattern is the same for both the medium and high population projections, but the effects are exaggerated under the high growth rate. (Note that with continuous population growth, the system can never achieve stationary equilibrium.) Domestic shipments expand substantially, rising 14.6 percent above base in the 16th-25th periods under the medium projection; 18.8 percent under high population growth. All prices increase as, at first, a relatively fixed supply becomes smaller in per capita terms.

Higher prices and shipments mean increasingly favorable returns to growers who respond by planting more vines, removing less, and allocating more grapes to raisin production. By the 16th-25th periods, raisin grape production is up 7 percent under the medium growth rate; 8.6 percent under the high; NTS deliveries are up 12.6 percent under the medium rate; 15.8 percent under the high. Production outpaces growth in demand so stocks build; supply increases by 17 percent under the medium and 20 percent under the high projections. With increased shipments and better prices, free tonnage is set 10.7 percent and 13.6 percent higher than base, respectively. With the larger levels of supply from increased plantings and allocation to raisins and larger amounts designated as free tonnage, domestic and fee tonnage price increases are moderated.

However, we have not considered that the populations of importing countries would likely also increase at similar rates. Such an increase in these populations would shift the aggregate export demand function facing packers, increase the upward pressure on prices, and encourage an even greater supply response.

In these experiments, the very large increase in predicted raisin grape plantings and the resulting increase in bearing acreage do not recognize competition from other crops that would also likely respond to population growth. This competition would moderate the impact of population growth on the California raisin industry.

Evaluation of a Reduction in Growers' Cost of Production

We now consider the impacts of a technological change that substantially reduces growers' costs in making NTS. Suppose, for example, that the dried-on-the-vine, mechanical harvesting technology were to replace the current labor-intensive method. The impact on cost of such a change is not known, but for simulation purposes, we will assume a 10 percent reduction.

Table 14. Effects of a High Population Growth Rate: Changes in Predicted Values of Key Endogenous Variables, Simulation 6 (S6) versus the Base Run (BR), Absolute and Percentage Changes S6 - BR, Yearly Averages, Periods 6—15 and 16—25; Comparison of High versus Medium Growth Rates, Simulation (S6) versus Simulation 5 (S5), Absolute and Percentage Changes S6 - S5, Differences in Predicted Values, Yearly Averages, Periods 6—15 and 16—25.

	S6 vs. BR		S6 vs. S5	
	6th-15th	16th-25th	6th-15th	16th-25th
Production				
Plantings, acres, PLANT	847 (27.2%)	2050 (53.4%)	126 (3.3%)	634 (12.1%)
Removals, acres, RMVL	-533 (10.7%)	-421 (10.3%)	-69 (1.5%)	-161 (4.2%)
Bearing acreage, 1000 acres, BA	4.4 (1.6%)	22.0 (8.6%)	.34 (0.1%)	4.2 (1.5%)
Production, 1000 short tons (st), QRG	37.2 (1.6%)	187.0 (8.6%)	2.9 (0.1%)	35.6 (1.5%)
Allocation to dry, 1000 st, QR	56.0 (4.4%)	192.5 (15.8%)	5.2 (0.4%)	39.2 (2.8%)
Deliveries, 1000 packed weight metric tons (pwmt), DEL	8.9 (4.4%)	30.5 (15.8%)	.83 (0.4%)	6.2 (2.8%)
Prices, deflated $ per pwmt				
f.o.b. packaged price, PPD	130 (11.6%)	109 (8.5%)	19 (1.5%)	37 (2.8%)
f.o.b. bulk price, PBD	117 (14.2%)	92 (9.5%)	17 (1.9%)	33 (3.2%)
f.o.b. export price, PX/GNPD	37 (7.0%)	11 (10.0%)	6 (0.5%)	9 (1.6%)
Free tonnage price, PFD	93 (12.6%)	85 (1.9%)	13 (1.6%)	27 (3.0%)
Price growers receive for NTS exports, PGX/GNPD	13 (3.1%)	3 (0.7%)	2 (1.2%)	3 (0.7%)
Shipments in pwmt				
Domestic shipments, 1000, QPKG+QBLK	8.1 (6.4%)	22.5 (18.8%)	1.1 (0.9%)	5.0 (3.6%)
Total exports, 1000, QXT	-1.5 (2.7%)	-.43 (0.8%)	-.26 (0.5%)	-.37 (0.7%)
The proportion of exports from the reserve pool, s	.05 (15.3%)	.05 (9.6%)	.006 (1.7%)	.01 (2.2%)
Supply and stocks, 1000 pwmt				
Free tonnage, QFR	5.9 (3.4%)	21.9 (13.6%)	.77 (0.4%)	4.6 (2.6%)
Packers' reported free tonnage stocks, BGSTK	2.5 (3.7%)	9.5 (15.2%)	.15 (0.2%)	1.6. (2.2%)
Growers' carryin reserve, CI	-1.8 (2.7%)	21.2 (47.0%)	-.61 (0.9%)	2.4 (3.8%)
Total supply, DEL+BGSTK+CI	9.5 (2.8%)	61.2 (20.4%)	.37 (0.1%)	10.3 (2.9%)
Growers' net returns, deflated $ per wet st				
RNETD[a]	14.3 (950.7%)	14.4 (87.3%)	2.1 (15.1%)	4.5 (17.2%)
Revenue, 1,000,000, deflated $				
Growers' export revenue, GXREVD[b]	.06 (0.3%)	-.03 (0.1%)	.005. (0.0%)	-.009 (0.0%)
Growers' total revenue, GTREVD[c]	21.0 (16.5%)	34.3 (24.7%)	3.0 (2.0%)	9.1 (5.6%)
Packers' export revenue, PXREVD[d]	2.4 (4.1%)	.61 (1.0%)	.39 (0.7%)	.52 (0.9%)
Packers' total revenue, PTREVD[e]	25.7 (17.1%)	39.8 (24.2%)	3.9 (2.3%)	11.2 (5.8%)

a. RNETD is the basis for the average past returns variables, RRD3 and RRD2, used in equations (1), (2), and (3); see identity (xxxii) in Table 3. Base run values for RNETD are -$8.85 in the initial period, $6.21 for 2nd-5th, $1.50 for 6th-15th periods, $16.50 for 16th-25th periods; SE7 values are $13.70 for 6th-15th, $26.36 for 16th-25th periods.

b. GXREVD=(PGX/GNPD)•QXT/1,000,000.

c. GTREVD=[PFD•QFR+s•(120/GNPD)•(QXT)]/1,000,000 where 120 is the amount paid for reserve pool raisins under the export incentive plan, in pwmt.

d. PXREVD=[(PX/GNPD)•(QXT)]/1,000,000.

e. PTREVD=[(PPD•QPKG+PBD•QBLK+(PX/GNPD)•QXT]/1,000000.

Simulation 7: Growers' Cost Reduced by 10 Percent

Simulation 7 tests the impact of a one-time reduction in cost of production. The growers' cost variable, GCRD, used in computing growers' net returns RNETD (identity xxxii in Table 3) is lowered by 10 percent; that is, GRCD • 0.9—a reduction of $11.97 per short wet ton. Predicted values are compared with base run values in Table 15.

Growers' net returns jump $11.97 from -$8.85 per short wet ton in 1981. In response, plantings are up 19 percent in the 2nd-5th periods; removals are down about 10 percent. The resulting increase in production comes when the new vines start to bear; after the 5th period, raisin grape production is up 2.5 percent above the base through the 15th period, and then up almost 3 percent after the 16th period.

The allocation to dry and NTS deliveries increase over base by almost 2 percent a year in the 2nd-5th periods, by over 4 percent in the 6th-15th and the 16th-25th periods.

These increases in raisin grape production and in NTS deliveries mean that a larger amount is designated as free tonnage: QFR increases by 1 percent per year through the 5th period, by over 4 percent in the 6th-15th and 16th-25th periods. Supply is also up by 2 percent, 8 percent, and nearly 10 percent for the respective periods considered. The extra supply builds up in the reserve pool with an increase of 82 percent over base in the 16th through 25th periods. Increased free tonnage and supply lead to substantial decreases for all prices. In the 16th-25th periods, f.o.b. prices for packages and bulk NTS are down 10 and 12 percent, respectively; the free tonnage price is 10 percent below base.[39] Both growers' and packers' export prices are also down. As a result, domestic and export shipments increase. By the 16th-25th periods, domestic shipments are almost 4 percent higher and exports are up 3.5 percent. However, because of inelastic demand functions, more shipped at lower prices means reduced revenue for growers and packers in all periods.

By the 16th-25th periods, growers' net returns, that had encouraged such increased supply, returned near to the base level, dropping $.38 below the base run predictions which averaged $16.50 per short wet ton during the 16th-25th periods. Meanwhile consumers at home and abroad enjoy larger shipments at lower prices.

Such a cost-reducing technological change apparently creates a dynamic window of profit for growers: The model suggests that successful adoption of a new technology that has an immediate effect on costs may allow growers to earn and retain above-equilibrium returns for a period of up to about 15 years. Thereafter, increased supply reduces price to fully compensate the reduced cost.

However, it is possible that a recurring cycle has been created by this one-time drop in grower costs. The supply response generated in the intermediate run may cause production to outpace demand beyond the 25th period, creating a trough of depressed returns bringing on a reduction in plantings, an increase in removals, and a smaller allocation to raisins. Then, with smaller supplies, prices would recover—and so on.

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39. In order to compare these price declines in Table 19 with the increase in growers' returns per wet short ton, divide the price in dollars per packed weight metric ton by the drying ratio (4.423), multiply by the sweatbox-to-packed weight conversion factor (.925), and divide by 1.10231, the short-to-metric ton converter. The average decreases in the free tonnage price, PFD, for example, become $2.66, $14.42, and $16.70 per short wet ton, in the respective periods.

Table 15. Effects of a 10 Percent Reduction in Growers' Costs: Changes in Predicted Values of Key Endogenous Variables, Simulation 7 (S7) versus the Base Run (BR), Absolute and Percentage Changes S7 - BR, Initial Period (1981), Yearly Averages of Periods 2—5, 6—15, and 16—25.

	Initial period	2nd-5th	6th-15th	16th-25th
Production				
Plantings, acres, PLANT	0	753 (18.9%)	292 (9.4%)	42 (1.1%)
Removals, acres, RMVL	0	-444 (9.7%)	-24 (0.5%)	148 (3.6%)
Bearing acreage, 1000 acres, BA	0	1.2 (0.4%)	6.6 (2.5%)	7.0 (2.7%)
Production, 1000 short tons (st), QRG	0	9.7 (0.4%)	56.3 (2.5%)	59.2 (2.7%)
Allocation to dry, 1000 st, QR	0	39.1 (1.9%)	55.9 (4.4%)	49.4 (4.1%)
Deliveries, 1000 packed weight metric tons (pwmt), DEL	0	6.2 (1.9%)	8.9 (4.4%)	7.8 (4.1%)
Prices, deflated $ per pwmt				
f.o.b. packaged price, PPD	0	-21 (1.8%)	-110 (9.8%)	-128 (10.0%)
f.o.b. bulk price, PBD	0	-20 (2.3%)	-100 (12.2%)	-117 (12.1%)
f.o.b. export price, PX/GNPD	0	-10 (1.7%)	-40 (7.6%)	-46 (7.9%)
Free tonnage price, PFD	0	-14 (1.8%)	-76 (10.3%)	-88 (10.4%)
Price growers receive for NTS exports, PGX/GNPD	0	-4 (0.8%)	-16 (3.6%)	-17 (3.7%)
Shipments in pwmt				
Domestic shipments, 1000, QPKG+QBLK	0	.78 (0.6%)	4.0 (3.2%)	4.7 (3.9%)
Total exports, 1000, QXT	0	.38 (0.7%)	1.6 (3.0%)	1.8 (3.5%)
The proportion of exports from the reserve pool, s	0	-.01 (1.3%)	-.04 (10.2%)	-.04 (8.3%)
Supply and stocks, 1000 pwmt				
Free tonnage, QFR	0	1.8 (1.0%)	7.4 (4.3%)	7.6 (4.7%)
Packers' reported free tonnage stocks, BGSTK	0	.46 (0.7%)	2.3 (3.5%)	2.5 (4.0%)
Growers' carryin reserve, CI	0	2.1 (4.3%)	16.8 (24.1%)	19.0 (42.3%)
Total supply, DEL+BGSTK+CI	0	6.5 (2.0%)	28.0 (8.2%)	29.4 (9.8%)
Growers' net returns, deflated $ per wet st				
RNETD[a]	11.97 (135.3%)	9.97(160.5%)	1.20 (80.0%)	-.38 (2.3%)
Revenue, 1,000,000, deflated $				
Growers' export revenue, GXREVD[b]	0	-.03 (0.1%)	-.17 (0.7%)	-.04 (0.2%)
Growers' total revenue, GTREVD[c]	0	-1.09 (0.8%)	-8.1 (6.4%)	-8.5 (6.2%)
Packers' export revenue, PXREVD[d]	0	-.63 (1.1%)	-2.8 (4.9%)	-2.8 (4.6%)
Packers' total revenue, PTREVD[e]	0	-2.1 (1.3%)	-11.1 (7.4%)	-11.4 (6.9%)

a. RNETD is the basis for the average past returns variables, RRD3 and RRD2, used in equations (1), (2), and (3); see identity (xxxii) in Table 3. Base run values for RNETD are -$8.85 in the initial period, $6.21 for 2nd-5th,$1.50 for 6th-15th periods; $16.50 for 16th-25th periods.

