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Dynamic Economic Relationships in the California Cling Peach Industry

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DYNAMIC ECONOMIC RELATIONSHIPS IN THE CALIFORNIA CLING PEACH INDUSTRY

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I. INTRODUCTION

Producers of California cling peaches have for many years faced recurring output adjustment and marketing problems because of changes in demand and cost structures that were unforeseen at the time of tree planting. Since cling peach trees require four to five years to begin bearing significant quantities of fruit and have a productive life of about 20 years, the bearing acreage base cannot be adjusted quickly. Consequently, unusually low or high returns may persist over considerable periods, sometimes modified or exacerbated in particular years by variations in yields. That these conditions have occurred in spite of strong organized efforts within the industry to coordinate supply with demand provides an indication of the inherent risk and uncertainty involved in cling peach production.

The purpose of this report is to add to the economic information base available to the industry. The specific objectives are:

(1) To develop a structural framework for analyzing interrelationships among prices, outputs, and other factors affecting returns;
(2) To show by statistical analysis how f.o.b. processor prices and farm prices have been related to quantities produced and processed and other demand and cost variables;
(3) To show by statistical analysis how cling peach plantings and tree removals have responded to changes in levels of prices and costs;
(4) To show how the estimated demand and supply relationships have interacted as a complete dynamic system; and
(5) To demonstrate the uses and limitations of these models as forecasting tools.

No econometric model can fully represent all the complexities of the economic process it attempts to measure. The estimates of behavioral relationships focus on the *major* price, quantity, and demand or supply shifting variables, with the influences of omitted variables reflected in the model as unexplained random errors or disturbances. Hence, the economic relationships measured are in the form of expected values within some probability distribution of actual values. The analysis is intended to supplement rather than supplant other forecasting methods used by industry members.

The plan of the report is as follows: Section II briefly describes some key characteristics of the industry and the historical statistics pertaining to output, prices, costs, and returns. Section III develops the structural specifications of the economic relationships involved and the empirical estimates of the component supply and demand relationships. Section IV combines the component relationships into a complete dynamic model and discusses the procedures and problems involved in dynamic analysis. Section V applies the model to evaluate dynamic responses to changes in the major exogenous variables of the system. Section VI provides a summary and discussion of the uses and limitations of this type of study.

II. INDUSTRY CHARACTERISTICS AND STATISTICS

Clingstone peaches are the primary peach used for canning. Small quantities of freestone peaches are also canned but the amount has declined to less than 5 percent of the pack in recent years. Cling peaches are grown almost exclusively in California and virtually all of the crop is utilized for canning.

Farm Production

Production of cling peaches is centered in four districts: the Yuba City-Marysville area, the Stockton area, the Modesto area, and the Kingsburg-Visalia area. In 1986 about 45 percent of the state total of 34,204 bearing and nonbearing acres was located in the Yuba City-Marysville area, about 44 percent in the Modesto district, another 9 percent in the Kingsburg-Visalia district, and the balance, a little over 2 percent, in the Stockton area. The acreage base includes more than 50 different individual varieties which vary in maturity date, thus permitting the harvest and processing season to be spread over a longer time period. The industry groups these varieties into four classes (1986 shares in parentheses): extra early (.24), earlies (.26), lates (.33), and extra late (.17).

Detailed price and cost data required to analyze and predict changes in district and variety shares (other than as descriptive trends) are not available. Hence, the focus of the study is on statewide totals for all districts, aggregated over all varieties.

The 1986 statewide total acreage (34,204) was managed by 711 farmers for an average of 48.1 acres per farmer. Ten years earlier, in 1976, 1,269 farmers managed 59,644 acres with an average of 47 acres per farmer (CPAB data). The reduction in total acreage involved many farmers ceasing to produce cling peaches altogether, but with the average acreage per farmer remaining essentially unchanged.

Historical data pertaining to statewide cling peach acreage and production are summarized in Appendix Tables A1 to A4. Table A1 shows that total acreage has declined from a high of over 85,000 in 1968 to only 34,204 in 1986. Bearing acreage declined similarly, from nearly 64,000 in 1969 to only 27,735 in 1986. This decline was a result of decreased plantings and increased removals due to unfavorable economic conditions. Table A1 also shows that increased yields have offset some of the decline in acreage. Further details of acreage, removals, and yields by age of tree are given in Tables A2, A3, and A4.

It should be noted that the planting and nonbearing acreage figures in Table A1 are adjusted for under-reporting and therefore are generally higher than the Cling Peach Advisory Board figures. New plantings often are not discovered in their first year or two. The reported industry figures thus sometimes show the number of trees planted in a particular year to be greater in year t+1 than in year t, a logical inconsistency. The reported CPAB data are only partially corrected for such inconsistencies, whereas an effort was made here to revise the estimates to remove these inconsistencies (see discussion of data sources, Appendix B). Since most new plantings are discovered by the time the trees reach bearing age, the bearing acre figures in Table A1 are essentially the same as the CPAB data.

Utilization

Historical data pertaining to the utilization of cling peaches are given in Appendix Table A5. The data show that except during the years of the volume-control marketing order programs, all or nearly all of the on-tree crop has been harvested for processing use, with an average of roughly 90 percent of the crop meeting quality standards for canning (about 93 percent in recent years). Of the sales to canning firms, about 71 to 75 percent has been allocated to "regular pack" canned peaches, 19 to 22 percent to fruit cocktail, and the small balance (four to eight percent) to other uses such as mixed fruits and fruits for salad.

Data pertaining to pack, carryover stocks, movement and exports are given in Appendix Tables A6 and A7. The canned pack values have, of course, moved closely with the raw product allocation figures given in Table A5. The stocks carried from one year to the next (beginning stocks, June 1), on the other hand, have varied widely; for regular pack, from a high of 7,458,000 cases in 1970-71 to a low of 1,140,000 cases in 1984-85. Expressed as a percent of the previous year total supply, carryover stocks ranged from a low of about 6 percent in 1974-75 to a high of 29 percent in 1982-83. The average over the period of the data set was about 15 percent (Table A7). These variations are indicative of the problems faced in matching variable supply to demand.

Exports of canned peaches, which averaged around five million cases in the early to mid-1960's (roughly 18 percent of total movement), dropped to a little over half that amount in the 1970's, with further decline in the 1980's to less than a million cases and less than 10 percent of total movement (Tables A6 and A7). In 1976, the United States exported 2.3 million cases with the principal markets being Canada (1.0 mil. cases), European Community (EC) (0.6 mil. cases), and Japan (0.4 mil. cases). By 1985 U.S. canned peach exports were 0.7 million cases with principal markets being Japan (0.4 mil. cases) and Canada (0.2 mil. cases). The losses in the Canadian market were due to competitive suppliers rather than a decrease in the total volume of imports (1.2 mil. cases in 1976 versus 1.1 mil. cases in 1985). Whereas the United States supplied 84 percent of the Canadian market in 1976, this market share was 15 percent in 1985. In this latter period the major suppliers were Australia (28.0 percent), EC (27.4 percent), South Africa (15.3 percent) and Others (11.2 percent). Sources of trade data are described in Appendix B.

Exports of fruit cocktail averaged about three million cases during the early to mid-1960's, dropped to an average around two million during the 1970's and maintained or improved a bit at the beginning of the 1980's. Fruit cocktail exports as a percent of movement declined much less than regular pack peaches—from about 22 percent in the 1960's to about 19 percent in 1980 and 1981. However, by 1983 and 1984 exports were only about 12 percent of sales. The effects of reduced export markets were further exacerbated in the 1980's by the first arrivals of imported peaches. From an insignificant 15,000 cases in 1982-83, canned peach imports increased to 1,165,300 cases in 1983-84, 1,237,900 in 1984-85, 1,405,300 in 1985-86, and 793,000 cases in 1986-87.

Table A8 shows the changes in the total seasonal supply (pack plus beginning stocks) for the main canned fruit competitors of peaches and fruit cocktail: apricots, Bartlett pears, and freestone peaches. Note that apricot and freestone peach supplies declined during the 1970's and reached new lows in the 1980's. Canned Bartlett pear production, on the other hand, actually increased overall during the 1970's and then declined again in the 1980's. The combined output of competing products (TSC) decreased about 54 percent from a peak in 1969 to 1985 while the total pack of cling peaches declined about 47 percent during the same period.

Prices and Per Capita Movement

Historical movements of prices received by farmers, f.o.b. processor prices, and per capita movement of regular pack and fruit cocktail are given in Appendix Table A9. The first three columns show actual prices; the next three the same prices deflated by the Personal Consumption Expenditure price deflator (PCE67R, 1967 = 1.0).

U.S. processor shipments of canned peaches and fruit cocktail, divided by U.S. population (QTMRPN, QTMFCN), increased through the 1950's, peaked in the 1960's, and then began a downward trend in the 1970's, reaching an all-time low in 1983 and 1984. The movement data include exports and hence reflect the loss of export markets as well as declining domestic consumption. U.S. per capita consumption (QDOMRPN and QDOMFCN) is given in the last two columns of Table A9. The values subtract exports from shipments and for canned peaches, add .005 cases of imports per capita in 1983-84, .0052 in 1984-85 and .0059 in 1985-86 and .0033 in 1986-87.

Returns, Costs, and Margins

Appendix Table A10 provides some measures of changes in farm returns, changes in the general level of food processing costs, and apparent processing margins. The adjusted return per ton was calculated by subtracting the marketing order assessment from the price received by farmers and adjusting for the loss of culled fruit. During the period when volume-control marketing order programs were in effect, the return measure was further adjusted for losses due to green drop and cannery diversions and for the costs of green dropping (see Minami, French, and King and Appendix B for further description). The cost data (FCOST) are believed to be representative of general movements in farm costs, but are not a random sample of such costs. The ratio of return to cost is believed to be representative of *changes* in such returns over time but should not be taken as an industry average.

The processing cost index (PCI) is a measure of changes in prices of major inputs used in all food processing. Its calculation is described more fully in Appendix B. It is not a precise indicator of change in costs of canning peaches, but a fairly high association with such costs would be expected. The variables PCRP and PCFC give measures of representative costs of processing a case of 24 No. 2-1/2 cans of regular pack peaches and fruit cocktail (excluding the raw product cost). These series are based on average accounting data reported by Touche Ross, Inc., extended after 1978 in accordance with the PCI index.

The case yields per ton given in Table A10 were computed by dividing the pack data (QPKRP and QPKFC) in Table A6 by the tons allocated to each use (QRAWRP and QRAWFC) in Table A5. No clear time trend in these conversion ratios is apparent.

The cost of the raw product in a case of canned peaches was calculated by dividing the farm price per ton by the case-yield coefficient. The processing margin then was calculated by subtracting the raw product cost per case from the f.o.b. price received by processors. These margins remained stable (or even declined slightly) until the 1970's, then moved upward rapidly, as did the processing cost index. It is of interest to compare these margin calculations with the representative processing cost series. Note that in most years the calculated margins are less than the representative per unit processing costs. However, they exceed variable processing costs (not shown) in all years. Possible explanations for the persistent excess of the reported cost over realized margins are: (1) the cost and price series are for a particular container size, but canners pack in a wide variety of sizes and styles; (2) the price series reflect primarily private label sales whereas national brand prices tend to be 10 to 15 percent higher per case; and (3) some plants actually were not covering all costs and have, in fact, left the industry.

Table A11 contains additional computed variables used in the econometric analysis, as reported later. Table A12 presents population data and other economic series that are related to demand or affect farmer returns.

Competitive and Institutional Structure

While the farm production of cling peaches fits the competitive model of many independent price-taking firms, the marketing and processing of the crop clearly does not. Marketing has departed from the competitive model in at least two ways. First, prices received by farmers have been influenced by the activities of the California Canning Peach Association in bargaining with processors. A voluntary cooperative association, the CCPA has represented from roughly one-third to as much as 70 percent the industry production. (See Minami, French, and King, pp. 11-13 for further description of the bargaining process.) In some recent years the contracts with processors scaled the price according to the size of the crop. The contracts may also include quality incentives.

A second major departure from the competitive model was the set of surplus-elimination marketing-order programs that were in effect throughout the period from the early 1950s to 1972. Under the terms of these marketing orders, the Cling Peach Advisory Board (the governing body of producers and processors for the marketing order programs) would examine market conditions each year with respect to expected supply and could order some portion of the crop to be eliminated by knocking immature fruit from trees (green dropping). Further elimination of harvested fruit could also occur if deemed necessary to maintain prices. Incentive programs were in effect during 1970-72 whereby growers could obtain extra credit to meet green drop requirements by early removal of trees. (See Minami, French, and King for further details). The decisions of the CPAB regulated the amount of peaches available to canners and hence, had an important influence on the price received by farmers and, ultimately, on the price paid by consumers.

Surplus elimination has not been used since 1972. However, the industry has maintained marketing-order programs which provide for quality control and assessments to support market development, promotion, statistical reporting, and market information.

In 1986, the cling peach crop was processed by eight canners and one freezer, down from 14 firms 10 years earlier (data from CCPA annual almanacs). This suggests the possible existence of oligopsony and oligopoly conditions, but the extent of effective departure from the competitive norm is not clear. This aspect is discussed further in the development of the structural model of the industry.

III. ECONOMIC STRUCTURE OF THE CLING PEACH INDUSTRY

Economic structure is defined as the set of supply, demand, and pricing relationships which underly the determination of farm production, the establishment of farm price, the allocation of farm production to major end uses, and the determination of f.o.b. processor prices, annual product movement, and inventory carryover. Nine types of behavioral relationships are specified and estimated in order to form a complete model that can be used to make conditional predictions of short-term, intermediate-term and long-term adjustments in prices, outputs and consumption.[1] These are as follows:

[1]Additional equations are required to predict the trends in yields by age class, but they are technical relationships rather than behavioral relationships.

A. **Farm Production**

1. **New plantings equation**
   Predicts new plantings as a function of past values of farm prices, costs, returns to alternative crops, age distribution of trees and risk perception.
2. **Tree removal equations**
   Predicts acreage of trees removed for each age group as a function of current prices and costs, and industry intervention programs.

B. **Grower-Processor Interaction**

3. **Raw product sales equation**
   (a) **1972 and before**
   Predicts CPAB decisions on quantity sold to canners as a function of the potential on-tree production, last year's farm price and quantity sold to processors, carryover stocks of peaches and fruit cocktail, exports, and tree removal incentive programs.
   (b) **Since 1972**
   Quantity sold to canners predicted by quantity harvested and cullage.
4. **Farm price prediction equation**
   Predicts farm price as a function of per capita quantity sold to canners, per capita carry-over stocks of canned peaches and fruit cocktail, last year's f.o.b. processor price for canned peaches, last year's processing cost, and past average per capita movement.

C. **Processor Raw Product Allocation**

5. **Regular pack and fruit cocktail allocation equations**
   Predicts the quantity of raw peaches allocated to regular pack canned as a function of the total quantity of peaches sold to canners, last year f.o.b. prices of canned peaches and fruit cocktail, carry-over stocks of canned peaches and fruit cocktail, and previous-year exports less imports. Allocation to fruit cocktail is obtained by subtracting the allocation to regular pack from the total less other uses, the latter treated exogenously as a given proportion of the total.

D. **Processed Product Sales and Price Determination**

6. **Regular Pack Price Markup**
   Predicts the f.o.b. canner price as a function of the farm price, unit processing cost, per capita raw quantity canned plus carryover stocks, current movement, supplies of competing products and time shift variables.
7. **Fruit Cocktail Price Markup**
   Predicts the f.o.b. canner price of fruit cocktail as a function of the same variables as for regular pack.
8. **Per Capita Demand, Regular Pack**
   Predicts per capita sales (movement) as a function of the f.o.b. canner price for regular pack, total disposable income per capita, and some trend shift variables.
9. **Per Capita Demand, Fruit Cocktail**
   Predicts per capita sales of fruit cocktail (movement) as a function of the f.o.b. canner price for fruit cocktail, total disposable income per capita, and trend shift variables.

These structural equations indicate how the major *endogenous* variables (prices, outputs and consumption) are interrelated and how they are influenced by *exogenous* variables such as population and costs whose values are determined outside the system. The system is recursive among the subsectors (A,B,C,D) in that the predictions are sequential. If new plantings, removals and yields are predicted, acreage of trees and total production are readily predicted (subsector A). If production is known, the quantity sold to canners and farm price can be predicted (subsector B). Given the total quantity of raw product sold to canners, the allocation to regular pack and fruit cocktail can be predicted (subsector C). The canned pack is then determined by applying the appropriate conversion factors. If the farm price, total pack and stocks are known, the f.o.b. prices and total movement may be predicted by simultaneous solution of the price-markup and demand equations (subsector D). Stocks carried to the next year are determined by subtracting movement from initial seasonal supplies.

The reasoning behind the selection of variables for each equation is explained in the next four sections. Each section also describes the empirical and stochastic specifications required for statistical estimation and then presents the estimation results. The order of presentation of equation sets is A, D, B, and C. Set D (processed product sales and price determination) is discussed second because the demand and pricing specifications affect the way in which the farm price prediction is modeled. For ease of reference, the variables used in the analysis are defined in Table 1. They are divided into three groups: basic endogenous variables, computed endogenous variables and exogenous variables. The basic endogenous variables are the primary variables of prediction interest. The computed endogenous variables are variables used in the analysis that are formed from combinations of the basic variables and exogenous variables. The exogenous variables are variables whose values are determined outside the system.

The data series used for estimation purposes are given in Appendix A. Since it is difficult to deal econometrically with the details of processed product can sizes and pack types, quantities in the various can sizes are expressed in standard equivalent units (cases of 24 No. 2-1/2 cans) and aggregated over all sizes and styles. The price for the No. 2-1/2 can (choice in heavy syrup) is used as a representative measure of movements in the set of commodity prices. All of the structural equations were estimated using data for the 29-year period, 1956-57 to 1984-85, except as specifically noted in the sections which present the empirical results. Data for 1985-86 and 1986-87 were used for out-of-sample tests.

Farm Production[2]

Since yields of peach trees vary with age (see Appendix Table A4), the industry production in a particular year is determined by the age composition of trees as well as by the total area of trees and natural factors which affect the general level of yields. Age composition is determined by the past history of tree plantings and removals. Therefore, to predict how production may respond to changes in prices and costs it is necessary to determine how plantings and removals have responded to changes in these variables, and to predict expected yields.

Table 1. Variable Identification

Basic Endogenous Variables

AGE_i	=	acres of cling peaches of age i as of May 1, i = 0,1,...,31+ (New plantings, AGE_0, are designated by AGE0)
REM_i	=	acres removed (after harvest) from trees of age i.
FARMPR	=	farm price per No. 1 ton.
QMART	=	quantity of peaches purchased by processors, tons.
BEGRP	=	canner stocks of canned peaches (regular pack) at beginning of year (June 1), 1,000 cases of 24 No. 2-1/2 cans or equivalent.
BEGFC	=	canner stocks of canned fruit cocktail at beginning of year (June 1), 1,000 cases of 24 No. 2-1/2 cans or equivalent.
QRAWRP	=	quantity of cling peaches allocated to regular pack, tons.
QRAWFC	=	quantity of cling peaches allocated to fruit cocktail, tons.
QTMRP	=	total crop-year movement of regular pack peaches, 1,000 cases of 24 No. 2-1/2 cans or equivalent.
QTMFC	=	total crop-year movement of fruit cocktail, 1,000 cases of 24 No. 2-1/2 cans or equivalent.
QPKRP	=	quantity packed, 1,000 cases of 24 No. 2-1/2 cans of regular pack peaches or equivalent.
QPKFC	=	quantity packed, 1,000 cases of 24 No. 2-1/2 cans of fruit cocktail or equivalent.
FOBRP	=	representative f.o.b. price received by canners per case of 24 No. 2-1/2 cans, regular pack.
FOBFC	=	representative f.o.b. price received by canners per case of 24 No. 2-1/2 cans, fruit cocktail.
GDCALL	=	proportion of production green dropped.
DIVRS	=	proportion of production diverted to lower use at the cannery.

Exogenous Variables

MO	=	dummy variable to reflect changing risk perception with the termination of the volume control marketing order, MO = 1 prior to 1973, 0 thereafter.

[2]This section draws heavily on the conceptual framework developed in French, King, and Minami.

Exogenous Variables continued

Y_i = yield of trees of age i (i=2 to 30+), tons per acre (based on harvested production).

T = time, 1956 = 1, 1957 = 2, etc.

T14 = 0 prior to 1969 and T minus 14 from 1969 onward, T = 1 in 1956.

ETRILE = early tree removal incentive variable under the marketing order program (see text on farm production subsector).

$RR3_t$ = $ETRILE_{t-1} + ETRILE_{t-2} + ETRILE_{t-3}$

DVR2 = dummy variable to allow for the voluntary tree removal program in 1981 (see text on farm production subsector).

P_{ij} = probability that trees of age i will survive for j additional years (see text on farm production subsector).

ASSMNT = marketing order assessment, dollars per ton.

CULLGE = proportion of production culled.

FCOST[a] = representative farm cost per ton.

PCE67R = personal consumption expenditure deflator, 1967 = 1.0.

ITDIP = index of total U.S. disposable income per capita, calendar year corresponding to the crop year, 1967 = 1.0.

ITDIER = ITDIP ÷ PCE67R.

PCI = index of processing cost, 1967 = 100.

D74 = dummy variable to account for shifts after price controls and the Arab oil embargo, D74 = 0 prior to 1974; 1 from 1974 on.

QSURP = quantity of peaches greendropped or diverted under the marketing order, not sold, or used for other than canning, tons.

QXRP = quantity of regular pack peaches exported, 1,000 cases of 24 No. 2-1/2 cans or equivalent.

QXFC = quantity of fruit cocktail exported, 1,000 cases of 24 No. 2-1/2 cans or equivalent.

QIRP = quantity of canned cling peaches imported, 1,000 cases of 24 No.2- 1/2 cans or equivalent.

QIRPN = QIRP ÷ POP1 (1,000).

POP1 = U.S. total population, July 1 of the crop year, millions.

POTHER = proportion of peaches sold to canners allocated to uses other than regular pack or fruit cocktail (e.g., mixed fruit, fruit salad), tons.

CTRP = cases of 24 No 2-1/2 cans per ton of regular pack raw peaches.

CTFC = cases of 24 No. 2-1/2 cans of fruit cocktail per ton of raw peaches.

TSCN = per capita seasonal supply of canned apricots, Bartlett pears, and freestone peaches, cases of 24 No. 2-1/2 cans or equivalent.

PCRP = processing cost per case of 24 No. 2-1/2 cans of regular pack peaches.

PCFC = processing cost per case of 24 2-1/2 cans of fruit cocktail.

u, v = unexplained disturbance to account for the influence of individually minor omitted variables.

Computed Endogenous Variables

TACRES = total acres = $\sum_{i=0}^{30+} AGE_i$, (30+ = 30 and over)

continued on next page

[a]During the period when marketing order programs were in effect, the representative cost was adjusted to account for greendrop, cannery diversions, and the cost of greendropping (see Minami, French, and King, pp. 34-37 and Appendix B).

RMVLS	=	total acres removed = $\sum_{i=0}^{30+} REM_i$
TNAL	=	total net acres = $TACRES_{t-1}$ - $RMVLS_{t-1}$
QPOTNL	=	potential production = $\sum_{i=2}^{30+} AGE_i \cdot Y_i$
EQ_{t+j}	=	expected production in year t+j $= \sum_{i=1}^{30+} AGE_{it} \cdot P_{ij} \cdot Y_{i+j,t}$
AEQ_t	=	average expected production for years t+5 to t+20 $= 1/16 \sum_{j=5}^{20} EQ_{t+j}$
$REQ516_t$	=	expected annual average future production from current acreage relative to expected current production from current acreage. $= (AEQ_t) \div EQ_{t+0}$
AGRT	=	adjusted grower return per ton = (FARMPR - ASSMNT) • (1 - CULLGE) • [1 - GDCALL - DIVRSN + GDCALL • DIVRSN]
RAGRT	=	AGRT ÷ FCOST
RAGRT4	=	$1/4\,(RAGRT + RAGRT_{t-1} + RAGRT_{t-2} + RAGRT_{t-3})$
FRPCER	=	FOBRP ÷ PCE67R
FFCCER	=	FOBFC ÷ PCE67R
QMARTN	=	total peaches purchased by processors, tons per million U.S. population = QMART ÷ POP1
SRAW	=	combined beginning stocks in raw product equivalent, tons = [BEGRP ÷ CTRP + BEGFC ÷ CTFC]1000

SRAWN	=	combined stocks, tons per million U.S. population = SRAW ÷ POP1
QTMRPN	=	per capita crop-year movement of regular pack peaches, equivalent cases of 24 No. 2-1/2 cans = QTMRP ÷ [POP1 (1,000)]
QTMFCN	=	per capita crop-year movement of fruit cocktail, equivalent cases of 24 No. 2-1/2 cans = QTMFC ÷ [POP1 (1,000)]
QMCRPN	=	QTMRPN + QIRPN
QTMNW	=	QTMRPN + QTMFCN (CTRP ÷ CTFC)
$QTMNW2_t$	=	$1/2(QTMNW_{t-1} + QTMNW_{t-2})$
TSRP	=	BEGRP + QPKRP
TSFC	=	BEGFC + QPKFC
TSRPN	=	TSRP ÷ [POP1 (1,000)]
TSFCN	=	TSFC ÷ [POP1 (1,000)]
$RQMTSR_t$	=	$(QTMRP_t + QIRP_t) \div (TSRP_t + QIRP_t)$
$RQMTSF_t$	=	$QTMFC_t \div TSFC_t$
QCRPN	=	per capita supply of canned fruit competing with canned peaches = TSFCN + TSCN
QCFCN	=	per capita supply of canned fruit competing with fruit cocktail = TSRPN + TSCN
RPCRP	=	cost of raw product per case of regular pack = FARMPR ÷ CTRP
RPCFC	=	cost of peaches per case of fruit cocktail = FARMPR ÷ CTFC
TCRPE	=	(PCRP + RPCRP) ÷ PCE67R
TCFCE	=	(PCFC + RPCFC) ÷ PCE67R

Determinants of Plantings

In specifying the new-plantings function, it is assumed that every producer of cling peaches decides each year on a desired area of the farm to be allocated to peaches. The area desired is determined by the expected long-run profitability of peaches, the expected profitability of alternative crops, some view of the riskiness of peach production, and other personal factors. Desired new plantings are determined by the difference between desired total acres and actual total net acres (TNAL) where $TNAL_t$ is total acres in year t-1 less total removals from the acreage in t-1. If this difference is positive, the farmer will initiate actions to bring the peach acreage to the desired level. If the difference is zero or negative, no plantings occur.

The total industry planting response is the sum of responses by all current and potential peach producers. Since there will almost always be some individual growers for whom desired acreage is greater than zero and for whom TNAL is less than desired acreage, total industry desired plantings are likely to be greater than zero in all years. That conclusion is supported by the fact that cling peach plantings have always been well above zero, even in periods of very low returns and declining acreage. This is an important consideration in selecting a functional form for the planting relationship.

