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# AN ECONOMIC ANALYSIS OF THE U.S. HONEY INDUSTRY:

# ECONOMETRIC MODEL

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# AN ECONOMIC ANALYSIS OF THE U.S. HONEY INDUSTRY: ECONOMETRIC MODEL

## INTRODUCTION

The U.S. honey industry is undergoing a period of rapid change. The industry has concern about the possible effects of the infiltration of Africanized honey bees into the United States and what those bees might mean for honey production and providing pollination services. Varroa mites have heightened the industry's awareness of the potential effects of spreading bee diseases and parasites on the migratory behavior of beekeepers and the package bee and queen bee industry. There is continuing concern about the influence of pesticides on bees as they forage for food and pollinate crops. The effects of changing the federal honey price support program has industry participants anxious about the ability to maintain a positive cash flow in the future. Industry support of the National Honey Board, which has taken a role in promoting the use of honey in domestic and export markets, is strong. Finally, honey producers, packers, importers and brokers want to insure that all consumers receive a high quality product that is void of chemical alteration or pesticide residues.

To assist in identifying these issues and other issues that are of concern to the U.S. honey industry, an economic study of the national honey industry was recommended and funded by the National Honey Board and the U.S. Department of Agriculture in 1989. This study, conducted by Cornell University, had two major components. The first emphasis was on a survey of the national honey industry. The purpose of the survey was to collect information to identify the needs and current economic status of the honey industry. The second emphasis of the research was to develop and expand an economic model of the national honey industry to aid in understanding the economic relationships in the industry. This model was to be used for simulation analysis of alternative scenarios. The results were to be interpreted and implications for the industry were to be identified.

This report is one in a series of reports that summarizes the research on the economic analysis of the industry. In this report, the development of the economic model of the national honey industry is described. Data requirements and the estimation technique are identified. Model validation processes are explained. The assumptions for the simulation analysis of alternative scenarios and results of these simulations are described.

Other Cornell University reports included in the series that details the economic analysis of the industry include works (1) describing the survey sample and the type of mailing used, (2) summarizing the statistical frequency, mean, median, standard deviation, minimum and maximum of each question (3) identifying the raw data obtained from the survey, and (4) summarizing the data from the survey. Additional works are to be published through the U.S. Department of Agriculture's publication series and in beekeeping trade journals.

## MODEL DEVELOPMENT

The purpose of an economic model is to represent the key relationships in an economic system while eliminating non-essential relationships. Hence, it is necessary to simplify reality into equations that contain the essence of the industry's behavioral relationships. In this section, the model of the national honey industry is described. The model is divided into three related sectors: colony response, the supply and demand for beekeepers' products, and the demand facing honey processors and their marketing decisions. Each sector includes the relevant supply and demand relationships describing the economic factors facing the operators and affecting their annual decision making strategies. The purpose of the model presented here is to provide a framework for economic projections, sensitivity analyses and the analyses of specific scenarios.

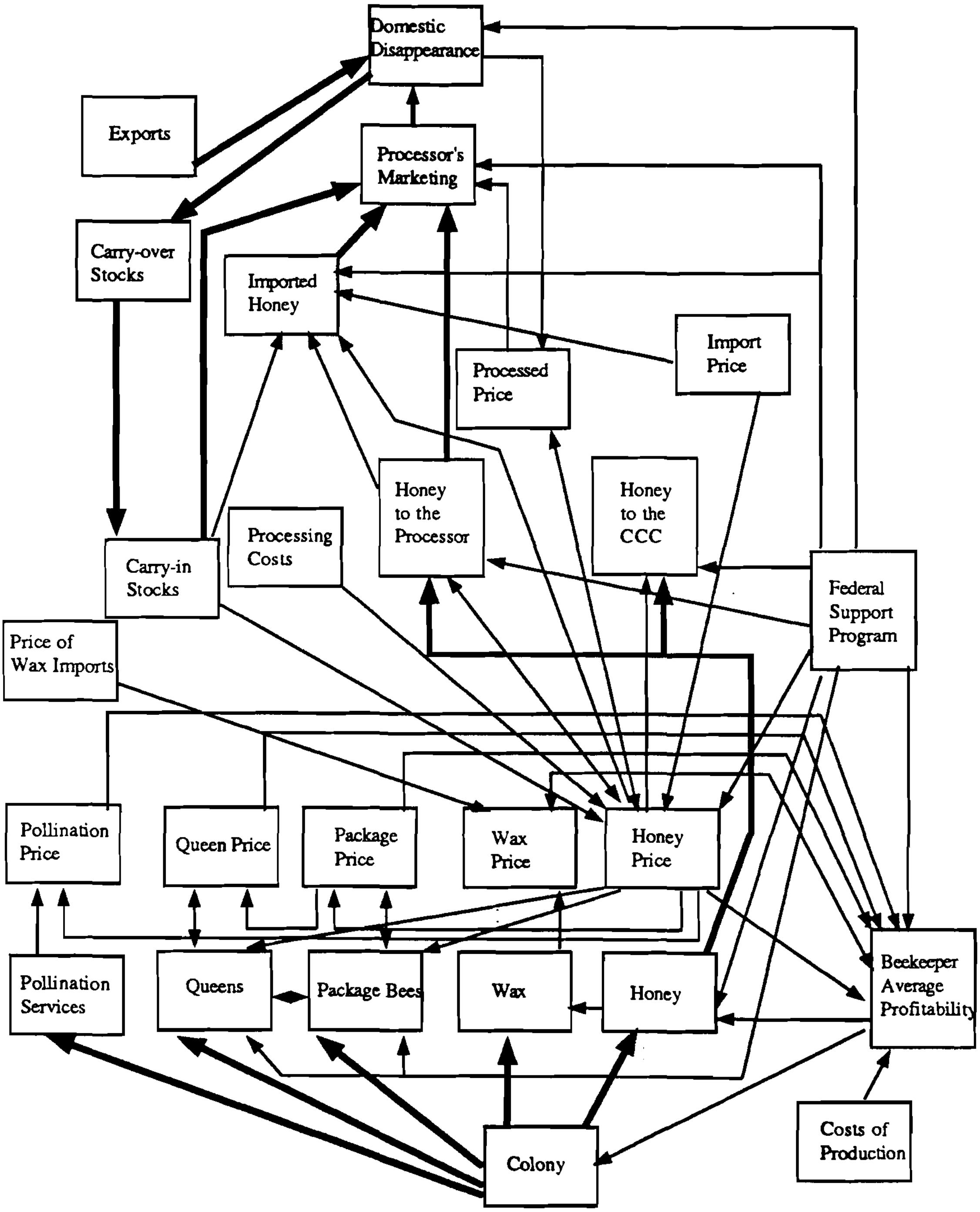
A diagrammatic representation of the model can be found in Figure 1. All information flows and product flows between variables are indicated by arrows. All product flows are represented by bold lines. A complete listing of the model of the honey industry is in Table 1. Variable definitions are identified in Table 2. A more detailed and theoretical presentation of the model's development can be found in Willett, Lois Schertz. An Econometric Analysis of Supply and Demand Relationships in the U.S. Honey Industry. University of California, Davis, Ph.D. dissertation, 1987.

Colony Response

The primary products of the bee industry are honey, beeswax, and pollination services. The primary production inputs are packages of bees and queen bees, transportation services, extraction and handling equipment and labor. Some beekeepers generate replacement or expansion colonies from their own brood stock. Other beekeepers purchase replacement packages and queens. Economics assumes that all producers are profit maximizers. It is this notion that guides their production decisions and their input demand decisions. The number of colonies, an input to the production of honey, is determined by the prices of colony outputs and production inputs. In this model, these costs and product prices have been combined into a measure of joint profitability (ratios of revenue per colony to cost per colony) for beekeepers specializing in honey production, pollination services and bee production. These profitability measures, averaged over a two-year period, were included in the model estimation.

Figure 1

Major Relationships in the Economic Model of the U.S. Honey Industry



## Table 1

### Econometric Model of the U.S. Honey Industry [1]

**COLONY RESPONSE**

Colony:

$$COL_{It} = 139.658 + 0.903\ COL_{It-1} + 242.299\ FACMT2_t \qquad \text{(Durbin h = 0.186)}$$
$$(1.102) \quad (34.323) \qquad (3.591)$$

Average Profitability (Lagged Endogenous):

$$FACMT2_t = (1/3) * [(FHOPMT_{t-1} + FHOPMT_{t-2})/2 + (FPOPMT_{t-1} + FPOPMT_{t-2})/2 + (FPKPMT_{t-1}+FPKPMT_{t-2})/2]$$

Honey Profitability:

$$FHOPMT_t=[PHMAXD_t*WHOHO+PWXD_t*WWXHO+PPOD_{Ct}*WPOHO+PPKD_{Ct}*WPKHO + PQND_{Ct}*WQNHO]/(PPKD_{Ct}*QPKHO+PQND_{Ct}*QQNHO+CHOPXD_t)$$

Bee Production Profitability:

$$FPKPMT_t=[PHMAXD_t*WHOPK+PWXD_t*WWXPK+PPOD_{Ct}*WPOPK+ PPKD_{Ct}*WPKPK + PQND_{Ct}*WQNPK]/(PPKD_{Ct}*QPKPK+PQND_{Ct}*QQNPK+CPKPXD_t)$$

Pollination Profitability:

$$FPOPMT_t = [PHMAXD_t*WHOPO+PWXD_t*WWXPO+PPOD_{Ct}*WPOPO+PPKD_{Ct}*WPKPO + PQND_{Ct}*WQNPO]/(PPKD_{Ct}*QPKPO+PQND_{Ct}*QQNPO+CPOPXD_t)$$

Farm Price Maximum:

$$PHMAXD_t= MAXIMUM(PHFD_t, PHSD_t)$$

**PRODUCT SUPPLY AND DEMAND**

Honey Supply:

$$QHF_t = 121.935 + 0.049COL_{It} + 117.232\ FHOPMT_t - 73.478\ FPKPMT_t$$
$$(3.347) \quad (5.749) \qquad (3.989) \qquad (-3.687)$$

$$- 230.157\ FPOPMT_t - 867.204\ X_t \qquad \text{(DW = 2.330)}$$
$$(-3.571) \qquad (-2.079)$$

Wax Supply:

$$QWX_t = WXHOR_t * QHF_t$$

Pollination Price Setting:

$$PPOD_{Ct} = 11.063 + 0.423\ PPOD_{Ct-1} +0.0044\ QPO_{Ct} - 0.0015\ COL_{It-1} +3.710\ PHMAXD_{t-1}$$
$$(4.300) \quad (4.245) \qquad (5.377) \qquad (-3.471) \qquad (3.465)$$

$$- 0.191\ TRND_t \qquad \text{(Durbin h = 0.414)}$$
$$(-4.341)$$

---

[1] Coefficient t statistics, which indicate the level of significance of the variable, are in parenthesis under each coefficient. Durbin h and DW statistics measure the variation in the error term of each equation. They are all within reasonable statistical levels.