b. GXREVD=(PGX/GNPD)•QXT/1,000,000.

c. GTREVD=[PFD•QFR+s•(120/GNPD)•(QXT)]/1,000,000 where 120 is the amount paid for reserve pool raisins under the export incentive plan, in pwmt.

d. PXREVD=[(PX/GNPD)•(QXT)]/1,000,000.

e. PTREVD=[(PPD•QPKG+PBD•QBLK+(PX/GNPD)•QXT]/1,000000.

SUMMARY COMMENTS

This study formulated an econometric model of the California raisin industry with primary focus on naturally sun-dried Thompson seedless raisins (NTS) on U.S. and world markets. The model included stochastic equations pertaining to: (1) growers' choice of when and how much raisin grape acreage to plant and remove; (2) their allocation of the crop between drying for raisins and selling for crush in the wine market; (3) the Raisin Administrative Committee's determination of how much of the NTS crop should be declared as free tonnage—and how much as reserve—under the federal marketing order; (4) the bargaining process for the price of free tonnage NTS; (5) domestic demand for packaged and bulk NTS; (6) packers' f.o.b. price-establishment behavior in response to their costs and how sales are moving relative to supply; (7) the industry's frequent use of reserve pool NTS for export and the pricing of NTS exports; and (8) demand for NTS by major importing countries.

The econometric model provides a framework for analyzing the impact of major factors that affect the raisin industry over the years studied. However, there generally are changes in the structure of markets that require continual updating of econometric models if they are to be useful in short- or longer-term forecasting. An example from this study is the out-of-sample analysis of exports which were underestimated due to important changes in competitors' supplies. Thus, any econometric model must be used in conjunction with detailed industry knowledge, rather than as the sole basis for forecasts.

The model was utilized here to explore two kinds of questions or issues. First, simulation experiments were performed to evaluate the economic effects of one of the marketing programs (the export incentive plan), implemented under the marketing order. However, the marketing order program itself was not evaluated. Second, further simulations were performed to ascertain the interim and long-run effects of changes in exogenous variables such as costs, exchange rates, tariffs, and population on the endogenous prices, acreage, and quantity variables. With perennial crops, a change in an exogenous variable may induce shock waves felt over periods as long as 25 years. Under real market conditions such shock waves may be obscured by changes in a wide variety of other factors affecting the system. The simulation analysis permits us to hold these other factors constant while focusing on the change of interest.

Analysis of the Effects of the Export Incentive Plan and Changes in Exchange Rates

Three analyses were performed. The first (Analysis A) investigated the effects of the industry's export incentive plan (EIP) beginning in 1981 whereby reserve tonnage raisins were offered to packers at $100 per short sweatbox ton to blend with free tonnage raisins already held by packers. The objective of EIP was to lower the f.o.b. export price, making U.S. NTS more competitive abroad.

Under Simulation 1 without EIP, export prices received by growers and packers were from about 20 to 50 percent higher over the period of analysis than those predicted by the base run under EIP, but domestic f.o.b. and growers' free tonnage prices were lower by roughly 20 percent in the nearer term, due mostly to a supply buildup as exports dropped. Net revenues per ton to growers decreased substantially without EIP over those values predicted with the program.

The second analysis (Analysis B) investigated the impact of a 25 percent stronger dollar (without EIP). A strong dollar scenario (Simulation 2) was compared to Simulation 1 in which exchange rates were held at 1981 levels. With the strong dollar, exports were down from 10 to 20 percent over the period considered, leading to a price-depressing supply buildup. Growers' and f.o.b. prices dropped some 6 to 8 percent. However, lower returns discouraged planting, increased vine removals, and diverted NTS to the wine market, reversing the supply buildup and decreasing the price differences. After six years, prices had recovered somewhat but were still from 3 to 5 percent lower than the 1981 exchange rate base predictions. After the 16th year they were only about 2 percent lower than the base of comparison.

The third analysis (Analysis C) again looked at the effects of the EIP program, but this time under a strong dollar assumption. One reason for EIP was the strengthening dollar in the early 1980s, so analysis C gives another indication of the program's impact. Simulation 3, under EIP and a 25 percent stronger dollar, was compared with Simulation 2 which used a strong dollar without EIP. As in analysis A, export prices were considerably higher without EIP, decreasing exports from 16 to over 30 percent during the period examined. Reduced shipments abroad meant price-depressing supply buildups, particularly in growers' carryin reserve stocks. Lower grower net returns and reduced grower and packer total revenues without EIP over those with the program, replicated the results in analysis A in which exchange rates were held at their 1981 levels.

Evaluation of the Effects of Tariffs

Simulation 4 tested the elimination of all tariffs by major importing countries. There was a very small impact on the U.S. industry, for these tariffs are not high. Among more recent importers are countries which do place high tariffs on raisins, but these countries were not included in the model.

Effects of Growth of the U.S. and Canadian Population

Two analyses were performed to evaluate the effects of population growth on the industry. Simulation 5 compared the effects of a medium growth rate projection for the U.S. and Canadian populations with the base run in which population was held constant at its 1981 level. Under the medium growth rate assumption, domestic shipments at first increased an average of 1.4 percent a year; after the 5th period 5.6 percent a year; after the 15th, nearly 15 percent a year above base level predictions. With all other exogenous variables held constant, prices also increased. Resulting improved growers' returns led to a large positive supply response in their planting, removal, and allocation decisions.

Simulation 6 used the high population projection and compared it with the base run which held population constant. The high growth rate assumption meant even greater increases in domestic shipments: After the 6th period, shipments were up 6.4 percent; after the 15th, nearly 19 percent. Returns were even more favorable than under the medium growth rate assumption, encouraging a still greater supply response. Raisin grape acreage was up, on average, nearly 9 percent after the 16th period.

Evaluation of a Reduction in Grower Costs

Simulation 7 used a one-time 10 percent reduction in growers' cost for making raisins, due, say, to a change in harvesting technology. These predictions were compared with the base run in which the cost was held at its 1981 level. The 10 percent lower cost increased growers' net returns per ton over 100 percent, encouraging a very positive supply response: In the near term, plantings were up an average of 19 percent per year, removals down nearly 10 percent; after the 6th period, plantings were still nearly 10 percent above the higher-cost base and allocations to raisins increased over 4 percent.

With increased deliveries, supplies began to build, depressing grower and f.o.b. domestic and export prices. However, grower's net returns remained above their base level for over 15 years.

Future Research

There are other experiments that could be performed. Of particular interest would be to use the model to ask the "ultimate question": What if there hadn't been a marketing order? Such a question is subject to the "Lucas critique"—the coefficients of the econometric model are not invariant to such a structural change. That is, without the marketing order in place, the parameters of the model would be quite different. There may be ways, however, to get some indication of price levels and returns under a no-marketing-order scenario. This we leave for future research.

APPENDIX A. RAISIN-GRAPE PRODUCTION

(Explanation of Variables Used, Sources of Data, and Time Series Observations on Variables of Interest)

Plantings

The California Crop and Livestock Reporting Service (CCLRS) in its *California Fruit and Nut Acreage* publishes annually, for each of the state's major fruit and nut crops, estimates of acreage standing in the current year that was planted in each of the previous several years—including the current year. But in each year's report, the estimate of what was planted in a particular year is different. Generally, the estimate goes up for a few years, peaks and then goes down. Apparently, more acreage that was planted in a particular year is discovered as time goes on. One explanation is that CCLRS resurveys a single county about every four years. So when a large raisin-grape county is resurveyed the state's average plantings figure for that year may show a big change. After the peak, the estimates of acreage standing that was planted in a certain year begin to decrease, indicating that some acreage has been removed.

Rather than using the reported plantings figure for raisin grapes (acreage standing in the current year, planted in the current year) which decidedly understates plantings most years, the peak-year figure was chosen. Picking the peak may still understate plantings: Some removals in that acreage age bracket may have occurred in the interim and, perhaps, in some cases not all acreage planted that year is ever discovered and reported. This is especially true for years in which the peak figure is the last one reported. The adjusted plantings data are reported in Table A.1 together with the dependent variable used in equation (1):

$$PPLT=PLANT/TNA$$

where TNA is total net acreage, total acreage in t-1 minus removals after harvest in year t, identity (v) in Table 3.

Bearing Acreage

Because of the adjustments to the plantings data, the bearing acreage (BA) data also had to be adjusted. In year t+3 acreage planted in t is counted as (commercially) bearing. To the published bearing acreage figure in t must be added the adjustments made in t to the plantings figures in all but the last three age brackets (which are nonbearing). On the way to the peak in the plantings data in any age bracket, the adjustment to BA is simply the difference between the reported acreage standing of that age and the adjusted plantings figure, PLANT, for that age. At the peak of the reported acreage planted standing in year t, the adjustment to BA equals zero. Beyond the peak the adjustments also equal zero unless the figures dip and come back up. When this occurs, the next highest figure after the peak was used, so the adjustment is the difference between this and the reported plantings figure.

These adjustments presumably make the data a more accurate reflection of actual BA. The adjusted bearing acreage figures are given in Table A.1. Total acreage (TA), identity (vii)—the adjusted BA plus PLANT in t, in t-1, and in t-2—also appears in Table A.1.

Removals

The CCRLS in its *California Grape Acreage* has published raisin grape removal figures since 1974. Given the adjustments necessary for the plantings data, adjustments would probably be advisable for these data as well. One way to calculate an adjusted series and to provide a time series on removals before the CCLRS published data series begins is to calculate removals with adjusted bearing acreage and plantings data, solving identity (iii) in Table 3 for RMVL:

$$RMVL=-BA_t+BA_{t-1}+PLANT_{t-3}$$

However, this calculation results in negative removal figures for 1964, 1977, and a very large negative value for 1984. Hence, the published removal series was used from 1974; the calculated series, for 1963-73; the negative value for 1964 was set to zero. RMVL, which is assumed to occur after harvest in year t-1, appears in Table A.2, together with the proportion of bearing acreage removed, $PRMVL=RMVL/BA_{t-1}$, used as the dependent variable in equation (2). Total net acreage, TA_{t-1}-RMVL, is also shown in Table A.2.

Returns

For use as an explanatory variable in the plantings and removal equations, (1) and (2), weighted averages of the past several years of returns to NTS producers were constructed. Most of the component parts of these returns variables are explained and reported in subsequent appendixes: the free tonnage price, PF; the reserve price, PR; domestic shipments to the packaged and bulk markets, QPKG and QBLK, respectively; and total exports, the sum of exports to major importers, QX, and exports to the rest of the world, QROW.