The industry-wide desired level of plantings is a function of aggregate expected long-run returns for peaches, expected returns to alternative crops, perhaps some indicator of change in risk perception such as might be associated with the termination of the surplus-control marketing order programs, and a random disturbance element that accounts for the effects of all other individually minor omitted factors. Neither desired plantings nor expected returns are directly observable. However, they are related to other variables that can be measured.

Actual plantings (AGE0) may differ from desired plantings (AGE0*) because of input restrictions (e.g., lags in obtaining nursery stocks), misjudgments, rigidities, inertia, and other frictions. Following the arguments of French and Matthews, it is assumed that the two variables are related according to

$$AGE0_t = a\, AGE0^*_t + v_t \quad 0 \leq a \leq 1$$

where v_t is a random disturbance. It is possible, however, that some residual effect of unfulfilled desired plantings in past periods could influence current plantings, thus, affecting the disturbance structure. That aspect is evaluated in terms of the observed statistical properties of the empirically estimated equations presented later.

How farmers (and other decision makers) form their price, cost and profit expectations has been the subject of a great amount of theoretical and empirical analysis, but no clear modeling guidelines have emerged. The most commonly used models have been (a) the extrapolative model which assumes decision makers project future values of decision variables from current or past values of these variables, (b) the adaptive expectations model which assumes that expectations are adjusted by adding to the previous period expectation some proportion of the difference between the previous period expectation and its observed value, and (c) the rational expectations model which assumes that farmers behave as if they possess a competitive stochastic model of the market. In making their production decisions, "rational" farmers are assumed to take account of the supply response of other similarly situated farmers and calculate the price that will prevail. The expected price is thus the expected competitive equilibrium price.

The rational expectations model is appealing in that it is consistent with the notion that economic agents are optimizers and that they make use of all the information available about economic conditions in their industry. However, strict application of the model requires that when they make their planting decisions, producers correctly perceive the full supply-demand structure and that their stochastic processes for projecting future changes in demand levels and factors affecting supply can be accurately specified. Observations of historical industry experience, described in the introductory sections of this report, suggest that cling peach growers have achieved only limited success in accurately predicting future economic conditions. Therefore, we have adopted a model in which growers are assumed to base their planting decisions on a more limited information set.

We retain the rationality assumption that growers recognize the existence of a downward sloping demand curve for their product and that they realize that other growers may respond similarly to changes in economic conditions. However, because of uncertainties as to the precise nature of the supply-demand structure and the difficulties in projecting future changes in exogenous variables affecting demand and supply, they are hypothesized to base their planting response primarily on two key decision variables: average profit experience over a recent period of years and projections of expected future production based on existing acreage and its age distribution.

Recent average profit experience reflects the composite effects of a variety of demand and cost factors. Thus, it may be regarded as having substantial information content. If the average profit experience deviates from the long-run normal competitive value, growers may be expected to attempt to adjust plantings so as to achieve a total acreage (desired acres) that will bring prices back to levels that provide normal competitive returns. The extent to which growers take account of other growers' supply response is reflected in the value of the partial derivative of plantings with respect to past average profitability. If, as seems likely, individual growers do assume other growers are responding similarly, they will be cautious in their adjustments and the change in plantings with respect a change in average profitability will be lower than otherwise. Assuming all growers experience similar variations in profitability, the industry planting response function reflects the summation of the individual grower responses.

Various measures of average profitability were explored. In an earlier study (Minami, French, and King), a simple unweighted four-year average of net returns (price less unit cost) deflated by a farm cost index proved to be the best predictor of new plantings. In the present study, for reasons to be explained, we used a four-year average of the ratio of adjusted net return to a measure of representative cost (RAGRT4 in Table 1 and Appendix Table 11).

Because of the lags and other complexities involved in perennial crop supply response, growers may have only vague notions of how changes in prices affect long-run output, other than the recognition that industry plantings are likely to increase if prices increase relative to costs. However, it is possible for growers to project future production likely to be generated from existing acreage if the age distribution is known (as it is for cling peaches). A high proportion of young acreage indicates increased future production over the planning period compared to the production associated with a high proportion of older acreage that is likely to be removed in the near future. Since higher future output can be expected to impact negatively on future prices, planting response will be further modified by the magnitudes of such projections.

Farmers who plant trees in year t are assumed to be concerned about competing production over the period t+5 to t+20. This period was chosen because cling peach trees do not bear significant quantities until age four or five and are considered to have a normal life of about 20 years. The expected future production from existing acreage for a particular year j years in the future (EQ_{t+j}), may be calculated as defined in Table 1. It is the sum of acreage in each age class multiplied by (a), the probability, P_{ij}, that trees of age i will survive j more years and (b), the expected yield of these trees when they reach age i+j. Expected yields were calculated from OLS trend regressions of actual yields (Table 2).[3] The probabilities of survival

Table 2. Yield-Age Relationships for California Cling Peaches, 1956-84

	Age Class						
	2 Years Y2	3 Years Y3	4 Years Y4	5 Years Y5	6-15 Years Y6	16-21 Years Y7	Over 21 Years Y8
Mean, tons per acre	1.48	4.83	8.82	11.81	14.53	13.17	12.53
Percent of Y6	10.16	33.24	60.74	81.28	100.00	90.66	86.22
Standard deviation	0.69	1.30	1.67	1.90	1.98	1.95	1.88
Coefficient of variation	0.47	0.27	0.19	0.16	0.14	0.15	0.15
High value	3.16	7.65	12.54	16.87	19.18	17.59	16.17
Low value	0.44	2.29	5.83	7.90	11.14	10.18	9.75
Trend analysis[a]:							
Intercept (b_0)	0.5526	3.0262	6.5892	9.6599	12.6596	11.6174	10.7752
Slope (b_1)	0.0616	0.1202	0.1491	0.1433	0.1247	0.1037	0.1168
Standard error of b_1	0.0103	0.0180	0.0245	0.0328	0.0377	0.0393	0.0360
Standard error of regression	0.4619	0.8128	1.1044	1.4764	1.6991	1.7713	1.6201
Trend correlation (r^2)	0.572	0.622	0.578	0.415	0.288	0.205	0.281
Durbin-Watson statistic	1.43	2.18	2.16	2.07	1.95	1.99	1.93

[a] $Y = b_0 + b_1T$ (T=1 in 1956)

[3] The regression results in Table 2 show, for example, that yields of trees in the six to 15-year age class have increased at an average rate of .1247 tons per year. Average yields have increased through age five, peaked at age six to 15, then declined with increased age. The reported average yields of older trees reflect acreage still in production and exclude acreage of less productive trees removed from orchards.

(P_{ij}) were estimated based on the proportions of trees removed from each age class over the 25-year period, 1956-80 (see Appendix Table A13). The expected average annual future production (AEQ_t) then is obtained by summing EQ_{t+j} over all years in the t+5 to t+20 interval (see definition in Table 1)[4] and dividing by 16 for scaling purposes. Finally, the expected average future production was expressed as a ratio to current expected production to obtain the variable REQ516 (see Table 1) which appears as one of the explanatory variables in the new planting equation.[5] As REQ516 increases, expected future prices would be expected to decrease, with all other factors constant. Hence, new plantings would be expected to decrease.

As has been the case for most studies of perennial crop supply response, measuring the effects of expected returns to alternative crops proved to be very difficult because of the wide variety of alternatives open to California growers and the complex mixture of long-run and short-run expected returns. Therefore, changes in returns to alternative crops are accounted for by a time trend variable T, (T = 1 in 1956, 2 in 1957, etc.), and the unexplained disturbance element. The trend variable may also reflect effects of systematic changes in factors such as concerns about labor availability or market perceptions not accounted for by the profitability measure.

Farmers' perceptions of the riskiness of peach production seem likely to be influenced by the degree of control they feel they have over market returns. This may affect planting response to given levels of returns. A major factor thought to affect farmer perceptions of risk is the existence or absence of the volume-control marketing-order program. To account for this, a variable (MO) was introduced which has a value of 1.0 during the period when volume-control marketing-order programs were in effect (1956-1972 in the data set) and is zero thereafter.

With these considerations, the new planting function was specified to have the following functional form:

$$\text{(1.1)} \quad \ln AGE0_t = a_{10} + a_{11}\ln RAGRT4_{t-1} + a_{12}\ln TNAL_t + a_{13}\ln REQ516_t + a_{14}MO + a_{15}T + u_{1t}$$

where $AGE0_t$ is new plantings, RAGRT4 is the average profitability measure, and REQ516 is the ratio of expected future production to current production (see Table 5 for further detail).[6] The total net acres variable (TNAL) is included to reflect the possibility (a) that the rate of planting response may vary with the size of the industry and (b) if the return ratio (RAGRT4) remains constant, fewer plantings may be required to achieve a given level of desired acreage as TNAL increases. Since these two effects are of opposite sign, it is not clear as to what sign may be expected for a_{12} and it is possible that the two effects could cancel.

The stochastic properties of u are uncertain. It could include positive autoregressive influences if the lag relationships between desired and actual plantings and the lags in expected returns are inaccurately specified. At the same time, there could be negative autoregressive influences if farmers consider past deviations of industry planting response from expected values when making current planting decisions. Since the stochastic properties of u are unknown *a priori*, the procedure followed was to apply ordinary least squares (all variables on the right are predetermined with respect to new plantings) and then to examine the residual structure to see if an alternative estimation procedure seemed required.[7]

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[4]Alternative models were also considered that allowed expected production in earlier years to receive greater weight, but the simple average of expected future production gave the best prediction.

[5]An alternative, and simpler, measure of potential future competitive production was obtained by computing the ratio of young acreage (five years and less) to the previous year total acreage less removals. Explorations with this variable gave results that were similar to, but slightly less statistically significant than those with REQ516.

[6]In an earlier study, French, King and Minami estimated the planting function in the form

$$AGE0_t = TNAL\,[b_0 + b_1 RTURN4_{t-1} + b_2(RTURN4_{t-1})^2 + b_3 REQ516_t + b_4 MO + b_5 TNAL_t + b_6 T + u_t]$$

where RTURN4 (the measure of past average returns) could be negative as well as positive. However, the quadratic term, while significant in measuring response over the historical period, turned out to have the undesirable property that for large negative values of RTURN4, the positive square term dominates and plantings may be predicted to again increase. The form used here, with returns measured as a ratio, avoids that problem and has the same general overall shape.

[7]We might also be concerned about the possibility that the disturbance term of the planting function might be correlated with the disturbance in the removal equations. It is argued here that such correlation is not likely to be important. While removals affect plantings through TNAL, removals are not themselves significantly affected by planting decisions. Further, the profit expectations affecting removals differ from the long-run expected profits affecting planting decisions.

New Planting Estimation Results

Ordinary least squares estimates of the new planting function are presented below:[8]

$$\text{(1.1a)}\quad \ln AGE0_t = \underset{(.9157)}{2.6546} + \underset{(3.9410)}{1.7429} \ln RAGRT4_{t-1} + \underset{(1.2410)}{.3180} \ln TNAL - \underset{(-4.0715)}{1.9543} \ln REQ516_t + \underset{(3.9914)}{.5944}\, MO - \underset{(-2.5058)}{.0420}\, T$$

$R^2 = .929$ and the Durbin-Watson statistic is DW = 1.92.

Values in parentheses are t-ratios.

The Durbin-Watson statistic provides no evidence of autoregressive disturbances. Further, while no formal test was made, the pattern of residuals in relation to trended variables did not suggest any significant level of heteroskedasticity. OLS is therefore viewed as an acceptable and appropriate estimation procedure.

With these statistical considerations, it may be noted that all coefficients except TNAL are large relative to their standard errors and have signs consistent with theoretical expectations. The coefficient for RAGRT4 indicates that a 1 percent increase in the rate of return has been associated with a 1.74 percent increase in plantings. The increasing response rate may be attributed to the fact that as desired acreage increases (with higher RAGRT4), with existing total net acres constant, more and more growers will move beyond the zero threshold of new plantings while growers already beyond the threshold may be expected to continue to expand—or vice versa in the case of reduced RAGRT4.

The coefficient for TNAL is positive, but not statistically significant because of the offsetting factors noted previously. The coefficient of REQ516 indicates that when expected future production from existing acreage increases relative to current expected production, farmers reduce plantings. The positive coefficient for MO indicates that during the period when the volume-control marketing order was in effect (MO = 1), planting rates were higher for a given level of average return than they were after termination of the order. This result is consistent with the hypothesis that farmers perceived cling peach production to be less risky under the umbrella of the marketing order.[9] This translates into roughly a 45 percent reduction in planting rates for a given level of net returns without the marketing order. It is possible, however, that the coefficient for MO could reflect some influence of other unmeasured time-related variables as well.

1985 and 1986 Plantings Predictions

A limited test for possible structural change in planting response was obtained by comparing equation 1.1a predictions with actual values for the out-of-sample years, 1985 and 1986. The results, presented in Table 3, indicate that although the model predicted plantings very closely in 1984, the 1985 and 1986 predictions are below the reported values by amounts that fall outside the 95 percent confidence interval. As indicated in Appendix Table A1, 1985 and 1986 plantings were relatively quite a bit higher than in the previous three years. A portion of the underprediction can be attributed to an apparently inappropriate continuation of the negative trend variable. But even when the trend is held at the 1984 level (columns 3 and 4, in Table 3), the prediction errors are greater than might be expected due to chance deviations.

Table 3. Comparison of Predicted and Actual Values of ln AGE0 (New Plantings) for 1985 and 1986

	Trend Extended		Trend Held at 29	
	1985	1986	1985	1986
Actual Value	7.7120	7.7039	7.7120	7.7039
Predicted Value	7.1685	7.1487	7.2105	7.2327
Difference (D)	.5944	.5552	.5015	.4712
SFa	.2209	.2180	.2220	.2150
D ÷ SF	2.46	2.55	2.26	2.19

[a]Standard error of forecast.

The underprediction may be explained by either or both of two factors. First, there is some uncertainty about the reported 1985 and 1986 planting values. As explained in the previous discussion, the planting figures computed here are not identical to the figures reported in California Cling Peach Advisory Board and California Canning Peach Association reports. Our figures are generally larger because of adjustments to account for initial underreporting of new acreage. In most years the difference has not been large. However, in 1985 and 1986, our adjusted figures

[8]Based on 28 observations for the period 1957-58 to 1984-85. Lagged values of returns back to 1953 were used to calculate RAGRT4. The 1956-57 observations on the dependent variable was omitted because values of TNA (TNAL is one year lag) prior to 1956 were not included in the data set.

[9]When Minami, French and King undertook their econometric analysis of the effects of the volume-control marketing orders for cling peaches, data were not available to observe grower response under free market conditions. The significant coefficient for MO suggests that their free-market simulation probably overestimated production in the later years and, hence, underestimated the prices that would have prevailed. Therefore, they may have overestimated the losses to consumers as a result of market control, although the general conclusions of the study would not have been greatly altered.

are somewhat higher relative to the CCPA figures than in previous years. Although the model would still underpredict relative to the CCPA values, it is possible that the discrepancy is less than indicated.[10]

Another possible data factor is the cost of production series. The cost estimates are rather crude. It is possible that production costs have increased less rapidly than indicated by recent price indexes. With lower costs, the profitability measure would increase and the planting prediction would be larger.

If, on the other hand, our data series for 1985 and 1986 are reasonably accurate, the results suggest a possible change in the structure of planting response. Plausible factors are some change in expected returns to alternative crops in favor of peaches and possibly some new grower projections of market conditions not reflected in the historical model. While two observations are insufficient to conclude there has been a permanent shift, the effects of the possible change in the level of planting response are explored in the dynamic simulation analysis that follows.

Determinants of Tree Removals

The area of trees farmers desire removed from production each year is influenced by the yield potential of the trees, which varies with age, and by natural factors such as disease or flooding. Decisions on tree removals may also be influenced by expected short-run returns for the next year; if high, trees of given productivity may be retained a bit longer; if low, they may be removed earlier. Industry-wide intervention programs which provide incentives for early tree removals also have affected removals. For some perennial crops, the impacts of urban expansion may be important, but it does not appear to have been a significant factor for cling peaches. A variable to reflect changing risk perception does not seem required (as it is for plantings) since removal decisions are dominated by biological factors and short-run profit considerations.

The effect of tree age on removals is difficult to capture in a single function because age affects removals nonlinearly. Therefore, separate functions were specified for each age class. Desired or planned removals are likely to be very close to actual values since such disinvestment is relatively easily accomplished. Expected short-run returns seem likely to be influenced mainly by average profitability in the most recent period (variable RAGRT in Table 1).

The influence of a tree removal incentive program that was in effect in some years under the marketing order program was accounted for by a variable (ETRILE) which takes on the value of the percentage early green drop requirement for the years 1970-72, which affected removals in1969-1971 (12.5, 24.3, and 25 percent) and is zero in all other years (see Minami, French, and King). As a result of the early removal of trees in 1969-71, the removals of trees in the two following years were abnormally low. To account for the possible effect of early removals on removals in later years, an additional variable RR3 was introduced: $RR3_t = ETRILE_{t-1} + ETRILE_{t-2} + ETRILE_{t-3}$. RR3 is a three-year sum of the tree-removal incentive values lagged one year. It has values of 12.5 in 1970, 36.8 in 1971, 61.8 in 1972, 49.3 in 1973, 25.0 in 1974 and zero all other years.

In 1981, the CCPA sponsored a voluntary tree removal program in which growers were paid up to $750 per acre for early tree removals. The CCPA reported 2,346 acres were removed under the program. Some of these acres might have been removed even without such a program, although that is not known. Most of the trees removed were pulled out in the spring of 1981 and hence would be part of the removals from the 1980 standing acreage. It seems possible, however, that some of the excess removals could have been included in 1981 values. Various approaches were used to attempt to account for the net effect of the removal incentive program and any possible carryover effect it might have had on removals in later years. The procedure finally adopted was simply to introduce a dummy variable DVR2 which has a value of 1.0 in 1980 and 1981 and zero in all other years. No further carryover effects in following years could be detected.

With these considerations, the final estimation form for the removal functions is as follows:

$$(2) \quad REM_{it}/AGE_{it} = a_{20i} + a_{21i}RAGRT_t + a_{22i}ETRILE_t + a_{23i}RR3_t + a_{24i}DVR2_t + u_{2it}$$

(i = age 0 to age 30 and over).

where all variables on the right are predetermined

[10]The CCPAB 1986-1987 Production Survey made a substantial downward adjustment in the acres planted in 1985 that would be available for 1986 harvest. If this adjustment is attributed to removals (343 acres), the proportion of new plantings removed falls considerably outside the historical 95 percent confidence interval. Hence, it seems possible that the initial report of plantings for 1985 was too high.

with respect to grower removal decisions in a particular year.[11]

Since the disturbance terms (u_{2i}) are likely to be correlated among the various age groups, seemingly unrelated regression estimation procedures would be appropriate. However, when a set of regressions involves exactly the same set of explanatory variables (as is the case here), seemingly unrelated regression estimators and ordinary least squares give equivalent results (Kmenta, p. 521). Therefore, the equations were estimated independently by OLS.

Removal Estimation Results

Estimates of removal functions by age of tree are presented in Table 4.[12] The proportion of trees removed in young age groups is very small and net return has had little effect on these proportions in the historical period of analyses. As age increases, the average proportion removed increases and the magnitude and statistical significance of the net return variable also increases in most cases. The signs of all coefficients are consistent with theoretical expectations (with some minor exceptions) and the level of statistical significance is generally high considering the detail and variability associated with the behavioral process being modeled. Most of the Durbin-Watson values are of magnitudes that do not suggest any serious serial correlation problems.

The regressions show that when current returns relative to cost (RAGRT) have increased, removals have been reduced in all age groups beyond six years, but with the more significant reductions among trees above about 16 years of age. When tree removals are deferred as a result of high current returns, the trees deferred become the next higher age class the following year and are subject to the removal function for that age group, which typically is higher—at least, until about age 22. The seemingly peculiar bulge at age three (the last year before being classed as bearing) may reflect a decision point at which growers decide whether or not recent plantings are likely to be profitable.

The findings with respect to the tree removal incentive programs are of some interest. Refer first to the program in effect from 1969-1971. The coefficients of ETRILE are generally positive and statistically significant, indicating that the program was effective in increasing removals. However, most of the coefficients for RR3 are negative and also statistically significant, indicating that the early removals reduced removal rates in the three subsequent years, but by a lesser amount than the initial increase due to the incentive.

The results of the 1981 voluntary removal incentive program are less clear. For some age classes, removals appeared to decrease under the program, but overall there was an increase in the removal proportion. No further carryover effects could be detected within the remainder of the sample period.

1985 and 1986 Removal Predictions

As in the case of new plantings, a limited test for a possible structural change in removal relationships was obtained by looking at the out-of-sample predictions for 1985 and 1986. For removals, however, the test is even more limited since removals by age class could not be computed for 1986 at the time this study was made and the reported 1985 values are subject to possible further revision as additional information is obtained for acreage in younger age groups.

For 1985, most equations predicted removals greater than actual reported values but most deviations were within the 95 percent confidence interval indicated by the standard error of forecast. The aggregate removal prediction was 3415 acres compared to reported removals of 1521 acres.[13] The 1986 aggregate prediction was 3830 compared to a

[11]The variables ETRILE, RR3 and DVR2 may be viewed as endogenous in the total system since industry decisions to establish removal incentive programs were based on Control Board and CCPA perceptions of economic conditions. In the Minami, French, King study of the marketing order program for cling peaches, surplusing decisions which determined green drop requirements, which then determined the values of ETRILE and RR3, were related to potential current-year production, canner stocks, and previous-year values of prices and product movement. However, since removal incentives were irregular events, rules for determining whether or not such programs would be implemented in a particular year could not be established. Therefore, the existence of a removal incentive program in a particular year was treated as an exogenous variable.

[12]Removal equations for ages zero to 26 were estimated with 1956-1984 data (29 observations). Accurate values for acreage in age classes over 26 could not be compiled for some of the earlier years (see Appendix Table A2). Hence, removal values could not be completed. Equations for ages 27, 28, 29, 30+ were based on 28, 27, 26 and 26 observations, respectively. (The 1956 value for age 27 in 1956 in Table A2 refers to acres 27 and older).

[13]As the industry total acreage has declined, removals in some age classes have in some recent years approached or been equal to zero. When some observations on the dependent variable (the proportion of acres removed) are zero or close to zero, ordinary least squares estimates may be biased. However, the limited dependent variable problem was not serious over the sample period and the estimates do not appear to be significantly biased because of this factor.

Table 4. Estimates of Removal Functions for California Cling Peaches by Age of Tree[a] (Dependent Variable is Proportion Removed in Each Age Class: $PR_i = REM_{it}/AGE_{it}$)

Age of Tree	Constant	RAGRT	ETRILE	RR3	DVR2	R^2	DW[b]	PRi[c]
0[d]	0.01600		-0.00030	-0.00028	-0.01412	0.043	0.612	0.0126
	(2.442)	(-0.329)	(-0.740)	(-0.624)				
1	0.01130		0.00227	-0.00014	0.05729	0.547	2.783	0.0192
	(2.749)		(3.977)	(-0.584)	(4.031)			
2	0.01449		0.00072	0.00010	0.03602	0.192	1.382	0.0191
	(3.054)		(1.092)	(0.348)	(2.196)			
3	0.12152	-0.04916	0.00242	-0.00057	0.03248	0.370	2.125	0.0753
	(3.283)	(-1.431)	(2.523)	(-1.444)	(1.343)			
4	0.02446		0.00195	-0.00002	0.01628	0.229	1.380	0.0296
	(4.455)		(2.568)	(-0.050)	(0.858)			
5	0.03129		0.00176	-0.00013	0.02549	0.130	1.668	0.0359
	(4.228)		(1.715)	(-0.315)	(0.997)			
6	0.02505		0.00175	-0.00017	0.04668	0.247	1.386	0.0309
	(3.990)		(2.015)	(-0.482)	(2.152)			
7	0.12372	-0.08916	0.00179	-0.00024	0.00640	0.438	1.523	0.0358
	(3.773)	(-2.929)	(2.113)	(-0.702)	(0.299)			
8	0.07315	-0.04129	0.00248	-0.00030	0.05243	0.579	2.217	0.0381
	(2.800)	(-1.703)	(3.666)	(-1.090)	(3.070)			
9	0.10243	-0.06139	0.00117	0.00011	0.01284	0.302	2.045	0.0441
	(3.102)	(-2.003)	(1.370)	(0.316)	(0.595)			
10	0.11886	-0.07037	0.00397	-0.00035	0.04794	0.612	2.009	0.0568
	(3.404)	(-2.171)	(4.400)	(-0.958)	(2.100)			
11	0.13496	-0.07543	0.00498	-0.00105	0.02414	0.562	2.204	0.0638
	(3.092)	(-1.862)	(4.410)	(2.277)	(0.846)			
12	0.17261	-0.10288	0.00663	-0.00082	0.02196	0.774	1.760	0.0784
	(4.907)	(-3.150)	(7.286)	(-2.193)	(0.955)			
13	0.20749	-0.12447	0.00572	-0.00099	0.04273	0.653	1.603	0.0898
	(4.489)	(-2.901)	(4.788)	(-2.025)	(1.414)			
14	0.18701	-0.08850	0.00675	-0.00076	0.06788	0.636	1.744	0.1112
	(3.643)	(-1.857)	(5.081)	(-1.401)	(2.023)			
15	0.26387	-0.14233	0.00844	-0.00145	0.06481	0.723	1.279	0.1324
	(4.889)	(-2.841)	(6.043)	(-2.537)	(1.837)			
16	0.30184	-0.15380	0.00851	-0.00169	0.05962	0.654	1.785	0.1569
	(4.647)	(-2.551)	(5.063)	(-2.464)	(1.404)			
17	0.41366	-0.23875	0.01171	-0.00229	-0.05403	0.743	1.184	0.1776
	(5.784)	(-3.596)	(6.330)	(-3.019)	(-1.156)			

continued on next page

Table 4 continued

Age of Tree	Constant	RAGRT	ETRILE	RR3	DVR2	R^2	DW[b]	PRi[c]
18	0.46162	-0.27710	0.00898	-0.00103	0.03282	0.664	1.263	0.1947
	(5.814)	(-3.759)	(4.372)	(-1.226)	(0.632)			
19	0.40199	-0.19323	0.01088	-0.00180	-0.00799	0.688	1.052	0.2167
	(5.491)	(-2.843)	(5.746)	(-2.317)	(-0.167)			
20	0.37689	-0.13325	0.01164	-0.00306	-0.01122	0.538	1.344	0.2459
	(3.688)	(-1.405)	(4.405)	(-2.824)	(-0.168)			
21	0.51403	-0.26068	0.01332	-0.00259	0.10480	0.649	1.223	0.2681
	(4.856)	(-2.653)	(4.864)	(-2.306)	(1.515)			
22	0.53719	-0.25635	0.01524	-0.00380	0.10497	0.649	1.065	0.2920
	(4.574)	(-2.351)	(5.017)	(-3.057)	(1.367)			
23	0.50937	-0.24279	0.01381	-0.00199	0.22616	0.683	2.134	0.2949
	(4.658)	(-2.392)	(4.884)	(-1.717)	(3.164)			
24	0.42015	-0.16747	0.01367	-0.00287	0.24796	0.607	1.655	0.2778
	(3.371)	(-1.447)	(4.242)	(-2.171)	(3.044)			
25	0.61980	-0.30229	0.01143	-0.00448	-0.05656	0.563	2.301	0.3043
	(5.121)	(-2.690)	(3.649)	(-3.492)	(-0.715)			
26	0.68188	-0.36893	0.00980	-0.00067	-0.17742	0.401	2.816	0.3112
	(3.987)	(-2.324)	(2.216)	(-0.372)	(-1.587)			
27	0.40819	-0.12295	0.01050	-0.00226	0.30766	0.394	2.097	0.3154
	(2.033)	(-0.645)	(2.243)	(-1.185)	(-2.599)			
28	0.10387	0.10663	0.02252	-0.00188	0.15258	0.404	1.407	0.2597
	(0.399)	(0.428)	(3.764)	(-0.769)	(1.009)			
29	0.13713	0.08443	0.01596	-0.00066	-0.00382	0.429	1.526	0.2526
	(0.690)	(0.435)	(3.850)	(-0.391)	(-0.036)			
30+	0.59651	-0.30608	0.01775	-0.00340	0.10287	0.749	2.008	0.3232
	(4.477)	(-2.354)	(6.390)	(-3.007)	(1.464)			

[a]OLS regressions, 1956-1984 data. Numbers in parentheses are t-statistics, variable definitions are given in Table 1.
[b]Durbin-Watson statistic.
[c]Mean annual proportion removed, 1956-1984.
[d]Age 0 is new plantings.

preliminary reported value of about 1500 acres removed. These relatively large deviations in the same direction, although not totally outside the range of historical variation, suggest the possibility of some shift in the structure of removal relationships. As in the case of plantings, some of the difference may be due to possible 1985 and 1986 reporting errors (underreporting in this case) and a possible overestimation of production cost (and, therefore, undervaluing the profitability measure). It seems possible also that the reduced removals could reflect some residual effect of the tree removal incentive program in 1981. Some of the trees that might normally have been removed in 1985 may have been removed previously under the incentive program. Factors that might account for possible changes in the removal coefficients would include improved varieties and cultural practices leading to longer survival and productivity of the trees.