Table 1 (continued)

Econometric Model of the U.S. Honey Industry

Package Price Setting:

$PPKD_{Ct} = 0.194 + 9.442\ PHFD_{t-1}$ (DW = 1.482)
(1.639) (19.302)

Queen Price Setting:

$PQND_{Ct} = -0.229 + 0.865\ PPKD_{Ct} + 3.045\ QQNCOL_t$ (DW = 1.469)
(-2.912) (24.562) (4.326)

Package Bee Demand:

$QPKCOL_t = 0.035 - 0.026\ PPKD_{Ct} + 0.243\ PHMAXD_{t-1} + 0.933\ QQNCOL_t - 0.894\ X_t$
(5.788) (-3.499) (2.944) (10.942) (-3.954)

$+0.029\ DUM65_t$ (DW = 1.770)
(6.038)

Queen Demand:

$QQNCOL_t = -0.113 - 0.022\ PQND_{Ct} + 0.289\ PHMAXD_{t-1} + 0.247\ QPKCOL_t - 0.169\ X_t$
(-2.602)(-3.577) (4.489) (4.205) (-1.023)

$+ 0.0023\ TRND_t$ (DW = 1.414)
(6.200)

Allocation of Honey between CCC and Processors:

$QHC_t = AHC_t * QHF_t$

$AHC_t = POS(-1.217 + 1.441\ PHSFARD_t)$[¥] (DW = 2.117)
(-3.059) (4.131)

$PHSFARD_t = PHSD_t/PHFD_t$

$QHP_t = (1-AHC_t) * QHF_t$

Demand for Beekeepers' Honey:

$PHFD_t = 0.263 - 0.0044\ QSHPM_t - 0.0028\ ICHPD_t + 0.249\ PHRDF_{t-1} + 0.017\ DHM_{t-1}$
(4.796) (-0.393) (-5.714) (3.939) (1.205)

$+ 0.613\ PHID_t + 0.098\ DUM73_t - 0.623\ X_t$ (DW = 1.526)
(13.629) (8.580) (-2.214)

$QSHPM_t = QHP_t/M_t + SHP_t/M_t$

Demand for Imported Honey:

$IHM_t = 0.375 - 0.143\ QSHPM_t + 0.827\ PHMAXD_t + 0.068\ PHRDF_{t-1} - 1.699\ PHID_t$
(3.570)(-4.735) (1.558) (0.282) (-4.035)

---

¥ The POS function takes the value in parenthesis or 0 whichever is larger.

Table 1 (continued)

Econometric Model of the U.S. Honey Industry

Package Price Setting:

$$PPKD_{Ct} = \underset{(1.639)}{0.194} + \underset{(19.302)}{9.442}\, PHFD_{t-1} \qquad (DW = 1.482)$$

Queen Price Setting:

$$PQND_{Ct} = \underset{(-2.912)}{-\,0.229} + \underset{(24.562)}{0.865}\, PPKD_{Ct} + \underset{(4.326)}{3.045}\, QQNCOL_t \qquad (DW = 1.469)$$

Package Bee Demand:

$$QPKCOL_t = \underset{(5.788)}{0.035} - \underset{(-3.499)}{0.026}\, PPKD_{Ct} + \underset{(2.944)}{0.243}\, PHMAXD_{t-1} + \underset{(10.942)}{0.933}\, QQNCOL_t - \underset{(-3.954)}{0.894}\, X_t$$

$$+\underset{(6.038)}{0.029}\, DUM65_t \qquad (DW = 1.770)$$

Queen Demand:

$$QQNCOL_t = \underset{(-2.602)}{-0.113} \underset{(-3.577)}{-0.022}\, PQND_{Ct} + \underset{(4.489)}{0.289}\, PHMAXD_{t-1} + \underset{(4.205)}{0.247}\, QPKCOL_t - \underset{(-1.023)}{0.169}\, X_t$$

$$+ \underset{(6.200)}{0.0023}\, TRND_t \qquad (DW = 1.414)$$

Allocation of Honey between CCC and Processors:

$$QHC_t = AHC_t * QHF_t$$

$$AHC_t = POS(\underset{(-3.059)}{-1.217} + \underset{(4.131)}{1.441}\, PHSFARD_t)^{¥} \qquad (DW = 2.117)$$

$$PHSFARD_t = PHSD_t/PHFD_t$$

$$QHP_t = (1-AHC_t) * QHF_t$$

Demand for Beekeepers' Honey:

$$PHFD_t = \underset{(4.796)}{0.263} - \underset{(-0.393)}{0.0044}\, QSHPM_t - \underset{(-5.714)}{0.0028}\, ICHPD_t + \underset{(3.939)}{0.249}\, PHRDF_{t-1} + \underset{(1.205)}{0.017}\, DHM_{t-1}$$

$$+ \underset{(13.629)}{0.613}\, PHID_t + \underset{(8.580)}{0.098}\, DUM73_t - \underset{(-2.214)}{0.623}\, X_t \qquad (DW = 1.526)$$

$$QSHPM_t = QHP_t/M_t + SHP_t/M_t$$

Demand for Imported Honey:

$$IHM_t = \underset{(3.570)}{0.375} - \underset{(-4.735)}{0.143}\, QSHPM_t + \underset{(1.558)}{0.827}\, PHMAXD_t + \underset{(0.282)}{0.068}\, PHRDF_{t-1} - \underset{(-4.035)}{1.699}\, PHID_t$$

---

¥ The POS function takes the value in parenthesis or 0 whichever is larger.

## Table 1 (continued)

## Econometric Model of the U.S. Honey Industry

$+ 0.143\ DUM73_t + 2.667\ X_t$ (DW = 1.848)
(2.562) (2.465)

Wax Demand:

$PWXD_t = 0.151 - 5.713\ QWXM_t + 0.055\ FHOPMT_{t-1} + 0.786\ PWXID_t - 2.159\ X_t$ (DW = 1.500)
(3.447) (-4.930) (2.529) (25.915) (-3.648)

$QWXM_t = QWX_t/M_t$

## PROCESSORS' MARKETING

Domestic Supply of Processed Honey:

$QDHMM_t = -0.295 + 0.943\ QSHPM_t + 1.179\ PHRDFX_t - 0.250\ PHMAXDX_t$
(-2.287)(15.472) (2.276) (-0.583)

$+ 0.0058\ TRND_t - 5.049\ X_t$ (DW = 1.586)
(2.385) (-4.692)

$PHRDFX_t = PHRDF_t - PHRDF_{t-1}$

$PHMAXDX_t = PHMAXD_t - PHMAXD_{t-1}$

Demand for Processed Honey:

$PHRDF_t = 0.423 - 0.043\ DHM_t + 0.213\ DUM73_t - 0.012\ TRND73_t - 0.993\ X_t$ (DW = 2.381)
(17.504) (-2.257) (21.798) (-9.338) (-2.340)

$DHM_t = QDHMM_t + IHM_t - EH_t/M_t$

Carry-over Stocks:

$SHP_{t+1} = QHP_t + (IHM_t * M_t) + SHP_t - (DHM_t * M_t) - EH_t$

Table 2

Model Variable Definitions[2]

| Name | Definition | Measure |
|---|---|---|
| AHC | Allocation of Honey to the CCC | (proportion) |
| CHOPXD | Exogenous Input Costs for Honey Producer | ($/colony) |
| *$COL_I$ | Industry Colonies | (thousands) |
| Constant | Intercept | (1) |
| CPKPXD | Exogenous Input Costs for Package Bee Producer | ($/colony) |
| CPOPXD | Exogenous Input Costs for Pollination Producer | ($/colony) |
| *DHM | Disappearance of Honey | (lbs/person) |
| DUM65 | Dummy in 1965 and After | (0 or 1) |
| DUM73 | Dummy in 1973 and After | (0 or 1) |
| EH | Exports of Honey | (million lbs) |
| *FACMT2 | Profitability Ratio for All Products in time t-1 and t-2 | (dimensionless) |
| *FHOPMT | Profitability Ratio for Honey Production | (dimensionless) |
| *FPKPMT | Profitability Ratio for Package Bee Production | (dimensionless) |
| *FPOPMT | Profitability Ratio for Pollination Services | (dimensionless) |
| ICHPD | Index of Costs of Honey Processing | (1972=100) |
| IHM | Imports of Honey | (lbs/person) |
| M | Population | (millions) |
| *PHFD | Farm Price of Honey | (72$/lb) |
| PHID | Price of U.S. Honey Imports | (72$/lb) |
| *PHMAXD | Maximum Farm Price of Honey | (72$/lb) |
| PHMAXDX | Farm Price of Honey Differential between t and t-1 | (72$/lb) |
| *PHRDF | Retail Price of Honey | (72$/lb) |
| PHRDFX | Retail Price of Honey Differential between t and t-1 | (72$/lb) |
| PHSD | Price Support for Honey | (72$/lb) |
| PHSFARD | Support to Farm Honey Price Ratio | (dimensionless) |
| $PPKD_C$ | Price of Package Bees (California) | (72$/lb) |
| *$PPOD_C$ | Price of Pollination Services (California) | (72$/service) |
| $PQND_C$ | Price of Queen Bees (California) | (72$/bee) |
| PWXD | Price of Wax | (72$/lb) |
| PWXID | Price of Wax Imports | (72$/lb) |
| QHC | Quantity of Honey to the CCC | (million lbs) |
| QHF | Quantity of Honey | (million lbs) |
| QDHMM | Quantity of Domestic Honey Marketed | (lbs/person) |
| QHP | Quantity of Honey to Processors | (million lbs) |
| QPKCOL | Ratio of Packages to Colonies in t-1 | (lbs/colony) |
| **QPK(J) | Packages Used by (J) Producer, where<br>J = HO Honey<br>PK Package Bee<br>PO Pollination | (lbs/colony) |

[2] Exogenous variables, those determined outside the model, are underlined. Lagged endogenous variables, those determined by the model in a previous period, are preceded by an asterisk. Parameters are identified by a double asterisk.