Also used in the returns calculation is the conversion factor (CF) to change the returns back to sweatbox tons from a packed-weight basis. The factor CF, largely stemmer loss, was taken from RAC's *Marketing Policy* reports and is used throughout the model. Up through 1970-71, CF was reported in the "NTS Tonnage Made Available for Disposition in Commercial Trade Channels" table. From 1971-72 on, CF is given on the "General Information" sheets in the reports, beginning with the October 1978 issue. CF is reported in Table A.3.

The Gross National Product implicit price deflator (GNPD) was used to deflate this returns variable and all prices, costs, and income measures in the model, except for prices in importing countries. GNPD was taken from the U.S. Council of Economic Advisers, *the Economic Report of the President*; it was put on more nearly a crop-year basis by averaging across years; GNPD also appears in Table A.3.

The deflated gross return was put on a net basis by subtracting an estimate of growers' deflated costs for producing raisins (GCRD). A time series of growers' (deflated) costs for crush (GCWGD) was constructed from University of California Cooperative Extension sample costs sheets for San Joaquin Valley wine grapes. The data which had been collected by Amspacher, were deflated and appear in Table A.3. From several other sample cost sheets for Thompson Seedless grapes for raisins and for crush for the late 1970s and early 1980s, it was determined that growers' costs for drying average about 9 percent more than selling for crush. So in deflated terms, GCRD=1.09•GCWGD. These raisin-grape cost sheets assumed a wet yield of 9 short tons per acre vs. a dry yield of 2 short tons per acre, so 4.5 was used as the average drying ratio to convert the returns variable to a wet basis. GCRD is reported in Table A.3.

The net return, RNETD, identity (vii), is the gross return constructed from NTS deflated grower prices received and shipments, converted to a wet, sweatbox short ton basis minus grower cost, GCRD; RNETD is reported in Table A.4; because of the lags needed in the model, RNETD is reported from 1960. A three-year average of past values of RNETD was used in the plantings equation (1); a two-year average in the removals equation (2); RRD3 and RRD2, identities (vi) and (viii), are also reported in Table A.4.

Production

Yield was calculated by dividing raisin-grape production figures from CCRLS, *Fruit and Nut Statistics*, annual issues, by adjusted bearing acreage (BA). Raisin-grape production, QRG, identity (viii) in Table 3 is reported in Table A.5 together with the quantity marketed fresh, QF, and the quantity canned, QCAN, also from the *Fruit and Nut Statistics*. The net quantity, Q, identity (ix), to be allocated between the crush and dry outlets also appears in Table A.5.

Table A.1. Raisin Grape Plantings (PLANT), the Proportion of Plantings to Total Net Acres (PPLT), Bearing Acres (BA), and Total Acres (TA).

Year	PLANT	PPLT	BA	TA
	acres		acres	
1963	5,844	0.02262	247,890	264,205
1964	4,564	0.01727	252,491	268,769
1965	5,935	0.02241	254,456	270,799
1966	4,600	0.01726	255,990	271,089
1967	1,626	0.00612	255,071	267,232
1968	1,034	0.00402	250,855	258,115
1969	1,551	0.00611	250,999	255,210
1970	1,810	0.00730	245,529	249,924
1971	2,952	0.01200	242,672	248,985
1972	3,144	0.01281	240,614	248,520
1973	5,756	0.02348	239,013	250,865
1974	5,403	0.02158	241,445	255,748
1975	3,114	0.01236	239,494	253,767
1976	2,359	0.00948	237,129	248,005
1977	4,027	0.01650	242,532	252,032
1978	7,800	0.03144	240,626	254,812
1979	12,544	0.04949	240,357	264,728
1980	15,862	0.06043	244,139	280,345
1981	10,870	0.03905	250,294	289,570
1982	8,237	0.02862	262,215	297,184
1983	4,802	0.01629	274,200	298,109
1984	2,293	0.00779	295,919	311,251
1985	602	0.00199	283,450	291,147

Table A.3. Sweat box-to-Packed Weight Conversion Factor (CF), the Gross National Product Implicit Price Deflator (GNPD), Deflated Grower Costs for Wine Grape (GCWGD) and Raisin Grape Production (GCRD).

Year	CF	GNPD	GCWGD	GCRD
		1971-72=1.0	dollars per short ton	
1963	0.920	0.7222	56.36	61.31
1964	0.920	0.7357	55.87	60.78
1965	0.920	0.7556	58.23	63.36
1966	0.929	0.7791	60.20	65.50
1967	0.930	0.808	59.16	64.36
1968	0.920	0.8467	57.52	62.58
1969	0.928	0.8912	60.93	68.37
1970	0.930	0.9373	64.01	68.30
1971	0.930	0.9801	66.93	68.29
1972	0.930	1.0288	69.11	75.19
1973	0.910	1.1042	76.98	83.75
1974	0.920	1.2044	82.12	89.34
1975	0.900	1.2907	82.13	89.35
1976	0.890	1.362	83.04	90.35
1977	0.910	1.4524	88.27	96.04
1978	0.915	1.5692	91.32	99.36
1979	0.890	1.7092	103.03	112.10
1980	0.890	1.8701	102.45	111.47
1981	0.925	2.0149	110.08	119.77
1982	0.920	2.1134	119.24	129.73
1983	0.910	2.1936	114.88	124.99
1984	0.900	2.28542	115.73	126.15
1985	0.902	2.35469	106.62	116.21

Table A.2. Raisin Grape Acreage Removed (RMVL); the Proportion of Removals to Bearing Acreage in t-1 (PRMVL); and Total Net Acres, Total Acres in t-1 minus Removals in t (TNA).

Year	RMVL	PRMVL	TNA
	acres		acres
1963	3,301	0.01369	258,361
1964	0	0	264,205
1965	3,905	0.01547	264,864
1966	4,310	0.01694	266,489
1967	5,483	0.02142	265,606
1968	10,151	0.0398	257,081
1969	4,456	0.01776	253,659
1970	7,096	0.02827	248,114
1971	3,891	0.01585	246,033
1972	3,609	0.01487	245,376
1973	3,411	0.01418	245,109
1974	520	0.00218	250,345
1975	3,874	0.01605	251,874
1976	5,029	0.02100	248,738
1977	3,875	0.01634	250,489
1978	1,543	0.00636	244,130
1979	1,357	0.00564	250,489
1980	2,222	0.00924	253,455
1981	1,960	0.00803	262,506
1982	1,723	0.00688	278,385
1983	2,420	0.00923	287,847
1984	3,657	0.01334	294,452
1985	9,034	0.03053	302,217

Table A.4 Deflated Net Grower Return to NTS Production (RNETD) and the Three- and Two-Year Average of Lagged Deflated Net Grower Returns (RRD3) and (RRD2).

Year	RNETD	RRD3	RRD2
	dollars per short (wet) ton		
1960	6.87	—	—
1961	1.72	—	—
1962	21.46	—	—
1963	13.29	10.02	11.59
1964	12.22	12.16	17.37
1965	6.55	15.65	12.75
1966	-2.91	10.69	9.38
1967	9.96	5.29	1.82
1968	10.00	4.53	3.53
1969	1.47	5.68	9.98
1970	-0.91	7.15	5.74
1971	0.72	3.52	0.28
1972	32.54	0.43	-0.09
1973	57.12	10.78	16.63
1974	22.74	30.13	44.83
1975	11.62	37.47	39.93
1976	75.57	30.49	17.18
1977	36.38	36.64	43.59
1978	127.23	41.19	55.98
1979	40.51	79.73	81.81
1980	33.35	68.04	83.87
1981	14.39	67.03	36.93
1982	-5.82	29.42	23.87
1983	-14.44	13.97	4.28
1984	-62.51	-1.96	-10.13
1985	-48.08	-27.59	-38.48

Table A.5. Raisin Grape Production (QRG); the Quantity Allocated to the Fresh Market (QF), to the Canned Market (QCAN), and the Net Quantity to be Allocated between Crushing and Drying (Q).

Year	QRG	QF	QCAN	Q
		short (wet) tons		
1963	2,192,400	209,400	43,000	1,940,000
1964	2,019,400	224,800	60,000	1,734,600
1965	2,575,000	246,000	54,800	2,274,200
1966	2,175,000	254,000	62,000	1,859,000
1967	1,635,000	215,000	54,000	1,366,000
1968	2,135,000	252,000	64,000	1,819,000
1969	2,155,000	236,700	66,300	1,852,000
1970	1,871,000	146,300	53,700	1,671,000
1971	2,312,000	156,600	58,400	2,097,000
1972	1,344,000	140,500	50,500	1,153,000
1973	2,376,000	140,000	59,000	2,177,000
1974	1,970,000	133,500	61,200	1,775,300
1975	2,205,000	173,700	52,700	1,978,600
1976	1,957,000	173,000	48,000	1,736,000
1977	1,935,000	155,000	54,000	1,726,000
1978	1,670,000	155,000	55,000	1,460,000
1979	2,320,000	184,000	60,000	2,076,000
1980	2,692,000	239,000	63,000	2,390,000
1981	1,779,000	204,000	42,000	1,533,000
1982	2,642,000	303,000	35,000	2,304,000
1983	2,350,000	252,000	35,000	2,063,000
1984	2,282,000	275,000	30,000	1,977,000
1985	2,475,000	328,000	45,000	2,102,000

APPENDIX B. ALLOCATION OF THE NET QUANTITY OF RAISIN GRAPES BETWEEN DRY AND CRUSH

(Explanation of Variables Used, Sources of Data, and Time Series Observations on Variables of Interest)

The quantities of raisin grapes allocated to be dried, QR, or crushed, QC, were taken from CCLRS, *Fruit and Nut Statistics*, various issues and are reported in Table B.1. The NTS returns variable on a wet short-ton basis used in the allocation equation (3), RRD3, is the same as was used in the plantings equation and is found in Table A.4. The crush return, CR, also came from the *Fruit and Nut Statistics*, was deflated by the GNPD, and is reported in Table B.1 as CRD. Deflated grower costs for wine grapes, GCWGD in Table A.3, were subtracted from CRD for the net crush return, CRDNET, identity (xi). GCWGD was one of the instruments in the estimation of equation (3); GCWGD is reported in Table B.1. Apparently, these data for growers' cost, extracted from Cooperative Extension costsheets, resulted in grower cost estimates that are (perhaps) unrealistically high, at least relative to the CCLRS average crush return data. The result is many negative values for the net crush return.

From the quantity allocated to be dried, QR, the quantity to NTS is determined in identity (xii). The drying ratio, DR, used was computed from CCLRS data as the fresh tonnage allocated to drying divided by the resulting dried tonnage, as reported in the *Fruit and Nut Statistics*. The dried tonnage was converted to a packed-weight, metric-ton basis using (1) CF in Table A.3; (2) the short-to-metric ton conversion factor, 1.10231; and (3) the historic proportion of the dried tonnage that is NTS, Π. Π was computed by forming the ratio of NTS deliveries, DEL, reported in RAC's *Marketing Policy* reports, to the CCLRS-reported dried raisin tonnage, QR. Π is reported in Table B.2 together with DR and DEL.

Table B.1. The Quantity of Raisin Grape Production Allocated to Dry for Raisins (QR) and to Crush (QC); the Gross and Net Crush Return (CRD) and (CRDNET)

Year	QR	QC	CRD	CRDNET
	short (wet) tons		dollars per short (wet) ton	
1963	1,069,000	871,000	46.39	-9.97
1964	1,033,000	701,600	56.14	0.27
1965	1,295,000	979,200	39.04	-19.19
1966	1,184,000	675,000	35.30	-24.90
1967	751,000	615,000	49.01	-10.15
1968	1,110,000	709,000	47.36	-10.16
1969	1,007,000	845,000	53.19	-7.74
1970	820,000	851,000	57.83	-6.19
1971	893,000	1,204,000	55.10	-11.84
1972	436,000	717,000	75.43	6.32
1973	967,000	1,210,000	71.09	-5.89
1974	1,021,300	754,000	48.99	-33.13
1975	1,249,600	729,000	45.71	-36.41
1976	981,000	755,000	61.38	-21.66
1977	1,132,000	594,000	68.71	-19.55
1978	758,000	702,000	97.50	6.18
1979	1,376,000	700,000	88.35	-14.69
1980	1,612,000	778,000	77.00	-25.45
1981	1,024,000	509,000	98.76	-11.32
1982	1,530,000	774,000	60.09	-59.15
1983	1,733,000	330,000	47.41	-67.47
1984	1,390,000	587,000	34.13	-92.02
1985	1,543,000	559,000	33.13	-83.09

Table B.2. The Proportion of the Quantity Dried that is NTS (Π), the Drying Ratio (DR), and NTS Delivered to Packers' Doors (DEL).