The potential impacts of these deviations are explored in the simulation analysis that follows.

Total Output

The acreage of trees of age zero (new plantings) is determined by equation (1.1a). The acreage in each other age class then is given by

$$(3)\quad AGE_{it} = AGE_{i-1,t-1} - REM_{i-1,t-1}\ ,\ i=1,...,30+$$

For example, the acreage of 10 year-old trees in year t is the acreage of nine year-old trees in year t-1 less quantities removed from that age class in t-1. Total output is given by

$$(4)\qquad QPOTNL_t = \sum_{i=2}^{30+} AGE_{it} \cdot Y_{it}$$

where Y_i is the yield of trees of age i. For prediction purposes, yields would be the values predicted by the trend equations in Table 2.

Note that the acres in age-class i can also be expressed as a function of the new plantings i years previously less the quantities removed each year up to i. That is

$$(5)\qquad AGE_{it} = AGE_{0,t-i} - \sum_{j=0}^{i-1} REM_{j,t-i+j}$$

For example, the acreage of trees age four in year t is

$$AGE_{4,t} = AGE_{0,t-4} - REM_{0,t-4} - REM_{1,t-3} - REM_{2,t-2} - REM_{3,t-1}.$$

If equations (1.1) and (2) are substituted in (5) and (5) then substituted in (4), total output in year t may be expressed as a complex function of past prices, costs and market intervention programs extending back 20 to 30 years.

Supply Elasticities

Many studies of supply response include estimates of the elasticity of supply—the relation between a percentage change in price and the associated percentage change in output. The elasticities may further differentiate between short-run and long-run values; short-run values showing (say) a one-year response to a price change and the long-run values the final percentage change after enough time has elapsed for all production adjustments to occur.

In the case of perennial crops, such supply elasticities may be more difficult to specify and to interpret. In the very short-run (periods less than required for trees to bear fruit) supply is very inelastic since output can be affected only by deferring removals. In the intermediate term (say five to 10 years), elasticity values may depend in part on the particular age distribution of trees resulting from historical precedents. Hence, the effects of changes in returns or factors affecting returns are best evaluated in the context of simulation solutions of a dynamic model of the entire system.

Processed Product Sales and Price Determination

Cling peach processors have the option of selling all of their seasonal supply (pack plus carry-in stocks) in the current year or carrying some part as inventory over to the next year. The manner in which this process is modeled depends on the assumptions made concerning the competitive behavior of canners. If canners are viewed as price takers, we may specify an allocation function that relates the quantity sold in the current year to available supply, current price, some measure of expected price if carried another year, and perhaps interest cost. The f.o.b. demand function facing processors relates price to quantity sold and variables which shift the level of demand. Price and current sales then are jointly determined by the interaction of the allocation function and the demand function facing processors.

An alternative approach developed by French and King is followed here. The French-King model views cling peach canners as price setters (rather than price takers) who plan to sell as much as the market will take at the given price, with the balance carried to the next year. Prices are set so as to attempt to cover the raw product cost plus the unit-cost of processing and to earn some target profit margin per unit, with further modifications depending on the annual seasonal supply (pack plus carryover stocks) and the rate of current movement relative to supply. The demand function expresses quantity sold as a function of the price that is set and variables associated with shifts in the level of demand. Prices and sales are then jointly determined by simultaneous solution of the two functions.

With either type of processor behavior (i.e., price taker or price setter), stocks carried to the next period are determined residually as the difference between the predetermined available seasonal supply and the actual processed product movement.

Equation System

The functional forms specified for empirical estimation of the system (including both regular pack cling peaches and fruit cocktail which has peaches as a major ingredient) are given below, with explanations following (see Table 1 for detailed variable definitions). All monetary variables are deflated by the Personal Consumption Expenditure deflator (PCE67R in Table 1)[14].

Price markup functions

(6.1) $\ln FRPCER_t = b_{10} + b_{11} \ln TCRPE_t + b_{12} \ln RQMTSR_t + b_{13} \ln QCRPN_t + b_{14}T + v_{1t}$

(6.2) $\ln FFCCER_t = b_{20} + b_{21} \ln TCFCE + b_{22} \ln RQMTSF_t + b_{23} \ln QCFCN_t + b_{24}T + v_{2t}$

(6.3) $\ln RQMTSR_t = \ln QMCRPN_t - \ln(TSRPN_t + QIRPN_t)$

(6.4) $\ln RQMTSF_t = \ln QTMFCN_t - \ln TSFCN_t$

F.o.b. demand functions

(6.5) $\ln QMCRPN_t = b_{50} + b_{51} \ln FRPCER_t + b_{52} \ln ITDIER_t + b_{53}D70 + b_{54} T14 + b_{55} (T14)^2 + v_{5t}$

(6.6) $\ln QTMFCN_t = b_{60} + b_{61} \ln FFCCER_t + b_{62} \ln ITDIER_t + b_{63} D70 + b_{64} T14 + b_{65} (T14)^2 + v_{6t}$

(6.7) $QTMRPN_t = QMCRPN_t - QIRPN_t$

Carryover stock identities

(6.8) $BEGRPN_{t+1} = TSRPN_t - QTMRPN_t$

(6.9) $BEGFCN_{t+1} = TSFCN_t - QTMFCN_t$

The pricing, demand and stock model involves nine current endogenous variables, including identities or definitional variables. The basic endogenous variables are FRPCER and FFCCER (deflated f.o.b. prices for regular pack canned peaches and fruit cocktail), QTMRPN and QTMFCN (annual shipments of regular peaches and fruit cocktail, expressed per U.S. population) and $BEGRPN_{t+1}$, $BFGFCN_{t+1}$, (per capita stocks carried over to period t+1). The other current endogenous variables are defined by equations (6.3), (6.4) and (6.7).

Explanation of Price-Markup Functions

Equations (6.1) and (6.2) relate the (natural log of) f.o.b. price set by canners to the previously-incurred processing and raw product cost per case (TCRPE, TCFCE), the ratio of current year movement to current year supply, the per capita supply of competing canned fruit (QCRPN, QCFCN), and a time trend (T). The log formulation was chosen because of a better overall fit of equations in the total system, especially the demand functions.

F.o.b. processor prices announced at the beginning of the marketing year are set so as to cover costs and to achieve the highest return based on expected market conditions and the cost of carrying inventories to the next year. However, as the market year progresses, canners may discover that the rate of product movement (QTMRP + QIRP, QTMFC) relative to the seasonal supply (TSRP + QIRP, TSFC) exceeds or falls below expectations and thus may make some further adjustment in price; hence the need for the variables RQMTSR and RQMTSF. Note that the logs of these ratios are the same as the logs of movement less the logs of supply. Also, the ratio is the same whether the variables are expressed per capita or in total terms. RQMTSR and RQMTSF are endogenous variables whose values are jointly determined with f.o.b. price.

The per capita supply of competing canned fruit (pears, apricots and fruit cocktail for canned peaches and pears, apricots and canned peaches for fruit cocktail) are taken as additional indicators of market conditions which influence the price set by canners. The trend variable was introduced to account for possible deviations of actual industry cost from the reported representative values, TCRPE and TCFCE.

The coefficients for lnTCRPE, lnTCFCE, lnRQMTSR and lnRQMSTF are expected to be positive and the coefficients for QCRPN and QCFCN are expected to be negative. The coefficient for T is not theoretically determined.

Explanation of Demand Functions

Demand functions facing processors of both regular pack and fruit cocktail may be grouped into three categories: (1) the U.S. domestic market demand; (2) export market demand; and (3) U.S. federal government demand. The total annual *domestic* consumption (U.S. purchases from canners) is a function of the f.o.b. processor prices for canned products, population, income, prices of competing products, price level, marketing costs and changing consumer tastes and habits. The *export* demand (sales to foreign countries) is a function of the f.o.b. prices, exchange rates and a wide variety of exogenous factors that affect the level of foreign demand. United States *government purchases* are made primarily for the military and government institutions and to support activities such as the school lunch program. Such

[14]In a previous study, French and King estimated the demand and price-markup system with equations expressed in logs of nominal rather than deflated values, for reasons explained in their paper. Subsequently, further exploration of the price-markup specification indicated that a revised formulation based on deflated values performs about as well and has an advantage of greater consistency and computational simplicity in the context of the total industry model.

purchases are also a function of f.o.b. prices and of variable government policy.

Data pertaining to export and government demand shifters that would be required to obtain separate estimates of the three jointly related demand functions could not be obtained. Therefore, the three equations were summed into a single function in which the effects of export demand shifters and government policy are imbedded as components of trend variables and the disturbance terms.[15] The aggregated demand equations express current year movement (including imports in the case of canned peaches) as functions of f.o.b. processor prices of canned peaches and fruit cocktail, total disposable income, population, and some time-form variables introduced in an attempt to account for the effects of complex changes in the level of demand.

The effects of changes in population were incorporated by expressing all quantities on a U.S. per capita basis. This is an imprecise specification with respect to the export component of demand since the latter is not affected by U.S. population. However, exports have been relatively small and such treatment greatly simplifies the analysis without appearing to introduce any serious specification error.

Prices of competing canned fruit, which might be expected to affect the movement of canned peaches and fruit cocktail, were deleted as variables because they turned out to have moved so closely with the canned peach and fruit cocktail prices (r = .99+) that it was not possible to measure the substitution effects. This seems unlikely to have much affect on the forecasting potential of the models. Such close movement among prices is inherent in the price-setting behavioral hypothesis because the prices are affected by many common variables. Hence, the close association observed historically may be expected to continue. A measure of distribution cost which might also be expected to affect the demand facing processors was likewise deleted in the final empirical analysis because its high correlation with per capita income growth made it impossible to obtain statistically significant estimates of the cost parameter.

The most difficult aspect of estimating demand functions for canned peaches and fruit cocktail is to account for the shifts in demand that cannot be explained by population or income growth. French and King (1986) identified three major factors that have contributed to such shifts.

First, the U.S. government ban on the use of cyclamates in diet foods in 1970 wiped out for some years what had been a developing market. Second, the beginning of accelerated inflation rates and energy shortages about 1974 seemed to have altered the general price structure and consumers' willingness to pay. There was, in effect, a temporary upward shift in the level of demand. Finally, in spite of the upward shift in pricing structure in 1974, there has been a general downward trend in the demand for canned fruit since the early 1970's. This may have been modified to some degree by partial recovery of the low-calorie market, but it was also exacerbated by a loss of export markets and the first-ever flow of imports in 1983 and 1984.

The procedure used to try to account for the effects of these complex structural changes was to include a variable (D70) which is zero prior to 1970 and then is 1.0 thereafter, plus a quadratic trend variable that begins in 1970 (T14 and $(T14)^2$). The zero-one variable allows for a possible immediate decline in the level of demand due to the cyclamate ban in 1970, while the quadratic trend variable is an attempt to reflect the combined influence of the several structural forces acting on the market since 1970.

We would, of course, expect the coefficients b_{51} and b_{61} to be negative and b_{52} and b_{62} to be positive, although the latter may reflect time-related shifts not directly related to real income.[16]

Demand and Price-Markup Estimation Results

The simultaneous system represented by equations 6.1 to 6.9 was estimated by three-stage least squares with data for the period 1956-1984.[17] The results are presented in Table 5.

Turning first to equations 6.1 and 6.2, the price-markup functions, all coefficients have the theoretically expected signs and are large relative to their standard errors. The values of the Durbin-Watson statistic do not provide evidence of possible serial correlation of disturbances.

The variables RQMTSR and RQMTSF are the ratios of current movement (QMCRPN, QTMFCN) to seasonal supply (TSRPN + QIRPN, TSFCN). Hence,

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[15]Government purchases are relatively minor and have varied somewhat randomly over time, so little is lost by combining them with the total U.S. demand. One means of attempting to obtain a separate estimate of the U.S. domestic demand function is to treat exports as an exogenous variable. However this appears to be an improper specification since disturbances in the domestic demand affect the price set and this affects exports which in turn affects quantities allocated to the U.S. market. A model which ignored the simultaneity (treated exports as exogenous) yielded estimates that were biased downward and of lower and uncertain statistical significance.

[16]An alternative model which permitted the values of b_{51} and b_{61} to vary over time yielded implausible results and hence was discarded.

[17]With the inclusion of lagged variables, the first observation on the dependent variables is 1957-58.

Table 5. Three-Stage-Least Squares Estimates of F.O.B. Processor Demand and Price-Markup Equations for Canned Peaches and Fruit Cocktail[a]

Equation	DW[b]
(6.1) lnFRPCER = -.52258 + 1.10879 lnTCRPE + .58508 lnRQMTSR - .25000 lnQCRPN - .00758 T	1.72
(2.958) (9.366) (3.429) (-3.316) (-3.942)	
(6.2) lnFFCCER =.333254 +.74614 lnTCFCE + .38781 lnRQM5TSF - .30185 lnQCFCN - .01173 T	1.70
(1.648) (5.335) (1.950) (4.086) (-6.127)	
(6.5) lnQMCRPN = .86563 - .70297 lnFRPCER + .15420 lnITDIER - .19665(D70) + .04598(T14) - .00474$(T14)^2$	2.44
(-2.837) (3.679) (.799) (-2.889) (2.386) (-4.451)	
(6.6) lnQTMFCN = -1.20452 - .73772 lnFFCCER + .19964 lnITDIER - .27666(D70 + .05651(T14) - .00558$(T14)^2$	2.27
(-5.241) (-5.917) (1.730) (6.750) (5.075) (-8.935)	

[a] See Table 1 for variable definitions. Estimates are based on 1957-58 to 1984-85 observations (n = 28). Values in parentheses are t ratios.
[b]Durbin-Watson statistic.

the logarithms of RQMTSR and RQMTSF are logarithms of movement less logarithms of supply. With seasonal supply held constant, a 1 percent increase in movement has been associated with a .58 percent increase in deflated f.o.b. price canners wish to set for canned peaches and a .39 percent increase in deflated price for fruit cocktail. If movement and all other explanatory variables remain constant, increases in seasonal supplies have had similar effects on price, but of opposite sign.

The equations indicate that the f.o.b. price has moved closely with movements of the sample data on total unit cost of processing plus the raw product cost. The lower coefficient values for the cost of processing fruit cocktail (.746) compared to canned peaches (1.109) may be due to the fact that the cost series for fruit cocktail includes only the raw product cost for peaches, but other fruits, especially pears, are also a component of fruit cocktail cost. The effect of changes in the price of pears is reflected in the larger coefficient for canned fruit competing with fruit cocktail (lnQCFCN). Large supplies of competing fruits are associated with lower raw product prices for pears and hence lower costs for fruit cocktail ingredients.

Referring finally to the demand functions (equations 6.5 and 6.6), the signs of the coefficients again are all consistent with theoretical expectations and, with the exception of the income variable, all are large relative to their standard errors. The nonsignificant coefficients for per capita income reflect a dominance of other shifts in demand level unrelated to income. These are represented by the time-form variables, D70 and T14.

The sign and significance of the variable D70 support the hypothesis of the downward effect on demand of the cyclamate ban in 1970. If all the effect of D70 is attributed to the cyclamate ban, it suggests that with other factors constant, there was an initial loss of market sales at a given price of about 17.8 percent for canned peaches and 24.2 percent for fruit cocktail.[18] However, the shift could reflect other unmeasured factors as well.

The quadratic trend (T14 and $(T14)^2$) picks up the combined effects of an altered price structure under accelerated inflation, accompanied by a more general downward trend due to changing tastes and loss of export markets. The downward trend may have been modified a bit by some recovery of the low-calorie or sugar-free market, but this aspect cannot be separately identified.

The potential effects of imports (QIRPN) were introduced into the demand system by adding them to the total movement of canned peaches (data on fruit cocktail imports, if any, have not been separately reported). Hence, the dependent variable for equation 6.5 is QTMRPN + QIRPN where QIRPN is viewed as an exogenous variable. QIRPN was zero for all years before 1983; it was .0050 in 1983-84; .0052 in 1984-85; and .0059 in 1985-86 and .033 in 1986-87.

Since the demand functions are expressed in logs they provide direct estimates of demand elasticities at the f.o.b. processor level. These are -.70 for canned peaches and -.74 for fruit cocktail.

Reduced-Form Solutions

To be most useful for prediction purposes, the price-markup and demand equations may be solved simultaneously to express the values of the endogenous prices and movements as functions of only the predetermined seasonal supplies and the exogenous variables. These reduced-form equations are given in Table 6.

The values of the explanatory variables are known at the beginning of the marketing year. Inserting these values in the reduced-form equations provides conditional predictions of current-year f.o.b. prices and movement. The coefficients in Table 6

[18]Percentage changes were computed by calculating predicted quantities with D70 at 0 and 1 and then taking their ratios. Mathematically, for small fractions of 1, the percentage changes would be 19.7 and 27.7, i.e., the values of the coefficients associated with (D70) in Table 5.

Table 6 Reduced-Form Equations for the F.O.B. Processor Demand, Price-Markup and Carryover-Stock System

Canned Peaches			Fruit Cocktail		
Predicted variable	lnFRPCER	lnQMCRPN	Predicted variable	lnFFCCER	lnQTMFCN
Constant term	-.72915	-.35306	Constant term	-.10409	-1.12773
Explanatory variables			Explanatory variables		
lnTCRPE	.78566	-.55229	lnTCFCE	.58016	-.42800
ln(TSRPN + QIRPN)	-.41457	.29143	lnTSFCN	-.30154	.22245
lnQCRPN	-.17714	.12453	lnQCFCN	-.23470	.17315
lnITDIER	.06393	.10926	lnITDIER	.06020	.15523
T	-.00537	.00378	T	-.00912	.00673
D70	-.08152	-.13934	D70	-.08342	-.21512
T14	.01906	.03258	T14	.01704	.04394
$(T14)^2$	-.00197	-.00336	$(T14)^2$	-.00168	-.00434

indicate predicted percentage changes in the price and movement variables for a 1 percent change in the explanatory variables. To illustrate, a 1 percent increase in the total processing and raw product cost per case of canned peaches (with other variables constant) is predicted to increase the deflated f.o.b. price by .79 percent in the current year. A 1 percent increase in the per capita seasonal supply (plus imports) is predicted to decrease the deflated f.o.b. price of canned peaches by about .41 percent. The coefficient for the shift variable D70 suggests that with other factors constant, the cyclamate ban may have decreased the f.o.b. price for canned peaches by about 7.7 percent and reduced sales by about 13 percent. The effects were slightly larger for fruit cocktail (about 8 and 19.4 percent).[19] As noted previously, however, it is possible that other unmeasured factors could also account for some of the D70 shift.

1985 and 1986 Processed Product Price and Movement Predictions

Conditional structural equation (Table 5) predictions of the prices and per capita movement of canned peaches and fruit cocktail for the out-of-sample years 1985 and 1986 are given in Table 7. The predictions are conditional in the sense that all right-side variables except T and T14 are entered at their observed 1985 and 1986 values. The trend variables are set at their 1984 levels. Since they were introduced to account for the effects of otherwise unmeasurable shifts, they are strictly applicable only over the period of the data set. Continuation of the quadratic approximation results in predictions of movement below observed values.

Comparison of the difference between actual and predicted values (in logs) with the standard errors of the regressions suggests that the prediction errors are

Table 7. Processed Product Demand and Price-Markup Structural Equation Predictions, 1985-1986[a]

		1985			1986		
	Sb	Actual	Predicted	Difference	Actual	Predicted	Difference
lnQMCRPN	.0650	-2.6267	-2.6788	.0521	-2.6269	-2.6740	.0471
QMCRPN		.0723	.0686	.0037	.0723	.0690	.0033
lnFRPCER	.0373	1.8749	1.7658	.1091	1.8500	1.7936	.0564
FRPCER[c]		6.52	5.84	.68	6.36	6.01	.35
lnQTMFCN	.0402	-3.3153	-3.2681	-.0472	-3.2189	-3.2688	.0499
QTMFCN		.0363	.0381	-.0018	.0400	.0381	.0019
lnFFCCER	.0430	1.9755	2.0047	-.0292	1.9851	2.0163	-.0312
FFCCER[c]		7.21	7.42	-.21	7.28	7.51	-.23

[a]T and T14 held at 1984 values.
[b]Standard error of the regression.
[c]Prices in 1967 dollars. To convert to nominal dollars multiply 1985 prices by 2.83, 1986 prices by 2.90 (see PCE67R in Appendix Table A12).

[19]See previous footnote regarding the calculation of the percentage effects of D70.

all within the range of historical variation with the exception of the 1985 prediction of the price-markup equation for canned peaches.[20] However, if compared with the larger standard error of forecast (roughly .088 as an OLS approximation), the prediction error still appears to be within the range of expected stochastic variation.Hence, other than the stabilizing (discontinuing) of the trend shifts, there is no clear evidence of structural change in the demand and price markup system in these two years.

Grower-Processor Interaction

Modeling the transfer of farm production to canners and the determination of the raw product price is complicated by the long-time existence of a bargaining structure and, during the period up to 1972, the existence of volume-control marketing-order programs. The major problem is that when there is bargaining, a derived grower-level demand function for the raw product may not exist (as it does under perfect competition—see French (1986)). Also, when market control programs are in effect it is necessary to model the control board decision process pertaining to quantity made available to canners.

Although unique equilibrium solutions for the raw-product price may not exist under bargaining, it is possible to define a range within which the final negotiated price will lie. The econometric approach to farm price prediction then is to specify a function in which the raw-product price is the dependent variable and the explanatory variables are those which may influence the position of the space within which price bargaining occurs and the further location of the price within the bargaining space.

The Farm-Price Prediction Model

Following French (1986), the upper limit of the farm price bargaining range is defined as the expected f.o.b. price of the processed product less the expected cost of transformation and storage, converted to raw product equivalents. The negotiated farm price then is this upper limit less an increment determined by the nature of competition in the processed product market and the bargaining structure. The farm price prediction equation is determined by specifying the relation of the expected f.o.b. price, the expected cost and the bargaining increment to observable variables.

In forming f.o.b. price expectations, processors are assumed to behave rationally in the sense that they take account of a perceived supply and demand structure for canned cling peaches. The perceived structure is specified to involve demand and price-markup functions similar to the equations presented in the previous section. However, the processor *ex ante* perceptions of the demand structure need not coincide exactly in form and variables with the empirically estimated functions based on *ex post* data.

The derivation of a farm price equation that is tractable for estimation purposes is simplified by assuming that the processor perceptions of demand and price-markup equations can be approximated by linear functions. The perceived demand function for canned peaches includes deflated marketing-year price ($FRPCER_t$) and per capita sales ($QTMRPN_t$) as endogenous variables, plus other variables which processors may view as indicators of shifts in the level of per capita demand. The latter are treated as exogenous or predetermined. Recall that the price-markup function for canned peaches expresses FRPCER as a function of the processing and raw product cost per case with further modification based on the per capita seasonal supply ($TSRPN_t$) and the current movement ($QTMRPN_t$). The unit processing cost (PCRP) is treated as an exogenous variable and the raw product cost and seasonal supply are predetermined with respect to the marketing year.

Simultaneous solution of the perceived demand and price-markup functions yields an equation that expresses the f.o.b. price as a function of unit processing cost, raw product price, seasonal supply (quantity canned plus carry-in stocks) and demand shift indicators. The explanatory variables are all predetermined (known to processors) in the marketing year for the processed product. However, at the time the raw product price is established, stocks carried in (on June 1), unit processing cost and the level of processed-product demand are not known. An expression for expected f.o.b. price is obtained by specifying projection models for each of the variables whose values are unknown.

Since industry inventory levels are monitored and reported frequently, it is assumed that June 1 stocks can be projected closely enough to be regarded as known at the time of farm price negotiations. Processing cost is assumed to be projected from the known cost value the previous year.

Demand shifters normally would include variables such as personal income and prices of substitute commodities. However, as noted in the previous section, since the early 1970s these variables have been overwhelmed by the downward effects of declining consumer preferences and loss of export

[20]Predictions of original values from equations estimated with logarithmic dependent variables may be biased. Kennedy suggests a correction for this bias but notes that the correction may worsen mean square error. The predictions here were not adjusted for bias, which is likely to be small over the range of analysis.

markets. Processor perceptions of such demand shifts are assumed to be captured by changes in the lagged f.o.b. price of canned peaches and a lagged two-year average of combined per capita movement of canned peaches and fruit cocktail. If the perceived canned product demand slope remains constant, a change in average sales with price constant or a change in price with sales constant provides an indication of a shift in the level of demand.

The supply of competing canned fruits was also included as a variable in an initial formulation, but proved to be nonsignificant, probably because the final value of such supplies is very uncertain at the time the cling peach farm price is established.

Another factor affecting f.o.b. price projections historically was a previously-noted shift of prices to new levels beginning about 1974 that cannot be accounted for fully by shifts in price level or reported unit processing cost. A zero-one variable (D74 which has a value zero prior to 1974, 1.0 thereafter) was introduced to reflect this shift. Variations which allowed the effect of D74 to decline over time were also considered, but did not perform as well.[21]

The first-ever significant quantities of canned peach imports were observed in 1983 and 1984. It was hypothesized that this would have a negative effect on processors f.o.b. price expectations, so per capita imports (QIRPN) were introduced as an additional shift variable.