Table 2 (continued)

Model Variable Definitions

| Name | Definition | Measure |
|---|---|---|
| $QPO_C$ | Quantity of Pollination Services (California) | (thsnd services) |
| QQNCOL | Ratio of Queens to Colonies | (bees/colony) |
| **QQN(J) | Queens Used by (J) Producer, where J is as in QPK(J) | (bees/colony) |
| QSHPM | Total Domestic Quantity of Honey at the Processor | (lbs/person) |
| QWX | Quantity of Wax | (million lbs) |
| QWXM | Quantity of Wax | (lbs/person) |
| *SHP | Stocks of Honey | (million lbs) |
| TRND | Linear Time Trend | (year, 1952=3) |
| TRND73 | Time Trend Beginning in 1973 | (year, 1973=1) |
| **WHO(J) | Honey Produced by (J) Producer, where J is as in QPK(J) | (lbs/colony) |
| **WPK(J) | Packages Produced by (J) Producer, where J is as in QPK(J) | (lbs/colony) |
| **WPO(J) | Pollination Services Produced by (J) Producer, where J is as in QPK(J) | (services/colony) |
| **WQN(J) | Queens Produced by (J) Producer, where J is as in QPK(J) | (bees/colony) |
| **WWX(J) | Wax Produced by (J) Producer, where J is as in QPK(J) | (lbs/colony) |
| WXHOR | Wax to Honey Production Ratio | (lbs/lbs) |
| X | Dummy Variable for Support Program Effectiveness | (0 or 72$/lb) |

Product Supply and Demand

The supply and demand of bee products are influenced by the level of colonies maintained in the industry. The supply of honey is determined by the number of colonies available, the profitability of using these colonies for honey production, providing pollination services and producing bees. In addition, the federal support program has an impact on the quantity of honey produced. The supply of wax is proportional to honey production.

The supply of pollination services is determined jointly with considerations of the demand for pollination services. Because there is little or no substitution between pollination and other farm inputs and because the cost of pollination relative to the total value of crop production is quite small, the demand for pollination services is not very responsive to price changes. The primary factors determining the demand for pollination services are the area of land requiring pollination services and the number of pollination services used per acre. The latter increased over the period of study due in part to changes in the crop mix and farmers' greater awareness of the potential benefits of bees. Analysis revealed no significant effect of the pollination price on the pollination services used per acre over the range of observed data. Hence, the quantity of pollination services demanded by crop producers is determined outside the specified model.

The price of pollination services is determined by the model. It is expressed as a function of the price of the service charged in the previous year, the quantity of services demanded, the availability of colonies to provide these services, the price received to produce honey, and a time trend. The previous period's pollination price reflects inertia in the system and existing contractual arrangements between farmers and beekeepers. The inclusion of honey price reflects the trade-off between honey production and pollination services due to the foraging intensity of providing pollination services. The time trend variable accounts for secular increases in beekeepers' willingness to supply colonies for pollination services.

Package bee producers base the package price on the price of honey, and sell whatever packages are demanded at that price. The price of queen bees has been set based on the price of packages, with some modification reflecting the movement of queens relative to the number of colonies. The demands for package bees and queens are proportional to the number of colonies. However, the proportions vary with the product price, the level of the federal support program and shifts over time that are measured by time trend variables and shifter variables.

Beekeepers are assumed to forfeit their honey to the Commodity Credit Corporation (CCC) when the support price exceeds the market price. However, the allocation does not jump from zero percent to one hundred percent, but increases with increases in the ratio of the support price to the market price. Some honey may be allocated to the CCC even when the market price is below the support price due to market imperfections, differences in availability and accessibility of CCC storage facilities across the country, and differences in honey quality. The quantity sold to processors is the difference between the total production and the quantity forfeited to the CCC.

Honey processors obtain raw honey from both U.S. producers and from other countries. Imported honey is not a perfect substitute for U.S. produced honey because of market contracts, concern over dependence on imports, and variations in quality and type of honey. Under the competitive conditions assumed here, the profit-maximizing behavior of processors generates a demand equation for beekeepers' honey that expresses the price they pay as a function of the quantity of available honey, the costs of processing, the retail price of the processed honey, domestic honey consumption, the price of imported honey, the influence of the federal support program and a variable which captures the shift in prices which occurred in the mid-1970's.

The demand for imported honey is a function of the import price, the domestic honey price, and the price at which processors expect to sell the honey. The variable reflecting the support program and a variable which captures the shift in prices which occurred in the mid-1970's was included in this relationship.

Beeswax is purchased by bee supply dealers and by manufacturing industries. Imported wax is a strong substitute for domestically produced wax. Hence, the demand facing beekeepers expresses the price of wax as a function of the quantity of wax, the profitability of honey production which accounts for changes in the wax demand from beekeepers, the price of imported wax, and the support program which may alter the demand.

Processors' Marketing

The annual supply of processed honey consists of the quantity of domestically produced raw honey which is converted to processed honey with little or no loss, the quantity of honey imported, and inventory carried into the current year. Processor decisions on the amount of the annual supply to market in the current year and to carry as inventory to the next year are made under conditions of uncertainty as to supply and demand conditions. There are no generally-accepted economic principles to predict processor behavior in the face of this uncertainty. This model's function describing the quantity of domestic honey marketed in the current year is specified as a function of the available supply of domestic honey, a change in the price of the product purchased from producers, and a change in the price of the processed honey. The trend variable accounts for a general increase in market allocation and reduced average inventory carry-over across the time period of the model. The variable capturing the impact of the support program is also included in the model.

Honey processors face a demand function derived from consumer, institutional and manufacturing uses. The demand for processed honey is expressed where price is a function of the total disappearance of honey and other variables that may influence the level of consumer demand. These variables include a trend variable and a dummy variable to reflect changes in the data over the sample used for estimation. The variable capturing the federal support program is also included to capture possible effects of free distribution of CCC stocks beginning with their accumulations in 1981.

Carry-over stocks in the model are determined by the sum of the total honey processed, imports, carry-in stocks, disappearance and honey exports.

## MODEL ESTIMATION AND VALIDATION

This model of the honey industry is a national model. Data used in the estimation are annual values for the period 1952 through 1984. Additional data are used for out-of-sample prediction testing. Data pertaining to bee colonies, honey quantities and prices are U.S. values. Data pertaining to costs of production, prices and quantities of pollination services, package bees and queen bees are for California since U.S. values are not reported. All monetary values in the model are deflated by the U.S. personal consumption expenditure deflator.

The model was estimated using econometric techniques. The three-stage least squares technique provides efficient, unbiased and consistent estimates of the coefficients while incorporating the simultaneous nature of the economic relationships. The model's coefficients and corresponding t statistics can be found in Table 1. The model was estimated on a VAX minicomputer using an econometric computer package called TSP (Time Series Processor).[3] The program used for model estimation can be found in Appendix A.

The model of the honey industry was validated according to the performance of its complete dynamic system. After specifying the initial values of the model variables all future values are predicted using previous model predictions. Commonly used procedures for evaluating a model's ability to track historical values are to perform static and dynamic deterministic simulations for the time period of the data set (Kost). In the

[3] TSP is produced by TSP International P. O. Box 61015, Station A Palo Alto, CA 94306.

static, or one-period-ahead, simulation the model computes the predicted values of current endogenous variables each period using the actual values of lagged endogenous variables. These one-period-ahead predictions serve mainly as an accuracy check. The dynamic simulation differs from the static simulation in that after the initial period the model's predicted values of lagged endogenous variables are used to generate future values of the endogenous variables. Measures of goodness of fit were calculated for the static and dynamic simulations. These measures indicated a sound econometric model.

The model's long run dynamic properties were evaluated using dynamic simulation. These properties indicated the model achieved stability when all variables determined outside the model system were held fixed at previous historical levels.

## SIMULATION ANALYSES

Several questions can be answered using the economic model of the industry. In all model analyses, it is important to remember that it is the relative change in model variables, rather than the absolute magnitude of the variables, that is of importance. Because of the importance of the relative changes, a base case of the model should be established for comparison purposes. This base case will use the economic model, as estimated, to project beyond the data set of the model. In the projection, all variables specified outside the model (such as costs of production, costs of processing, etc.), are held at a fixed level. The base case can be used to gain an understanding of the model links and the importance of model sectors. Once the base case is established, other scenarios are used to analyze a single change in the industry. A comparison with the base case enables the model user to isolate the impacts of key factors. For this analysis, six scenarios were evaluated. The first scenario establishes the base case. The second scenario assumes the federal support program is ineffective. The remaining scenarios are coupled with the assumption that the federal support program remains ineffective. In other words all industry participants respond to market forces. An increase in honey demand is assumed in the third scenario. The fourth simulation assumes there is an increase in the price paid to producers. Scenario five assumes higher costs of production for producers. The final scenario assumes that honey exports have expanded. The assumptions for each of these scenarios and the results of the model simulation are described. Simulation values for these analyses can be found in Table 3. This table includes the values for select model variables for the first five periods and the tenth period following initiation of the simulation. Computer programs for each scenario can be found in Appendices B through G.