Year	Π	DR	DEL metric tons, packed weight
1963	0.77	4.24	163,056
1964	0.91	4.49	175,187
1965	0.90	4.80	203,063
1966	0.93	4.23	218,340
1967	0.89	4.15	136,103
1968	0.91	4.20	201,099
1969	0.91	4.01	191,465
1970	0.91	4.25	148,544
1971	0.89	4.60	145,406
1972	0.87	4.15	76,994
1973	0.89	4.32	164,078
1974	0.88	4.23	177,263
1975	0.89	4.40	206,787
1976	0.54	4.50	94,954
1977	0.88	4.56	180,639
1978	0.43	4.40	61,766
1979	0.87	4.55	212,432
1980	0.82	5.21	205,609
1981	0.88	4.00	188,357
1982	0.70	5.23	171,679
1983	0.88	4.37	287,241
1984	0.89	4.15	244,510
1985	0.88	4.49	248,182

APPENDIX C. RAC-DECLARED FREE TONNAGE AND RBA–BARGAINED FREE TONNAGE PRICE

(Explanation of Variables Used, Sources of Data, and Time Series Observations on Variables of Interest)

Free Tonnage

The initial free tonnage set by the RAC and purchased by packers is reported in RAC's *Marketing Policy* annual reports, Table No. 8, "Natural Seedless Raisins Tonnage Made Available for Disposition in Commercial Trade Channels." Additional purchases made by packers from the reserve pool for free tonnage uses, are also given in the *Marketing Policy* reports; these purchases were added to the initially declared free tonnage and the result was put on a packed-weight, metric ton basis to accord with the shipments and other data in the marketing model, using CF (Table A.3) and the metric-to-short ton conversion factor; see QFR in Table D.1.

POP, the population of the United States and Canada, is used to put the free tonnage quantity on a per capita basis. The U.S. January 1st population figures were from U.S. Bureau of the Census in its Series P-25, No. 952, May 1984, Table 1, and for 1982-85, in its *Current Population Reports*, P-25, No. 962. (Hawaii and Alaska are included as are armed forces overseas.) The Canadian population statistics are from the U.N. *Monthly Bulletin of Statistics*. POP appears in Table C.1 together with the per capita free tonnage quantity, QFR/POP.

The explanatory variables used in equation (6) are:

- PD_{t-1}, identity (xxxiii) in Table 3 is the weighted average of packaged and bulk f.o.b. domestic prices, explained in Appendix E; PD for 1962-85 is reported in Table C.2.
- Total domestic shipments lagged, QPKG, identity (xvii), plus QBLK, identity (xviii), are explained in Appendix E.
- Packers' reported beginning stocks, BGSTK, is described in Appendix D.

- Other supply includes deliveries, DEL, identity (xii) (Table B.2), and growers' carryin reserve (CI). CI is from RAC's *Marketing Policy* reports and is reported in Table C.2. In the simulation model, CI is predicted by identity (xiii) which uses identities (xiv) and (xxvii). Identity (xiv) is the remaining reserve, RES, after all free tonnage sales to packers; RES is reported in Table C.2. OTHER is the sum of uses of the reserve pool other than exports and carryover stocks; these uses include sales to wineries for alcohol manufacture, sales for cattle feed, shrinkage, etc. Identity (xv) in Table 3 predicts OTHER where the historic (1963-83) proportion of OTHER to RES is used, i.e., 0.10.
- The quasi dummy variable, X, equals zero until 1977 after which it equals lagged total exports. (X is entered in equation (5) to reflect the RAC policy change with respect to exports.) Total exports, QX in identity (xxv) plus QROW in identity (xxvi), are explained in Appendix F.

Free Tonnage Price

The free tonnage field price is the Raisin Bargaining Association's bargained-for price. The price received on the RAC initially declared free tonnage was taken from RAC, *Raisin Industry Statistical Information*, "Independent Producer Returns on Natural Thompson Seedless Raisins Segregated by Pools and Total Deliveries"; the 1983 and later free tonnage prices were from the RBA *Communique*. The price used in the model, PFD, is a (deflated) weighted average of this initial free tonnage price and the cost of additional purchases from the reserve pool for free use, which includes interest and storage. Prices paid for the additional free tonnage purchases are from the *Marketing Policy* reports, "Supply and Disposition of Reserve Pool Natural Thompson Seedless Raisins." The weighted average of the original free tonnage price and prices paid for additional purchases was converted to a packed-weight, dollars per metric ton basis and deflated by the GNPD; PFD is reported in Table C.2.

The net f.o.b. price, PNETD, is lagged one period and used in equation (7). PNETD has same components as PD in Table C.2, but is put on a net basis by subtracting processing costs. Processing costs for packaged and bulk NTS which are an important factor in the price establishment equations, are explained in Appendix E. PNETD is also reported in Table D.2. Also in equation (7) are the per capita free tonnage quantity (Table C.1) and the per capita remaining supply, i.e., total supply, DEL+BGSTK+CI, identity (xvi), minus the free tonnage quantity, QFR, which was reported in Table D.1.

The other variable in equation (7) is X which is explained above.

APPENDIX D. PACKERS' REPORTED BEGINNING STOCKS

(Explanations of variables used in equation (6) and times series observations.)

When packers' ending stocks are calculated as free tonnage supplies minus all free tonnage shipments and small amounts sold to the government, the residual amount does not equal packers' reported beginning stocks in t+1 as of September 1st in the RAC's *Marketing Policy* reports. Consequently, packers' *reported* stocks were used in the model as predicted by equation (6), which uses as variables free tonnage supplies, QFR_{t-1} and $BGSTK_{t-1}$, and free tonnage marketings, QMF_{t-1}. QFR is explained in Appendix C. QMF, identity (xxxi), includes packaged and bulk domestic shipments, QPKG and QBLK, identities (xviii) and (xvii), which are described in Appendix E and free tonnage exports, QXF, identity (xxx), explained in Appendix F. BGSTK and QMF are reported in Table D.1.

Table C.1. Free Tonnage NTS, the Initial Free Tonnage plus Packer Purchases during the Marketing Year (QFR); the U.S. and Canadian Population (POP); and Per Capita Free Tonnage.

Year	QFR metric tons, packed weight	POP millions	QFR/POP grams
1963	124,486	209.57	594.01
1964	120,291	212.52	566.01
1965	112,159	215.14	521.33
1966	117,839	217.84	540.95
1967	121,533	220.21	551.90
1968	115,632	222.56	519.55
1969	111,050	224.85	493.89
1970	103,981	227.77	456.52
1971	111,963	230.52	485.70
1972	79,879	232.79	343.14
1973	164,078	235.03	698.11
1974	129,402	237.43	545.01
1975	149,082	239.90	621.45
1976	106,090	242.28	437.88
1977	180,393	244.78	736.97
1978	61,766	247.38	249.68
1979	193,769	250.14	774.63
1980	175,899	252.78	695.86
1981	185,590	255.56	726.22
1982	200,958	258.11	778.59
1983	166,705	260.53	639.87
1984	235,405	260.76	902.78
1985	206,681	265.89	777.31

Table C.2. The Weighted Average f.o.b. Price for Packaged and Bulk NTS (PD), the Residual Reserve after Free Tonnage Shipments (RES), Growers' Carryin Reserve (CI), the Deflated Free Tonnage Grower Price (PFD), and the Weighted Average Net f.o.b. Price for Packaged and Bulk NTS (PDNET).

Year	PD	RES	CI	PFD	PDNET
	$/metric ton	metric tons,packed weight		$/metric ton	
1962	573.91	—	—	—	420.87
1963	555.66	38,570	0	420.16	401.24
1964	548.48	55,535	638	412.42	361.86
1965	554.98	102,381	11,477	403.96	306.67
1966	535.10	134,358	33,858	357.57	326.66
1967	591.95	62,187	47,617	447.41	394.42
1968	624.83	97,125	11,659	442.22	444.89
1969	610.81	106,071	25,656	423.18	429.72
1970	597.91	80,112	35,549	404.66	422.42
1971	634.55	56,107	22,663	393.04	467.44
1972	1043.01	0	2,885	574.59	841.53
1973	1102.15	0	0	767.91	902.00
1974	911.73	47,861	0	636.69	705.74
1975	853.44	75,255	17,550	624.61	659.49
1976	1418.12	22,840	33,976	954.83	1152.58
1977	1029.17	246	0	721.81	746.73
1978	2092.97	0	0	1228.36	1692.70
1979	1247.73	18,663	0	850.54	903.54
1980	1137.75	41,515	11,806	807.16	810.32
1981	1067.39	42,384	39,616	762.89	790.84
1982	995.80	0	29,278	742.23	728.21
1983	900.50	120,536	0	719.57	619.02
1984	599.10	89,905	80,800	383.61	357.11
1985	612.13	115,576	74,076	400.09	381.67

Table D.1. Packers' Reported Beginning Stocks (BGSTK); Free Tonnage Shipments to the NTS Packaged and Bulk Markets and Free Tonnage Exports (QMF).

Year	BGSTK	QMF	Year	BGSTK	QMF
	metric tons, packed weight			metric tons, packed weight	
1962	18,852	146,773	1974	12,421	129,993
1963	17,737	123,725	1975	9,858	134,999
1964	17,276	119,079	1976	32,544	114,535
1965	20,209	113,808	1977	23,410	153,735
1966	16,537	114,464	1978	50,100	97,666
1967	14,444	115,241	1979	13,812	162,083
1968	20,221	110,506	1980	44,829	178,348
1969	23,852	109,224	1981	44,888	170,441
1970	24,323	108,323	1982	48,463	156,631
1971	17,207	115,645	1983	69,761	149,973
1972	12,579	91,670	1984	51,684	212,207
1973	1,233	148,621	1985	78,162	220,213

APPENDIX E. DOMESTIC DEMAND AND PRICING SYSTEM

(Explanation of Variables Used, Sources of Data, and Time Series Observations on Variables of Interest.)

The shipments data on quantities of packaged and bulk pack NTS, QPKG and QBLK, were from the table "Shipments of Natural Thompson Seedless to Domestic and Canadian Markets, Packed Weight Basis," in RAC's *Marketing Policy* reports, various issues. In 1975-76, the marketing order fiscal year was changed from a September-August to a August-July basis. To avoid adjusting the packaged and bulk shipments data either back to 1963 or forward which might not have accorded well with other data used, the 11-month total for 1975-76 was multiplied by the ratio 12/11.

Serious efforts were made to obtain Canadian shipments data good enough to estimate a separate NTS import demand function as was done for other major importers. There was a tradeoff between using (1) NTS shipments disaggregated by packaged and bulk but aggregated for the United States and Canada and (2) shipments disaggregated by country but not by type. The RAC reports NTS shipments to Canada in its *Final Report*, "Monthly Shipment Report Designating Countries by Destination by Varietal Type," August, various years, but the information is only available from 1974 on and it is not disaggregated by packaged and bulk. Other sources on U.S. raisin exports are for *all* raisins not just NTS;[40] sometimes currants are also included. Marketing order pooling arrangements differ by type of raisin; for instance there have not been reserve pools for Muscats, Sultanas, Golden Seedless, or Zante Currants since the 1950s. In the tradeoff between separating out Canada from the all-raisin shipments data and separating out NTS from the two-country shipments data, the latter course was chosen.