The bargaining increment subtracted from the expected f.o.b. processor price (less expected unit processing cost) is a random variable whose mean value is hypothesized to vary with previous-year processed product price and processing cost, with the level of supply, and with underlying structural characteristics of the bargaining environment.

Lagged processed product price and cost reflect the processors' *ex post* profit experience. When previous-year processor returns are relatively high, processors may be less resistant and growers more aggressive. Hence, the bargaining increment may decrease. The reverse might be expected when past processor returns are low.

It seems reasonable to expect that processors also may be willing to settle for lower unit margins when supplies are large and growers may be more aggressive in seeking reduced processor margins as prices decline as a result of larger supplies. When supplies are small, processors may aim for larger per unit margins while, with higher prices because of smaller volume, growers may be less aggressive in bargaining. This hypothesis cannot be tested since seasonal supply also affects f.o.b. price expectations. However, if it is correct, the effect of quantity processed on farm price is reduced since a smaller bargaining increment would be subtracted from the expected f.o.b. price when supplies are large.

The value of the bargaining increment may also fluctuate as a result of variations in bargaining strategies and conditions. If processors are very competitive, the increment may be near zero. As processor power increases relative to bargaining association power, the value of the increment increases. However, efforts to relate changes in the mean value of the bargaining increment to factors such as share of industry volume controlled by the CCPA, the concentration of canners and the termination of the marketing order program in 1972 were not successful.

With these considerations and appropriate substitutions, the farm-price predicting equation is expressed in the following form.

$$(7)\quad FRMCER_t = c_0 + c_1\,(QMARTN + SRAWN)_t + c_2PCRPE_{t-1} + c_3FRPCER_{t-1} + c_4QTMNW2_t + c_5QIRPN + c_6D74 + w_t$$

The dependent variable is deflated farm price and the explanatory variables are quantity of raw peaches purchased by packers per million U.S. population (QMARTN) plus carry-in stocks of canned peaches and fruit cocktail in raw peach equivalents per million U.S. population (SRAWN), deflated per unit processing cost the previous year (PCRPE), deflated f.o.b. price of canned peaches the previous year (FRPCER), lagged average per capita movement of canned peaches and peaches in fruit cocktail (QTMNW2), per capita imports (QIRPN, treated as exogenous), the price-structure shift variable, D74, and an unexplained disturbance (w_t).[22]

All variables on the right except the quantity of peaches sold to processors (QMARTN) clearly are predetermined with respect to the farm price. The existence of marketing control programs up to 1972 and at least the potential for the CCPA to affect sales, suggests that QMARTN may be jointly determined with the farm price. This would require an equation to predict QMARTN (rather than being determined by

[21]The effects of the cyclamate ban in 1970, which was a significant variable in the estimated processed product demand functions, did not show up as significant in the farm prediction equation. This may have been because processor perceptions are based on a smaller set of measurable variables, and the cyclamate ban effect was eventually absorbed by the lagged per capita movement variable.

[22]Lagged costs and prices of fruit cocktail may also affect the farm price. However, they have moved closely with canned peach prices and canned peaches account for three fourths of the total utilization. The level of peaches marketed as fruit cocktail is included in QTMNW2.

total production) and then simultaneous estimation of the two equations.

It is argued here, however, that for all practical purposes, QMARTN may be regarded as predetermined with respect to farm price. During the period when volume-control marketing-order programs were in effect, decisions pertaining to quantities surplused (not marketed), which were accomplished mainly by "green drop" requirements, were generally set prior to the completion of the CCPA bargaining process. Therefore the quantity sold to processors was essentially predetermined by acreage, yields and the prior decisions of the control board, although in selected years this may not have held precisely.

The CCPA has the further potential power to influence the farm price by withholding some of the available supply from the market. It appears, however, that this power has generally not been exercised to any great extent.[23] The CCPA has obtained its bargaining strength from the potential threat of withholding from individual canners and from the provision in California legislation which specifies that growers are entitled to "fair" prices. Failure to agree is subject to adjudication. Overall, the value of QMARTN appears to have been determined mainly by supply factors and control decisions made prior to the price negotiations. With QMARTN treated as predetermined, equation (7) may be estimated by ordinary least squares.

Farm Price Equation Estimation Results

Estimates of the parameters of the price-prediction equation, based on data for the period 1956 to 1984 (28 observatons due to the inclusion of lagged variables) are given below. The variables and units of measurement are defined in Table 1.

$$
\begin{aligned}
(7.1)\ FRMCER_t = {} & 67.6342 - .00857\,QSRAWN_t - 17.81990\,PCRPE_{t-1} \\
& (2.092) \quad (-2.804) \qquad\qquad (4.053) \\
& + 12.19004\,FRPCER_{t-1} + 301.71190\,QTMNW2_t \\
& (4.613) \qquad\qquad (2.496) \\
& + 17.32610\,D74 - 1581.022\,QIRPN \\
& (4.213) \qquad\qquad (1.618)
\end{aligned}
$$

The R^2 value for (7.1) is .655 and the Durbin-Watson statistic is 1.49. Values in parenthesis are t ratios.

The coefficients all have signs consistent with theoretical expectations and, with the exception of QIRPN, all are statistically highly significant. The value of the Durbin-Watson statistic provides no clear indication of serially correlated disturbances[24]. Measured in terms of the prediction of deflated prices, the R^2 value (.655) is modest. However, if computed with respect to the wider variation of nominal prices, the R^2 value is about .97.

Equation (7.1) indicates that, with other variables held constant, the negotiated farm price has decreased with increases in the annual seasonal supply of canned peach products and peaches for canning relative to population (QSRAWN = QMARTN + SRAWN), has decreased with increases in a measure of previous-year processing cost per case, ($PCRPE_{t-1}$) and has increased with increases in the previous-year f.o.b. canner price of canned peaches ($FRPCER_{t-1}$) and the lagged two-year average per capita movement measure (QTMNW2). The per capita value of canned peach imports in 1983 and 1984 was approximately .005, suggesting that the deflated farm price was reduced by about 1581 x .005 = $7.90 per ton. However, this estimate should be viewed with caution since only two years of imports are included and the coefficient for QIRPN is not highly significant.

The coefficient for variable D74 suggests that in 1974, with other variables constant, the deflated farm price moved to a level about $17.30 per ton above previous levels. That impact was modified subsequently by a downward shift in demand as reflected by QTMNW2.

It should be noted that the farm-price prediction equation pertains to short-run predictions and does not reflect the full impact of a change in a variable such as lagged processing cost. Since lagged cost is an imperfect projector of actual processing cost, processors may respond initially only partially to an observed change in processing cost, especially since such costs may include a significant fixed component that need not be covered each year. Further, in accordance with the price-setting hypothesis advanced previously, canners may compensate in part for increased processing cost by setting higher f.o.b. prices for the processed product, as well as lowering their farm price offers. But an increase in the f.o.b. price, with demand constant, leads to an increase in carry-over stocks which, along with the reduced movement at the higher price, shifts the bargaining range downward the next year and thus reduces farm price. Eventually the system adjusts to reflect the full impact of a change in processing cost on

[23]In 1981, the CCPA affected the total quantity produced by paying for a voluntary tree removal incentive program which later influenced the level of the negotiated price. However, the removals were not directly a part of the negotiation process.

[24]French (1986) initially estimated the equation with data for 1956-1982 assuming first-order serial correlation of the disturbances. However, the value of the autocorrelation coefficient was low. With the addition of 1983 and 1984 observations, it was further reduced and not statistically significant. Therefore, the first-order serial correlation specification was dropped.

farm price, but it is a dynamic process that can be measured only by solution of the complete model of the total industry system.

1985 and 1986 Farm Price Predictions

The 1985 and 1986 out-of-sample predictions of the deflated grower price for cling peaches are given in Table 8. The 1985 prediction is very close to the actual value. In 1986 the reported grower price decreased for reasons not entirely clear and the model substantially overpredicted the price, although the prediction was still within twice the standard error of the forecast. This may have been due in part to the fact that the reported grower price is the CCPA base price and the realized price may have been a bit higher. In 1987 the grower price increased substantially to a level likely to be consistent with the equation prediction. Hence, there is no clear indication of a structural shift in the determination of the farm price.

Table 8. Deflated Grower Price Predictions, 1985 and 1986 (Predicted Value is FRMCER)

	1985	1986
Actual Value[a]	66.61	57.59
Predicted Value	66.50	69.51
Difference	.11	-11.92
Standard Error of Forecast	6.58	6.11

[a]1967 dollars. Nominal values may be obtained by multiplying by 2.83 and 2.90 (the 1985 and 1986 values of the price deflator, PCE67R).

Processor Raw Product Allocation

The final equations to be estimated predict the allocation of the raw peaches purchased by canners among regular pack canned peaches, fruit cocktail, and other uses.

Determinants of Raw Product Allocation

The average shares of the peach crop allocated to each product-form group have remained fairly stable over time. However, the annual shares have fluctuated somewhat as processors attempt to adjust the product allocations in accordance with inventory levels and the expected returns for each form. The equations to predict these allocation are as follows:

$$(8.1)\ QRAWRP_t = d_0 + d_1(1\text{-}POTHER_t)QMART_t + d_2FRPCER_{t-1} + d_3FFCCER_{t-1} + d_4BEGRP_t + d_5BEGFC_t + d_6(QXRP - QIRP)_{t-1} + d_7QXFC_{t-1}$$

$$(8.2)\ QRAWFC_t = (1\text{-}POTHER)QMART_t - QRAWRP_t$$

where QRAWRP and QRAWFC are raw product quantities allocated to canned peaches and fruit cocktail, QMART is total raw peaches purchased by canners, FRPCER and FFCCER are f.o.b. processed product prices for canned peaches and fruit cocktail, BEGRP and BEGFC are beginning stocks, QXRP and QXFC are exports and QIRP is imports of canned peaches. The small proportion of peaches allocated to uses other than canned regular pack or fruit cocktail (POTHER) is treated as an exogenous variable. Hence only (8.1) must be estimated directly. All variables on the right are predetermined (values known) at the time the allocation decisions are made. It would be expected that d_1, d_2, d_5 and d_6 would be positive; d_3, d_4 and d_7 negative.

Raw Product Allocation Estimation Results

Equation (8.1) was estimated in linear form by ordinary least squares with data for the period 1956 to 1984 (the first observation on the dependent variable was 1957 because of the lagged values of f.o.b. prices). The regression results are as follows:

$$(8.1a)\ QRAWRP_t = \underset{(-.108)}{-3132.35} + \underset{(54.246)}{.80697}(1\text{-}POTHER_t)QMART_t + \underset{(2.581)}{14337.5}FRPCER_{t-1} - \underset{(-2.440)}{12981.8}FFCCER_{t-1} - \underset{(-2.616)}{2.94131}BEGRP_t + \underset{(2.545)}{5.37627}BEGFC_t + \underset{(1.527)}{2.56684}(QXRP - QIRP)_{t-1} - \underset{(1.614)}{6.56943}QXFC_{t-1}$$

The R^2 value for (8.1a) is .995 and the Durbin-Watson statistic is 2.10. The values in parentheses are t ratios. All coefficients are of the sign expected *a priori* and are large relative to their standard errors, although the coefficients for lagged exports are only modestly so. As indicated by the value of R^2, the equation explains more than 99 percent of the variance of the quantity allocated to canned peaches.

The total quantity of peaches purchased is, as expected, the dominant factor determining the quantity of regular pack. However, with QMART and other variables constant, a $1.00 per case increase in the previous period deflated f.o.b. price for regular pack has, on the average, increased the allocation to regular pack (QRAWRP) by 14,338 tons. Similarly, a $1.00 increase in the previous period f.o.b. price of fruit cocktail has decreased the allocation to regular pack by 12,982 tons.

The coefficients for BEGRP and BEGFC indicate that with other variables constant, a 1,000 case increase in beginning stocks of regular pack peaches has been associated with a decrease of 2.94 tons allocated to regular pack. A 1,000 case increase in beginning stocks of fruit cocktail, on the other hand, has been associated with a shift to regular pack of 5.38 tons. Similarly, a 1,000 case increase in previous-year net exports of canned peaches has been associated with an increase of 2.57 tons allocated to the canned peach pack while a 1,000 case increase in previous-year fruit cocktail exports has been associated with a decrease of 6.57 tons allocated to fruit cocktail pack.

There are approximately 18 to 19 tons of raw product in 1,000 cases of canned peaches and about 9.5 tons of peaches in 1,000 cases of fruit cocktail (24 No. 2-1/2 cans). It seems somewhat surprising therefore, that a given change in fruit cocktail stocks apparently has had a greater effect on the allocation to canning than the same change in canned peach stocks or exports. However, this result was also obtained using different data years and other equation formulations.

1985 and 1986 Predictions of Raw Product Allocation

The 1985 and 1986 out-of-sample predictions of the quantity raw product purchased by canners that is allocated to regular pack canned peaches are given in Table 9. Quantities not canned are allocated to fruit cocktail or other uses. The predictions are close, deviating by less than one standard error of forecast. Hence there is no indication of any change in the allocation procedure.

Table 9. Raw Product Allocation Predictions, 1985 and 1986 (Predicted Value is QRAWRP)

	1985	1986
Actual Value	317,043	287,446
Predicted Value	314,924	293,464
Difference	2,119	-6,018
Standard Error of Forecast	8,478	8,465

IV. THE COMPLETE DYNAMIC MODEL

Each of the estimated behavioral equations presented previously provides a basis for making limited or conditional short-run predictions. If past grower net returns are known, plantings and removals can be predicted. If production and carryover stocks are known, the farm price can be predicted. If the farm price, quantity of production and stocks are known, the f.o.b. processor price can be predicted. And, if the f.o.b. price is given, the canned product sales can be predicted. However, changes in one period feed back into the system to generate further changes in the next period. Hence, if it is desired to predict the full effect of changes in variables such as costs, population, imports, exports, or some type of control program, it is necessary to solve the model as a dynamic system. The complete industry model, arranged for dynamic sequential calculation, is summarized in Table 10.[25]

The validity of this model as a representation of the cling peach industry rests on the appropriateness of the theoretical specifications, the equation forms selected to represent them, and the extent to which the econometric estimates provide results which are consistent with the hypothesized relationships and which are good fits to the data. In this regard, all of the estimated coefficients have the expected signs, most are large relative to their standard errors, and there is no clear evidence of serially correlated residuals. Hence the model appears to be an acceptable representation of the historical industry supply and demand structure. Out-of-sample predictions for 1985 and 1986 suggested the possibility of some structural change in the levels of planting and removal response. The possible impacts of such changes are explored in the simulation analysis. Before using the model for economic analysis, however, we need also to consider its properties as a dynamic system—in particular, the relation of the time paths of predicted and actual values and the stability characteristics of the model.

Dynamic Predictions

For simple linear systems, the dynamic properties of the model may be determined by analytical solution. For complex nonlinear models such as this one, however, it is necessary to use computer simulation.[26] This involves specifying an initial (first period) set of values of lagged endogenous variables, setting all exogenous variables at actual or projected values, and then allowing the

[25]Note that the equations are arranged so that all endogenous variables appear once on the left and that they are computed sequentially so that values of endogenous variables which become predetermined values in other equations are computed first. For example, $QSRAWN_t$, which is a predetermined variable in step 20 (equation 7.1), is generated in the previous sequential calculations.

[26]Nonlinear models are sometimes converted to linear approximations by Taylor series expansion of the nonlinear equations around fixed values. This may be a reasonable approach when there are relatively few nonlinear equations and the nonlinearities are simple. However, when this does not hold, as in the present case, the practice seems likely to lead to some distortion.

Table 10. The Complete Industry Model (Underlined variables are exogenous)

1. Acreage in each age class (i = 1 to 30+)
   $AGE_{it} = AGE_{i-1,t-1} - REM_{i-1,t-1}$
2. Total net acres
   $TNAL_t = TACRES_{t-1} - RMVLS_{t-1}$
3. Expected yield by age of tree (see Table 2, T=1 in 1956)
   $Y2_t = .5526 + .0616\underline{(T)}$
   $Y3_t = 3.0262 + .1202\underline{(T)}$
   $Y4_t = 6.5892 + .1491\underline{(T)}$
   $Y5_t = 9.6594 + .1433\underline{(T)}$
   Y6 to Y15 : $Y_{it} = 12.6596 + .1247\underline{(T)}$
   Y16 to Y21 : $Y_{it} = 11.6174 + .1037\underline{(T)}$
   $Y22$ to $Y30_t$: $Y_{it} = 10.7752 + .1168\underline{(T)}$
4. Potential production (tons)
   $$QPOTNLt = \sum_{i=2}^{30+} AGE_{it} \cdot Y_{it}$$
5. Expected production in year t+j, (j = 5 to 20)
   $$EQ_{t+j} = \sum_{i=1}^{30+} AGE_{it} \cdot \underline{P}_{ij} \cdot Y_{i+j,t}$$
6. Expected average future production relative to expected production in year t
   $$REQ516_t = [1/16 \sum_{j=5}^{20} EQ_{t+j}] \div EQ_{t+0}$$
7. Average farm profitability measure
   $RAGRT4_{t-1} = 1/4 \ (RAGRT_{t-1} + RAGRT_{t-2} + RAGRT_{t-3} + RAGRT_{t-4})$
8. Log of new plantings (see equation 1.1a)
   $lnAGE0_t = 2.6546 + 1.7429 \ lnRAGRT4_{t-1} + .3180 \ lnTNAL_{t-1} - .9543 \ lnREQ516_t + .5944 \ \underline{MO} - .0420\underline{(T)}$
9. New plantings
   $AGE0_t = \exp lnAGE0_t$
10. Total acres
   $$TACRESt = \sum_{i=0}^{30+} AGE_{it}$$
11. Quantity surplused
   For the years prior to 1972, a function is required to predict quantities of total production not marketed (see Minami, French and King). QSURP is zero since 1972, the period of predictive interest in the present study.
12. Quantity of production sold to canners
   $QMART_t = (QPOTNL - QSURP)_t \ (1-\underline{CULLGE})_t$
13. QMART per million U.S. population (tons)
   $QMARTN_t = QMART_t \div \underline{POP1}_t$
14. Beginning stock prediction, 1000 cases regular pack
   $BEGRP_t = BEGRP_{t-1} + QPKRP_{t-1} - QTMRP_{t-1}$
15. Beginning stock prediction, 1000 cases fruit cocktail
   $BEGFC_t = BEGFC_{t-1} + QPKFC_{t-1} - QTMFC_{t-1}$
16. Combined beginning stocks, raw product equivalent (tons)
   $SRAW_t = (1000 \ BEGRP_t \div \underline{CTRP_t}) + (1000 \ BEGFC_t \div \underline{CTFC_t})$
17. Combined stocks per million U.S. population (tons)
   $SRAWN_t = SRAW_t \div \underline{POP1}_t$
18. Quantity purchased by canners plus equivalent stocks, tons per million U.S. population
   $QSRAWN_t = QMARTN_t + SRAWN_t$
19. Lagged average per capita consumption of peaches canned and in fruit cocktail
   $QTMNW2_t = (QTMNW_{t-1} + QTMNW_{t-2}) \div 2$
20. Farm price prediction, deflated value (1967 $), (equation 7.1)
   $FRMCER_t = 67.6342 - .00857 \ QSRAWN_t - 17.81990 \ PCRPE_{t-1} + 12.19004 \ FRPCER_{t-1} + 301.7119 \ QTMNW2_t + 17.32610 \ \underline{D74} - 1581.022 \ \underline{QIRPN_t}$
21. Farm price, nominal value
   $FARMPR_t = FRMCER_t \cdot \underline{PCE67R_t}$
22. Allocation of raw peaches (QMART) to regular pack canned peaches, tons (equation 8.1a)
   $QRAWRP_t = -3132.35 + .80697 \ (1-\underline{POTHER_t}) \ QMART_t + 14337.5 \ FRPCER_{t-1} - 12981.8 \ FFCCER_{t-1} - 2.94131 \ BEGRP_t + 5.37627 \ BEGFC_t + 2.56684 \ \underline{(QXRP\text{-}QIRP)}_{t-1} - 6.56943 \ \underline{QXFC_{t-1}}$
23. Allocation of raw peaches (QMART) to fruit cocktail, (tons)
   $QRAWFC_t = (1 - \underline{POTHER_t}) \ QMART_t - QRAWRP_t$
24. Quantity packed, canned peaches (1000 cases)
   $QPKRP_t = (\underline{CTRP_t} \cdot QRAWRP_t) \div 1000$
25. Quantity packed, fruit cocktail (1000 cases)
   $QPKFCt = (\underline{CTFC_t} \cdot QRAWFC_t) \div 1000$

Continued on next page

Table 10 continued

26. Total seasonal supply of canned peaches (1000 cases)
$TSRP_t = QPKRP_t + BEGRP_t$

27. Total seasonal supply of fruit cocktail (1000 cases)
$TSFC_t = QPKFC_t + BEGFC_t$

28. Per capita total supply of canned peaches (cases)
$TSRPN_t = TSRP_t \div (\underline{POP1}_t \cdot 1000)$

29. Per capita total supply of fruit cocktail (cases)
$TSFCN_t = TSFC_t \div (\underline{POP1}_t \cdot 1000)$

30. Per capita supply of canned fruit competing with canned peaches (cases)
$QCRPN_t = TSFCN_t + \underline{TSCN}_t$

31. Per capita supply of canned fruit competing with fruit cocktail (cases)
$QCFCN_t = TSRPN_t + \underline{TSCN}_t$

32. Total processing and raw-product cost per case of canned peaches (deflated values, 1967 $).
$TCRPE_t = \underline{PCRPE}_t + (FRMCER_t \div \underline{CTRP}_t)$

33. Total processing and raw-product cost per case of fruit cocktail (deflated values, 1967 $)
$TCFCE_t = \underline{PCFCE}_t + (FRMCER_t \div \underline{CTFC}_t)$

34. Reduced form of processed product demand and pricing equations (Table 6)
   a) Log of U.S. per capita consumption of canned peaches (cases)

$$\ln QMCRPN_t = -.35306 - .55229 \ln TCRPE_t + .29143 \ln(TSRPN + \underline{QIRPN})_t + .12453 \ln QCRPN_t + .10926 \ln \underline{ITDIER}_t + .00378(\underline{T}) - .13934(\underline{D70}) + .03258(\underline{T14}) - .00336(\underline{T14})^2$$

   (b) Log of f.o.b. canner price per case of canned peaches (deflated, 1967 $)

$$\ln FRPCER_t = -.72915 + .78566 \ln TCRPE_t - .41457 \ln(TSRPN + QIRPN)_t - .17714 \ln QCRPN_t + .06393 \ln \underline{ITDIER}_t - .00537(\underline{T}) - .08152(\underline{D70}) + .01906(\underline{T14}) - .00197(\underline{T14})^2$$

   (c) Log of U.S. per capita consumption of fruit cocktail (cases)

$$\ln QTMFCN_t = -1.12773 - .42800 \ln TCFCE_t + .22245 \ln TSFCN_t + .17315 \ln QCFCN_t + .15523 \ln \underline{ITDIER}_t + .00673(\underline{T}) - .21512(\underline{D70}) + .04394(\underline{T14}) - .00434(\underline{T14})^2$$

   (d) Log of f.o.b. canner price per case of fruit cocktail (deflated, 1967 $).

$$\ln FFCCER_t = .10409 + .58016 \ln TCFCE_t - .30154 \ln TSFCN_t - .23470 \ln QCFCN_t + .06020 \ln \underline{ITDIER}_t - .00912(\underline{T}) - .08342(\underline{D70}) + .01704(\underline{T14}) - .00168(\underline{T14})^2$$

35. Original values of deflated f.o.b. prices and movement
   (a) $QMCRPN_t = \exp \ln QMCRPN_t$
   (b) $FRPCER_t = \exp \ln FRPCER_t$
   (c) $QTMFCN_t = \exp \ln QTMFCN_t$
   (d) $FFCCER_t = \exp \ln FFCCER_t$

36. Per capita movement of canned peaches by U.S. canners (cases)
$QTMRPN_t = QMCRPN_t - \underline{QIRPN}_t$

37. Total U.S. movement of canned peaches (1000 cases)
$QTMRP_t = QTMRPN_t \cdot \underline{POP1}_t \cdot 1000$

38. Total U.S. movement of fruit cocktail (1000 cases)
$QTMFC_t = QTMFCN_t \cdot \underline{POP1}_t \cdot 1000$

39. Nominal value of f.o.b. price of canned peaches
$FOBRP_t = FRPCER_t \cdot \underline{PCE67R}_t$

40. Nominal value of f.o.b. price of fruit cocktail
$FOBFC_t = FFCCER_t \cdot \underline{PCE67R}_t$

41. Weighted sum of canned peach and fruit cocktail movement (cases per capita)
$QTMNW_t = QTMRPN_t + (\underline{CTRP} \div \underline{CTFC})_t\, QTMFCN_t$

42. Adjusted grower return per ton
$AGRT_t = (FARMPR - \underline{ASSMNT})_t\,(1-\underline{CULLGE})_t\,[1-GDCALL - DIVRSN + GDCALL \cdot DIVRSN]_t$
(GDCALL and DIVRSN are zero after 1972. See Minami, French and King.)

43. Ratio of adjusted grower return to farm cost per ton
$RAGRT_t = AGRT_t \div \underline{FCOST}_t$

44. Acres of trees removed by age of tree (i = 0 to 30+).
$REM_i = AGE_i\,[a_{20i} + a_{21i}\, RAGRT_t + a_{22i}\, \underline{ETRILE}_t + a23_i\, \underline{RR3}_t + a_{24i}\, \underline{DVR2}_t]$
(See Table 4 for coefficient values.)

45. Total acres removed

$$RMVLS_t = \sum_{i=0}^{30+} REM_{it}$$

computer to generate sequential predictions of future-period values of the endogenous variables as modeled in Table 10. If the unexplained disturbances (omitted from Table 10 for simplicity) are set at their expected values (zero), the simulation is called "deterministic." An alternative procedure is "stochastic" simulation where random values of the disturbance elements are generated for each period and the model predictions are obtained as mean values of repeated simulation runs.

Deterministic simulations require substantially less computer time but do not provide any measures of dynamic forecasting error variances. To gain some indication of how well the deterministic model may predict actual behavior, it has been common practice to compare simulated and actual values over the historical period of the data set used to estimate the system's equations. Frequently-used goodness-of-fit measures are the root-mean-square-error, the root-mean-square-percentage-error, the mean absolute error, the mean absolute percentage error, and, for one-period-ahead simulations (static simulation), Theil's inequality (U_2) statistic (see Kost for further elaboration).

Smaller values of the goodness-of-fit statistics suggest better forecasting potential. It may not be clear, however, as to whether close historical correspondence is due primarily to the interactive process that generates endogenous variable predictions or to the dominant influence of exogenous variables whose values are "read in" to the computer. Further, it has been noted by Howrey and Kelejian, Hendry and Richard, Peters and Freedman and others that in dynamic deterministic simulations even if the structural equation disturbances are homoskedastic and not serially correlated, the residuals obtained by subtracting dynamic predictions from actual values will be autocorrelated and heteroskedastic. This means that historical predictions may remain above or below actual values over extended periods and the differences may tend to widen except for the mitigating influence of exogenous variables. This will be true even for linear models and the problem is compounded with nonlinear models (as in Table 10), where the error terms may enter in a multiplicative form. Conversely, it is also possible that a model that tracks poorly still may be valid in the sense of representing the system structure except for the unexplained random disturbances. Hence, historical deterministic tracking simulations may provide little additional information concerning the validity of the model and its forecasting characteristics.