Scenario 1 - Base Case

A base case was established where all variables specified outside the model are held at fixed levels. This base case was used to project past the time period of the model and to gain an understanding of the model links and the importance of model sectors. Its key purpose was to serve as a benchmark for comparisons with other scenarios. The comparison allows for isolation of the impacts of a single change in the industry.

Implementation of this scenario required that all external variables be held constant. These variables include the support price variables, time trend variables, costs of production, pollination services demanded, the price of imported beeswax, the price of imported honey, honey exports, population, and costs of honey processing. The variables are held at the final value of the data set used in the model estimation. The model was allowed to generate values of the internal model variables.

In this base case scenario, the model achieves a stationary equilibrium by the tenth time period. The level of colonies ($COL_I$) falls leading to a decrease in the honey supply (QHF). There is an increase in the price for pollination services ($PPOD_C$) since there are fewer colonies to provide the number of services. However, there is a decrease in the price for package bees ($PPKD_C$) and queens ($PQND_C$) since there is a drop in the demand for packages and queens. The ratios of packages to colonies (QPKCOL) and

## Table 3
## Simulation Analyses - Scenarios 1 through 6

| | Period | Scenario 1 Base Case | Scenario 2 Ineffective Federal Support Program | Scenario 3 Ineffective Support and Increase in Honey Demand | Scenario 4 Ineffective Support and Increase in Price Paid to Producers | Scenario 5 Ineffective Support and Higher Costs of Production | Scenario 6 Ineffective Support and Expansion of Honey Exports |
|---|---|---|---|---|---|---|---|
| Colony | 1 | 4,266 | 4,266 | 4,266 | 4,266 | 4,266 | 4,266 |
| ($COL_I$) | 2 | 4,235 | 4,226 | 4,226 | 4,229 | 4,208 | 4,226 |
| (thousands) | 3 | 4,204 | 4,180 | 4,182 | 4,197 | 4,130 | 4,180 |
| | 4 | 4,177 | 4,143 | 4,150 | 4,183 | 4,063 | 4,143 |
| | 5 | 4,152 | 4,112 | 4,127 | 4,185 | 4,004 | 4,112 |
| | 10 | 4,068 | 4,003 | 4,097 | 4,276 | 3,800 | 4,003 |
| Honey supply | 1 | 185 | 213 | 213 | 215 | 230 | 213 |
| (QHF) | 2 | 186 | 213 | 214 | 214 | 229 | 213 |
| (million pounds) | 3 | 183 | 207 | 208 | 208 | 222 | 207 |
| | 4 | 181 | 205 | 205 | 205 | 217 | 205 |
| | 5 | 179 | 202 | 202 | 202 | 213 | 202 |
| | 10 | 172 | 193 | 196 | 202 | 197 | 193 |
| Pollination price | 1 | 8.58 | 8.58 | 8.58 | 8.58 | 8.58 | 8.58 |
| ($PPOD_C$) | 2 | 8.58 | 8.37 | 8.37 | 8.45 | 8.37 | 8.37 |
| (1972$/service) | 3 | 8.63 | 8.41 | 8.44 | 8.59 | 8.44 | 8.41 |
| | 4 | 8.70 | 8.49 | 8.56 | 8.78 | 8.58 | 8.49 |
| | 5 | 8.77 | 8.58 | 8.69 | 8.96 | 8.74 | 8.58 |
| | 10 | 9.05 | 8.94 | 9.02 | 9.06 | 9.41 | 8.94 |
| Package price | 1 | 2.23 | 2.23 | 2.23 | 2.23 | 2.23 | 2.23 |
| ($PPKD_C$) | 2 | 2.13 | 2.34 | 2.34 | 2.54 | 2.33 | 2.34 |
| (1972$/pound) | 3 | 2.15 | 2.50 | 2.58 | 2.90 | 2.50 | 2.50 |
| | 4 | 2.15 | 2.49 | 2.64 | 3.08 | 2.49 | 2.49 |
| | 5 | 2.15 | 2.48 | 2.72 | 3.28 | 2.49 | 2.48 |
| | 10 | 2.15 | 2.48 | 2.87 | 3.48 | 2.48 | 2.48 |

Table 3 (continued)
Simulation Analyses - Scenarios 1 through 6

| | Period | Scenario 1 Base Case | Scenario 2 Ineffective Federal Support Program | Scenario 3 Ineffective Support and Increase in Honey Demand | Scenario 4 Ineffective Support and Increase in Price Paid to Producers | Scenario 5 Ineffective Support and Higher Costs of Production | Scenario 6 Ineffective Support and Expansion of Honey Exports |
|---|---|---|---|---|---|---|---|
| Queen price | 1 | 2.11 | 2.17 | 2.17 | 2.17 | 2.17 | 2.18 |
| (PQND$_C$) | 2 | 2.03 | 2.18 | 2.18 | 2.36 | 2.18 | 2.18 |
| (1972$/bee) | 3 | 2.04 | 2.32 | 2.39 | 2.68 | 2.32 | 2.32 |
| | 4 | 2.04 | 2.31 | 2.45 | 2.85 | 2.31 | 2.31 |
| | 5 | 2.04 | 2.31 | 2.52 | 3.03 | 2.31 | 2.31 |
| | 10 | 2.04 | 2.31 | 2.66 | 3.20 | 2.31 | 2.31 |
| Package demand | 1 | 0.162 | 0.218 | 0.218 | 0.218 | 0.218 | 0.218 |
| (QPKCOL) | 2 | 0.168 | 0.177 | 0.177 | 0.179 | 0.177 | 0.177 |
| (pounds/colony) | 3 | 0.167 | 0.179 | 0.179 | 0.182 | 0.178 | 0.179 |
| | 4 | 0.167 | 0.178 | 0.179 | 0.183 | 0.178 | 0.178 |
| | 5 | 0.167 | 0.178 | 0.180 | 0.185 | 0.178 | 0.178 |
| | 10 | 0.167 | 0.178 | 0.182 | 0.187 | 0.178 | 0.178 |
| Queen demand | 1 | 0.132 | 0.154 | 0.154 | 0.154 | 0.154 | 0.154 |
| (QQNCOL) | 2 | 0.136 | 0.128 | 0.128 | 0.129 | 0.128 | 0.128 |
| (bees/colony) | 3 | 0.135 | 0.129 | 0.130 | 0.133 | 0.129 | 0.129 |
| | 4 | 0.135 | 0.129 | 0.130 | 0.134 | 0.129 | 0.129 |
| | 5 | 0.135 | 0.129 | 0.131 | 0.136 | 0.129 | 0.129 |
| | 10 | 0.135 | 0.129 | 0.132 | 0.138 | 0.129 | 0.129 |
| Allocation | 1 | 0.780 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| (AHC) | 2 | 0.764 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| (proportion) | 3 | 0.765 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | 4 | 0.765 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | 5 | 0.765 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | 10 | 0.765 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

Table 3 (continued)
Simulation Analyses - Scenarios 1 through 6

| | Period | Scenario 1 Base Case | Scenario 2 Ineffective Federal Support Program | Scenario 3 Ineffective Support and Increase in Honey Demand | Scenario 4 Ineffective Support and Increase in Price Paid to Producers | Scenario 5 Ineffective Support and Higher Costs of Production | Scenario 6 Ineffective Support and Expansion of Honey Exports |
|---|---|---|---|---|---|---|---|
| Honey price | 1 | 0.205 | 0.227 | 0.227 | 0.248 | 0.227 | 0.227 |
| (PHFD) | 2 | 0.207 | 0.244 | 0.252 | 0.286 | 0.244 | 0.244 |
| (1972$/pound) | 3 | 0.207 | 0.243 | 0.259 | 0.306 | 0.243 | 0.243 |
| | 4 | 0.207 | 0.243 | 0.267 | 0.327 | 0.243 | 0.243 |
| | 5 | 0.207 | 0.243 | 0.276 | 0.348 | 0.243 | 0.243 |
| | 10 | 0.207 | 0.243 | 0.284 | 0.348 | 0.243 | 0.242 |
| Honey Imports | 1 | 0.539 | 0.280 | 0.280 | 0.296 | 0.269 | 0.280 |
| (IHM) | 2 | 0.542 | 0.327 | 0.336 | 0.360 | 0.316 | 0.327 |
| (pounds/person) | 3 | 0.543 | 0.329 | 0.341 | 0.380 | 0.319 | 0.329 |
| | 4 | 0.543 | 0.330 | 0.345 | 0.399 | 0.321 | 0.330 |
| | 5 | 0.544 | 0.331 | 0.349 | 0.417 | 0.324 | 0.331 |
| | 10 | 0.545 | 0.337 | 0.351 | 0.418 | 0.335 | 0.337 |
| Honey Disappearance | 1 | 0.717 | 1.374 | 1.374 | 1.394 | 1.429 | 1.368 |
| (DHM) | 2 | 0.696 | 1.182 | 1.154 | 1.221 | 1.242 | 1.175 |
| (pounds/person) | 3 | 0.692 | 1.167 | 1.139 | 1.221 | 1.221 | 1.161 |
| | 4 | 0.691 | 1.162 | 1.135 | 1.231 | 1.208 | 1.155 |
| | 5 | 0.689 | 1.153 | 1.130 | 1.240 | 1.193 | 1.147 |
| | 10 | 0.683 | 1.120 | 1.145 | 1.241 | 1.134 | 1.114 |
| Honey processing price | 1 | 0.422 | 0.434 | 0.468 | 0.433 | 0.432 | 0.435 |
| (PHRDF) | 2 | 0.423 | 0.443 | 0.511 | 0.441 | 0.440 | 0.443 |
| (1972$/pound) | 3 | 0.425 | 0.443 | 0.546 | 0.441 | 0.441 | 0.443 |
| | 4 | 0.424 | 0.443 | 0.580 | 0.440 | 0.441 | 0.444 |
| | 5 | 0.424 | 0.444 | 0.614 | 0.440 | 0.442 | 0.444 |
| | 10 | 0.424 | 0.445 | 0.613 | 0.440 | 0.445 | 0.445 |

queens to colonies (QQNCOL) actually increase due to the fall in colony levels by the tenth time period. A small drop in the allocation of honey to the Commodity Credit Corporation (AHC) occurs. This decrease is not large since the honey price paid to producers (PHFD) remains below the federal support price specified in the model's base case.