Packaged and bulk NTS shipments were put on a per capita basis by dividing by the population of the United States and Canada, POP, reported in Table C.1. The resulting per capita quantities, QCPKG and QCBLK, are reported in Table E.1 together with total shipments, QPKG and QBLK. QPKG and QBLK, lagged in equation (5) are reported for 1962-85.

U.S. personal consumption expenditures were taken as representative of both countries and were taken from U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, various issues. The third and fourth quarters of one year were averaged with the first and second of the next to put the series on a near crop-year basis. U.S. expenditures were put on a per capita basis by dividing by the U.S. population, POPUS. Per capita expenditures, ECUD, used in the domestic demand equations (10) and (11) and POPUS are reported in Table E.2.

Data on substitutes for NTS were provided by Art Hamlin of the U.S. Department of Labor, Bureau of Labor Statistics: a wholesale price index for cookies, crackers, and related products, used in the domestic packaged demand equation (10) and a wholesale price index for cereal and bakery products in the domestic bulk demand equation (11). This latter index is a weighted average of: bread; bread-type rolls; bread stuffing, croutons, and breadcrumbs; sweet yeast goods; soft cakes; pies; cake-type donuts; cookies, crackers, and related products; flour, flour-base mixes and doughs; milled rice; cereals. Both indexes were put on a crop-year basis by averaging monthly observations, and then they were deflated by the GNPD. The price index for cookies and crackers used as a substitute in equation (10) (PSUBD) and for bakery products used as a complement in equation (11) (PCOMPD) are also reported in Table E.2.

The initial f.o.b. price series for packaged and bulk NTS were taken from the weekly quotes in the *Pacific Fruit News*, "Dried Fruit and Tree Nuts Packer Quotations," averaged over the

40. The U.S. Department of Agriculture, Economic Research Service publishes detailed export data by commodity and by country in its *Foreign Agricultural Trade of the United States* on calendar year, fiscal year, and monthly bases. The USDA, Foreign Agricultural Service also provides raisin export data in its *Foreign Agricultural Circular*, various series. The USDA-State of California, Federal-State Market News Service gives raisin exports from the United States by country of destination. And the United Nations, Food and Agriculture Organization, *Trade Yearbook*, gives exports from and imports to most countries in the world.

crop year. The last weekly quote of the month (or as near as possible) was used in the 12-month average.

For a representative price of packaged NTS, the cents-per-pound list price for a case of 48 15-oz. packages or of 24 15-oz packages was converted to dollars per metric ton and then deflated by the GNPD. Later, these *Pacific Fruit News* list prices for 1974 through 1983 were adjusted by trading information given in American Institute of Food Distribution's, *Food Institute Report*. The 1984 and 1985 prices are also from this report. This weekly report not only gives list prices for branded and private label packaged and bulk NTS, but also reports whether trading was at list or below, and, if below, how much below. The final selection of a representative annual packaged NTS price from 1974 on was a (somewhat subjective) combination of the original list prices, the branded and private label quotes, the final trades in August and September, opening prices for the new crop, and adjustments made through the marketing year. The resulting annual average converted to dollars per metric ton and deflated by the GNPD appears as PPD in E.3.

The price of bulk pack NTS in deflated dollars per metric ton is also reported in Table E.3. Initially, a partial series was constructed using the cents-per-pound list prices for bulk NTS in *Pacific Fruit News*. In 1972-73 and again in 1974-75, *Pacific Fruit News* gave no quotes for bulk pack. Brian Todd of the American Institute of Food Distribution, using the institute's reports, provided list and trading prices for 30 lb. Selects (bulk pack) NTS for 1972-73, 1973-74, and 1974-75. The institute reports were available from 1975 on and were used to adjust the *Pacific Fruit News* list prices by the trading information they provided.

A series for costs other than for raw product purchases was constructed using Sun-Maid and Sun-Diamond annual reports for 1973-79 and 1980-86, respectively. For 1971 through 1983, the statements of operations from these reports were used; the line items for processing and packing, freight and storage; marketing, selling, and administration; and advertising were added. Because raisins are mostly left unprocessed until sold, these costs were divided by tons sold. The annual reports also summarized processor costs per ton sold for earlier years; these figures were used for 1963-70. These Sun-Maid costs were taken as representative of the industry. Charles Bonner of Bonner Packing Company suggested (in a letter of October 7, 1985) that packaged NTS processing costs were about 1.12 times bulk costs. The Sun-Maid series was taken as the packaged NTS cost, PC, so the bulk processing cost, PCB=PC/1.12. Both cost series in deflated terms, PCD and PCBD, are reported in Table E.3.

The cost of raisins for most shipments is the free tonnage price, PFD, explained in Appendix C and reported in Table C.2. The sum of the fruit and nonfruit costs is used in the two price setting equations, (8) and (9).

Table E.1. Domestic Market NTS Shipments to Packaged and Bulk Markets (QPKG) and (QBLK); Per Capita Domestic NTS Shipments to Packaged and Bulk Markets.

Year	QPKG	QBLK	QCPKG	QCBLK
	metric tons		grams	
1962	56,238	58,677	—	—
1963	55,286	57,280	263.81	273.32
1964	54,350	60,324	255.73	283.85
1965	50,906	58,280	236.62	270.90
1966	52,954	57,711	243.09	264.93
1967	53,923	58,136	244.87	264.01
1968	49,541	58,735	222.60	263.91
1969	50,530	56,335	224.73	250.55
1970	50,954	55,246	223.71	242.56
1971	54,251	58,239	235.34	252.64
1972	35,743	45,402	153.55	195.04
1973	61,334	52,475	260.96	223.27
1974	60,237	50,956	253.70	214.61
1975	66,230	63,616	276.08	265.18
1976	52,185	53,467	215.39	220.68
1977	57,123	56,945	233.37	232.64
1978	36,827	43,754	148.87	176.87
1979	56,410	56,787	225.51	227.02
1980	59,943	72,984	237.14	288.73
1981	63,672	71,893	249.15	281.32
1982	64,824	68,976	251.15	267.24
1983	60,058	71,723	230.52	275.30
1984	74,225	89,703	284.65	344.01
1985	70,239	101,217	264.16	380.67

Table E.2. U.S. Per Capita Deflated Personal Consumption Expenditures (ECUD), U.S. Population (POPUS), Deflated Price Index of Cookies, Crackers, and Related Products (PSUBD) and of Bakery Products (PCOMPD).

Year	ECUD	POPUS	PSUBD	PCOMPD
	dollars	thousands		
1963	2,810.81	190,668	128.22	127.14
1964	2,910.57	193,223	127.19	125.77
1965	3,037.24	195,539	127.12	127.18
1966	3,098.22	197,736	127.03	128.97
1967	3,161.14	199,808	126.92	124.06
1968	3,271.52	201,760	121.77	120.57
1969	3,306.13	203,849	123.90	118.30
1970	3,313.60	206,466	125.48	118.71
1971	3,408.63	208,917	123.69	114.62
1972	3,556.25	210,985	120.38	117.39
1973	3,595.09	212,932	133.97	141.72
1974	3,599.98	214,931	161.52	147.44
1975	3,705.95	217,095	152.27	135.59
1976	3,850.22	219,179	150.10	125.03
1977	3,954.40	221,477	156.11	126.11
1978	4,062.91	223,880	154.37	127.07
1979	4,113.81	226,444	156.06	132.75
1980	4,125.87	228,878	160.30	133.25
1981	4,132.30	231,256	154.01	126.56
1982	4,189.69	233,506	148.34	121.48
1983	4,363.17	235,627	150.30	121.69
1984	4,610.42	238,207	152.52	120.78
1985	4,733.33	240,523	156.11	119.90

Table E.3. Deflated f.o.b. Prices for Packaged and Bulk NTS (PPD) and (PBD) and Deflated Processor Costs for Packaged and Bulk NTS (PCD) and (PCBD).

Year	PPD	PBD	PCD	PCBD	Year	PPD	PBD	PCD	PCBD
		dollars per metric ton					dollars per metric ton		
1963	595.27	517.42	163.32	145.82	1975	967.69	734.49	204.70	182.76
1964	591.83	509.43	197.77	176.58	1976	1511.01	1327.46	280.76	250.68
1965	637.52	482.88	263.37	235.15	1977	1147.07	910.91	298.40	266.43
1966	614.05	462.66	220.77	197.11	1978	2247.64	1962.78	424.99	379.46
1967	652.11	536.15	209.16	186.75	1979	1490.76	1006.32	363.74	324.77
1968	717.34	546.79	191.04	170.57	1980	1310.09	996.20	347.90	310.62
1969	698.84	531.86	191.93	171.37	1981	1191.62	957.37	293.22	261.80
1970	691.52	511.58	185.85	165.94	1982	1089.71	907.54	283.24	252.89
1971	726.55	548.85	176.92	157.96	1983	1027.53	794.13	298.92	266.89
1972	1143.08	964.23	214.33	191.36	1984	665.39	544.25	257.06	229.52
1973	1123.07	1077.70	210.56	188.00	1985	687.42	559.88	246.02	219.66
1974	1033.30	768.02	216.62	193.41					

APPENDIX F. THE EXPORT SECTOR

(Explanation of Variables Used, Sources of Data, and Time Series Observations on Variables of Interest.)

Shipments to Major Importers

RAC's table "Natural Seedless Raisin Shipments by Country of Destination" in its *Marketing Policy* reports, annual issues was used for U.S. exports to major importing countries. The major importing countries included in the model—the United Kingdom, West Germany, Netherlands-Belgium, Norway-Sweden-Denmark, and Japan—accounted for from 70 to 80 percent of total NTS exports between 1963 and 1983; shipments, in metric tons, to these five major importing countries or groups of country, QU(I), I=UK, WG, NB, NSD, and J, are reported in Table F.1.

Shipments to major importers, Q(I), were put on a per capita basis QC(I) by dividing by the population of importer I as reported in the U.N. *Monthly Bulletin of Statistics.* Shipments to the Netherlands-Belgium were divided by the population of both countries; to Scandinavia, by the populations of Norway, Sweden, and Denmark. These population figures are reported in Table F.2; per capita shipments are found in Table F.3.

Total Exports

The sum of shipments to major importers, QX, identity (xxv) and shipments to the rest of the world, QROW, appear in Table F.4. QROW represents many other countries, including ten Latin American countries, other European countries, and other Asian countries. QROW is exogenous in the econometric model; in the simulation identity (xxvi), the 1963-83 proportion to QX is used, i.e., QROW=.39•QX. (Taiwan, Korea, and other Asian importers have become increasingly important buyers in the late 1970s and early 1980s.) Total exports (QXT), the sum of QX and QROW is also reported in Table F.4.

Reserve tonnage exports (QXR) and free tonnage exports (QXF) were taken from RAC's *Marketing Policy* reports and are reported in Table F.4. Except in the short crop years, 1972 and 1973, most exports were from the reserve pool, until 1977 when RAC changed its policy and exported only from free tonnage. The proportion, s, of total exports that is from the reserve pool is reported in Table F.4. From 1977-1980, s=0. Then in 1981, the export incentive plan began, so s again is the proportion of exports from the reserve pool. Under EIP these exports were sold to packers at $100 per short sweatbox ton. The proportion, s, through 1976 is predicted by equation (13); for 1981 and after, by (13a) in Table 3.

Prices Landed in Importing Region, I

PU(I)D, the deflated prices of U.S. NTS in importing country I, I=the United Kingdom (UK), West Germany (WG), the Netherlands (N), Sweden (S), and Japan (J), identities (xx) through (xiv), are reported in Table F.5. The construction of these identities involves, first the f.o.b. export price, PX, identity (xix):

$$PX=PGX+(PB-PF)$$

where PGX is the reserve tonnage price that growers receive for NTS that are to be exported, and PB and PF are the undeflated bulk NTS f.o.b. and free tonnage prices, respectively. The export price, PX, is kept in nominal dollars, for import prices will be deflated by the consumer price indexes in the respective countries. PX is reported in Table F.6, together with its component parts, the bulk price, PB; the free tonnage price, PF; and the reserve NTS for export price, PGX.