With stochastic simulation, random disturbances are added to each equation, and to the estimated coefficients. They are generated for each period from the estimated variance-covariance structure of the equations' disturbances and the assumed probability distribution form. Repeated simulations are performed, each with a different set of random disturbances. Mean values of the predicted endogenous variables and their variances then may be computed for each period over which the forecasts are made. The stochastic simulation approach has been further refined and extended by a statistical approach called the "bootstrap" (see Peters and Freedman).

A disadvantage of stochastic simulation is that it may be substantially more expensive in terms of computer time—possibly 50 to 100 times more, depending on the number of replications and specific procedures used. This may not be a serious problem for relatively simple models but each 25-year simulation run of the model in Table 10 requires up to an hour of time on the VAX750.[27]

Whether the advantages of stochastic simulation are worth the added cost depends on the magnitude of the cost increase, the gain in prediction efficiency and the importance of having measures of forecast error variance. In the present case the cost is high. The possible gain in efficiency is unknown, but is viewed subjectively as likely to be small relative to the cost, given the use to be made of the model. Therefore, the effects of changes in imports, exports, costs, and other variables treated as exogenous will be evaluated by deterministic simulations. The analysis does not, however, provide confidence intervals for the model predictions.

Sales-Inventory Restrictions and Historical Fit

Recall that f.o.b. prices and per capita movement of canned peaches and fruit cocktail are predicted by simultaneous solution of the demand and price-markup equations—i.e., by the reduced-form equations in Table 6. An important constraint on the prediction of movement is that it should not exceed the available supply. With the log-linear functions used to approximate the demand and price-markup relationships there is no guarantee that the constraint will not be violated in years of high demand and low supplies. Printouts of the historical equation solutions revealed that in two years the predicted movement did in fact slightly exceed the total supply, although the predicted values were close to the actual values of movement.

[27]Note that the model keeps track of and adjusts acreages in 31 age classes and each year computes the expected values of future production over a 16-year future period, given the acreage distribution for that year. It contains 171 endogenous variables including identities and variable transformations. It is possible that a more efficient computer program could be devised, but the computer simulation time would still be high.

One possible solution to this kind of problem is to choose equation forms that guarantee the predicted movement will not exceed the available supply, but this imposes a complex algebraic structure that is difficult to estimate. Another alternative is to impose the movement constraint as part of the estimation process but that is difficult because there are no particular coefficients to constrain. A third alternative, and the one used here, is simply to impose limits of the following form on the predictions of movement :

$$k1R(TSRP) \leq QTMRP \leq k2R(TSRP)$$

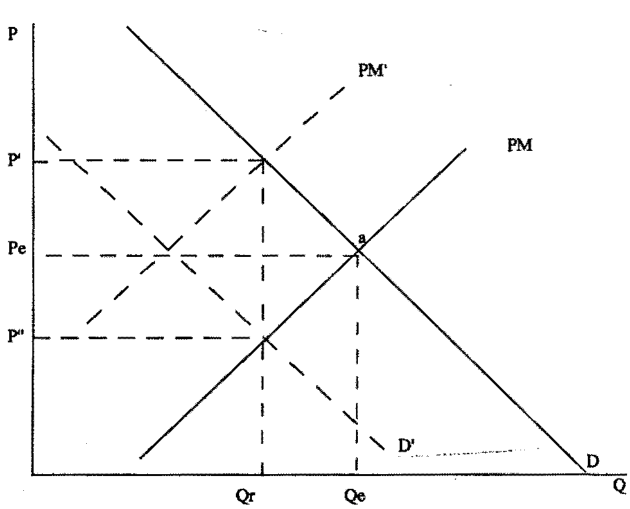
$$k1F(TSFC) \leq QTMFC \leq k2F(TSFC)$$

where QTMRP, QTMFC, TSRP and TSFC are annual movement and seasonal supply of canned peaches and fruit cocktail, k2 = .96 is the maximum historically observed proportion of supply sold in any year and k1 = .70 is the lowest observed proportion of supply sold. If the reduced form equations (34a, 34c in Table 6) predict QTMRP or QTMFC outside these bounds, they are set at the nearest limit value.

Whenever the movement restriction is effective, the movement prediction will be inconsistent with the deterministic reduced form prediction of price. The problem and the effects of alternative solution procedures are illustrated in Figure 1.

The curve D is the f.o.b. demand function and PM is the price-markup function with all variables held constant except price and movement. The curves are drawn as linear approximations for ease of reference.

Figure 1. Effects of Movement Restrictions on Price Predictions



Qe and Pe are unconstrained equilibrium (reduced form) solutions given by equations 34a, b, c, d in Table 10 with the equation disturbances set at zero. Suppose now that the predicted Qe exceeds the total supply. The movement then must be reduced to a value Qr such that Q is less than total supply. But Pe then will be inconsistent with Qr, PM and D. The price prediciton can be made consistent with Qr by adding a disturbance to either or both the demand and price-markup function. If the price prediction is obtained by inserting Qr in the deterministic demand equation to obtain P', it is equivalent to adding a disturbance P' - P'' to the price-markup function shifting it to PM'. If the price prediction is obtained by inserting Qr in the deterministic price markup equation to obtain P'', it is equivalent to adding a corresponding disturbance to the demand function, shifting it to D'.

If the price prediction is left at Pe, it is equivalent to adding smaller disturbances to both the demand and price-markup functions so that they intersect at point a. The latter seems a good compromise and is the procedure followed here. These restrictions have little overall impact on the dynamic predictions of the model.

Table 11 provides some historical goodness-of-fit measures for the period 1973-84 which followed the termination of the volume-control marketing order program. The predictions are from a dynamic simulation with actual values of lagged endogenous variables read in for 1973 and then generated sequentially by the model for all years following.

Although these measures cannot be used as indicators of reliability of future model predictions, they provide information as to how the model performed over a past period with known values of the exogenous variables. Variables such as total acres, production and pack were predicted with relatively small margins of error. The individual-year planting and removal predictions were subject to somewhat greater error, but the errors of cumulative predictions were substantially smaller, as reflected in the small error of total acres prediction. Prices were predicted with average annual errors in the range of 7 to 10 percent. Stocks of canned peaches and fruit cocktail, which fluctuate substantially from year-to-year, were subject to the greatest error. The restrictions on movements were effective historically in only two years.

Stability Properties

An essential property of all dynamic models is that if all the exogenous variables remain constant and the values of the endogenous variables are generated sequentially on into the future, the prediction of each endogenous variable eventually should approach a

Table 11. Goodness-of-Fit Measures for Key Endogenous Variables, Dynamic Simulation, 1973-1984

	Mean of variable 1973-84	Mean absolute percent-age error	Root-mean-square-error		Mean of variable 1973-84	Mean absolute percent-age error	Root-mean-square-error
Total acres (TACRES)	50,132	2.4	1,382	FOB price per case, canned (FOBRP)	12.15	6.9	1.42
New plantings (AGE0)	1,868	16.6	412	FOB price per case, fruit cocktail (FOBFC)	14.48	5.4	1.36
Total removals (RMVLS)	4,681	31.7	1,582	Beginning stocks, canned, 1000 cases (BEGRP)	4,503	34.7	2,037
Grower price (FARMPR)	144	8.4	19.1	Beginning stocks, fruit cocktail, 1000 cases (BEGFC)	2,939	22.8	767
Grower price/cost ratio (RAGRT)	.922	8.7	.105	Canned movement, 1000 cases (QTMRP)	21,728	6.1	1,467
Grower sales to canners, tons (QMART)	568,232	4.0	31,072	Fruit cocktail movement, 1000 cases (QTMFC)	12,215	4.0	516
Quantity packed, canned, 1000 cases (QPKRP)	21,945	4.7	1,338				
Quantity packed, fruit cocktail, 1000 cases (QPKFC)	12,158	7.0	901				

stationary value. Otherwise, the model may explode—a situation generally inconsistent with real world observations. The empirical estimates of the model equations do not necessarily guarantee this will hold, so it is necessary to test for stability.

For linear models, the stability properties may be determined readily by calculating eigen values of the matrix of coefficients of the lagged endogenous variables of the reduced-form equations. Such calculations are not possible for the present nonlinear model. The test procedure followed in this case was simply to hold all the exogenous variables at a recent (1984) level, then proceed with dynamic simulations for about 30 years. All variables appeared to be converging toward stable values along a dampening cyclical path. The stability test results are presented in the next section.

V. SIMULATION ANALYSIS

This section presents the results of simulation experiments designed to evaluate the dynamic effects of the existing age distribution of trees and changes in farm production cost, yield trends, imports, exports and population on prices and outputs. The procedure is first to set all exogenous variables at recent constant values, then read in initial values of endogenous variables and allow the model to generate predictions of all future endogenous variables over a 25-year period. This is called the "Base Run" and serves the dual purpose of providing a stability test and a base against which to measure the effects of changes in the exogenous variables of interest. The simulation experiments then involve changing a particular exogenous variable and observing the changes over time in the *expected values* of the endogenous variables of the system.

The Base Run

Table 12 specifies the base-run values of all the exogenous variables and coefficients such as case yields per ton and proportion culled. Trend variables affecting the level of per capita demand and planting response (T, T14, D70) were held at their 1984 levels (see previous discussion of out-of-sample predictions). The price level measure, per capita income and costs were set at 1986 values. Variables such as imports, exports, cullage proportions and raw-to-processed conversion ratios were set at their 1984-86 average values. The first prediction year is 1986. Actual values of lagged endogenous variables for 1985 (and earlier as appropriate) were read in to generate the 1986 predictions. The 1986 predictions were then used as lagged endogenous variables in the 1987 predictions and so on for all future years.

One additional constraint should be noted. The ratios of carryover stocks of canned peaches and fruit cocktail to their seasonal supply have fluctuated from year to year but their mean values have not shown any clear long-run trend. Therefore, we would expect the predicted long-run equilibrium stock-supply ratios to be near their historical mean values. However, because of the simple equation forms that were necessarily used to estimate the price-markup functions, there is no guarantee that this will hold (see previous discussion of sales-inventory restrictions). Since these ratios affect farm and processed product prices, we set them at their mean values, or more precisely, the ratios of movement to supply (QTMRP/TSRP and QTMFC/TSFC) were set at their 1956-84 mean values of .85 and .82. To test the possible implications of imposing this constraint we ran the historical 1973-84 simulation with these mean ratios imposed. The root-mean-square errors of the predictions were only slightly larger than the values given in Table 11.

Table 12. Base Values of Exogenous Variables for the Simulation Analysis

Variable	Value	Comment	Variable	Value	Comment
T	29	a	PCFC	19.86	f
Y2	2.34	b	PCE67R	2.90	f
Y3	6.51	b	QIRP	1145	e
Y4	10.91	b	QIRPN	.0048	g
Y5	13.81	b	TSCN	.050	f
Y6 to Y15	16.28	b	ITDIER	1.53	f
Y16 to Y21	14.62	b	FCOST	175.6	f
Y22 to Y30+	14.16	b	QXRP	678	e
P_{ij}	c	c	QXFC	932	e
QSURP	0	d	D70	1	
CULLGE	.070	e	D74	1	
CTRP	52.70	e	T14	15	
CTFC	102.94	e	(T14)2	225	
POTHER	.088	e	ETRILE	0	h
ASSMNT	4.80	e	RR3	0	h
POP1	236.6	f	DVRZ	0	h
PCRP	15.26	f	MO	0	h

a - Trend variable, 1956 = 1
b - Predicted yields with T = 29
c - See Appendix Table A13.
d - Surplusing regulations not in effect
e - 1984-86 mean value
f - 1986 value
g - QIRPN = QIRP ÷ POP1(1000)
h - Variables defined as zero in 1984

Table 13. Base Run Values for Key Endogenous Variables, 1986-2010

Variable	1986	1988	1990	1995	2000	2005	2010
New Plantings (AGE0)	1,392	1,437	1,505	1,504	1,517	1,521	1,514
Removals (RMVLS)	3,285	2,654	2,235	1,676	1,511	1,495	1,505
Total Acres (TACRES)	33,486	29,918	27,841	25,494	25,056	25,171	25,292
Total Production (QPOTNL)	435,531	379,132	347,986	310,829	304,518	305,892	307,737
Quantity Canned (QPKRP)	15,134	12,892	11,782	10,501	10,287	10,335	10,398
Quantity Fruit Cocktail (QPKFC)	8,465	7,919	7,369	6,626	6,493	6,520	6,557
Canned per capita Movement (QTMRPN)	.0747	.0553	.0502	.0445	.0435	.0437	.0439
Fruit Cocktail per capita Movement (QTMFCN)	.0398	.0343	.0314	.0281	.0274	.0276	.0277
Farm Price (FARMPR)	195	213	223	239	243	242	242
F.O.B. Canned Price (FOBRP)	17.12	19.75	20.81	22.25	22.54	22.49	22.41
F.O.B. Fruit Cocktail Price (FOBFC)	21.38	23.43	24.43	25.76	26.03	25.99	25.92
Grower Profitability Measure (RAGRT)	1.01	1.10	1.15	1.24	1.26	1.26	1.25
Percent of Trees Under 6-Years of Age	25.5	27.4	31.1	33.7	34.4	34.4	34.3
Percent of Trees Over 19-Years of Age	10.8	13.3	13.5	10.9	10.0	9.5	9.1

The Base-Run values for the major endogenous variables are given in Table 13 for selected years over a 25-year period. These are not forecasts. They are the sequentially-determined predictions of the model with all exogenous variables held constant at the levels given in Table 12. They do not take account of population changes or possible continuation of past trends. Prices are in 1986 dollars.

Stable equilibrium values are approached by the year 2000 with new plantings approximately equal to total removals. Under the Base-Run conditions, acreage and per capita movement stabilize at values below the 1986 levels and prices and the grower profitability measure stabilize at higher levels than the predicted (and observed) values for 1986-88.

Simulation Experiment No. 1. Effects of a Change in Production Cost

Referring back to the section on model estimation, it may be recalled that the 1985 and 1986 out-of-sample predictions of new plantings were below the observed values by amounts somewhat greater than might have been expected in relation to the historical forecast errors. Further, the model also tended to overpredict removals for 1985 and 1986, although the reported removal values for these years may be subject to some upward revision. These results suggest the possibility that grower perceptions of future profitability may have exceeded the values indicated by the RAGRT measure for these years. This could have been due to new interpretations of

Table 14. Simulation Experiment No. 1. Effect of Reducing FCOST from 176.5 to 158.0 (10 percent) (Changes from Base-Run Predictions)[a]

Variable	1986	1988	1990	1995	2000	2005	2010
New Plantings (AGE0)	0	186	282	199	190	197	196
		(13.9)	(18.8)	(13.2)	(12.5)	(12.9)	(12.8)
Removals (RMVLS)	-388	-236	-92	84	127	165	198
	(-11.8)	(-8.9)	(-4.1)	(5.0)	(8.4)	(11.0)	(13.2)
Total Acres (TACRES)	0	963	1,890	2,986	3,409	3,692	3,779
		(3.2)	(6.8)	(11.7)	(13.6)	(14.7)	(14.9)
Total Production (QPOTNL)	0	9,916	17,215	33,741	42,242	46,315	47,379
		(2.6)	(5.0)	(10.9)	(13.9)	(15.1)	(15.4)
Quantity Canned (QPKRP)	0	352	606	1,174	1,466	1,609	1,644
		(2.7)	(5.1)	(11.2)	(14.2)	(15.5)	(15.8)
Quantity Fruit Cocktail (QPKFC)	0	176	320	652	826	905	924
		(2.2)	(4.4)	(9.8)	(12.7)	(13.9)	(14.1)
Canned Per Capita Movement (QTMRPN)	0	.0014	.0024	.0048	.0061	.0067	.0070
		(2.5)	(4.8)	(10.8)	(14.2)	(15.3)	(16.0)
Fruit Cocktail Per Capita Movement (QTMFCN)	0	.0007	.0013	.0027	.0035	.0039	.0039
		(2.0)	(4.1)	(9.6)	(12.8)	(14.2)	(14.1)
Farm Price (FARMPR)	0	-2.01	-4.75	-12.32	-16.70	-18.33	-18.60
		(-1.0)	(-2.1)	(-5.2)	(-6.9)	(-7.6)	(-7.7)
F.O.B. Canned Price (FOBRP)	0	-.25	-.52	-1.21	-1.56	-1.70	-1.72
		(-1.3)	(-2.5)	(-5.4)	(-6.9)	(-7.6)	(-7.7)
F.O.B. Fruit Cocktail Price (FOBFC)	0	-.23	-.47	-1.10	-1.43	-1.55	-1.57
		(-1.0)	(1.9)	(-4.3)	(-5.5)	(-6.0)	(-6.1)
Grower Profitability Measure (RAGRT)	.112	.111	.101	.066	.042	.032	.030
	(11.1)	(10.1)	(8.7)	(5.3)	(3.4)	(2.6)	(2.4)

[a]Values in parentheses are percentage changes from Base-Run values.

information such as contained in CCPA reports to members, or to possible overvaluing of real unit production cost by our FCOST measure. One means of evaluating the impact of such a change is simply to reduce FCOST (which increases RAGRT) and observe the dynamic effects on future prices and outputs.

Tables 14 and 15 present the results of two variants of this experiment. In the first variant the unit cost of production measure (FCOST) was reduced by 10 percent. The values of all other exogenous variables and the initial values of the lagged endogenous variables remained as in the Base Run. Table 14 gives the predicted changes in the key endogenous variables of the system compared to their Base Run values.

With FCOST reduced by 10 percent, the 1986 value of RAGRT increases by .112 (11.1 percent) which causes removals to be reduced in that year. Other endogenous variables are not affected immediately and hence remain as in the Base Run. By 1988 the cost reduction has affected total acres and production, and planting rates have also increased. Grower profitability remains high for several years (relative to the Base Run), then declines gradually as acreage expands and prices decrease. By 2010, plantings and removals are about the same and the system appears to have approached a steady state. The long run effect of the 10 percent cost reduction is to increase output by about 15 percent, to decrease

Table 15. Simulation Experiment No. 1A. Same As Experiment No. 1 Except Initial Values of RAGRT Set at 1.11(Changes from Base-Run Predictions)[a]

Variable	1986	1988	1990	1995	2000	2005	2010
New Plantings (AGE0)	775	204	163	184	203	198	191
(55.5)		(14.2)	(10.9)	(12.2)	(13.4)	(13.0)	(12.6)
Removals (RMVLS)	-378	-218	-27	113	161	200	200
(-11.5)		(-8.2)	(-1.2)	(6.7)	(10.7)	(13.3)	(13.3)
Total Acres (TACRES)	775	2,043	2,691	3,402	3,729	3,838	3,763
(2.3)		(6.8)	(9.7)	(13.3)	(14.9)	(15.3)	(14.9)
Total Production (QPOTNL)	0	11,686	26,553	42,028	47,273	48,182	47,312
		(3.1)	(7.6)	(13.5)	(15.5)	(15.8)	(15.4)
Quantity Canned (QPKRP)	0	416	936	1,462	1,640	1,672	1,642
		(3.2)	(8.0)	(13.9)	(15.9)	(16.2)	(15.8)
Quantity Fruit Cocktail (QPKFC)	0	207	489	815	923	941	924
		(2.6)	(6.6)	(12.3)	(14.2)	(14.4)	(14.1)
Canned Per Capita Movement (QTMRPN)	0	.0016	.0037	.0061	.0069	.0070	.0070
		(2.9)	(7.4)	(13.7)	(15.9)	(16.0)	(16.0)
Fruit Cocktail Per Capita Movement (QTMFCN)	0	.0008	.0020	.0034	.0039	.0040	.0039
		(2.3)	(6.4)	(12.1)	(14.2)	(14.6)	(14.1)
(Farm Price (FARMPR)	0	-2.18	-6.85	-15.61	-18.62	-19.03	-18.61
		(-1.0)	(-3.1)	(-6.5)	(-7.7)	(-7.9)	(-7.7)
F.O.B. Canned Price (FOBRP)	0	-.29	-.77	-1.50	-1.74	-1.76	-1.72
		(-1.5)	(-3.7)	(-6.7)	(-7.7)	(-7.8)	(-7.7)
F.O.B. Fruit CocktailPrice (FOBFC)	0	-.26	-.70	-1.37	-1.59	-1.61	-1.57
		(-1.1)	(-2.9)	(-5.3)	(-6.1)	(-6.2)	(-6.1)
Grower Profitability Measure (RAGRT)	.112	.110	.088	.046	.031	.028	.030
	(11.1)	(10.0)	(7.7)	(3.7)	(2.5)	(2.2)	(2.4)

[a]Values in parentheses are percentage changes from Base-Run values.

prices by about 7.7 percent and to increase the overall grower profitability ratio by about 2 percent.

The simulation results presented in Table 14 reduce FCOST 10 percent in 1986 (and hence increase RAGRT) but read in actual values of RAGRT for previous years as starting values. However, if there was, in fact, a change in grower perceptions of future profitability in 1985 and 1986 (compared to the average historical values of RAGRT), then the initial values of RAGRT would need to be increased as well. Table 15 presents the predicted changes in endogenous variables with all conditions the same as in Table 14 except the initial values of RAGRT are set at 1.11 for the years 1982-85 as well as 1986. (The 1986 value of RAGRT is 1.01 in the Base Run—see Table 13).

The effect of the modest increase in the initial profitability measure is to increase plantings and lower removal predictions for 1986 to values well within the forecast error confidence interval. Planting levels remain above the values of Experiment No. 1 for the first three years and acreage increases at a bit higher rate. However, with no change in the coefficients for RAGRT in the plantings and removal equations, the long-run outcome does not change: a 10 percent reduction in real unit cost is associated eventually with about a 15 percent increase in output and about a 7.7 percent decrease in price. A reverse relationship might be expected for a 10 percent increase in real unit cost, although the latter does not seem likely.

Simulation Experiment No. 2. Effects of Yield Trends

The calculations in Experiment No. 1 hold average yields constant at their expected 1984 values. However, Table 2 shows a steady upward trend in yields that seems likely to continue for some time. Increased yields affect both the total output and the farm production cost per ton. To gain some insight into the effects of continued increases in yields, the trend values in Table 2 were extended forward to 2010 and farm production cost was adjusted for increased yields. The latter was done by holding total cost per acre at the 1986 level and letting yield per acre increase as a function of the average yield of trees in the 6-15 year age class (Y6).[28]

Simulation values obtained with these specifications are given in Table 16. As would be expected, planting rates increase compared to the base run because of reduced costs. Removal rates are lower up to about 1995 and then increase compared to the base run. Total acreage is slightly higher than in the base run but with higher yields production increases relatively more. With higher production, prices are lower than in the base run. Note, however, that the ratio of net farm price to cost is generally higher than base run values.

While there is strong reason to expect average yields to continue to increase for some time, the effect on unit production cost is less clear. It is likely that the total cost per acre may not remain constant as in the Experiment 2 scenario. As yields increase there may be some increase in both cultural and harvest costs per acre. Hence, while we would expect unit production costs to decline, the rate of decline likely would be a bit less than indicated in Table 16. If so, plantings would increase a bit less and prices would decrease a bit less, but the overall pattern likely would be similar. Of course, the projections beyond the year 2000 become increasingly hazardous.

Experiment 2A (Table 17) is identical to Experiment 2 except that the level of farm production cost (FCOST) is reduced by 10 percent. As explained above, the cost reductions due to increased yields may be exaggerated, but the simulation gives an indication of the potential impacts of reduced costs that might occur with new varieties and continued improvements in cultural practices. With the reduced cost, plantings increase more than in Experiment 2, acreage and output are greater and prices decrease more, but the grower profitability measure also increases more. In interpreting these numbers it is important to remember that the level of demand and population remain constant at the 1984 level. If the *aggregate* level of demand were maintained at the 1984 level, but population allowed to increase, as it surely will, the per capita movement predictions (QTRMRPN, QTMFCN) would decrease compared to the increases in Table 17, but still would be higher than the Base Run values. The other changes predicted by Experiment 2A would be the same. If, on the other hand, aggregate demand continued to decrease relative to the 1984 level, prices would be lower initially and planting rates reduced. The effects of population shifts are explored further in another experiment.

Simulation Experiment No. 3. Effects of Imports

A major concern of the cling peach industry has been the increase in imports of canned peaches in recent years. To isolate and evaluate the impacts, imports were reduced from the Base Run average value of QIRP = 1,145,000 cases to zero, with all other conditions held as in the Base Run. Two variations were explored. In the first, QIRP and QIRPN were set at zero wherever they appeared in the model, including the farm price predicting equation. However, in that variation the model predicted a somewhat greater impact of the reduced imports than might reasonably be expected. By the year 2000, the pack of canned peaches was predicted to increase by about twice the amount of the import reduction—an implausible result. The reason for this was the influence attributed to per capita imports (QIRPN) in the farm price prediction equation. Including QIRPN, which was zero prior to 1983, as a shifter (in 1983 and 1984) to account for the concern about the new emergence of imports apparently attributed too much of the observed price deviation to this concern, at least as a reversible factor. It may be recalled also that the coefficient for QIRPN had a relatively large standard error.

To deal with this problem, a second simulation was performed in which QIRPN was held at its Base Run of .0048 in the farm price equation, but QIRP and QIRPN were zero elsewhere. This keeps the farm price prediction equation at its 1984-86 level (in 1986 dollars), but it is not directly affected by the reduction in import quantities. The simulation results are given in Table 18. In this case, the canned pack increases by 897,000 cases by 2010, almost offsetting the 1,145,000 case reduction in imports. This appears to be a more reasonable result.

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[28] Since the Base Run held yields at their expected values for 1984, but held unit cost at the 1986 value, we obtain $TCA_{86} = FCOST_{86} \bullet Y_{86}$ where TCA is total cost per acre and Y is average yield. Let $Y_t = k\,Y6_t$. Then $FCOST_t = TCA_{86} \div Y_t = (FCOST_{86} \bullet k \bullet Y6_{84}) \div kY6_t = (175.6 \bullet 16.28) \div Y6_t = 2859 \div Y6_t$.