The per capita demand for imported honey (IHM) remains strong since a significant amount of domestic honey is allocated to the Commodity Credit Corporation. The per capita disappearance of honey (DHM) decreases due to increases in the price of processed honey (PHRDF).

Scenario 2 - Ineffective Federal Support Program

This scenario eliminates the federal support program and allows the economic model to determine the prevailing market prices. This scenario does not assume the support program elimination is due to an increase in the price received by producers. Implementation of this scenario requires that all price support variables be set such that the federal support program is ineffective. These variables include the support price and a switching variable. The switching variable is turned off in this simulation. There are no other changes in the model variables. These scenario results will be compared with the Base Case.

In the first period of the simulation, the allocation of honey to the Commodity Credit Corporation (AHC) falls to 0. All honey is marketed through other channels. The honey price paid to producers (PHFD) rises by nearly seventeen (17) percent in the tenth period of simulation when compared to Scenario 1 - Base Case. By model equilibrium there is a thirty-three (33) percent decrease in the per capita quantity of honey imported (IHM). Since honey is not allocated to the Commodity Credit Corporation and thus not distributed by the CCC, there is an increase in the per capita disappearance of honey (DHM). This disappearance is actual honey marketed by producers. This expansion puts upward pressure on the processed price of honey (PHRDF). The elimination of the effective support program leads to a small decrease in the number of colonies ($COL_I$). Due to the tradeoff between production of honey and other products such as packages, queens, wax and pollination services, this decrease in colonies is used to expand honey production (QHF). At equilibrium, there is a twelve (12) percent increase in the honey supply (QHF). The 64 percent increase in the per capita disappearance of honey (DHM) is consistent with the five (5) percent increase in the honey processing price at equilibrium (PHRDF).

Scenario 3 - Ineffective Federal Support Program and Increase in Honey Demand

In the economic model the price for processed honey is determined by the supply of honey and the demand for honey at the processed market level. The demand for honey is expressed by a function which relates the quantity demanded to price and other variables. In this scenario it is assumed there is a shift in the demand function for processed honey and an ineffective federal support program. The shift in demand could result from increased income of consumers, increased awareness by consumers of the benefits of honey and/or increased advertising. In this scenario, it is assumed the demand function for honey shifts outward over a five year period. Each year there is an eight (8) percent increase in the demand function for honey (i.e. a forty (40) percent total shift in the demand function). Even though there is a shift in the demand function for honey, all other model interactions remain intact. Hence, the model determines the producer price (PHFD), the processed market price (PHRDF), quantity of honey production (QHF), the per capita disappearance of honey (DHM) and per capita import levels (IHM), etc. that result from the shift in honey demand. The discussion of this model scenario includes a comparison with Scenario 2 - Ineffective Federal Support Program so that the impacts of a shift in honey demand are isolated.

As seen in Table 3, the shift in honey demand coupled with an ineffective support program leads to a thirty-eight (38) percent increase in the price for processed honey (PHRDF) when compared to Scenario 2 - Ineffective Federal Support Program. Some of this price increase is passed to producers. By the tenth period of analysis, the price to producers (PHFD) is seventeen (17) percent greater than under Scenario 2. The increased demand for honey leads to increases in the level of per capita imports (IHM). However, there is an initial decrease in the disappearance of honey (DHM) due to the higher processed honey price (PHRDF). Hence, the quantity of domestic honey that is sold by processors falls and stock levels increase. Higher honey prices increase the profitability of producing honey and give beekeepers incentive to expand their colony levels ($COL_I$). More queens and package bees are demanded driving up the price of these products ($PQND_C$ and $PPKD_C$). Even though there is a two (2) percent increase in the number of colonies ($COL_I$) there is virtually no change in the production of domestic honey (QHF).

Scenario 4 - Ineffective Federal Support Program and Increase in Price Paid to Producers

The price paid to producers for honey is determined by the producer's supply of honey and the demand for producer's honey at the farm level. In this model of the honey industry, the demand function for producer honey is specified as a relationship between the price paid for producers' honey (PHFD) and the total honey supply (QSHPM) and other variables. The honey price is the dependent variable in the equation. In this scenario it is assumed there is an ineffective federal support program and a shift in this price function of producer honey. This shift in demand could result from changes in the costs of processing honey, or changes in the honey requirements of manufactured products. It is assumed the price function for producer price of honey shifts outward over a five year period. Each year there is an eight (8) percent increase in the price specification for honey (i.e. a forty (40) percent total shift in the price function). All other model interactions remain intact. Hence, the model determines the processed market price (PHRDF), the quantity of honey production (QHF), the per capita disappearance of honey (DHM) and per capita import levels (IHM), etc. that result from the shift in the price function.

As seen in Table 3 there is a forty-three (43) percent increase in the price paid to producers (PHFD) by the tenth period of the simulation when compared to Scenario 2 - Ineffective Federal Support Program. The higher price increases the profitability of beekeeping and leads to a seven (7) percent increase in colony levels ($COL_I$). Higher colony levels generate new demand for queens and package bees leading to a forty (40) percent increase in the prices of these products ($PQND_C$ and $PPKD_C$). The higher producer price (PHFD) makes imports more attractive to processors. A twenty-five (25) percent increase in per capita imports (IHM) results. The larger quantity of imports coupled with the increase in honey production yields an increase in the disappearance of honey (DHM). However, this increase in disappearance and the increase in supply yields a market condition where there is a small decrease in the processed price of honey (PHRDF).

Scenario 5 - Ineffective Federal Support Program and Higher Costs of Production

In this scenario a twenty (20) percent increase in beekeeper costs of production is evaluated. The cost increases could occur if there were increased regulation of the industry or increased management required due to the Africanized honey bee or mite infestations. These cost increases were coupled with an ineffective federal support program. To isolate the effects of increased costs of production, this scenario should be compared with Scenario 2 - Ineffective Federal Support Program. Implementation of this scenario is through a one time increase in the costs of production specified by the model. The higher costs of production remain in effect for the remainder of the simulation.

As seen in Table 3, a twenty (20) percent increase in beekeeper costs of production impacted the profitability of beekeeping. Five (5) percent fewer colonies

($COL_I$) were maintained. There was a five (5) percent increase in the price charged for pollination services ($PPOD_C$). However, price for packages ($PPKD_C$) and the price for queen bees ($PQND_C$) remained virtually unchanged. The price received by producers for honey (PHFD) is similar to the price under Scenario 2. Hence, the increased costs of production are not covered by increased honey prices.

Scenario 6 - Ineffective Federal Support Program and Expansion of Honey Exports

In this scenario a twenty (20) percent increase in honey exports was analyzed. This expansion could occur if a targeted export program were in place. To isolate the effects of increased exports, this scenario should be compared with Scenario 2 - Ineffective Federal Support Program. Scenario implementation is through a one time increase in the level of honey exports. The increase will not be phased in over a five year period. The twenty (20) percent increase in honey exports is based on the final value of the data set used for model estimation. This expansion remains effective for the remainder of the scenario analysis.

As seen in Table 3, an increase in exports immediately reduces the disappearance of honey (DHM) since the disappearance of honey (DHM) reflects the domestic honey marketed plus imports less exports. There is some upward pressure on the processed price of honey (PHRDF) in the initial period of the simulation. However, this twenty (20) percent increase in exports is equivalent to a 1.5 million pound or one-half of one percent decrease in the total domestic disappearance of honey. Hence, this relatively large increase in honey exports is a fairly small change in the industry. The impacts are not significant.

## CONCLUSIONS

The research reported here presents an economic model of the national honey industry. The data required for estimation and the estimation techniques were identified. Model validation processes were explained. The assumptions for simulation analysis of six scenarios were presented. These scenarios presented model results under a base case, an ineffective federal support program an increase in honey demand, an increase in price paid to producers, an increase in the costs of production and an expansion in exports.

All model analyses indicate that the complete effects of any of these changes, particularly the increase in honey demand and the increase in the price paid to producers, are mitigated by the economic interactions in the industry. Since the model consists of relationships that capture the economic factors influencing demand and supply, the price is established by these factors. The model allows the prices and other variables to reflect the economic situation in the complete industry. Hence, a forty percent increase in the demand for honey and a forty percent increase in the price paid to producers may be difficult to maintain since economic signals in the industry could cause industry adjustment that may lessen these effects.

## REFERENCES


Anderson, Earl D. An Appraisal of the Beekeeping Industry. United States. Department of Agriculture. Agricultural Research Service. ARS 42-152. Beltsville: GPO, 1969.

Bauer, Frederick W. Honey Marketing. University of California. Division of Agricultural Sciences. Bulletin 776. Berkeley: University of California Press, 1960.

Beck, C. R. "Economic Problems We Must Face to Survive." American Bee Journal 108 (1968): 100-101.