The Reserve NTS for Export Price, PGX

PGX is a weighted average of the free and reserve tonnage prices that growers receive for exported NTS. It is composed of (1) PR, a weighted average over the crop year of packers' purchases from the reserve pool for export, using RAC's table "Supply and Disposition of Reserve Pool Natural Thompson Seedless Raisins," in its *Marketing Policy* reports, annual issues; (2) the export tonnage from the reserve pool, QXR; and (3) the free tonnage price (PF), and free tonnage exports, QXF. The resulting price per sweat box short ton was converted to a dollars per packed-weight, metric-ton basis. In certain years, e.g., 1976, even though no reserve was declared, purchases for export were made from the carryin reserve. In other short-crop years, 1972 and 1973, PGX equals PF because all reserve pool purchases for export were considered free tonnage. Packer reserve-purchases-for-export stopped with the marketing policy change that declared all exports as free tonnage, so PR=PF for 1977 through 1980.

Then, in 1981 the export incentive plan (EIP) was initiated. During the 1981-82 crop year and following, prices for NTS to be exported were blended down to be more "competitive" on world markets. Under EIP, packers were offered reserve tonnage at $100 per sweatbox short ton to blend with free tonnage, purchased at the free tonnage price, PF. The price $100 per ton stayed constant, as the proportions reserve-to-free were varied according to a schedule.[41] PGX, the price growers receive for NTS to export, is the blend of the free tonnage price, PF and EIP sales. That is, $PGX = (1-s)\bullet PF + s\bullet 120$, where 120 is approximately $100 converted to a packed weight metric ton basis. Details about EIP and the proportion of reserve NTS at $100 per ton to blend with free tonnage held by packers are from RonWorthley of the RAC. (In 1982 there was no reserve pool, but EIP was continued in anticipation of a reserve pool the next year.)

PGX is the dependent variable in equation (12) and is used in the computation of PX and the landed prices in importing countries.

The explanatory variables in equation (12) are the Greek raisin price, PGR, and per capita total supply; PGR is reported in Table F.6 and is explained later in this appendix.

Duties, Transportation Costs, Exchange Rates, and CPIs

Transportation costs were added to PX, and the respective duties, exchange rates, and consumer price indexes applied to compute the deflated, landed prices in the respective importing countries.

Duties

Information on duties charged by country I for U.S. raisin imports was drawn from various sources including personal communications. Rates for the beginnning of the time series (1963) up to the conclusion of the Kennedy Round (1967) were taken from the General Agreement on Tariffs and Trade (GATT), *Consolidated Schedules of Tariff Concessions*, Geneva, January1952. Post-Kennedy Round rates were from GATT, *Legal Instruments Embodying the Results of the 1964-7 Trade Conference*, Geneva, 1967, and from the loose-leaf Dried Fruit Association (DFA) of California, *Exporter's Handbook*. The DFA source was used for rates charged in the mid-to late-1970s. Duties for the 1980s were obtained by phoning the U.S. Department of Commerce, International Library, San Francisco, and the U.S. State Department's European Economic Community (EEC) and Japan desks in Washington, D.C.

The schedules for the United Kingdom are rather complicated. In 1967 the base rate was 8 shillings 6 pence per long cwt. (112 pounds) or 0.91 pence per pound. The concessionary rate was 4 shillings per long cwt., but evidently U.S. raisins did not enjoy this concessionary treatment: A letter from Theodore Horoschak of the Foreign Agricultural Service, U.S. Department of Agriculture, to the DFA explains the Kennedy Round tariff reduction from 6 shillings 8 pence per long cwt. before 1970 to 5 shillings 9 pence per long cwt. after January 1, 1970. When the United Kingdom joined the EEC in the mid-1970s, the rates were blended into the 4 percent EEC rate in two steps: In 1975 the U.K. duty was 2.4 percent plus 1.57 pounds per metric ton; in 1976, 3.2 percent plus 0.78 pounds per metric ton; after 1976 the U.K. duty is the same as other EEC countries. To make the U.K. duties managable in the model, these per pound and per long cwt. charges were converted to percentage terms, based on actual U.S. shipments; that is, DUK equals 1 plus the duty charged divided by the amount shipped in year t.

In the Tokyo Round, agreements were made to gradually lower the EEC's and the Japanese tariffs on raisin imports from other GATT members. Beginning at a 4 percent level in the late 1970s the EEC rate was reduced about 0.1 percent each year. In Japan, reductions (from 5 percent) also began January1st, 1980. In 1982 the effective rate was 3.1 percent with plans for reduction to 2.8 percent by 1985. However, a "temporary" rate of 2 percent was used in 1983.

Duties, in ad valorem percentage plus 1, are reported in Table F.7 for major importing regions, I: the United Kingdom (DUK), West Germany (DWG), the Netherlands (DN), and Japan (DJ). Raisins are duty free in Sweden. Because other data are on a crop year basis and

41. For example, EIP began in November 1981 on a 25 percent reserve tonnage basis yielding a blend price of $956 per sweatbox short ton. The mix was changed twice during the marketing year (April 1st and June 1st), yielding an overall blend price for the year of about $1192 per packed weight, metric ton.

changes in rates charged were usually as of January 1st, changes are reported as having occurred the previous year.

Transportation Costs

The series constructed by Bushnell (1978) and continued by King in Bushnell and King (1986) for transporting almonds were updated through 1985 by the tariff analysist at the Pacific Coast European Conference at the World Trade Center in San Francisco. The series for Japan was updated through 1983 by phoning the Pacific Westbound Conference, San Francisco. Because this office was no longer there in 1987, two other sources were used to continue the series to 1985: Bill Hargraves at the American President Lines and Barbara Kennedy with Nippon Yussen, Kaisha, NYK shipping. To continue the series from 1983 through 1985, both for Europe and Japan, three components were involved: the basic freight per 20 foot container, the currency adjustment factor, and the container receiving charge.[42] The transportation costs from the United States to the United Kingdom (TUUK), West Germany (TUWG), the Netherlands (TUN), Sweden (TUS),[43] and Japan (TUJ) are reported in Table F.8.

For shipping raisins to the United Kingdom, freight-insurance-duty (FID) in cents per pound was provided by Sun-Maid for groups of years. Interpolations were made for the missing years (1971-73 and1977) and the resulting series was converted to dollars per metric ton. According to the Sun-Maid source, these FID data are representative of industry costs rather than actual costs incurred by Sun-Maid. FID is reported in Table F.9.

Because the FID series was considered more accurate than using almond costs, FID became the basis for the European transportation cost. Thus, the UK duty was removed from FID by division (i.e., FID/DUK) and the result was added to PX. Then, the *differences* in (almond) transportation costs between the United Kingdom and (1) West Germany (TUKWG), (2) the Netherlands (TUKN), and (3) Sweden (TUKS) were added; where TUKWG=TUUK-TUWG, etc. These transportation differences are also reported in Table F.9. The negative values mean that it cost less to unload in Scandinavia than in London in spite of the greater distance.

Exchange Rates

The series used by Bushnell (1978) and Bushnell and King (1986) were updated using quarterly exchange rates, series ae (for the United Kingdom, the reciprocal ag) in International Monetary Fund, *International Financial Statistics*, monthly. To put the exchange rates on a near crop-year basis, the third and fourth quarters for one year were averaged with the first and second quarters of the next year. Exchange rates used in the model (country I-to-United States, ER(I)U are reported in Table F.10.

Consumer Price Indexes

The series in Bushnell (1978) and Bushnell and King (1986) were updated using the U.N. *Monthly Bulletin of Statistics*. CPI(I) was put on a near crop-year basis by averaging across years, i.e., $(CPI_t+CPI_t+1)/2$. CPI(I) for the major importing countries are reported in Table F.11. These CPI(I) are used to deflate all price and income variables in the respective equations and identities.

Prices of Substitutes in Major Importing Countries

Other raisin exporters include Greece, Turkey, Australia, Afghanistan, Iran, South Africa, and Iraq. Even if price data were available for all sources, multicollinearity would preclude using more than one price besides the U.S. price in any demand equation. The Federal-State Market News Service (MNS) gives prices landed in London (in U.S. dollars) for Greek, Turkish, and Australian raisins. To choose which price to use in a particular equation, shipments data were consulted. The U.S. Department of Agriculture, Foreign Agricultural Service (FAS) circulars provide information on shipments from the several source countries to importing country

42. In updating the series, I discovered that the charges on bulk almonds are considerably more than on raisins. For example, the 1987 average for almonds to Japan worked out to about $64 per metric ton; for raisins, about $50. Almonds were used initially because the series was already existing and it is difficult to reconstruct long time series using sources whose main concern is the current charges.

43. Bushnell's transportation was to Denmark, but because Sweden is being used as the representative country for Scandinavia, the variable is named TUS.

I, though a consistent time series on these shipments could not be constructed. Ed Missiaen of FAS provided a computer printout of shipments data for 1970 through 1983. Because all European importers buy some raisins from Greece, the Greek price was chosen as representative.[44] The price of Greek No. 4 Sultanas was taken from MNS's "Raisins: Price Quotations for the United Kingdom-North European Ports Market, by Specific Country, by Weeks," in its *Marketing California Grapes, Raisins, and Wine*, 1969-71; and *Marketing California Dried Fruits*, 1972-82. The information for 1982-83 was obtained from Mel Ries, California Department of Food and Agriculture; for 1984-85 and 1985-86, from the same office at CDFA (but these were for Greek Sultanas No. 2). The MNS quotations available in Sacramento are obtained weekly from the U.S. Department of Agriculture, FAS which in turn gets them from a London newsletter, Public Ledger's, *Commodity Week*.[45] Weekly quotes for the Greek price were averaged over the California crop year. The crop-year average Greek raisin price was checked against a Sun-Maid provided graph of Greek and California landed-in-London prices (however, Sun-Maid's graph was likely based on MNS data). The annual average Greek price was converted from cents per pound to U.S. dollars per metric ton; the variable PGR was reported in Table F.6.

The deflated price of Greek raisins in the United Kingdom is:

PGUKD=PGR•ERUKU/CPIUK.

To compute the price of Greek raisins in West Germany, the Netherlands, and Sweden, PGUKD served as the base. Greek raisins have been duty free in the United Kingdom since 1974, so from 1963-73, PGUKD was divided by the U.K. duty (DUK); from 1974 on, this step was not done. Then the differences in transportation costs between the United Kingdom and West Germany (TUKWG), the Netherlands (TUKN), and Sweden (TUKS), respectively, were added. Greek raisins have also been duty free in the European Economic Community since 1974, so only between 1963-73, the German and Dutch duties were applied. (All raisins are duty free in Sweden.) The result was multiplied by ER(I)U and divided by CPI(I), where I=WG, N, and S, respectively.

In Japan, the price of Australian raisins was selected as a substitute for NTS. Export values of dried vine fruit were taken from the Australian Bureau of Agricultural Economics, *Historical Trends in Australian Agricultural Production, Exports, Income, and Prices*, 1952-53 to 1978-79, Canberra, Australian Publishing Service, 1980. Data for 1979-80 through1983-84 were from the Bureau's *Quarterly Review of the Rural Economy*, November 1984 and other issues. The U.S./Australian exchange rate was used to convert these values to U.S. dollars.

Information on transportation costs for raisins from Australia to Japan was not available, so TUJ was used instead, i.e., the almond transportation cost from the United States to Japan. The justification is twofold: First, the distance from Melborne to Tokyo is almost the same as from San Francisco to Tokyo,[46] and, of course, unloading costs are identical. Second, freight rates for heavy grain between Australia and Japan and the Northwest Pacific and Japan are nearly identical. For selected years (other years were just as close), they are in dollars per metric ton (International Wheat Council):

	from Pacific Northwest:	from Australia:
1963	8.17	7.97
1970	10.50	10.64
1975	14.58	14.33
1980	31.46	30.68

The price of Australian raisins in Japan is computed as:

PAJD={[(PXA•ERAU)+TUJ]•DJ•ERJU}/CPIJ

where PXA is the Australian dried vine fruit

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44. Preliminary work using the Turkish price instead in the West German and Netherland-Belgium equations made very little difference in the results.