Table 16. Simulation Experiment No. 2. Increasing Yield and Declining FCOST (Changes from Base-Run Predictions)[a]

Variable	1986	1988	1990	1995	2000	2005	2010
New Plantings (AGEO)	3	26	51	78	104	134	164
	(.3)	(1.8)	(3.4)	(5.2)	(6.9)	(8.8)	(10.8)
Removals (RMVLS)	-39	-38	-30	-7	13	36	63
	(-1.2)	(-1.5)	(-1.4)	(-0.4)	(0.9)	(2.4)	(4.2)
Total Acres (TACRES)	3	115	279	721	1,183	1,692	2,223
	([b])	(0.4)	(1.0)	(2.8)	(4.7)	(6.7)	(8.8)
Total Production (QPOTNL)	7,129	13,709	20,176	37,195	56,670	78,007	180,337
	(1.6)	(3.6)	(5.8)	(12.0)	(18.6)	(25.5)	(32.6)
Quantity Canned (QPKRP)	257	483	709	1,295	1,971	2,719	7,504
	(1.7)	(3.8)	(6.0)	(12.3)	(19.2)	(26.3)	(33.7)
Quantity Fruit Cocktail (QPKFC)	120	253	377	717	1,097	1,501	1,916
	(1.4)	(3.2)	(5.1)	(10.8)	(16.9)	(23.0)	(29.2)
Canned Per Capita Movement (QTMRPN)	.0009	.0020	.0029	.0053	.0082	.0113	.0147
	(1.2)	(3.6)	(5.8)	(11.9)	(18.9)	(25.9)	(33.5)
Fruit Cocktail Per Capita Movement (QTMFCN)	.0004	.0010	.0015	.0029	.0046	.0063	.0080
	(1.0)	(2.9)	(4.8)	(10.3)	(16.8)	(22.9)	(28.9)
Farm Price (FARMPR)	-.70	-3.07	-5.67	-13.37	-21.09	-27.96	-34.17
	(-0.4)	(-1.5)	(-2.6)	(-5.6)	(-8.9)	(-11.5)	(-14.2)
F.O.B. Canned Price (FOBRP)	-.11	-.36	-.61	-1.32	-2.01	-2.65	-3.x24
	(-0.6)	(-1.8)	(-2.9)	(-5.9)	(-8.9)	(-11.8)	(-14.5)
F.O.B. Fruit Cocktail Price (FOBFC)	-.11	-.33	-.56	-1.20	-1.84	-2.44	-2.98
	(-0.5)	(-1.4)	(-2.3)	(-4.7)	(-7.1)	(-9.3)	(-11.5)
Grower Profitability Measure (RAGRT)	.011	.017	.021	.027	.029	.030	.032
	(1.1)	(1.5)	(1.9)	(2.2)	(2.3)	(2.4)	(2.6)
Farm Production Cost (FCOST)[c]	173.0	170.5	168.0	162.0	156.5	151.3	146.5
Average Yield of Trees Age 6-15 (Y6)[d]	16.53	16.77	17.02	17.65	18.27	18.89	19.51

[a]Values in parentheses are percentage changes from Base-Run values.
[b]Less than 0.05.
[c]FCOSTt = 2859 + Y6t.
[d]Predicted from Table 2 trend equations.

The time paths of adjustment to the decreased imports are of interest. In the first year (when imports are reduced to zero) the only significant impact is on the f.o.b. price of canned peaches, increasing by $.38 per case. Per capita movement from U.S. canners (QTMRPN) does not change but per capita consumption (not shown) declines by .0048 with the removal of imports. There likely would be some minor immediate impact on the price of fruit cocktail as well, but the model does not pick that up in the first year.

In the second year the effects begin to feed back on the other variables and by the third year the farm price has increased by $6.83 per ton (3.2 percent) and the f.o.b.prices of canned peaches and fruit cocktail have increased by $.61 and $.36 per case. Processors have shifted some of their pack from fruit cocktail to canned peaches. The improved returns to farmers stimulate increased plantings and, initially, reduce removals. However, it is about five years before there is a significant impact on total production. Grower returns hold at the higher level for eight to ten years,

Table 17. Simulation Experiment No. 2A. Same as Experiment No. 2 Except the Production Cost Per Acre is Reduced 10 percent (Change from Base-Run Predictions)[a]

Variable	1986	1988	1990	1995	2000	2005	2010
New Plantings (AGE0)	3	215	341	287	308	352	388
	(0.3)	(15.0)	(23.6)	(19.7)	(20.3)	(23.1)	(25.6)
Removals (RMVLS)	-430	-280	-129	76	138	198	262
	(-13.1)	(-10.6)	(-5.8)	(4.5)	(9.1)	(13.2)	(17.4)
Total Acres (TACRES)	3	1,091	2,208	3,813	4,762	5,661	6,420
	(b)	(3.7)	(7.9)	(15.0)	(19.0)	(22.5)	(25.4)
Total Production (QPOTNL)	7,129	24,040	38,598	75,468	106,945	136,362	164,093
	(1.6)	(6.3)	(11.1)	(24.3)	(35.1)	(44.6)	(53.3)
Quantity Canned (QPKRP)	257	851	1,359	2,637	3,736	4,774	5,758
	(1.7)	(6.6)	(11.5)	(25.1)	(36.3)	(46.2)	(55.4)
Quantity Fruit Cocktail (QPKFC)	120	437	716	1,439	2,040	2,581	3,080
	(1.4)	(5.5)	(9.7)	(21.7)	(31.4)	(39.6)	(47.0)
Canned Per Capita Movement (QTMRPN)	.0009	.0034	.0055	.0109	.0156	.0200	.0242
	(1.2)	(6.2)	(11.0)	(24.5)	(35.9)	(45.8)	(55.1)
Fruit Cocktail Per Capita Movement (QTMFCN)	.0004	.0017	.0029	.0059	.0086	.0109	.0129
	(1.0)	(5.0)	(9.2)	(21.0)	(31.4)	(39.6)	(46.6)
Farm Price (FARMPR)	-.70	-5.11	-10.40	-25.23	-36.23	-43.75	-49.53
	(-0.4)	(-2.4)	(-4.7)	(-10.6)	(-14.9)	(-18.1)	(-20.5)
F.O.B. Canned Price (FOBRP)	-.11	-.60	-1.12	-2.48	-3.45	-4.16	-4.74
	(-0.6)	(-3.1)	(-5.4)	(-11.2)	(-15.3)	(-18.5)	(-21.2)
F.O.B. Fruit Cocktail Price (FOBFC)	-.11	-.55	-1.03	-2.27	-3.17	-3.84	-4.40
	(-0.5)	(-2.4)	(-4.2)	(-8.8)	(-12.2)	(-14.8)	(-17.0)
Grower Profitability Measure (RAGRT)	.125	.128	.123	.093	.072	.066	.067
	(12.4)	(11.7)	(10.6)	(7.5)	(5.7)	(5.2)	(5.3)
Farm Production Cost (FCOST)[c]	155.7	153.4	151.2	145.8	140.8	136.2	131.9
Average Yield of Trees Age 6-15 (Y6)[d]	16.53	16.77	17.02	17.65	18.27	18.89	19.51

[a]Values in parentheses are percentage changes from Base-Run values.
[b]Less than 0.05.
[c]$FCOST_t = 2573 \div Y6_t$.
[d]Predicted from Table 2 trend equations.

then begin to decline as increased production forces prices downward. The long-run impact (by 2010) of the 1,145,000 case reduction in imports is that production and acreage increase by about 6 percent, with growers retaining about a 1 percent gain in the profitability measure. The effects of a 1,145,000 case *increase* in imports would be approximately the reverse (opposite sign) of the values in Table 18.

Table 19 presents the results of a simulation run in which imports are reduced to zero as in Experiment 3, but with FCOST and yields calculated as in Experiment 2. In the latter, yields were permitted to follow their past upward trends over the entire projection period. Comparison with the values in Tables 16 and 18 shows, as would be expected, larger acreage and production increases and lower prices, but also higher grower price-cost ratios (RAGRT).

Table 18. Simulation Experiment No. 3. Effects of Reducing Imports (QIRP) From 1145 to Zero[a] (Change from Base-Run Predictions)[b]

Variable	1986	1988	1990	1995	2000	2005	2010
New Plantings (AGE0)	0	23	73	85	81	82	80
		(1.6)	(4.8)	(5.6)	(5.3)	(5.4)	(5.3)
Removals (RMVLS)	0	-97	-65	5	41	62	78
		(-3.7)	(-2.9)	(0.3)	(2.7)	(4.1)	(5.2)
Total Acres (TACRES)	0	102	407	1,013	1,316	1,482	1,546
		(0.3)	(1.5)	(4.0)	(5.3)	(5.9)	(6.1)
Total Production (QPOTNL)	0	1,167	3,947	10,559	15,687	18,463	19,394
		(0.3)	(1.1)	(3.4)	(5.2)	(6.0)	(6.3)
Quantity Canned (QPKRP)	0	302	359	594	771	865	897
		(2.4)	(3.1)	(5.7)	(7.5)	(8.4)	(8.6)
Quantity Fruit Cocktail (QPKFC)	0	-488	-357	-239	-136	-78	-58
		(-6.2)	(-4.9)	(-3.6)	(-2.1)	(-1.2)	(-0.9)
Canned Per Capita Movement (QTMRPN)	0	.0012	.0015	.0024	.0032	.0036	.0038
		(2.7)	(3.0)	(5.4)	(7.4)	(8.2)	(8.7)
Fruit Cocktail Per Capita Movement (QTMFCN)	0	-.0018	-.0015	-.0011	-.0006	-.0003	-.0002
		(-5.3)	(-4.8)	(-3.9)	(-2.2)	(-1.1)	(-.07)
Farm Price (FARMPR)	0	6.83	7.65	6.76	4.43	2.95	2.39
		(3.2)	(3.4)	(2.8)	(1.8)	(1.2)	(1.0)
F.O.B. Canned Price (FOBRP)	.38	.61	.63	.49	.28	.15	.11
(2.2)		(3.1)	(3.0)	(2.2)	(1.2)	(0.7)	(0.5)
F.O.B. Fruit Cocktail (FOBFC)	0	.36	.32	.17	-.03	-.14	-17
		(1.6)	(1.3)	(0.7)	(-0.1)	(-0.5)	(-0.7)
Grower Profitability Measure (RAGRT)	0	.036	.041	.036	.024	.016	.013
		(3.3)	(3.5)	(2.9)	(1.9)	(1.2)	(1.0)

[a]QIRN is held at .0048 in the farm price reduction equation (same as Base-Run)
[b]Values in parentheses are percentage changes from Base-Run values

Table 19. Simulation Experiment No. 3A. Same as Experiment No. 3 Except Production Costs and Yields are as in Experiment No. 2 (Changes from Base-Run Predictions)[a]

Variable	1986	1988	1990	1995	2000	2005	2010
New Plantings (AGE0)	3	50	124	161	179	208	236
(0.3)		(3.5)	(8.3)	(10.7)	(11.8)	(13.7)	(15.6)
Removals (RMVLS)	-39	-136	-95	2	56	97	138
(-1.2)		(-5.1)	(-4.2)	(0.1)	(3.7)	(6.5)	(9.2)
Total Acres (TACRES)	3	218	688	1,723	2,448	3,085	3,652
(6)		(0.7)	(2.5)	(6.8)	(9.8)	(12.3)	(14.4)
Total Production (QPOTNL)	7,128	14,919	24,313	48,702	73,979	98,623	122,299
(1.6)		(3.9)	(7.0)	(15.7)	(24.3)	(32.2)	(39.7)
Quantity Canned (QPKRP)	257	784	1,070	1,916	2,791	3,650	4,480
(1.7)		(6.1)	(9.1)	(18.2)	(27.1)	(35.3)	(43.1)
Quantity Fruit Cocktail (QPKFC)	120	-228	32	510	1,008	1,482	1,927
(1.4)		(-2.9)	(0.4)	(7.7)	(15.5)	(22.7)	(29.4)
Canned Per Capita	.0009	.0031	.0044	.0079	.0116	.0153	.0189
Movement (QTMRPN)	(1.2)	(5.6)	(8.8)	(17.8)	(26.7)	(35.0)	(43.1)
Fruit Cocktail Per Capita	.0004	-.0008	.0001	.0020	.0042	.0062	.0081
Movement (QTMFCN)	(1.1)	(-2.3)	(0.3)	(7.1)	(15.3)	(22.6)	(29.2)
Farm Price (FARMPR)	-.70	3.51	1.46	-7.80	-17.97	-26.19	-32.88
(-0.4)		(1.7)	(0.7)	(-3.3)	(-7.4)	(-10.8)	(-13.6)
F.O.B. Canned Price (FOBRP)	.27	.23	-0.3	-.94	-1.85	-2.60	-3.23
(1.6)		(1.2)	(-0.2)	(-4.2)	(-8.2)	(-11.6)	(-14.4)
F.O.B. Fruit Cocktail Price (FOBFC)	-.11	.01	-.27	-1.11	-1.93	-2.62	-3.20
(-0.5)		(0.1)	(-1.1)	(-4.3)	(-7.4)	(-10.1)	(-12.3)
Grower Profitability	.011	.053	.061	.059	.047	.041	.040
Measure (RAGRT)	(1.1)	(4.8)	(5.3)	(4.8)	(3.8)	(3.3)	(3.2)

[a]Values in parentheses are percentage changes from Base-Run values.

Simulation Experiment No. 4. Effects of Exports

A major factor affecting the cling peach industry has been the loss of export markets. This experiment evaluates the impact of gaining back a segment of these lost markets. The procedure is to set all exogenous variables as in the Base Run except QXRP and QXFC (canned and fruit cocktail exports). The latter are increased by 1 million cases each (QXRP increased from 678 to 1,678 and QXFC from 932 to 1,932). Correspondingly, the intercepts of the f.o.b. demand equations for canned peaches and fruit cocktail (equations 6.5, 6.6, Table 5) were adjusted to predict sales of an additional 1 million cases under 1984 conditions.[29] Imports are assumed to remain constant at Base Run values. In practice, imports might be affected negatively by the increased export demand and positively by the higher U.S. price. The net effect is assumed here to be small.

The simulation results are given in Table 20. As would be expected, during the first few years there is relatively little increase in production, but there is a small shift toward fruit cocktail. The farm price increases by roughly $8.00 per ton while the f.o.b.

[29]This shifts the intercept of the reduced-form equations in Table 6 for lnFRPCER from -.72915 to -.70110 and for lnFFCCER from -.10409 to -.07059.

Table 20. Simulation Experiment No. 4. Effects of Increasing Exports (QXRP and QXFC) Each by One Million Cases Per Year (Change from Base-Run Predictions)[a]

Variable	1986	1988	1990	1995	2000	2005	2010
New Plantings (AGE0)	0	30	85	80	75	78	77
		(2.1)	(5.6)	(5.3)	(4.9)	(5.1)	(5.1)
Removals (RMVLS)	0	-116	-63	16	44	61	75
		(-4.4)	(-2.8)	(1.0)	(2.9)	(4.1)	(5.0)
Total Acres (TACRES)	0	130	481	1,050	1,282	1,419	1,475
		(0.4)	(1.7)	(4.1)	(5.1)	(5.6)	(5.8)
Total Production (QPOTNL)	0	1,489	4,633	11,155	15,544	17,760	18,475
		(0.4)	(1.3)	(3.6)	(5.1)	(5.8)	(6.0)
Quantity Canned (QPKRP)	0	-26	25	255	406	481	505
		(-0.2)	(0.2)	(2.4)	(3.9)	(4.7)	(4.9)
Quantity Fruit Cocktail (QPKFC)	0	181	356	477	565	611	626
		(2.3)	(4.8)	(7.2)	(8.7)	(9.4)	(9.6)
Canned Per Capita Movement (QTMRPN)	0	-.0003	.0000	.0010	.0017	.0020	.0022
		(-0.5)	(0)	(2.3)	(3.9)	(4.6)	(5.0)
Fruit Cocktail Per Capita Movement (QTMFCN)	0	.0011	.0015	.0020	.0024	.0026	.0027
		(3.2)	(4.8)	(7.1)	(8.8)	(9.5)	(9.8)
Farm Price (FARMPR)	0	8.17	7.97	5.99	3.78	2.68	2.33
		(3.9)	(3.6)	(2.5)	(1.6)	(1.1)	(1.0)
F.O.B. Canned Price (FOBRP)	.49	.68	.63	.42	.23	.14	.11
	(2.8)	(3.5)	(3.1)	(1.9)	(1.0)	(0.6)	(0.5)
F.O.B. Fruit Cocktail Price (FOBFC)	.73	.64	.53	.30	.13	.05	.02
	(3.4)	(2.7)	(2.2)	(1.2)	(0.5)	(0.2)	(0.1)
Grower Profitability Measure (RAGRT)	0	.043	.042	.032	.020	.014	.012
		(3.9)	(3.7)	(2.6)	(1.6)	(1.1)	(1.0)

[a]Values in parentheses are percentage changes from Base-Run values.

Thereafter, increased output leads to a reduction in price, with about two-thirds of the price gain dissipated after 20 years (by 2005). Over this period, the 1 million case increase in canned and fruit cocktail exports (Δ QXRP = 1000, Δ QXFC = 1000) generates an increased output of 481,000 cases canned and 611,000 cases of fruit cocktail. Grower profitability (RAGRT), which increases by about 3.7 - 3.9 percent in the first few years eventually stabilizes with about a 1 percent gain compared to the Base Run.

Simulation Experiment No. 5.
Effect of U.S. Population Growth

While it is very difficult to project changing consumer tastes, it is not difficult to project the growth in the size of the market as measured by total population, at least for the next 10 to 15 years. Experiment No. 5 (Table 21) isolates the effects of the expected population increase up to the year 2000 using the mid-range projections of the U.S. Bureau of the Census. All conditions are the same as in the Base Run except population grows as indicated on the bottom line of Table 21. Per capita imports of canned peaches (QIRPN) are assumed to remain constant at the Base Runvalue (.0048). This requires total canned imports (QIRP) to increase with population.

Table 21. Simulation Experiment No. 5. Effect of Increasing Population Growth Through 2000(Changes from Base-Run Predictions)[a]

Variable	1986	1988	1990	1995	2000
New Plantings (AGE0)	0	18 (1.2)	41 (2.7)	85 (5.7)	120 (7.9)
Removals (RMVLS)	-21 (-0.6)	-41 (-1.5)	-47 (-2.1)	-35 (-2.1)	-6 (-0.4)
Total Acres (TACRES)	0	86 (0.3)	241 (0.9)	805 (3.2)	1,461 (5.8)
Total Production (QPOTNL)	0	929 (0.3)	2,304 (0.7)	8,155 (2.6)	16,150 (5.3)
Quantity Canned (QPKRP)	19 (0.1)	25 (0.2)	86 (0.7)	299 (2.8)	581 (5.7)
Quantity Fruit Cocktail (QPKFC)	-37 (-0.4)	32 (0.4)	32 (0.4)	129 (1.9)	276 (4.2)
Canned Per Capita Movement (QTMRPN)	-.0015 (-2.0)	-.0018 (-3.3)	-.0023 (-4.6)	-.0029 (-6.5)	-.0030 (-6.9)
Fruit Cocktail Per Capita Movement (QTMFCN)	-.0009 (-2.3)	-.0011 (-3.2)	-.0015 (-4.8)	-.0020 (-7.1)	-.0030 (-8.0)
Farm Price (FARMPR)	1.13 (0.6)	3.16 (7.5)	5.11 (2.3)	8.77 (3.7)	10.06 (4.1)
F.O.B. Canned Price (FOBRP)	.18 (1.1)	.36 (1.9)	.54 (2.6)	.83 (3.7)	.92 (4.1)
F.O.B. Fruit Cocktail Price (FOBFC)	.22 (1.0)	.37 (1.6)	.55 (2.3)	.85 (3.3)	.96 (3.7)
Grower Profitability Measure RAGRT	.006 (0.6)	.017 (1.5)	.027 (2.4)	.047 (3.6)	.053 (4.2)
U.S. Population (POP1)	241.4	245.3	249.7	259.6	268.0

[a]Values in parentheses are percentage changes from Base-Run values.

With the level of per capita demand unchanged (equations 6.5 and 6.6), the expanding domestic market causes prices to increase compared to the Base Run and this leads to increase plantings and decreased removals (the latter at least for a while). Total acreage and output increase relative to the Base Run, reaching a level about 5 percent higher by the year 2000. Because of the lags in adjusting output to the population growth, per capita movement actually declines compared to the Base Run so prices increase. Grower prices and profitability are about 4 percent higher than the Base Run values by 2000. With continued population growth and other factors constant, the system never achieves a stationary equilibrium.

The results of this experiment are encouraging from the point of view of the industry. However these potential gains would be eroded if the past downtrend in per capita demand should continue.

VI. SUMMARY COMMENTS

The econometric model developed in this study provides a framework for better understanding and quantitative examination of the supply-demand structure of the cling peach industry. The model may be used for both short-run (year ahead) predictions and more importantly, to evaluate the dynamic adjustment process that follows changes in variables such as costs, yields, imports, exports and demand shift variables such as population. Like most econometric models, it has some important limitations.

First, the economic relationships in the model are approximated by relatively simple functional forms that are either linear or log-linear in their parameters. This can lead to problems in deterministic solutions or solutions outside the historical data range, such as the need to impose restrictions on the range of inventory values. The inventory restrictions seem unlikely to have much effect on the validity of the dynamic analysis results but it would be desirable in future research to find a specification that would eliminate this problem. The farm price prediction equation also needs further study as more data become available to account for an apparent downshift in the level beginning in 1983.

Second, the data set includes cost and processed product price series of somewhat uncertain quality. While both the farm production and processing costs are believed to represent general movements over time, their levels are not necessarily representative of average industry experience and cost data availability has been more limited in recent years. The processed product price series for a single product size and type are used to represent a larger set of sizes and types and it is not always clear as to how closely the trade prices conform to actual transaction prices.

Third, the coefficients of some of the estimated historical supply and demand relationships may shift in the future. An effort was made to evaluate this to some extent with the out-of-sample predictions and in the simulation experiments. However, it is still quite possible that there will be future structural changes.

Fourth, while demand-shift variables such as population can be projected with a reasonably high degree of accuracy, the time-trend variables used to account for otherwise unmeasurable shifts in factors such as consumer tastes and relative returns to alternative crops are strictly valid only over the range of the data set. The out-of-sample tests indicated that extension of the trends beyond the end of the data set (1984) worsened the model predictions.

Because of these limitations, specific *forecasts* of future prices and production based on the model must be viewed with some caution. However, the conditional predictions of dynamic changes in endogenous variables associated with specific changes in exogenous variables may be viewed with somewhat greater confidence. Even if there are changes in the structural equation coefficients we would expect the same general patterns of price and output behavior to emerge. Hence, the simulation experiments provide some useful insights concerning both dynamic adjustment processes and the approximate final impacts of the several scenarios examined.

Note that the full effects of changes in exogenous factors generally are not realized until 15-20 years have passed, and in some cases the adjustment toward long-run equilibrium may extend well beyond. The interim values of prices and outputs may differ considerably from the final equilibrium values, as indicated in Tables 13-20. The major long-run results of the simulation experiments include the following.

a. With yields constant, a 10 percent reduction in farm production cost may lead eventually to about a 15 percent increase in acreage and output and a 7 to 8 percent decrease in price (Table 14).
b. If yield trends continue, the acreage increase is reduced compared to a. and production is substantially increased (Table 16). The farm price decreases about 14 percent, but grower profitability still increases.
c. If imports are reduced to zero from the 1984-86 average of 1,145,000 cases, acreage and production may eventually increase about 6 percent and, following initial larger increases, grower prices finally stabilize about 1 percent higher (Table 18).
d. If exports of canned peaches and fruit cocktail are both increased by 1 million cases per year, acreage and production eventually increase about 6 percent and, following a period of larger gains, the farm price is finally stabilized about 1 percent higher (Table 20).
e. With all other factors constant, including per capita imports, continued population growth increases production and acreage by roughly 5 percent by the year 2000 compared to the Base Run. The farm price increases about 4 percent over the Base Run value. Such gains

could, of course, be quickly eroded by an extension of the historical downtrend in the per capita demand for canned peaches.

Two final points should be noted. First, the predictions of the simulation experiments are *expected* values obtained by setting the unexplained disturbances at zero. Actual values may be expected to fluctuate around the simulation results due to variation in yields and year-to-year variations in demand levels, bargaining conditions and the like. Second, if the results of this study led a significant number of growers to alter their future profitability expectations, the supply structure of the model would be affected. The model predictions would not hold under the changed expectation process. Hence, the dynamic adjustment paths would differ. How much they might be altered and how this would affect long-run equilibrium values is not clear. Since long-run adjustments are determined mainly by cost and demand factors, it is possible that there would not be much difference.

TABLE A1

CALIFORNIA CLING PEACH ACREAGE, PLANTINGS, REMOVALS, QUANTITY HARVESTED AND AVERAGE YIELD PER BEARING ACRE a/ FROM 1956

	Acreage			Acres Planted	Total Acres Removed	Yield per Bearing Acre
	Bearing	Nonbearing	Total			Realized b/
Year	BACRES	NACRES	TACRES	AGEO	RMVLS	Y
1956	44746	19894	64640	7468	2788	14.19
1957	46936	25211	72147	10295	3515	11.12
1958	46529	28505	75034	6402	2054	10.58
1959	48948	33089	82037	9057	5513	11.67
1960	50964	30432	81396	4872	7130	11.63
1961	54068	23562	77630	3364	4691	12.06
1962	55760	21197	76957	4018	5191	12.88
1963	59634	16823	76457	4691	3644	12.10
1964	60844	15887	76731	3918	3286	14.04
1965	60873	18368	79241	5796	3833	11.69
1966	61085	19758	80843	5435	3940	13.49
1967	62087	21490	83577	6674	2988	10.95
1968	63142	22492	85634	5045	5286	13.31
1969	63809	21467	85276	4928	10187	13.90
1970	59019	20473	79492	4363	13588	12.10
1971	52285	17629	69914	4050	10442	12.05
1972	47075	16008	63083	3611	1882	12.76
1973	49411	13612	63023	1822	2074	12.96
1974	51607	10584	62191	1242	3854	15.34
1975	51828	8909	60737	2400	4222	13.74
1976	51127	8824	59951	3436	7169	13.05
1977	45862	9477	55339	2557	6257	16.27
1978	41028	9712	50740	1658	3769	14.80
1979	39806	8701	48507	1386	2346	17.44
1980	40754	7539	48293	2132	5719	18.27
1981	37553	6798	44351	1795	5846	15.87
1982	33560	6294	39854	1349	5889	15.31
1983	29081	6299	35380	1416	3406	11.66
1984	27558	5639	33197	1224	1918	18.67
1985	27635	5879	33514	2235	1521	17.74
1986	27741	6469	34210	2217	1500 c/	16.26

a/ Values may differ slightly from those in CCPAB survey reports for reasons explained in Appendix B
b/ Excludes green drop and unsold tonnage, based on total tonnage
c/ Preliminary value

Source: See Appendix B

TABLE A2

PART A

CALIFORNIA CLING PEACH ACREAGE BY AGE CLASS AS OF MAY 1, FROM 1956

Year	Age Class										
	AGE0	AGE1	AGE2	AGE3	AGE4	AGE5	AGE6	AGE7	AGE8	AGE9	AGE10
1956	7468	4390	3124	4912	4354	2286	1777	3503	2295	1773	1421
1957	10295	7453	4371	3092	4676	4125	2209	1749	3453	2251	1648
1958	6402	10295	7438	4370	3037	4637	4102	2187	1749	3438	2244
1959	9057	6371	10260	7401	4215	3003	4612	4102	2185	1740	3438
1960	4872	9045	6336	10179	6792	4183	2967	4575	4026	2148	1694
1961	3364	4872	9031	6295	9487	6616	4126	2905	4377	3919	2002
1962	4018	3340	4819	9020	5800	9324	6542	3991	2887	4199	3846
1963	4691	3995	3331	4806	8264	5547	9124	6312	3870	2765	4024
1964	3918	4679	3980	3310	4196	8114	5503	8996	6209	3767	2646
1965	5796	3915	4677	3980	3059	4133	7891	5456	8876	6047	3694
1966	5435	5781	3885	4657	3714	3040	4111	7472	5426	8592	5801
1967	6674	5433	5565	3818	4392	3683	3018	4060	7219	5154	8256
1968	5045	6501	5395	5551	3595	4369	3678	3018	4051	7006	5096
1969	4928	5026	6368	5145	5123	3576	4154	3618	2947	3941	6751
1970	4363	4921	4910	6279	4611	4998	3420	3998	3505	2770	3689
1971	4050	4338	4418	4823	5370	4184	4695	3136	3657	3336	2556
1972	3611	4037	4188	4172	4302	5023	3822	4460	2810	3155	3052
1973	1822	3607	4016	4167	3945	4246	4927	3769	4404	2787	2910
1974	1242	1822	3592	3928	4040	3890	4138	4826	3673	4361	2715
1975	2400	1242	1776	3491	3656	3755	3820	4042	4633	3614	4232
1976	3436	2385	1242	1761	3372	3640	3170	3777	4009	4586	3556
1977	2557	3396	2284	1240	1687	3266	3583	3058	3524	3816	4384
1978	1658	2453	3323	2278	1183	1680	3218	3489	2966	3382	3477
1979	1386	1644	2399	3272	2025	1176	1620	3196	3412	2827	3312
1980	2132	1372	1636	2399	3065	1978	1153	1593	3142	3376	2818
1981	1795	2124	1333	1564	2298	3030	1897	1114	1526	2969	3187
1982	1349	1795	1893	1257	1279	2137	2810	1689	1040	1334	2761
1983	1416	1349	1794	1740	1134	1162	1926	2420	1458	964	1154
1984	1224	1317	1349	1749	1561	1061	1089	1824	2177	1386	932
1985	2235	1085	1281	1278	1628	1521	1002	1084	1752	2132	1338
1986	2217	1891	1085	1276	1278	1628	1521	1002	1084	1752	2113

Source: See Appendix B

TABLE A2

PART B

CALIFORNIA CLING PEACH ACREAGE BY AGE CLASS AS OF MAY 1,
FROM 1956

... continued ...