Brandt, Jon A., and Ben C. French. An Analysis of Economic Relationships and Projected Adjustment in the U.S. Processing Tomato Industry. Research Report No. 331. Berkeley: Giannini Foundation of Agricultural Economics, 1981.

Burnham, T. J. "This Almond Orchard Yields a 'Super Crop'." California-Arizona Farm Press 26 April 1986:1.

California County Agricultural Commissioner. County Agricultural Crop Report. All counties, all years.

Chavas, Jean-Paul, Stanley R. Johnson. "Supply dynamics: The Case of U.S. Broilers and Turkeys." American Journal of Agricultural Economics 64 (1982): 558-564.

Chern, Wen S., and Richard E. Just. Econometric Analysis of Supply Response and Demand for Processing Tomatoes in California. Monograph Number 37. Berkeley: Giannini Foundation of Agricultural Economics, 1978.

Cheung, Steven N. S. "The Fable of the Bees: An Economic Investigation." The Journal of Law and Economics 16 (1973): 11-33.

Dadant and Sons, ed. The Hive and the Honey Bee. Hamilton, Illinois: Dadant and Sons Inc., 1975.

Eckstein, Zvi. "The Dynamics of Agriculture Supply: A Reconsideration." American Journal of Agricultural Economics 67 (1985): 204-214.

Ek, Carl W. Honey Price Support: Background and Policy Issues for the 1985 Farm Bill. United States. Congressional Research Service. Environment and Natural Resources Policy Division. 85-984 ENR. Washington: Library of Congress, October 24, 1985.

French, Ben C., and Gordon A. King. "Demand and Price-Markup Functions for Canned Cling Peaches and Fruit Cocktail." Western Journal of Agricultural Economics 11(1986): 8-18.

French, Ben C., Gordon A. King, Dwight D. Minami. "Planting and Removal Relationships for Perennial Crops: An Application to Cling Peaches." American Journal of Agricultural Economics 67 (1985): 215-223.

French, Ben C., and Jim L. Matthews. "A Supply Response Model for Perennial Crops." American Journal of Agricultural Economics 53 (1971): 478-490.

Gardner, Bruce L. "The Farm-Retail Price Spread in a Competitive Food Industry." American Journal of Agricultural Economics 57 (1975): 399-407.

---. The Governing of Agriculture. Lawrence: The Regents Press of Kansas, 1981.

Garoyan, Leon and Stephen Taylor. Economic Trends in the U.S. Honey Industry. University of California. Division of Agricultural Sciences. Leaflet 21219. Berkeley: University of California Press, 1980.

Gary, Norman E. "The Environmental Impact of Underpriced Honey Imported Into the U.S." American Bee Journal 124 (1984): 120-123.

Gojmerac, Walter. Bees, Beekeeping, Honey and Pollination. Westport: AVI Publishing Company, Inc., 1980.

Gould, J. R. "Meade on External Economies: Should the Beneficiaries be Taxed?" The Journal of Law and Economics 16 (1973): 53-66.

Greene, William H. "On the Asymptotic Bias of the Ordinary Least Squares Estimator of the Tobit Model." Econometrica 49 (1981): 505-513.

Hall, Bronwyn H., and Rebecca Schnake. Time Series Processor. Version 4.0 and 4.1A. Computer software. TSP International, 1985 and 1986.

Harp, Harry H. The Food Marketing Cost Index. Unites States Department of Agriculture. Economics, Statistics and Cooperative Service. Technical Bulletin No. 1633. Washington: GPO. August 1980.

Hazell, Peter B. R. "Application of Risk Preference Estimates in Firm-Household and Agricultural Sector Models." American Journal of Agricultural Economics 64 (1982): 384-390.

Henderson, James, M., and Richard E. Quandt. Microeconomic Theory A Mathematical Approach. 3rd edition. New York: McGraw-Hill, 1980.

Hoff, Fred L. Report on the Beekeeper Indemnity Payment Program. United States. Department of Agriculture. Economic Research Service. Commodity Economics Division. Washington: GPO, 1976.

Hoff, Fred L., and Frederick Gray. Honey Background for 1985 Farm Legislation. United States. Department of Agriculture. Economic Research Service. National Economics Division. Agriculture Information Bulletin Number 465. Washington: GPO, 1984.

Hoff, Fred L., and Jane K. Phillips. Honey Background for 1990 Farm Legislation. United States. Department of Agriculture. Economic Research Service. Commodity Economics Division. Staff Report Number AGES 89-43. Washington: GPO, 1989.

Holroyd, William M. Number, Size, and Location of Plants for a Honey Marketing-Processing Cooperative. Diss. University of Maryland, 1972. Ann Arbor: UMI, 1985. 72-29,617.

Holroyd, William, and Billy V. Lessley. Number, Size and Location of Processing Plants for a Honey Processing-Marketing Cooperative. University of Maryland. Department of Agricultural and Resource Economics. AREIS 14. College Park: University of Maryland, 1974.

Howrey, Philip and H. H. Kelejian. "Simulation Versus Analytical Solutions." The Design of Computer Simulation Experiments. Ed. Thomas H. Naylor. Durham: Duke University Press, 1969, 207-231.

---. "Simulation Versus Analytical Solutions: The Case of Econometric Models." Computer Simulation Experiments with Models of Economic Systems. Ed. Thomas H. Naylor. New York: John Wiley & Sons, 1971, 299-319.

Intrilligator, Michael D. Econometric Models, Techniques, and Applications. Englewood Cliffs: Prentice-Hall, Inc. 1978.

Johnson, David B. "Meade, Bees and Externalities." The Journal of Law and Economics 16 (1973): 35-52.

Johnston, J. Econometric Methods. 3rd ed. New York: McGraw-Hill Book Company, 1984.

Jorgenson, Dale W. "Capital Theory and Investment Behavior." American Economic Review 53.2 (1963): 247-259.

---. "Econometric Studies of Investment Behavior: A Survey." Journal of Economic Literature 9 (1971): 1111-1147.

Judge, George G., et al. The Theory and Practice of Econometrics. 2nd ed. New York: John Wiley & Sons, Inc., 1985.

Kost, William E. "Model Validation and the Net Trade Model." Agricultural Economics Research 32.2 (1980): 1-16.

Labys, Walter C. Dynamic Commodity Models: Specification, Estimation, and Simulation. Lexington: D.C. Heath and Company, 1973.

Levin, M. D. "Beekeeping for Pollination in the United States." Apiacta 7 (1972): 157-158.

---. "Value of Bee Pollination to United States Agriculture." American Bee Journal 124 (1984): 184-186.

Maddala, G. S. Econometrics. New York: McGraw-Hill Book Company, 1977.

---. Limited-Dependent and Qualitative Variables in Econometrics. Cambridge: Cambridge University Press, 1983.

Martin, E. C., et al. Beekeeping in the United States. United States. Department of Agriculture. Science and Education Administration. Agriculture Handbook No. 335 (revised). Washington: GPO, 1980.

McDowell, Robert. The Africanized Honey Bee in the United States: What Will Happen to the U.S. Beekeeping Industry? United States. Department of Agriculture. Economic Research Service. Natural Resource Economics Division. Agricultural Economic Report No. 519. Washington: GPO, 1984.

McGregor, S.E. Insect Pollination of Cultivated Crop Plants. United States. Department of Agriculture. Agricultural Research Service. Agriculture Handbook No. 496. Washington: GPO, 1976.

Meade, J. E. "External Economies and Diseconomies in a Competitive Situation." The Economic Journal 62 (1952): 54-67.

Minami, Dwight D. "The Economic Analysis of Market Control in the California Cling Peach Industry." Diss. U of California, Davis, 1977.

Minami, Dwight D., Ben C. French, Gordon A. King. An Econometric Analysis of Market Control in the California Cling Peach Industry. Monograph No. 39. Berkeley: Giannini Foundation, 1979.

Morse, Roger A. "The Fall of BIPP." Gleanings in Bee Culture 109 (1981) 290-291.

---. "Honey Production and Marketing in the United States." Bee World 44 (1963): 150-157.

Morse, Roger A. and Richard Nowogrodzki. "Trends in American Beekeeping, 1985-1981." American Bee Journal 123 (1983): 372-378.

Morse, Roger A. and Kim Flottum, eds. ABC and XYZ of Bee Culture. Medina, Ohio: A. I. Root Co. 1990.

Mussen, Eric. "Bees." A Guidebook to California Agriculture. Ed. Ann Foley Scheuring. Berkeley: University of California Press, 1983, 208-211.

Muth, John F. "Rational Expectations and the Theory of Price Movements." Econometrica 29 (1961): 315-335.

Naylor, Thomas H. and J. M. Finger. "Validation." Computer Simulation Experiments with Models of Economic Systems. Ed. Thomas H. Naylor. New York: John Wiley & Sons, Inc, 1971, 153-164.

Nerlove, Marc. The Dynamics of Supply: Estimation of Farmer's Response to Price. Baltimore: John Hopkins Press, 1958.

---. "The Dynamics of Supply: Retrospect and Prospect." American Journal of Agricultural Economics 61 (1979): 874-888.

Newey, Whitney K. and Kenneth D. West. A Simple, Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix. National Bureau of Economic Research. Technical Working Paper No. 55. Cambridge. April 1986.

"Novice, A." "Experiences of a Sideline Beekeeper in the Honey Loan and Purchase Program." American Bee Journal 124 (1984): 582-583.

Oertel, Everett. "Estimated Honey Bee Pollination Business in Selected States." American Bee Journal 123 (1983): 200-201.

Olmstead, Alan L., and Donald B. Wooten. "Bee Pollination and Productivity Growth: The Case of Alfalfa." American Journal of Agricultural Economics 69 (1987): 56-63.

Owens, Charles D., Thayer Cleaver, and Roger E. Schneider. An Analysis of Beekeeping Production Cost and Returns. United States. Department of Agriculture. Agricultural Research Service. Production Research Report No. 151. Washington: GPO, 1973.