45. The figures are in the text of this newsletter rather than being presented in a consistent tablular format, so some caution must used in working with these data. The Sacramento-published figures come flagged with many footnotes.

46. Syndey-Yokohama is 4330 nautical miles, then Melborne-Sydney is 582 n. miles for a total of 4912 n. miles. Without a stop at Sydney, the Melborne-Yokohama distance would be very close to the 4536 n. miles between San Francisco and Yokohama (Theel, 1963).

export price in Australian dollars per metric ton; ERAU is the Australian-U.S. exchange rate; TUJ, the transportation cost; DJ, the duty in Japan; ERJU, the Japanese-U.S. exchange rate; and CPIJ, the Japanese consumer price index. PAJD is in deflated yen per metric ton.

The prices of substitute raisins—Greek raisins in Europe and Australian raisins in Japan—are reported in Table F.12.

Per Capita Consumption Expenditures in Importing Countries

To represent consumer purchasing power in importing country I, private final consumption expenditures on a calendar-year basis were divided by the mid-year population estimate for that year, yielding per capita expenditures in the currency of country I. In the demand functions for grouped countries, one country's expenditures were taken as representative: the Netherlands for Netherlands-Belgium and Sweden for Norway-Sweden-Denmark. The source for expenditure and population data is the U.N. *Monthly Bulletin ofStatistics*. The 1983 and 1984 Japanese figures were from the Economist Intelligence, *Quarterly Economic Review of Japan*, Annual Supplement. Per capita expenditures were deflated by the CPI(I); the five EC(I)D are reported in Table F.13. (A comparable 1985 figure for Japan was not available in late 1987, so ECJD for 1985 was extrapolated by a trend.)

Table F.1. NTS Shipments to Major Importers, United Kingdom (QUK), West Germany (QWG), the Netherlands-Belgium (QNB), Norway-Sweden-Denmark (QNSD), and Japan (QJ).

Year	QUK	QWG	QNB	QNSD	QJ
			metric tons		
1963	8,602	2,819	1,227	8,783	14,728
1964	8,794	2,026	630	8,798	14,984
1965	6,556	1,859	783	8,753	16,628
1966	8,552	2,239	989	6,800	14,481
1967	9,993	2,212	986	9,366	16,567
1968	8,577	2,238	1,250	8,785	17,789
1969	9,572	2,191	873	8,154	19,741
1970	10,835	3,104	1,243	6,713	17,177
1971	8,331	4,298	1,450	8,441	19,255
1972	744	1,519	683	2,362	1,893
1973	5,974	2,801	1,482	7,228	8,503
1974	6,680	3,230	2,023	7,577	19,345
1975	6,619	2,179	2,386	7,126	19,548
1976	3,324	1,549	1,345	5,781	12,705
1977	2,326	3,053	2,121	7,002	15,687
1978	569	1,720	765	4,445	5,182
1979	6,641	4,843	2,559	7,401	15,020
1980	2,642	3,256	1,533	7,648	20,019
1981	2,113	2,526	1,979	8,748	16,830
1982	2,207	2,559	1,590	4,904	17,538
1983	4,578	4,667	2,559	7,345	16,709
1984	6,776	6,818	2,048	8,166	21,999
1985	10,969	6,427	2,884	10,423	21,948

Table F.2. Population of Major Importing Countries, the United Kingdom (POPUK), West Germany (POPWG), the Netherlands-Belgium (POPNB), Norway-Sweden-Denmark (POPNSD), and Japan (POPJ).

Year	POPUK	POPWG	POPNB	POPNSD	POPJ
			millions		
1963	53.6	57.6	21.29	15.95	95.9
1964	54.2	58.3	21.48	16.07	96.9
1965	54.6	59.0	21.76	16.21	97.9
1966	54.7	59.7	22.03	16.36	98.9
1967	55.1	59.9	22.18	16.5	99.9
1968	55.3	60.2	22.32	16.59	101.1
1969	55.5	60.8	22.55	16.72	102.3
1970	55.4	60.7	22.66	16.85	104.3
1971	55.6	61.3	22.87	16.97	104.7
1972	55.8	61.7	23.01	17.04	107.0
1973	55.9	62.0	23.14	17.12	108.3
1974	56.0	62.0	23.27	17.20	109.6
1975	56.0	61.8	23.50	17.27	111.0
1976	56.0	61.5	23.58	17.32	112.8
1977	55.9	61.4	23.71	17.38	113.9
1978	55.8	61.3	23.82	17.43	114.9
1979	55.9	61.4	23.83	17.48	115.9
1980	56.0	61.6	23.94	17.52	116.8
1981	56.3	61.7	24.05	17.54	117.6
1982	56.3	61.6	24.15	17.56	118.5
1983	56.4	61.4	24.25	17.57	119.3
1984	56.49	61.2	24.28	17.59	120.02
1985	56.62	61.0	24.38	17.61	120.75

Table F.3. NTS Per Capita Shipments to Major Importers, United Kingdom (QCUK), West Germany (QCWG), the Netherlands-Belgium (QCNB), Norway-Sweden-Denmark (QCNSD), and Japan (QCJ).

Year	QCUK	QCWG	QCNB grams	QCNSD	QCJ
1963	160.48	48.95	57.63	550.50	153.58
1964	162.26	34.74	29.34	547.42	154.63
1965	120.07	31.50	35.98	539.87	169.85
1966	156.35	37.51	44.87	415.67	146.42
1967	181.35	36.93	44.47	567.69	165.84
1968	155.10	37.18	56.01	529.54	175.95
1969	172.47	36.03	38.71	487.76	192.97
1970	195.59	51.14	54.84	398.34	164.68
1971	149.83	70.11	63.41	497.56	183.91
1972	13.34	24.63	29.70	138.62	17.69
1973	106.86	45.18	64.04	422.22	78.51
1974	119.29	52.10	86.94	440.47	176.51
1975	118.19	35.26	101.53	412.62	176.11
1976	59.36	25.18	57.05	333.80	112.63
1977	41.61	49.72	89.46	402.86	137.73
1978	10.19	28.06	32.11	255.03	45.10
1979	118.79	78.87	107.39	423.39	129.60
1980	47.17	52.86	64.04	436.56	171.39
1981	37.53	40.93	82.31	498.75	143.11
1982	39.20	41.54	65.85	279.29	148.00
1983	81.16	76.02	105.53	418.02	140.06
1984	119.95	111.43	84.33	464.22	183.30
1985	193.73	105.32	118.29	591.86	181.77

Table F.4. NTS Exports to Major Importers (QX), to the Rest of the World (QROW), Total Exports (QXT), Reserve Tonnage Exports (QXR), Free Tonnage Exports (QXF), and the Proportion of Total Exports Sold to Packers from the Reserve Pool, s; under export incentive plan, s is the proportion sold at $100 per short sweatbox ton (1981 and after).

Year	QX	QROW	QXT metric tons	QXR	QXF	s proportion
1963	36,159	12,635	48,794	37,634	11,160	0.77
1964	35,231	12,041	47,272	42,867	4,405	0.91
1965	34,579	14,288	48,866	44,244	4,622	0.91
1966	33,060	14,324	47,384	43,584	3,799	0.92
1967	39,124	14,251	53,375	50,193	3,182	0.94
1968	38,640	17,220	55,860	53,630	2,229	0.96
1969	40,531	16,497	57,028	54,670	2,358	0.96
1970	39,072	12,075	51,147	49,023	2,124	0.96
1971	41,775	14,399	56,174	53,019	3,155	0.94
1972	7,203	3,322	10,524	0	10,525	0.00
1973	25,988	8,823	34,811	0	34,811	0.00
1974	38,855	9,120	47,975	29,175	18,800	0.61
1975	37,858	8,811	46,668	41,515	5,154	0.89
1976	24,704	6,038	30,742	21,860	8,883	0.71
1977	30,188	9,479	39,667	0	39,668	0.00
1978	12,681	4,403	17,084	0	17,084	0.00
1979	36,463	12,423	48,886	0	48,886	0.00
1980	35,098	10,323	45,421	0	45,421	0.00
1981	32,196	13,876	46,072	11,214	34,877	0.24
1982	28,799	13,016	41,815	18,992	22,831	0.45
1983	35,858	14,396	50,254	32,051	18,192	0.64
1984	45,806	14,395	60,201	22,311	48,278	0.37
1985	52,650	13,414	66,084	17,326	48,758	0.26

Table F.5. Deflated Landed U.S. NTS Prices in the United Kingdom (PUUKD), West Germany (PUWGD), the Netherlands (PUND), Sweden (PUSD), and Japan (PUJD).

Year	PUUKD pounds	PUWGD marks	PUND guilders	PUSD kronor	PUJD yen
1963	198.82	2,082.84	2,243.66	2,740.10	214,536.23
1964	190.02	1,999.38	2,103.31	2,606.44	202,694.98
1965	167.81	1,803.78	1,859.47	2,305.14	179,626.00
1966	164.45	1,693.66	1,680.96	2,180.66	172,476.45
1967	180.52	1,720.36	1,659.03	2,181.36	169,284.53
1968	192.10	1,839.51	1,723.10	2,326.28	171,583.92
1969	185.95	1,706.71	1,670.84	2,265.13	165,629.17
1970	172.33	1,593.42	1,573.29	2,124.83	158,698.13
1971	199.95	1,787.61	1,754.10	2,450.77	170,539.42
1972	367.37	3,064.13	2,883.35	4,184.93	279,696.78
1973	396.69	2,840.58	2,803.07	4,467.98	271,313.75
1974	239.14	1,812.28	1,697.17	2,690.16	172,825.19
1975	166.48	1,455.24	1,327.46	2,107.45	121,567.58
1976	441.56	2,994.11	2,661.93	4,364.20	265,270.38
1977	308.09	2,116.76	1,937.08	3,564.02	171,229.20
1978	556.88	4,098.75	3,651.01	6,865.68	396,863.75
1979	251.19	2,190.05	1,965.08	3,472.57	201,387.53
1980	236.79	2,566.08	2,281.45	3,549.83	179,861.50
1981	234.57	2,461.56	2,185.18	3,655.13	165,201.20
1982	206.95	2,021.18	1,799.47	3,399.30	132,779.94
1983	152.54	1,488.39	1,341.77	2,396.25	80,873.38
1984	186.68	1,878.28	1,700.56	2,749.44	97,460.25
1985	166.14	1,607.55	1,453.83	2,451.68	81,799.47

Table F.6. The f.o.b. Export Price (PX), the f.o.b. Bulk NTS Price (PB), the Free Tonnage Price (PF), the Growers' Average Price for NTS Exports (PGX), and the Greek Raisin Price (PGR).

Year	PX	PB	PF	PGX	PGR
	nominal dollars per metric ton				
1963	330.88	373.68	303.44	270.43	375.67
1964	327.29	374.79	303.42	260.35	378.75
1965	298.80	364.86	305.23	245.41	365.97
1966	299.66	360.46	278.58	222.66	339.51
1967	305.57	433.21	361.51	241.48	354.94
1968	336.32	462.97	374.43	252.83	328.49
1969	346.30	473.99	377.14	254.73	349.21
1970	349.12	479.50	379.29	254.32	326.28
1971	464.46	537.93	385.22	315.88	324.08
1972	992.00	992.00	591.14	591.14	700.63
1973	1190.00	1190.00	847.93	847.93	1056.45
1974	795.63	925.00	766.82	688.15	842.61
1975	615.47	948.00	806.18	510.37	595.25
1976	1626.12	1808.00	1300.48	1171.15	897.28
1977	1323.00	1323.00	1048.36	1048.36	1119.95
1978	3080.00	3080.00	1927.54	1927.54	1555.36
1979	1720.00	1720.00	1453.74	1453.74	1765.90
1980	1863.00	1863.00	1509.47	1509.47	1548.53
1981	1583.86	1929.00	1537.14	1192.00	1073.65
1982	1259.97	1918.00	1568.63	910.60	943.58
1983	812.56	1742.00	1578.44	649.00	862.89
1984	964.31	1243.84	876.72	597.19	878.91
1985	1103.39	1318.34	942.08	727.13	992.00

Table F.7. Duties Charged on Raisin Imports in the U.K. (DUK), West Germany (DWG), the Netherlands (DN), and Japan (DJ).