Year	Age Class									
	AGE11	AGE12	AGE13	AGE14	AGE15	AGE16	AGE17	AGE18	AGE19	AGE20
1956	1713	2731	2374	2846	2725	2366	1620	2218	2185	2331
1957	1381	1617	2639	2287	2695	2642	2212	1554	2101	2043
1958	1574	1321	1531	2536	2150	2473	2394	1944	1375	1858
1959	2222	1538	1277	1488	2378	2071	2335	2231	1833	1269
1960	3365	2134	1406	1152	1260	2087	1864	1950	1936	1435
1961	1623	3187	1969	1187	969	1065	1588	1536	1511	1364
1962	1960	1563	3021	1878	1035	846	934	1300	1244	1121
1963	3627	1890	1496	2880	1730	880	742	796	1066	924
1964	3909	3501	1789	1424	2677	1582	766	617	721	839
1965	2522	3755	3255	1692	1337	2511	1412	680	528	610
1966	3552	2359	3580	3026	1546	1279	2264	1248	555	436
1967	5590	3424	2249	3406	2857	1427	1043	2031	1066	438
1968	8068	5456	3310	2110	3137	2636	1282	938	1824	903
1969	4795	7619	5146	3065	1924	2605	2390	1103	766	1535
1970	5758	4222	6547	4432	2705	1383	1773	1594	767	484
1971	3350	4334	3315	4975	3187	1902	833	831	966	420
1972	2091	3033	3240	2616	3606	2192	1429	513	450	514
1973	2991	2055	2957	3134	2504	3440	2027	1339	408	405
1974	2791	2939	2015	2856	2953	2400	3198	1839	1239	362
1975	2621	2683	2788	1892	2586	2624	2039	2905	1642	976
1976	4112	2563	2552	2634	1754	2233	2244	1621	2211	1356
1977	3337	3637	2281	2157	2318	1408	1731	1496	909	1520
1978	4198	3088	3005	1888	1660	1788	1144	1220	1040	603
1979	3390	3915	2916	2785	1720	1460	1523	973	965	761
1980	3232	3333	3817	2793	2647	1613	1340	1327	870	798
1981	2517	2910	2985	3305	2253	2064	1249	1131	907	696
1982	2846	2290	2591	2524	2757	1814	1578	1053	904	672
1983	2385	2361	1988	2209	2147	2229	1298	1158	837	683
1984	1026	2144	2123	1701	1946	1941	1866	1160	985	694
1985	901	1011	2089	2123	1645	1784	1820	1713	1011	903
1986	1315	871	1011	2028	2006	1554	1674	1672	1607	885

Source: See Appendix B

TABLE A2

PART C

CALIFORNIA CLING PEACH ACREAGE BY AGE CLASS AS OF MAY 1, FROM 1956

... continued ...

Year	Age Class										
	AGE21	AGE22	AGE23	AGE24	AGE25	AGE26	AGE27	AGE28	AGE29	AGE30	AGE31
1956	1096	651	324	240	232	298	1387 a/	N/A	N/A	N/A	N/A
1957	2032	1006	579	291	205	184	263	1094 a/	N/A	N/A	N/A
1958	1619	1630	815	464	257	163	127	213	691 a/	N/A	N/A
1959	1601	1475	1500	749	436	232	131	116	197	574 a/	N/A
1960	936	1169	1058	1115	536	260	172	101	96	158	389 a/
1961	887	617	725	714	704	272	181	99	57	76	305
1962	929	601	414	532	553	554	228	105	19	39	295
1963	775	625	374	264	406	411	328	187	83	13	231
1964	776	621	396	266	190	324	346	287	173	45	164
1965	671	623	485	300	170	129	240	283	220	125	169
1966	485	593	491	325	212	109	89	183	220	163	214
1967	353	394	437	381	260	147	88	81	141	165	327
1968	354	316	359	324	312	218	115	71	69	104	423
1969	735	263	221	296	256	255	145	76	67	59	378
1970	825	417	132	135	206	144	124	74	47	45	214
1971	213	418	134	53	50	92	93	54	21	19	91
1972	268	80	199	50	25	23	18	54	14	8	28
1973	480	248	75	157	49	24	15	18	54	12	31
1974	344	420	227	72	137	46	18	10	16	43	39
1975	304	266	303	156	51	95	42	11	7	13	72
1976	777	195	202	259	121	35	57	28	11	6	46
1977	771	444	116	117	131	76	8	23	23	8	33
1978	874	552	230	64	95	59	62	7	20	14	22
1979	472	599	375	152	40	80	36	35	3	11	27
1980	596	340	383	289	91	21	58	31	23	3	24
1981	588	361	160	155	112	54	20	19	16	15	15
1982	528	353	246	86	87	89	36	9	15	15	17
1983	521	320	285	168	71	58	73	22	9	13	28
1984	636	422	268	263	151	51	31	62	22	9	27
1985	556	595	367	207	215	93	31	14	51	22	27
1986	834	461	522	353	157	191	90	26	14	51	41

a/ Acreage of the indicated age and over

Source: See Appendix B

TABLE A3

PART A

CALIFORNIA CLING PEACH TREE REMOVALS BY AGE CLASS AS OF MAY 1, FROM 1956

Year	Age Class (acres)										
	REM0	REM1	REM2	REM3	REM4	REM5	REM6	REM7	REM8	REM9	REM10
1956	15	19	32	236	229	77	28	50	44	125	40
1957	0	15	1	55	39	23	22	0	15	7	74
1958	31	35	37	155	34	25	0	2	9	0	22
1959	12	35	81	609	32	36	37	76	37	46	73
1960	0	14	41	692	176	57	62	198	107	146	71
1961	24	53	11	495	163	74	135	18	178	73	42
1962	23	9	13	756	253	200	230	121	122	175	219
1963	12	15	21	610	150	44	128	103	103	119	115
1964	3	2	0	251	63	223	47	120	162	73	124
1965	15	30	20	266	19	22	419	30	284	246	142
1966	2	216	67	265	31	22	51	253	272	336	211
1967	173	38	14	223	23	5	0	9	213	58	188
1968	19	133	250	428	19	215	60	71	110	255	301
1969	7	116	89	534	125	156	156	113	177	252	993
1970	25	503	87	909	427	303	284	341	169	214	339
1971	13	150	246	521	347	362	235	326	502	284	465
1972	4	21	21	227	56	96	53	56	23	245	61
1973	0	15	88	127	55	108	101	96	43	72	119
1974	0	46	101	272	285	70	96	193	59	129	94
1975	15	0	15	119	16	585	43	33	47	58	120
1976	40	101	2	74	106	57	112	253	193	202	219
1977	104	73	6	57	7	48	94	92	142	339	186
1978	14	54	21	253	7	60	22	77	139	70	87
1979	14	8	0	207	47	23	27	54	36	9	80
1980	8	39	72	101	35	81	39	67	173	189	301
1981	0	231	76	285	161	220	208	74	192	208	341
1982	0	0	153	123	117	211	390	231	76	180	376
1983	99	0	45	179	73	72	102	243	72	32	128
1984	139	36	71	121	40	59	5	72	45	48	31
1985	344	0	5	0	0	0	0	0	0	19	23

Source: See Appendix B

TABLE A3

PART B

CALIFORNIA CLING PEACH TREE REMOVALS BY AGE CLASS AS OF MAY 1, FROM 1956

... continued ...

Year	Age Class (acres)									
	REM11	REM12	REM13	REM14	REM15	REM16	REM17	REM18	REM19	REM20
1956	96	92	87	151	83	154	66	117	142	299
1957	60	86	103	137	222	248	268	179	243	424
1958	36	44	43	158	79	138	163	111	106	257
1959	88	132	125	228	291	207	385	295	398	333
1960	178	165	219	183	195	499	328	439	572	548
1961	60	166	91	152	123	131	288	292	390	435
1962	70	67	141	148	155	104	138	234	320	346
1963	126	101	72	203	148	114	125	75	227	148
1964	154	246	97	87	166	170	86	89	111	168
1965	163	175	229	146	58	247	164	125	92	125
1966	128	110	174	169	119	236	233	182	117	83
1967	134	114	139	269	221	145	105	207	163	84
1968	449	310	245	186	532	246	179	172	289	168
1969	573	1072	714	360	541	872	796	336	282	710
1970	1424	907	1572	1245	803	550	902	628	347	271
1971	317	1094	699	1369	995	473	320	381	452	152
1972	36	76	106	112	166	165	90	105	45	34
1973	52	40	101	181	104	242	188	100	46	61
1974	108	151	123	270	329	361	293	197	263	58
1975	58	131	154	138	353	380	418	694	286	199
1976	475	282	395	316	346	502	748	712	691	585
1977	249	632	393	497	530	264	511	456	306	646
1978	283	172	220	168	200	265	351	255	279	131
1979	57	98	123	138	107	120	196	103	167	165
1980	322	348	512	540	583	364	209	420	174	210
1981	227	319	461	548	439	486	196	227	235	168
1982	485	302	382	377	528	516	420	216	221	151
1983	241	238	287	263	206	363	138	173	143	47
1984	15	55	0	56	162	121	153	149	82	138
1985	30	0	61	117	91	110	148	106	126	69

Source: See Appendix B

TABLE A3

PART C

CALIFORNIA CLING PEACH TREE REMOVALS BY AGE CLASS AS OF MAY 1
FROM 1956

... continued ...

Year	Age Class (acres)									
	REM21	REM22	REM23	REM24	REM25	REM26	REM27	REM28	REM29	REM30+
1956	90	72	33	35	48	35	293	N/A	N/A	N/A
1957	402	191	115	34	42	57	50	403	N/A	N/A
1958	144	130	66	28	25	32	11	16	117	N/A
1959	432	417	385	213	176	60	30	20	39	185
1960	319	444	344	411	264	79	73	44	20	242
1961	286	203	193	161	150	44	76	80	18	86
1962	304	227	150	126	142	226	41	22	6	103
1963	154	229	108	74	82	65	41	14	38	80
1964	153	136	96	96	61	84	63	67	48	40
1965	78	132	160	88	61	40	57	63	57	80
1966	91	156	110	65	65	21	8	42	55	50
1967	37	35	113	69	42	32	17	12	37	69
1968	91	95	63	68	57	73	39	4	10	149
1969	318	131	86	90	112	131	71	29	22	223
1970	407	283	79	85	114	51	70	53	28	168
1971	133	219	84	28	27	74	39	40	13	82
1972	20	5	42	1	1	8	0	0	2	5
1973	60	21	3	20	3	6	5	2	11	4
1974	78	117	71	21	42	4	7	3	3	10
1975	109	64	44	35	16	38	14	0	1	39
1976	333	79	85	128	45	27	34	5	3	19
1977	219	214	52	22	72	14	1	3	9	19
1978	275	177	78	24	15	23	27	4	9	9
1979	132	216	86	61	19	22	5	12	0	14
1980	235	180	228	177	37	1	39	15	8	12
1981	235	115	74	68	23	18	11	4	1	13
1982	208	68	78	15	29	16	14	0	2	4
1983	99	52	22	17	20	27	11	0	0	14
1984	41	55	61	48	58	20	17	11	0	9
1985	95	73	14	50	24	3	5	0	0	8

Source: See Appendix B

TABLE A4

CALIFORNIA CLING PEACH YIELDS BY AGE CLASS
FROM 1956

Year	Age Class (tons per acre)						
	2 Years Y2	3 Years Y3	4 Years Y4	5 Years Y5	6-15 Years Y6	16-21 Years Y7	Over 21 Years Y8
1956	0.70	3.56	7.10	12.36	15.23	14.05	12.42
1957	0.54	3.47	6.65	9.71	12.20	10.92	9.83
1958	0.44	2.29	5.83	7.90	11.14	11.03	10.08
1959	1.55	4.95	8.85	11.15	13.05	11.43	10.88
1960	0.94	4.46	8.09	10.97	13.47	11.52	11.02
1961	0.70	3.47	7.81	10.77	14.25	12.70	12.06
1962	1.02	3.98	8.38	11.64	14.58	13.22	12.81
1963	0.72	3.32	7.12	10.84	14.45	14.00	13.74
1964	0.87	3.83	8.52	11.59	16.23	15.14	14.32
1965	1.22	4.17	7.54	10.83	12.50	10.86	9.93
1966	1.51	4.84	8.90	11.27	13.69	12.06	11.59
1967	0.76	3.42	6.17	8.67	11.38	10.18	9.75
1968	1.14	4.43	7.73	10.33	13.55	12.56	12.16
1969	1.57	5.19	9.86	12.18	14.51	12.63	11.91
1970	1.45	4.17	8.27	11.15	13.60	12.98	12.58
1971	1.43	5.68	9.32	12.80	15.64	14.90	13.52
1972	1.97	3.92	8.27	10.67	13.66	12.90	13.07
1973	1.15	4.79	8.07	10.84	13.22	12.58	11.43
1974	1.91	5.28	9.97	12.84	15.83	14.26	13.46
1975	1.43	5.09	8.84	12.52	14.37	12.74	12.00
1976	1.82	5.04	9.55	11.92	13.81	11.40	10.65
1977	2.43	5.73	9.79	13.15	16.86	15.09	14.88
1978	2.09	5.56	8.76	11.73	14.97	13.30	12.86
1979	3.16	7.25	11.49	13.88	17.26	16.32	15.28
1980	2.53	6.89	11.90	15.61	18.75	17.25	16.17
1981	2.90	7.16	11.80	14.02	16.39	14.02	14.75
1982	1.96	5.97	10.28	14.06	15.57	14.32	14.03
1983	1.49	4.49	8.53	10.21	12.03	10.07	10.06
1984	1.41	7.65	12.54	16.87	19.18	17.59	16.07
1985	1.83	6.43	12.50	15.87	18.45	17.19	15.01
1986	1.87	4.68	10.36	14.58	16.76	16.45	13.82

Source: See Appendix B

TABLE A5

CALIFORNIA CLING PEACH UTILIZATION DATA (TONS)
FROM 1956

	Tons on Trees	Surplus Quantity a/	Proportion Culled	Proportion Diverted at Cannery	No. 1 Tons Paid for by Canners	Canner Raw Product Allocation		
						Regular Pack	Fruit Cocktail	Other
Year	QPOTNL	QHRVST	CULLGE	DIVRSN	QMART	QRAWRP	QRAWFC	QOTHER
1956	634774	0	0.047	0.075	559437	415870	102377	41190
1957	621298	99408	0.060	0.010	485684	352007	97586	36091
1958	492163	0	0.061	0.000	462032	331746	97160	33126
1959	636791	65379	0.051	0.006	539021	393567	108797	36657
1960	658242	65520	0.051	0.030	545478	394827	118727	31924
1961	692023	39908	0.059	0.050	582439	429290	120321	32828
1962	775689	57618	0.056	0.058	638357	476763	124427	37168
1963	794457	72783	0.063	0.000	675969	508661	128171	39137
1964	921726	67719	0.088	0.000	778747	583516	156320	38911
1965	742221	30528	0.110	0.015	624027	444483	143126	36418
1966	822949	0	0.102	0.000	739371	559803	149411	30157
1967	678485	0	0.115	0.000	600568	432002	136264	32302
1968	840299	0	0.101	0.000	755352	559339	165347	30666
1969	907750	20982	0.105	0.023	774963	580438	162774	31751
1970	792464	78149	0.090	0.051	616693	462634	126739	27320
1971	799504	169349	0.097	0.000	569895	411798	129012	29085
1972	625385	24665	0.098	0.000	541834	405753	111469	24612
1973	640393	0	0.125	0.000	560300	411798	121441	27061
1974	791817	0	0.095	0.000	716854	543682	143270	29902
1975	718086	6029	0.113	0.000	631634	477260	131232	23142
1976	667264	0	0.114	0.000	591141	437892	129324	23925
1977	750362	4042	0.077	0.000	688270	521308	128936	38026
1978	607063	0	0.099	0.000	547302	389794	115160	42348
1979	694226	0	0.094	0.000	628801	450998	135481	42322
1980	744395	0	0.101	0.000	669431	474907	151019	43505
1981	613171	17000	0.127	0.000	543107	389455	112614	41038
1982	549183	35362	0.131	0.000	458391 b/	333294	84007	41090
1983	339036	0	0.094	0.000	307206	210740	75600	20866
1984	520162	6200	0.074	0.000	475384	352053	82858	40473
1985	488887	0	0.069	0.000	454677	317043	96196	41438
1986	450606	0	0.066	0.000	414065	287446	90092	36527

a/ Includes green drop and cannery diversion prior to 1973; unsold or alternate use from 1973 on.
b/ Beginning in 1981, includes paid for No. 2 peaches.

Source: See Appendix B

TABLE A6

PART A

CLING PEACH PACK, STOCK AND MOVEMENT DATA
FROM 1956-57
(equivalent cases of 24 no. 2-1/2 cans, 1000's)

Crop Year	Regular Pack							
	Pack	Beginning Stocks	Total Supply	Total Movement	Exports	U.S. a/ Supply	U.S. b/ Movement	Imports
	QPKRP	BEGRP	TSRP	QTMRP	QXRP	SPLYRP	QDOMRP	QIRP
1956	21322	1556	22879	18300	2321	20557	15979	
1957	18484	4579	23063	20581	2621	20442	17960	
1958	17545	2482	20027	16988	2239	17788	14749	
1959	21485	3039	24524	21874	3506	21018	18368	
1960	21587	2650	24237	20793	4133	20104	16660	
1961	22940	3443	26383	23001	5316	21067	17685	
1962	25574	3382	28956	25765	6443	22513	19322	
1963	25089	3191	28280	25722	4722	23558	21000	
1964	30640	2558	33198	28007	5175	28023	22832	
1965	23233	5191	28424	25604	4597	23827	21007	
1966	30348	2820	33168	29052	5067	28101	23985	
1967	22566	4116	26682	23631	2053	24629	21578	
1968	29867	3051	32918	27282	2495	30423	24787	
1969	31479	5636	37115	28787	4996	32119	23791	
1970	24878	7458	32336	25573	3698	28638	21875	
1971	21839	6763	28602	24712	2645	25957	22067	
1972	21233	3890	25123	23532	2647	22476	20885	
1973	21615	1591	23206	21819	2819	20387	19000	
1974	28983	1387	30370	26009	2147	28223	23862	
1975	25691	4361	30052	23794	2077	27975	21717	
1976	22783	6258	29041	23760	2542	26499	21218	
1977	27568	5281	32849	26703	3557	29292	23146	
1978	19874	6146	26020	22691	3192	22828	19499	
1979	24053	3330	27383	22918	3008	24375	19910	
1980	24990	4465	29455	22816	2879	26576	19937	
1981	20658	6639	27297	19432	2599	24698	16833	
1982	17846	7865	25711	20136	1822	23889	18316	c/
1983	10586	5573	16159	15019	778	15381	14241	1165
1984	18687	1140	19827	15636	560	19267	15076	1238
1985	17351	4191	21542	15894	691	20851	15203	1405
1986	14465	5648	20113	16779	783	19330	15996	793
1987	15161	3334	18495					

a/ SPLYRP = TSRP-QXRP
b/ QDOMRP = QTMRP-QXRP
c/ Insignificant quantity

Source: See Appendix B

TABLE A6

PART B

CLING PEACH PACK, STOCK AND MOVEMENT DATA
FROM 1956-57
(equivalent cases of 24 no. 2-1/2 cans, 1000's)

... continued ...

Crop Year	Fruit Cocktail						
	Pack	Beginning Stocks	Total Supply	Total Movement	Exports	U.S. a/ Supply	U.S. b/ Movement
	QPKFC	BEQFC	TSFC	QTMFC	QXFC	SPLYFC	QDOMFC
1956	11033	1548	12581	10430	1394	11187	9036
1957	10638	2151	12789	10567	1453	11336	9114
1958	10734	2222	12956	10649	1404	11552	9245
1959	10274	2307	14381	12189	1656	10925	10533
1960	12848	2192	15040	11913	1868	13172	10045
1961	13660	3127	16787	13389	2625	14162	10764
1962	13771	3398	17169	14936	3095	14074	11841
1963	12565	2233	14798	12706	2740	12058	9966
1964	16176	2092	18268	15875	3520	14748	12355
1965	14504	2393	16897	13457	2730	14167	10727
1966	15781	3440	19221	16545	3333	15888	13212
1967	13399	2676	16075	13239	2020	14055	11219
1968	16570	2836	19406	16090	2365	17041	13725
1969	16686	3316	20002	15935	2666	17336	13269
1970	13081	3113	16194	12741	1842	14352	10899
1971	13334	3453	16787	12451	1633	15154	10818
1972	11855	4336	16191	13856	2119	14072	11737
1973	13384	2335	15719	14479	2500	13219	11979
1974	14907	1240	16147	13082	1679	14468	11403
1975	13677	3065	16742	13502	1748	14994	11754
1976	13605	3240	16845	13573	1796	15049	11777
1977	12980	3272	16252	13652	1978	14274	11674
1978	11704	2600	14304	12616	2013	12291	10603
1979	13815	1688	15503	12807	2498	13005	10309
1980	14826	2696	17522	12475	2408	15114	10067
1981	11383	5047	16430	11188	2163	14267	9025
1982	8722	5242	13964	11016	1890	12074	9126
1983	8223	2948	11171	9272	1128	10043	8144
1984	8671	1899	10570	8912	1034	9536	7878
1985	10058	1658	11665	8692	835	10830	7857
1986	8976	2973	11912	9642	926	10896	8716
1987	9340	2270	11614				

a/ SPLYFC = TSFC-QXFC
b/ QDOMFC = QTMFC-QXFC

Source: See Appendix B

TABLE A7

CALIFORNIA CLING PEACHES: RELATIVE VALUES OF RAW PRODUCT ALLOCATION, CARRYOVER STOCKS, AND EXPORTS FROM 1956-57
(proportions)

	Canner Raw Product Allocation			Ending Stock Relative to Seasonal Supply		Exports Relative to Total Sales	
	Regular Pack QRAWRP/QMART	Fruit Cocktail QRAWFC/QMART	Other QOTHER/QMART	Regular Pack BEGRP/TSRP(-1)	Fruit Cocktail BEGFC/TSFC(-1)	Regular Pack QXRP/QTMRP	Fruit Cocktail QXFC/QTMFC
Year	PQRAWRP	PQRAWFC	PQOTHER	BEGTSRP	BEGTSFC	QXQTMRP	QXQTMFC
1956	0.743	0.183	0.074	0.084	0.140	0.127	0.134
1957	0.725	0.201	0.074	0.200	0.171	0.127	0.138
1958	0.718	0.210	0.072	0.108	0.174	0.132	0.132
1959	0.730	0.202	0.068	0.152	0.178	0.160	0.136
1960	0.724	0.218	0.059	0.108	0.152	0.199	0.157
1961	0.737	0.207	0.056	0.142	0.208	0.231	0.196
1962	0.747	0.195	0.058	0.128	0.202	0.250	0.207
1963	0.752	0.190	0.058	0.110	0.130	0.184	0.216
1964	0.749	0.201	0.050	0.090	0.141	0.185	0.222
1965	0.712	0.229	0.058	0.156	0.131	0.180	0.203
1966	0.757	0.202	0.041	0.099	0.204	0.174	0.201
1967	0.719	0.227	0.054	0.124	0.139	0.087	0.153
1968	0.741	0.219	0.041	0.114	0.176	0.091	0.147
1969	0.749	0.210	0.041	0.171	0.171	0.174	0.167
1970	0.750	0.206	0.044	0.201	0.156	0.145	0.145
1971	0.723	0.226	0.051	0.209	0.213	0.107	0.131
1972	0.749	0.206	0.045	0.136	0.258	0.112	0.153
1973	0.735	0.217	0.048	0.063	0.144	0.129	0.173
1974	0.758	0.200	0.042	0.060	0.079	0.083	0.128
1975	0.756	0.208	0.037	0.144	0.190	0.087	0.129
1976	0.741	0.219	0.040	0.208	0.194	0.107	0.132
1977	0.757	0.187	0.055	0.182	0.194	0.133	0.145
1978	0.712	0.210	0.077	0.187	0.160	0.141	0.160
1979	0.717	0.215	0.067	0.128	0.118	0.131	0.195
1980	0.709	0.226	0.065	0.163	0.174	0.126	0.193
1981	0.716	0.207	0.075	0.225	0.288	0.134	0.193
1982	0.727	0.183	0.090	0.288	0.319	0.090	0.172
1983	0.686	0.245	0.068	0.217	0.211	0.085	0.121
1984	0.741	0.174	0.085	0.070	0.170	0.042	0.116
1985	0.697	0.212	0.091	0.211	0.157	0.043	0.096
1986	0.694	0.218	0.088	0.262	0.255	0.047	0.096

Source: See Appendix B

TABLE A8

TOTAL SUPPLY OF CANNED APRICOTS, PEARS, AND FREESTONE PEACHES (PACK PLUS BEGINNING STOCKS) FROM 1956-57
(equivalent cases of 24 no. 2-1/2 cans, 1000's)