Reed, A. D. An Economic Analysis of the California Bee Industry. University of California. Agricultural Extension. MA-29. Berkeley: University of California Press, 1970.

Reed, A. D., and L. A. Horel. An Economic Analysis of the California Bee Industry. University of California. Agricultural Extension. MA-29 (revised) Berkeley: University of California Press, 1973.

---. Bee Industry Economic Analysis for California. University of California. Division of Agricultural Sciences. Leaflet 2345. Berkeley: University of California Press, 1976.

Roberts, William C., Ward Stanger. "Survey of the Package Bee and Queen Industry." American Bee Journal 109 (1969): 8-11.

Robinson, Frank. "A Honey Promotion Bill-What's It All About?" American Bee Journal 124 (1984): 704-706.

Robinson, Willard. S. Richard Nowogrodzki and Roger A. Morse. "The Value of Honey Bees as Pollinators of U.S. Crops." American Bee Journal 129(1989): 411-423, 477-487.

Schmidt, Peter. "Constraints on the Parameters in Simultaneous Tobit and Probit Models." Structural Analysis of Discrete Data with Econometric Applications. Ed. Charles F. Manski and Daniel McFadden. Cambridge: The MIT Press, 1981. 422-434.

Shehata, Sabry A. "Analyzing the Market for Honey in the United States." American Bee Journal 124 (1984): 352.

REFERENCES (continued)

---. "Who Likes Honey? A Determination of Consumer Awareness and Preferences for Honey in the Fresno Markets." American Bee Journal 124 (1984): 26-29.

Sickles, Robin C. and Peter Schmidt. "Simultaneous Equations Models with Truncated Dependent Variables: A Simultaneous Tobit Model." Journal of Economics and Business 31 (1978): 11-21.

Siebert, John W. Almonds, Bees, and Externalities in the California Agricultural Economy. Diss. University of California, Berkeley, 1978. Ann Arbor: UMI, 1985. 7914762.

---. "Beekeeping, Pollination, and Externalities in California Agriculture." American Journal of Agricultural Economics 62 (1980): 165-171.

Smith, David K. "An Economic Analysis of California Egg Supply and Wholesale-Retail Price Adjustments." Diss. University of California, Davis, 1983.

Stanger, Ward, Robbin W. Thorp, and Len Foote. Honey Bee Pollination in California. University of California. Division of Agricultural Sciences. 75-LE/2243. Berkeley: University of California Press, 1975.

Theil, Henri. Applied Economic Forecasting. Amsterdam: North-Holland Publishing Company, 1966.

---. Economic Forecasts and Policy. Amsterdam: North-Holland Publishing Company, 1961.

---. Linear Aggregation of Economic Relations. Amsterdam: North-Holland Publishing Company, 1954.

---. Principles of Econometrics. New York: John Wiley & Sons, Inc., 1971.

Thorp, Robbin W., and Eric Mussen. Honey Bees in Almond Pollination. University of California. Division of Agricultural Sciences. Leaflet 2465. Berkeley: University of California Press, 1977.

United States. Congress. House. Subcommittee on Livestock, Dairy, and Poultry. Hearings on Honey Research, Promotion, and Consumer Information Act. 98th Congress, 2nd session. H.R. 5358. Washington: GPO, 1984.

---. ---. Senate. Beekeeper Preservation Act of 1985. 99th Congress, 1st session. S. 1025. Washington: GPO, April 26, 1985.

---. ---. Senate. Subcommittee on Agricultural Research and General Legislation. Hearings on the Honey Research, Promotion, and Consumer Information Act. 98th Congress, 2nd session. S. 2857. Washington: GPO, 1984.

---. Department of Agriculture. Agricultural Marketing Service. Seed Crops and Vegetables. Washington: GPO, Annual Reports.

---. ---. ---. Vegetables. Washington: GPO, Annual Reports.

---. ---. ---. Fruit and Vegetable Division. National Honey Market News. Washington: GPO, Monthly Reports.

---. ---. Crop Reporting Board. Honey and Beeswax Production. [variously titled Honey and Beeswax Production (1943-52), U.S. Honey and Beeswax Production (1953-56), Honey-Annual Summary (1957-63), Honey Production (1964-66), Honey Production: Annual Summary (1967-76), Honey (1977-82)] Washington: GPO, 1943 through 1982.

---. ---. Economic Research Service. Agricultural Outlook. Washington: GPO, Annual Reports.

---. ---. ---. Economic Indicators of the Farm Sector. National Financial Summary. ECIFS 4-3. Washington: GPO, 1984.

---. ---. ---. Farm-Retail Spreads for Food Products. Miscellaneous Publication No. 741. Washington: GPO, January 1972.

---. ---. ---. Food Consumption Prices and Expenditures 1964-84. Statistical Bulletin No. 736. Washington: GPO, December 1985.

---. ---. ---. Marketing and Transportation Situation. Washington: GPO, Annual Reports.

---. ---. ---. Working Data for Demand Analysis. Washington: GPO, June 1985.

---. ---. ---. International Economics Division. U.S. Foreign Agricultural Trade Statistical Report, Calendar Years. Washington: GPO, Annual Reports.

---. ---. Foreign Agricultural Service. Sugar, Molasses and Honey. Washington: GPO, Quarterly Reports.

---. ---. Statistical Reporting Service. California Crop and Livestock Reporting Service. Bees and Honey. Washington: GPO, Monthly Reports.

---. ---. ---. ---. California Agriculture Summary. Washington: GPO, Annual Reports.

---. ---. ---. ---. California Fruit and Nut Crops. Washington: GPO, Annual Reports.

---. ---. ---. Data Services Branch. Agricultural Statistics. Washington: GPO, Annual Reports.

---. Department of Commerce. Bureau of the Census. Statistical Abstract of the United States. Washington: GPO, Annual Reports.

---. General Accounting Office. Federal Price Support for Honey Should be Phased Out. GAO/RCED-85-107. Washington: GPO, 1985.

---. International Trade Commission. Honey Report to the President on Investigation No. TA-201-14 under section 201 of the Trade Act of 1974. USITC Publication 781. Washington: GPO, 1976.

Walton, George P. "Sources and Values of Honey." Crops in Peace and War The Yearbook of Agriculture 1950-1951. Washington: U. S. Department of Agriculture, 1950-1951.

Whitcombe, Harry J. Bees are My Business. New York: G.P. Putnam's Sons, 1955.

Willett, Lois Schertz. An Econometric Analysis of Supply and Demand Relationships in the U.S. Honey Industry. University of California, Davis, Ph.D. dissertation, 1987.

Womack, Abner, W. and Jim L. Matthews. "Linear Approximations of Nonlinear Relationships by the Taylor's Series Expansion Revisited." Agricultural Economics Research 24 (1972): 93-101.

Wonnacott, Ronald J., Thomas H. Wonnacott. Econometrics. 2nd edition. New York: John Wiley & Sons, 1979.

Voorhies, E. C., F. E. Todd, J. K. Galbraith. Economic Aspects of the Bee Industry. Bulletin 555. Berkeley: Giannini Foundation of Agricultural Economics, 1933.