Year	DUK	DWG	DN	DJ
1963	1.16	1.10	1.12	1.05
1964	1.16	1.10	1.12	1.05
1965	1.17	1.10	1.12	1.05
1966	1.17	1.06	1.06	1.05
1967	1.13	1.06	1.06	1.05
1968	1.09	1.06	1.06	1.05
1969	1.09	1.06	1.06	1.05
1970	1.07	1.06	1.06	1.05
1971	1.06	1.06	1.06	1.05
1972	1.03	1.06	1.06	1.05
1973	1.02	1.06	1.06	1.05
1974	1.03	1.06	1.06	1.05
1975	1.03	1.05	1.05	1.05
1976	1.03	1.04	1.04	1.05
1977	1.04	1.04	1.04	1.05
1978	1.039	1.039	1.039	1.05
1979	1.038	1.038	1.038	1.05
1980	1.037	1.037	1.037	1.03
1981	1.036	1.036	1.036	1.03
1982	1.035	1.035	1.035	1.02
1983	1.034	1.034	1.034	1.02
1984	1.032	1.032	1.032	1.02
1985	1.030	1.030	1.030	1.02

Table F.8. Transportation Costs—U.S. to the U.K. (TUUK), to West Germany (TUWG), to the Netherlands (TUN), to Sweden (TUS), and to Japan (TUJ).

Year	TUUK	TUWG	TUN	TUS	TUJ
	nominal dollars per metric ton				
1963	52.00	52.44	52.00	54.64	69.72
1964	54.64	54.64	54.64	56.85	74.32
1965	57.76	57.76	57.76	60.15	74.59
1966	60.70	60.70	60.70	62.91	76.71
1967	61.43	60.99	60.99	63.19	77.69
1968	64.08	62.97	62.97	65.78	78.65
1969	67.38	66.28	66.28	68.93	81.22
1970	74.42	73.74	73.52	76.91	86.24
1971	86.56	86.34	86.34	89.76	100.11
1972	94.65	95.09	94.65	97.96	99.22
1973	127.23	125.03	125.03	129.09	93.83
1974	149.27	144.83	147.04	149.27	124.75
1975	138.55	137.05	137.05	138.55	103.81
1976	138.55	137.05	137.05	138.55	96.91
1977	145.80	144.30	144.30	145.80	132.00
1978	137.00	124.78	124.78	137.00	140.57
1979	137.00	124.00	124.00	148.00	151.80
1980	144.50	130.50	130.50	155.50	123.39
1981	165.50	151.50	151.50	176.50	106.00
1982	165.00	151.00	151.00	176.00	100.00
1983	165.00	151.00	151.00	176.00	79.00
1984	145.85	133.90	133.41	147.05	58.15
1985	133.19	121.13	120.24	131.17	37.30

Table F.9. Freight-Insurance-Duty from the U.S. to the U.K. (FID); the Difference in Transportation Costs between the U.K., West Germany (TUKWG), the Netherlands (TUKN), and Sweden (TUKS).

Year	FID	TUKWG	TUKN	TUKS
	nominal dollars per metric ton			
1963	85.98	-0.44	0.00	-2.64
1964	85.98	0.00	0.00	-2.21
1965	85.98	0.00	0.00	-2.39
1966	85.98	0.00	0.00	-2.21
1967	85.98	0.44	0.44	-1.76
1968	85.98	1.11	1.11	-1.70
1969	85.98	1.10	1.10	-1.55
1970	85.98	0.68	0.90	-2.49
1971	105.82	0.22	0.22	-3.20
1972	105.82	-0.44	0.00	-3.31
1973	105.82	2.20	2.20	-1.86
1974	125.66	4.44	2.23	0.00
1975	125.66	1.50	1.50	0.00
1976	125.66	1.50	1.50	0.00
1977	143.30	1.50	1.50	0.00
1978	158.73	12.22	12.22	0.00
1979	158.73	13.00	13.00	-11.00
1980	158.73	14.00	14.00	-11.00
1981	211.64	14.00	14.00	-11.00
1982	211.64	14.00	14.00	-11.00
1983	211.64	14.00	14.00	-11.00
1984	187.09	11.95	12.44	-1.20
1985	170.81	12.06	12.95	2.02

Table F.10. Exchange Rates for Major Importers, the U.K. to the U.S. (ERUKU), West Germany to U.S. (ERWGU), Netherlands to U.S. (ERNU), Sweden to U.S. (ERSU), and Japan to U.S. (ERJU).

Year	ERUKU	ERWGU	ERNU	ERSU	ERJU
1963	0.36	3.98	3.61	5.17	362.13
1964	0.36	3.98	3.60	5.16	360.50
1965	0.36	4.01	3.61	5.17	361.95
1966	0.36	3.98	3.61	5.17	362.25
1967	0.40	3.99	3.61	5.17	361.77
1968	0.42	4.00	3.63	5.17	358.35
1969	0.42	3.74	3.62	5.18	357.90
1970	0.42	3.60	3.59	5.18	357.58
1971	0.40	3.23	3.28	4.85	313.58
1972	0.41	3.04	3.01	4.52	288.05
1973	0.42	2.54	2.67	4.39	277.75
1974	0.43	2.43	2.51	4.11	295.08
1975	0.45	2.59	2.71	4.43	289.74
1976	0.59	2.37	2.49	4.25	288.85
1977	0.54	2.06	2.28	4.66	233.13
1978	0.49	1.86	2.03	4.33	251.15
1979	0.45	1.79	1.97	4.22	232.60
1980	0.45	2.06	2.27	4.55	213.00
1981	0.55	2.36	2.61	5.80	238.00
1982	0.63	2.47	2.74	7.18	246.00
1983	0.70	2.68	3.02	7.93	233.00
1984	0.81	3.08	3.47	8.82	249.51
1985	0.68	2.41	2.72	7.50	190.52

Table F.11. Consumer Price Indexes in Importing Countries, the United Kingdom (CPIUK), West Germany (CPIWG), the Netherlands (CPIN), Sweden (CPIS), and Japan (CPIJ).

Year	CPIUK	CPIWG	CPIN	CPIS	CPIJ
			1970=100		
1963	0.75	0.85	0.73	0.76	0.71
1964	0.78	0.88	0.77	0.79	0.75
1965	0.82	0.91	0.81	0.83	0.79
1966	0.84	0.93	0.85	0.88	0.83
1967	0.87	0.94	0.88	0.90	0.86
1968	0.92	0.96	0.93	0.92	0.91
1969	0.97	0.99	0.98	0.97	0.97
1970	1.05	1.03	1.04	1.04	1.03
1971	1.13	1.08	1.12	1.11	1.09
1972	1.23	1.15	1.21	1.18	1.18
1973	1.37	1.23	1.31	1.27	1.38
1974	1.64	1.31	1.44	1.40	1.65
1975	2.01	1.38	1.58	1.55	1.80
1976	2.33	1.44	1.70	1.70	1.97
1977	2.59	1.48	1.79	1.91	2.08
1978	2.83	1.53	1.87	2.04	2.14
1979	3.35	1.60	1.96	2.26	2.27
1980	3.82	1.69	2.09	2.57	2.43
1981	4.21	1.79	2.23	2.82	2.51
1982	4.48	1.87	2.33	3.07	2.57
1983	4.70	1.92	2.40	3.33	2.62
1984	5.00	1.96	2.44	3.67	2.67
1985	5.24	1.98	2.47	3.89	2.71

Table F.12. Deflated NTS Substitute Prices in Importing Countries: the Greek Raisin Price in the United Kingdom (PGUKD), in West Germany (PGWGD), in the Netherlands (PGND), and in Sweden (PGSD); the Australian Raisin Price in Japan (PAJD).

Year	PGUKD pounds	PGWGD marks	PGND guilders	PGSD kronor	PAJD yen
1963	179.17	1668.81	1798.15	2192.44	215,671.44
1964	174.15	1629.31	1713.99	2121.33	126,841.20
1965	159.60	1515.50	1562.29	1934.35	206,664.08
1966	144.78	1317.69	1307.82	1693.70	191,423.16
1967	163.64	1413.30	1362.92	1789.77	184,936.22
1968	149.43	1337.81	1253.14	1687.50	175,171.13
1969	150.22	1289.83	1262.72	1708.39	171,711.19
1970	129.23	1128.83	1114.81	1500.70	157,194.83
1971	113.63	967.27	949.14	1319.24	142,005.03
1972	234.45	1903.62	1791.75	2595.76	143,080.53
1973	323.41	2266.10	2236.17	3561.53	226,722.78
1974	218.72	1612.12	1509.27	2391.60	181,155.94
1975	133.71	1119.98	1021.65	1702.22	125,037.69
1976	226.17	1479.24	1315.13	2240.56	114,837.02
1977	235.32	1560.93	1428.44	2732.44	147,927.91
1978	267.43	1905.69	1697.51	3303.23	159,157.34
1979	236.10	1990.14	1785.71	3272.97	173,521.64
1980	181.36	1904.62	1693.36	2722.08	166,188.91
1981	140.26	1434.00	1272.99	2185.59	145,467.13
1982	132.69	1264.82	1126.08	2181.08	92,264.36
1983	128.52	1223.99	1103.42	2028.67	75,561.37
1984	142.50	1400.72	1268.35	2108.72	50,962.50
1985	129.34	1223.04	1106.30	1917.03	60,743.11

Table F.13. Per Capita Personal Consumption Expenditures, Deflated, in the United Kingdom (ECUKD), West Germany (ECWGD), the Netherlands (ECND), Sweden (ECSD), and Japan (ECJD).

Year	ECUKD pounds	ECWGD marks	ECND guilders	ECSD kronor	ECJD yen
1963	497.46	4,409.72	3,598.52	8,242.37	193,790.48
1964	507.10	4,539.61	3,826.77	8,727.25	206,990.02
1965	512.02	4,762.53	3,999.00	9,217.16	220,090.27
1966	526.79	4,951.28	4,109.84	9,438.31	247,968.63
1967	528.40	5,047.42	4,285.35	9,768.54	269,071.41
1968	530.51	5,222.18	4,316.74	10,897.46	296,703.31
1969	531.09	5,533.96	4,615.01	11,108.77	315,627.16
1970	535.14	5,902.02	4,851.26	11,118.60	338,279.22
1971	549.17	6,200.53	4,950.62	10,944.64	361,162.94
1972	573.07	6,354.73	5,108.43	11,134.75	373,657.53
1973	584.07	6,500.13	5,311.04	11,221.44	379,180.22
1974	562.33	6,495.94	5,424.38	11,568.17	407,149.97
1975	557.27	6,759.77	5,577.94	11,847.92	428,123.13
1976	561.26	7,041.55	5,922.00	12,370.54	435,999.22
1977	585.75	7,368.61	6,182.23	12,075.20	446,532.88
1978	621.89	7,611.77	6,843.77	12,946.04	471,397.34
1979	621.17	7,929.56	7,012.79	12,847.98	482,969.88
1980	635.74	8,011.22	6,906.58	12,728.14	484,307.19
1981	637.54	7,960.67	6,733.72	12,830.06	491,649.06
1982	655.19	7,902.46	6,657.76	13,164.22	510,138.09
1983	682.90	8,034.75	6,594.04	13,189.06	527,427.81
1984	684.56	8,362.74	6,671.35	13,133.48	549,664.94
1985	704.52	8,622.77	6,844.29	13,619.41	553,287.50

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