Crop Year	Apricots	Bartlett Pears	Freestone Peaches	Total
	TSA	TSBP	TSFS	TSC
1956	5295	10046	6256	21597
1957	4998	10745	5942	21685
1958	2322	9682	6790	18794
1959	5002	10785	7549	23336
1960	6530	9895	7880	24305
1961	6510	10769	7835	25114
1962	5125	11688	7370	24183
1963	5042	7175	6590	18807
1964	5710	11202	7391	24303
1965	6348	8408	6431	21187
1966	6133	12325	5761	24219
1967	5233	7711	4884	17828
1968	5483	11451	5310	22244
1969	6579	12973	5750	25302
1970	5833	11237	3669	20739
1971	4959	13597	3527	22083
1972	3602	12751	2655	19008
1973	4392	12272	2487	19151
1974	2454	12465	3188	18107
1975	4657	13490	3017	21164
1976	3921	14879	2506	21306
1977	3139	13118	2102	18359
1978	2579	11710	1828	16117
1979	3154	13184	1717	18055
1980	3710	14484	1893	20087
1981	2277	14552	1491	18320
1982	1885	12991	1148	16024
1983	1386	9831	878	12095
1984	1984	9220	900 a/	12104 b/
1985	2076	9458	900 a/	11534 b/
1986	869	10227	900 a/	11996 b/

a/ Reporting discontinued in 1984, estimated value
b/ Estimated assuming TSFS = 900

Source: See Appendix B

TABLE A9

CALIFORNIA CLING PEACHES: PRICES AND PERCAPITA MOVEMENT
FROM 1956-57
(movement in cases of no. 24 2-1/2 cans per capita)

		Canner F.O.B. Price per case, 24 no. 2-1/2 cans a/		Prices Deflated by PCE67R			Per Capita Total Movement		U.S. Per Capita Consumption	
	Farm Price	Regular Pack	Fruit Cocktail	Farm Price	Regular Pack	Fruit Cocktail	Regular Pack	Fruit Cocktail	Regular Pack	Fruit Cocktail
Year	FARMPR	FOBRP	FOBFC	FRMCER	FRPCER	FFCCER	QTMRPN	QTMFCN	QDOMRPN	QDOMFCN
1956	70.0	5.35	6.22	86.85	6.64	7.72	0.109	0.062	0.095	0.054
1957	65.0	5.10	6.28	78.03	6.12	7.54	0.120	0.062	0.105	0.053
1958	66.0	5.36	6.83	77.65	6.31	8.04	0.098	0.061	0.085	0.053
1959	59.7	4.89	6.27	68.82	5.64	7.23	0.123	0.069	0.103	0.059
1960	56.8	4.86	6.17	64.28	5.50	6.99	0.115	0.066	0.092	0.056
1961	67.0	4.70	5.75	75.11	5.27	6.45	0.125	0.073	0.096	0.059
1962	65.0	4.50	5.40	71.82	4.97	5.97	0.138	0.080	0.104	0.063
1963	57.0	4.87	6.50	62.02	5.30	7.07	0.136	0.067	0.111	0.053
1964	62.0	4.51	5.78	66.52	4.84	6.20	0.146	0.083	0.119	0.064
1965	69.0	4.65	6.75	72.78	4.91	7.12	0.132	0.069	0.108	0.055
1966	68.5	4.63	6.00	70.26	4.75	6.15	0.148	0.084	0.122	0.067
1967	83.0	5.50	7.20	83.00	5.50	7.20	0.119	0.067	0.109	0.056
1968	76.0	5.30	6.35	73.15	5.10	6.11	0.136	0.080	0.124	0.068
1969	74.0	5.05	6.10	67.40	4.60	5.56	0.142	0.079	0.117	0.065
1970	81.0	5.60	7.30	71.30	4.93	6.43	0.125	0.062	0.107	0.053
1971	79.0	5.90	7.70	66.61	4.97	6.49	0.119	0.060	0.106	0.052
1972	75.0	6.50	8.20	61.03	5.29	6.67	0.112	0.066	0.099	0.056
1973	97.0	7.75	9.20	74.67	5.97	7.08	0.103	0.068	0.090	0.057
1974	132.0	9.90	11.15	92.31	6.92	7.80	0.122	0.061	0.112	0.053
1975	128.5	9.25	10.90	83.50	6.01	7.08	0.110	0.063	0.101	0.054
1976	115.0	9.60	11.35	71.08	5.93	7.01	0.109	0.062	0.097	0.054
1977	115.0	9.55	11.70	67.21	5.58	6.84	0.121	0.062	0.105	0.053
1978	135.0	11.15	13.90	73.69	6.09	7.59	0.102	0.057	0.088	0.048
1979	150.0	12.10	14.60	75.15	6.06	7.31	0.102	0.057	0.088	0.046
1980	155.0	13.00	15.95	70.49	5.91	7.25	0.100	0.055	0.088	0.044
1981	180.0	13.83	16.85	75.47	5.80	7.06	0.084	0.049	0.073	0.039
1982	172.0	14.40	17.50	68.20	5.71	6.94	0.087	0.047	0.079	0.039
1983	160.0	16.85	19.50	60.98	6.42	7.43	0.064	0.040	0.066	0.035
1984	183.0	18.45	21.10	67.58	6.81	7.79	0.066	0.038	0.069	0.033
1985	188.5	18.45	20.40	66.61	6.52	7.21	0.066	0.036	0.069	0.033
1986	167.0	18.45	21.10 c/	57.59	6.36	7.28	0.069	0.040	0.070	0.036
1987	193.0 b/									

a/ Choice, h.s.
b/ Base price
c/ Preliminary value

Source: See Appendix B

TABLE A10

CALIFORNIA CLING PEACHES: NET FARM RETURNS, COSTS AND PROCESSOR MARGINS FROM 1956-57

	Adjusted Grower Return Per Ton	Farm Cost Per Ton	Ratio of Return to Cost	Processing Cost Index 1967=100	Representative Unit Processing Cost Per Case		Canning Case Yield per Ton		Raw Product Cost per Case		Processing Margin	
					Regular Pack	Fruit Cocktail	Regular Pack	Fruit Cocktail	Regular Pack	Fruit Cocktail	Regular Pack	Fruit Cocktail
Year	AGRT	FCOST	RAGRT	PCI	PCRP	PCFC	CTRP	CTFC	RPCRPR	RPCFCR	MRP	MFC
1956	59.93	40.38	1.484	80.30	3.85	4.53	51.27	107.77	1.37	0.65	3.98	5.57
1957	48.88	40.72	1.200	84.50	3.97	4.74	52.51	109.01	1.24	0.60	3.86	5.68
1958	59.71	43.11	1.385	85.80	4.06	4.94	52.89	110.48	1.25	0.60	4.11	6.23
1959	47.53	43.29	1.098	86.80	3.92	4.78	54.59	94.43	1.09	0.63	3.80	5.64
1960	42.53	43.98	0.967	88.90	3.87	4.73	54.67	108.21	1.04	0.52	3.82	5.65
1961	50.80	44.88	1.132	89.70	3.89	4.88	53.44	113.53	1.25	0.59	3.45	5.16
1962	48.98	45.40	1.079	91.10	3.83	4.71	53.64	110.68	1.21	0.59	3.29	4.81
1963	43.98	46.20	0.952	91.60	3.87	4.92	49.32	98.03	1.16	0.58	3.71	5.92
1964	48.91	47.78	1.024	93.20	3.80	4.76	52.51	103.48	1.18	0.60	3.33	5.18
1965	55.01	49.39	1.114	94.60	4.06	4.97	52.27	101.34	1.32	0.68	3.33	6.07
1966	59.52	52.39	1.136	97.00	4.09	5.06	54.21	105.62	1.26	0.65	3.37	5.35
1967	71.48	54.57	1.310	100.00	4.55	5.65	52.24	98.33	1.59	0.84	3.91	6.36
1968	66.29	57.30	1.157	102.10	4.46	5.53	53.40	100.21	1.42	0.76	3.88	5.59
1969	57.68	59.26	0.973	106.90	4.77	5.83	54.23	102.51	1.36	0.72	3.69	5.38
1970	53.70	60.17	0.893	113.30	5.10	6.37	53.77	103.21	1.51	0.78	4.09	6.52
1971	48.17	62.24	0.774	120.60	5.27	6.41	53.03	103.35	1.49	0.76	4.41	6.94
1972	48.74	66.13	0.737	124.20	5.44	6.64	52.33	106.35	1.43	0.71	5.07	7.49
1973	84.00	76.94	1.092	135.60	5.88	7.09	52.49	110.21	1.85	0.88	5.90	8.32
1974	115.88	93.31	1.242	158.60	8.08	9.44	53.31	104.05	2.48	1.27	7.42	9.88
1975	109.98	108.59	1.013	174.20	8.50	10.20	53.83	104.22	2.39	1.23	6.86	9.67
1976	98.76	114.05	0.866	193.00	8.95	10.83	52.03	105.20	2.21	1.09	7.39	10.26
1977	101.53	122.78	0.827	207.10	9.01	11.38	52.88	100.67	2.17	1.14	7.38	10.56
1978	117.17	132.06	0.887	223.20	9.83	12.79	50.99	101.63	2.65	1.33	8.50	12.57
1979	132.28	142.97	0.925	248.90	10.97	14.26	53.33	101.97	2.81	1.47	9.29	13.13
1980	134.18	166.98	0.804	284.00	12.51	16.27	52.62	98.17	2.95	1.58	10.05	14.37
1981	152.99	170.26	0.899	313.60	13.81	17.96	53.37	101.08	3.37	1.78	10.46	15.07
1982	143.38	174.62	0.821	325.70	14.34	18.66	53.54	103.82	3.21	1.66	11.19	15.84
1983	141.79	179.54	0.790	332.70	14.65	19.06	50.71	108.77	3.16	1.47	13.69	18.03
1984	166.68	184.99	0.901	348.00	15.00	19.51	53.05	104.64	3.45	1.75	15.00	19.35
1985	170.00	181.70	0.936	352.40	15.19	19.76	54.73	104.57	3.44	1.80	15.01	18.60
1986	149.48	175.60	0.851	354.10	15.26	19.86	50.32	99.63	3.32	1.68	15.13	19.42

Source: See Appendix B

TABLE A11

ADDITIONAL COMPUTED VARIABLES USED IN THE BEHAVIORAL EQUATIONS a/

Year	RAQRT4	TNA	REG516	QMARTN	SRAW	SRAWN	TSCN	QCRPN	QCFCN
1956	1.435	61852	0.334	3326	44713	265.83	0.128	0.203	0.264
1957	1.396	68632	0.376	2835	106934	624.25	0.127	0.201	0.261
1958	1.475	72980	0.455	2654	67043	385.08	0.108	0.182	0.223
1959	1.270	76524	0.453	3030	80099	450.25	0.131	0.212	0.269
1960	1.131	74266	0.486	3017	68725	380.11	0.134	0.218	0.268
1961	1.118	72939	0.469	3171	91974	500.68	0.137	0.228	0.280
1962	1.032	71766	0.417	3421	93751	502.42	0.130	0.222	0.285
1963	0.996	72813	0.382	3571	87473	462.09	0.099	0.178	0.249
1964	1.013	73445	0.361	4058	68932	359.21	0.127	0.222	0.300
1965	1.013	75408	0.340	3210	122926	632.34	0.109	0.196	0.255
1966	1.036	76903	0.342	3761	84587	430.25	0.123	0.221	0.292
1967	1.134	80589	0.338	3021	106011	533.25	0.090	0.171	0.224
1968	1.175	80348	0.343	3764	85438	425.70	0.111	0.208	0.275
1969	1.139	75089	0.334	3823	136270	672.27	0.125	0.224	0.308
1970	1.065	65904	0.344	3007	168851	823.26	0.101	0.180	0.259
1971	0.916	59472	0.356	2744	160933	774.83	0.106	0.187	0.244
1972	0.798	61201	0.366	2581	115106	548.39	0.091	0.168	0.210
1973	0.833	60949	0.344	2644	51498	243.03	0.090	0.165	0.200
1974	0.933	58337	0.307	3351	37936	177.35	0.085	0.160	0.227
1975	1.008	56515	0.274	2924	110423	511.22	0.098	0.175	0.237
1976	1.053	52782	0.264	2712	151078	693.02	0.098	0.175	0.231
1977	0.987	49082	0.280	3126	132365	601.11	0.083	0.157	0.233
1978	0.898	46971	0.287	2459	146125	656.45	0.072	0.137	0.189
1979	0.876	46361	0.272	2793	78992	350.92	0.080	0.149	0.202
1980	0.861	42574	0.252	2940	112314	493.25	0.088	0.165	0.218
1981	0.879	38620	0.259	2363	174316	758.55	0.080	0.151	0.199
1982	0.862	33918	0.255	1975	175295	755.26	0.069	0.129	0.180
1983	0.828	29418	0.254	1311	136861	584.13	0.052	0.117	0.138
1984	0.853	29763	0.249	2012	39381	166.44	0.051	0.097	0.136
1985	0.862	31449	0.235	1900	92431	386.26	0.048	0.053	0.094
1986	0.869	31512	0.243	1715	142082	588.33	0.050	0.099	0.133

a/ See Text Table 1 for variable definitions

Source: See Appendix B

TABLE A12

ECONOMIC SERIES OF IMPORTANCE TO THE CALIFORNIA CLING PEACH INDUSTRY FROM 1956

	U.S. Total Population (millions)	Disposable Income Per Capita 1967=1.0	ITDIP / PCE67R	Personal Consumption Expenditure Deflator 1967=1.0	Marketing Cost Index 1967=100	Marketing Order Assessment
Year	POP1	ITDIP	ITDIER	PCE67R	MCI	ASSMNT
1956	168.2	0.63	0.78	0.81	73.40	2.00
1957	171.3	0.65	0.78	0.83	77.00	2.50
1958	174.1	0.66	0.78	0.85	78.40	2.40
1959	177.1	0.69	0.80	0.87	78.80	2.40
1960	180.8	0.71	0.80	0.88	81.10	2.40
1961	183.7	0.72	0.81	0.89	83.60	2.40
1962	186.6	0.75	0.83	0.90	85.80	2.40
1963	189.9	0.78	0.85	0.92	87.70	2.40
1964	191.9	0.83	0.89	0.93	90.10	2.40
1965	194.3	0.89	0.94	0.95	92.50	2.25
1966	196.6	0.95	0.97	0.98	95.60	2.25
1967	198.8	1.00	1.00	1.00	100.00	2.25
1968	200.7	1.07	1.03	1.04	105.90	2.25
1969	202.7	1.14	1.04	1.10	112.70	2.25
1970	205.1	1.23	1.08	1.14	121.20	2.00
1971	207.7	1.31	1.11	1.19	129.90	3.25
1972	209.9	1.40	1.14	1.23	140.30	2.95
1973	211.9	1.57	1.21	1.30	150.20	1.00
1974	213.9	1.69	1.18	1.43	168.20	4.00
1975	216.0	1.84	1.20	1.54	185.70	4.50
1976	218.1	1.99	1.23	1.62	201.70	3.50
1977	220.3	2.17	1.27	1.71	219.70	5.00
1978	222.6	2.40	1.31	1.83	241.20	5.00
1979	225.1	2.66	1.33	2.00	266.00	4.00
1980	227.7	2.91	1.32	2.20	299.40	5.75
1981	230.1	3.23	1.35	2.38	333.60	4.75
1982	232.4	3.40	1.35	2.52	354.60	7.00
1983	234.5	3.62	1.38	2.62	365.30	3.50
1984	236.6	3.94	1.46	2.71	377.60	3.00
1985	239.3	4.19	1.48	2.83	374.30	5.50
1986	241.5	4.44	1.53	2.90	N/A	6.00

Source: See Appendix B

TABLE A13

PART A

PROBABILITY THAT CLING PEACH TREES OF AGE i WILL SURVIVE FOR AT LEAST j ADDITIONAL YEARS

TREE AGE	j															
i	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	1	.9940	.9773	.9650	.9007	.8796	.8537	.8337	.8106	.7835	.7519	.7140	.6719	.6206	.5671	.5045
1	1	.9832	.9708	.9062	.8850	.8588	.8387	.8155	.7882	.7564	.7183	.6760	.6244	.5705	.5075	.4411
2	1	.9874	.9216	.9001	.8735	.8531	.8294	.8017	.7694	.7306	.6875	.6351	.5803	.5162	.4486	.3804
3	1	.9334	.9116	.8847	.8640	.8400	.8119	.7792	.7399	.6963	.6432	.5877	.5228	.4544	.3852	.3153
4	1	.9766	.9478	.9256	.9000	.8698	.8348	.7927	.7460	.6891	.6296	.5601	.4868	.4127	.3378	.2707
5	1	.9705	.9478	.9215	.8907	.8548	.8117	.7639	.7056	.6447	.5735	.4985	.4226	.3459	.2772	.2159
6	1	.9766	.9495	.9177	.8808	.8364	.7871	.7270	.6643	.5910	.5136	.4354	.3564	.2857	.2225	.1656
7	1	.9723	.9397	.9019	.8564	.8060	.7445	.6802	.6051	.5259	.4459	.3649	.2925	.2278	.1695	.1239
8	1	.9665	.9276	.8808	.8289	.7657	.6996	.6224	.5409	.4586	.3753	.3008	.2343	.1744	.1274	.0884
9	1	.9597	.9113	.8577	.7922	.7238	.6439	.5596	.4745	.3883	.3113	.2424	.1804	.1319	.0914	.0641
10	1	.9496	.8937	.8255	.7542	.6710	.5831	.4944	.4047	.3243	.2526	.1880	.1374	.0953	.0668	.0477
11	1	.9411	.8693	.7943	.7066	.6141	.5206	.4261	.3415	.2660	.1980	.1447	.1003	.0704	.0502	.0349
12	1	.9237	.8440	.7508	.6525	.5532	.4528	.3629	.2827	.2103	.1537	.1066	.0748	.0534	.0371	.0257
13	1	.9137	.8128	.7064	.5989	.4902	.3929	.3060	.2277	.1664	.1154	.0809	.0578	.0402	.0279	.0195
14	1	.8896	.7732	.6555	.5365	.4300	.3349	.2492	.1822	.1263	.0886	.0632	.0440	.0305	.0214	.0152
15	1	.8691	.7368	.6031	.4834	.3765	.2802	.2048	.1420	.0996	.0711	.0494	.0343	.0240	.0171	.0121
16	1	.8478	.6939	.5562	.4332	.3224	.2356	.1634	.1146	.0818	.0568	.0394	.0276	.0197	.0140	.0094
17	1	.8185	.6560	.5110	.3802	.2779	.1927	.1352	.0964	.0671	.0465	.0326	.0232	.0165	.0110	.0074
18	1	.8015	.6243	.4645	.3395	.2354	.1651	.1178	.0819	.0568	.0398	.0283	.0201	.0135	.0090	.0061
19	1	.7789	.5796	.4236	.2937	.2060	.1470	.1022	.0709	.0497	.0354	.0251	.0168	.0113	.0076	.0051
20	1	.7441	.5439	.3771	.2645	.1888	.1312	.0911	.0638	.0454	.0323	.0216	.0145	.0097	.0065	.0044
21	1	.7309	.5068	.3555	.2537	.1763	.1224	.0857	.0610	.0434	.0291	.0195	.0131	.0088	.0059	.0000
22	1	.6934	.4864	.3471	.2413	.1674	.1172	.0835	.0593	.0398	.0266	.0179	.0120	.0080	.0000	.0000
23	1	.7014	.5005	.3480	.2415	.1691	.1204	.0855	.0573	.0384	.0258	.0173	.0116	.0000	.0000	.0000
24	1	.7136	.4961	.3442	.2411	.1717	.1220	.0817	.0548	.0367	.0246	.0165	.0000	.0000	.0000	.0000
25	1	.6952	.4824	.3378	.2406	.1709	.1146	.0768	.0515	.0345	.0231	.0000	.0000	.0000	.0000	.0000
26	1	.6939	.4859	.3460	.2458	.1648	.1104	.0740	.0496	.0333	.0000	.0000	.0000	.0000	.0000	.0000
27	1	.7003	.4987	.3543	.2375	.1592	.1067	.0715	.0479	.0000	.0000	.0000	.0000	.0000	.0000	.0000
28	1	.7121	.5059	.3391	.2273	.1524	.1021	.0685	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
29	1	.7104	.4762	.3192	.2139	.1434	.0961	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
30+	1	.6703	.4493	.3012	.2019	.1353	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

Source: Computed from average proportions of trees removed in each age class, 1956–1980. See TableA2 and Appendix B.

TABLE A13

PART B

PROBABILITY THAT CLING PEACH TREES OF AGE i WILL SURVIVE FOR AT LEAST j ADDITIONAL YEARS

... continued ...

TREE AGE i	j: 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30+
0	.4385	.3717	.3042	.2439	.1899	.1413	.1033	.0716	.0502	.0359	.0249	.0173	.0121	.0090	.0058
1	.3740	.3061	.2453	.1911	.1422	.1039	.0721	.0505	.0361	.0251	.0174	.0122	.0087	.0062	.0041
2	.3113	.2495	.1944	.1446	.1057	.0733	.0514	.0367	.0255	.0177	.0124	.0088	.0063	.0042	.0000
3	.2527	.1968	.1465	.1071	.0742	.0521	.0372	.0258	.0179	.0126	.0089	.0063	.0043	.0000	.0000
4	.2109	.1569	.1147	.0795	.0558	.0398	.0277	.0192	.0134	.0096	.0068	.0046	.0000	.0000	.0000
5	.1607	.1174	.0814	.0571	.0408	.0283	.0197	.0138	.0098	.0070	.0047	.0000	.0000	.0000	.0000
6	.1210	.0839	.0589	.0420	.0292	.0203	.0142	.0101	.0072	.0048	.0000	.0000	.0000	.0000	.0000
7	.0859	.0603	.0430	.0299	.0207	.0145	.0103	.0073	.0049	.0000	.0000	.0000	.0000	.0000	.0000
8	.0620	.0442	.0307	.0213	.0149	.0106	.0076	.0051	.0000	.0000	.0000	.0000	.0000	.0000	.0000
9	.0458	.0318	.0221	.0155	.0110	.0078	.0052	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
10	.0331	.0230	.0161	.0115	.0081	.0055	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
11	.0242	.0170	.0121	.0086	.0058	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12	.0180	.0128	.0091	.0061	.0041	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
13	.0139	.0099	.0066	.0044	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
14	.0108	.0072	.0049	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
15	.0081	.0055	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
16	.0063	.0042	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
17	.0050	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18	.0041	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
19	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
20	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
21	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
22	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
23	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
24	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
25	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
26	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
27	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
28	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
29	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
30+	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

Source: Computed from average proportions of trees removed in each age class, 1956-1980. See TableA2 and Appendix B.

APPENDIX B: DATA SOURCES

Tables A1, A2, A3, A4

Cling Peach Advisory board, annual issues. Planting and nonbearing acreage were adjusted for underreporting of particular year plantings in first reports. Whenever the number of trees reported planted in a particular year, k, was greater in a later year t than in t-1, the increment from t to t-1 was added to the new plantings reported for year k. New acreage is usually found by the time the trees reach bearing age, so in most cases only the nonbearing acreage values required adjusting. The acres removed from each age class were also adjusted to be consistent with the adjusted plantings data.

Tables A5, A6A

California Canning Peach Association (CCPA) Almanac, annual issues.

Table A6B

Kuznets up to 1981. California League of Food Processors annual reports thereafter.

Table A7

Computed from data in Tables A5 and A6.

Table A8

Kuznets up to 1981. California League of Food Processors annual reports thereafter.

Table A9

Farm price data are from CCPA annual reports except 1983 from California Crop and Livestock reporting service. Prices from the two sources were very close in most years. However, in 1983 the CCPA reported price of $148 per ton was substantially below the Crop Reporting Service value of $160 per ton. The reason for this was that CCPA contracts apparently were established before it was known how small the crop would be. Consequently, that price was not representative of total industry experience in that year.

F.o.b. prices were from Kuznets to 1981 and then were computed from the Food Institute Report thereafter. The Kuznets price data were said to reflect actual transaction prices rather than list prices. The Food Institute values are private label prices which are believed to be comparable to the Kuznets series, but the exact degree of consistency is not known. Deflated values of the f.o.b. prices were computed by dividing by the Personal Consumption Expenditure Deflator (PCE67R) as reported in USDA *Working Data for Demand Analysis* (1967=1.0).

The per capita movement data were calculated by dividing the movement data in Table A6 by the U.S. total population as of July 1 of each year.

Table A10

The adjusted grower return (AGRT) was calculated from data in Table A5, A9, and A12 as defined in Table 1. Farm costs per ton up to 1980 were measured by extending the series in Minami, French, and King. During that period, the MFK cost series showed approximately the same overall relative movement as several periodic Cooperative Extension sample cost studies for San Joaquin-Sacramento counties. However, from 1980 to 1984, the costs reported in Extension studies increased less than indicated by the input price index used by MFK. Since the Extension studies seemed more likely to reflect actual cost changes, the series used here was adjusted to be consistent with the Extension measures. Extension studies were not available for 1985 and 1986, so our cost series was moved forward from 1984 in accordance with relative changes in the MFK input price index. This series is believed to be a reasonable measure of the relative changes in farm production costs over time, but is not necessarily a representative measure of the average annual levels of such costs. RAGRT = AGRT ÷ FCOST.

The processing cost index (PCI) was calculated from data and weights in Harp, extended for the years prior to 1967 from comparable series in the *Marketing and Transportation Situation* and ERS, USDA Miscellaneous Publication 741 (computations available from the authors). The measures of unit processing cost (PCRP, PCFC) were calculated from data in a study prepared for the USDA Agricultural Cooperative Service by the accounting firm, Touche, Ross, and Co. The cost estimates for the period 1978 and beyond were obtained by extending the Touche, Ross series using the PCI.

The case yields per ton were obtained from data in Tables A5 and A6. The raw product cost per case is obtained by dividing the farm prices (FARMPR) by the case yields per ton. The processing margin is the f.o.b. price less the raw product cost per case.

Table A11

RAGRT, TNAL, REQ516, QUARTN, SRAW, and SRAWN were calculated from data in the previous tables, as defined in Table 1. TSCN is TSC (Table A8) divided by U.S. population (TSCN = TSC ÷ POP1(1000)).

Table A12

U.S. total population (July 1 of crop year, POP1), the index of total disposable income per capita (ITDIP), and the personal consumption expenditure deflator (PCE67R) were as reported in USDA, ERS, *Working Data for Demand Analysis*. ITDIP is for the calendar year corresponding to the crop year. ITDIER is per capita disposable income deflated by the personal consumption expenditure deflator.

The marketing cost index MCI, not used in the final analysis, was calculated from data in Harp as explained for the PCI (Table A10). The marketing order assessments per ton were taken from CCPA annual reports.

Table A13

Computed from data in Table A2. Based on the mean proportion removed from each age class (as in Table 3). To illustrate the calculations, the probability that trees of age (say) 5 will survive to age 6 is one minus expected proportion removed from age 5. The probability of surviving to age 7 then is the probability of surviving to age 6 multiplied by one minus the proportion of trees removed from age group 7.

World Trade Data

See discussion in Section II under Utilization. Data were compiled from reports of the California Canning Peach Association, USDA Foreign Agricultural Service and the European Community Commission.

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