# APPENDICES

# APPENDIX A

## COMPUTER PROGRAM FOR MODEL ESTIMATION

Appendix A: Computer Program for Model Estimation

```
NAME LSW 'ESTIMATION OF HONEY MODEL';
?
?
?
FREQ A;
SMPL 1952, 1984;
IN NEWHON;
?
?
OPTIONS PLOTS;
OLSQ AHC, C, PHSFARD;
?
PRINT AHC, PHSFARD;
?
?--------------------------------------------------------------------------------
FRML COLSUP COL=A0+A1*COL(-1)+A2*FACMT2;
?
FRML HONSUP    QHF = B0 + B1*COL + B2*FHOPMT + B3*FPKPMT +
B4*FPOPMT+B5*DUMPHSDF;
IDENT WAXSUP   QWX = WXHOR*QHF;
FRML POLSUP    PPOD=C0+C1*PPOD(-1) +C2*QPO+C3*COL(-1)+C4*PHMAXD(-
1)+C5*TRND;
FRML PPKPR     PPKD = D0 +D1*PHFD(-1);
FRML QQNPR     PQND = E0 + E1* PPKD + E2*QQNCOL;
IDENT ALLOC1   AHC = POS(F0 + F1*PHSFARD)*DUMALL;
IDENT ALLOC2   QHP = (1-AHC)*QHF;
FRML WAXDMD    PWXD = G0 + G1*QWXM+ G2*FHOPMT(-1) +
G3*PWXID+G4*DUMPHSDF;
FRML PPKDMD    QPKCOL = H0 + H1*PPKD + H2*QQNCOL + H3*PHMAXD(-1)
+ H4*DUM65 + H5*DUMPHSDF;
FRML QQNDMD    QQNCOL = I0+ I1* PQND+ I2*QPKCOL + I3*PHMAXD(-1) +
I4*TRND + I5*DUMPHSDF;
FRML HONDMD    PHFD = J0 + J1* QSHPM  + J2*ICHPD+ J3*PHRDF(-1)+ J4*
PHID+J5*DUM73+J6*DUMPHSDF+J7*DHM(-1);
FRML IMPDMD    IHM = K0 +K1 * QSHPM+ K2* PHRDF(-1)+K3*PHID + K4*
PHMAXD + K5*DUM73+K6*DUMPHSDF;
IDENT HONPROF
FHOPMT=(PHMAXD*WHOHO+PWXD*WWXHO+PPOD*WPOHO+PPKD*WPKH
O+PQND*WQNHO) / (PPKD*QPKHO+PQND*QQNHO + CHOPXD);
IDENT PPKPROF  FPKPMT=
(PHMAXD*WHOPK+PWXD*WWXPK+PPOD*WPOPK+PPKD*WPKPK+PQND*W
QNPK) / (PPKD*QPKPK+PQND*QQNPK+CPKPXD);
IDENT POLPROF  FPOPMT=
(PHMAXD*WHOPO+PWXD*WWXPO+PPOD*WPOPO+PPKD*WPKPO+PQND*W
QNPO) / (PPKD*QPKPO+PQND*QQNPO+CPOPXD);
IDENT PRICE21    PHSFARD =PHSD/PHFD;
IDENT PRICE22    PPKDD73 =PPKD*DUM73;
IDENT QUANT21    QWXM=QWX/M;
IDENT QUANT22    QSHPM = (QHP+SHP)/M;
?  IDENT QUANT23  QSIHPM=QHPM+IHM;
IDENT PRICE23 PHMAXD = PHFD + POS(PHSD-PHFD);
```

```
IDENT DUMMY  DUMPHSDF=POS(PHSD-PHFD(-1));
?
FRML PROALL1  QDHMM = L0 + L1* PHRDFX + L2* QSHPM + L3 *PHMAXDX
+ L4*TRND+L5*DUMPHSDF;
FRML PRODMD1  PHRDF = M0 + M1* DHM + M2*
DUM73+M3*DUMPHSDF+M4*TRND73;
IDENT PRICE31  PHRDFX = PHRDF - PHRDF(-1);
IDENT PRICE32 PHMAXDX=PHMAXD-PHMAXD(-1);
IDENT DISAP31  DHM =  QDHMM+IHM-EH/M;
IDENT STOCK31  SHPF = SHP + QHP + IHM*M - EH - DHM*M;

PARAM A0, 114, A1, .93, A2, 180,
      B0, 111, B1, .05, B2, 75, B3, -52,  B4, -171,B5, -995,
   C0, 8.4 C1, .48, C2, .004, C3, -.0011,  C4, 3.6, C5, -.15,
   D0,.2, D1, 9.5,
   E0, -.2, E1, .8, E2, 3.3,
   G0, .18, G1, -6.4, G2, .05, G3, .77, G4, -2.3
   H0, .03, H1, -.02, H2,.79, H3, .26, H4, .04, H5, -.8,
   I0, -.009, I1, -.03, I2, .19, I3, .32, I4, .002, I5, -.38,
   J0, .22, J1, -.01, J2, -.002, J3, .26, J4, .67, J5, .08, J6, -.58, J7, .02,
    K0,.27, K1, -.13, K2, .18, K3, -2.05, K4, 1.3, K5, .08, K6, 2.78,
    L0, -.3, L1, 1.5, L2,.90, L3, -1.3, L4, .006, L5, -5.1,
       M0, .4, M1, -.005, M2, .21, M3, -.8, M4, -.01;
CONST WHOHO, 100, WPKHO, .6, WQNHO, 0, WPOHO, 1, WWXHO, 1, QPKHO,
1.3182, QQNHO, 0,
   WHOPK, 20, WPKPK, 8, WQNPK,4, WPOPK, 1, WWXPK, 1, QPKPK, 0, QQNPK,
0,
   WHOPO, 25, WPKPO, .8, WQNPO, 0, WPOPO, 1.65, WWXPO, 1, QPKPO, 0,
QQNPO, 2.5357,
   F0, -1.217034, F1, 1.441219;
?
?  3SLS ESTIMATES
OPTIONS PLOTS;
LSQ (NOPRINT, INST =(C, DUMALL,DUMPHSDF,COL(-1), FACMT2, PHSD,
WXHOR, FHOPMT(-1), PHRDF(-1), ICHPD, PHID, CHOPXD, CPKPXD, CPOPXD,
M, SHP, QPO, TRND, TRND73,DUM73, EH, PHFD(-1), PPOD(-1), PWXID, DUM65,
DHM(-1), PHMAXD(-1)))COLSUP, HONSUP,  POLSUP, PPKPR, QQNPR,
WAXDMD, PPKDMD, QQNDMD, HONDMD, IMPDMD, PROALL1, PRODMD1;
?
?
?----------------------------------------------------------------------------------------
?
OPTIONS LIMPRN=132;
STOP; END;
```

# APPENDIX B

# COMPUTER PROGRAM FOR

# SCENARIO 1 - BASE CASE

Appendix B: Computer Program for Scenario 1 - Base Case

```
NAME LSW 'SCENARIO 1";
?   BASE CASE
?
?
?
FREQ A;
SMPL 1950 1984;
IN NEWHON;
SMPL 1950 1984;
?
SMPL 1983 1983;
PFHOPMT=FHOPMT;
PFPKPMT=FPKPMT;
PFPOPMT=FPOPMT;
?
SMPL 1984 1984;
PCOL=COL;
PFHOPMT=FHOPMT;
PFPKPMT=FPKPMT;
PFPOPMT=FPOPMT;
PPHFD=PHFD;
PPHRDF=PHRDF;
PDHM=DHM;
PSHPF=SHPF;
PPHMAXD=PHMAXD;
PPPOD=PPOD;
?
SMPL 1985 2009;
?   THESE EXOGENOUS VARIABLES ARE SET TO 1984 VALUES
PHSD=0.28423;
DUM73=1;
TRND=35;
TRND73=12;
CPOPXD=24.82117;
CHOPXD=29.61123;
CPKPXD=41.35723;
QPO=1386.1;
WXHOR=0.02336;
PWXID=0.66924;
PHID=0.16069;
M=237.0;
EH=7.5;
ICHPD=121.33909;
DUM65=1;
?
PDMPHSDF=.04018;
?
SMPL 1985 2009;
?
?
?   INITIATING THE SIMULATION
```

```
DO I=1985 TO 1995;
SMPL I I;
?----------------------------------------------------------------------------
?  BLOCK 1--THE INITIAL SET OF EQUATIONS
A0=139.6578;
A1=.9033466;
A2=242.2987;
C0=11.06271;
C1=0.4232625;
C2=0.004378899;
C3=-0.001536991;
C4=3.710412;
C5=-0.1907491;
D0=0.1941980;
D1=9.441638;
?
PFACMT2=(1/6)*(PFHOPMT(-1)+PFPKPMT(-1)+PFPOPMT(-1)+PFHOPMT(-
2)+PFPKPMT(-2)+PFPOPMT(-2));
?
? PDMPHSDF=POS(PHSD-PPHFD(-1));
?
PPPKD=D0+D1*PPHFD(-1);
PCOL=A0+A1*PCOL(-1)+A2*PFACMT2;
PPPOD=C0+C1*PPPOD(-1)+C2*QPO+C3*PCOL(-1)+C4*PPHMAXD(-
1)+C5*TRND;
?----------------------------------------------------------------------------
?  BLOCK 2--THE BIG GROUP
FRML HONSUP    QHF = B0 + B1*PCOL + B2*FHOPMT + B3*FPKPMT +
B4*FPOPMT+B5*PDMPHSDF;
IDENT WAXSUP  QWX = WXHOR*QHF;
FRML QQNPR      PQND = E0 + E1* PPPKD + E2*QQNCOL;
IDENT ALLOCA  AHCA=F0+F1*PHSFARD;
IDENT ALLOCB  AHCB=1-POS(1-AHCA);
IDENT ALLOC1  AHC=POS(AHCB);
IDENT ALLOC2 QHP=(1-AHC)*QHF;
FRML WAXDMD   PWXD = G0 + G1*QWXM+ G2*PFHOPMT(-1) + G3*PWXID +
G4*PDMPHSDF;
FRML PPKDMD    QPK = PCOL*(H0 + H1*PPPKD + H2*QQNCOL + H3 *
PPHMAXD(-1) + H4*DUM65+H5*PDMPHSDF);
FRML QQNDMD    QQN =PCOL*(I0+ I1* PQND+ I2*QPKCOL + I3*PPHMAXD(-1)
+ I4*TRND + I5* PDMPHSDF);
FRML HONDMD    PHFD = J0 +J1* QSHPM + J2*ICHPD + J3*PPHRDF(-1) + J4 *
PHID + J5*DUM73 + J6*PDMPHSDF + J7*PDHM(-1);
FRML IMPDMD    IHM = K0 +K1 * QSHPM+ K2* PPHRDF(-1)+ K3*PHID +
K4*PHMAXD + K5* DUM73 + K6*PDMPHSDF;
IDENT HONPROF
FHOPMT=(PHMAXD*WHOHO+PWXD*WWXHO+PPPOD*WPOHO+PPPKD*WPK
HO+PQND*WQNHO) / (PPPKD*QPKHO+PQND*QQNHO + CHOPXD);
IDENT PPKPROF  FPKPMT=
(PHMAXD*WHOPK+PWXD*WWXPK+PPPOD*WPOPK+PPPKD*WPKPK+PQND*
WQNPK) / (PPPKD*QPKPK+PQND*QQNPK+CPKPXD);
```

```
IDENT POLPROF  FPOPMT=
(PHMAXD*WHOPO+PWXD*WWXPO+PPPOD*WPOPO+PPPKD*WPKPO+PQND*
WQNPO) / (PPPKD*QPKPO+PQND*QQNPO+CPOPXD);
IDENT PRICE21   PHSFARD =PHSD/PHFD;
IDENT PRICE23   PHMAXD=PHFD+POS(PHSD-PHFD);
IDENT QUANT21   QWXM=QWX/M;
IDENT QUANT22   QSHPM = (QHP+PSHPF(-1))/M;
IDENT QUANT24   QPKCOL=QPK/PCOL;
IDENT QUANT25   QQNCOL=QQN/PCOL;
?
PARAM B0, 121.9352, B1, 0.0495234, B2, 117.2318, B3, -73.47820, B4, -230.1567,
B5, -867.2041;
PARAM  E0, -.2291193, E1, 0.8651651, E2,3.045417 , F0, -1.217034, F1, 1.441219;
PARAM G0, 0.1514005, G1, -5.713230, G2, 0.05483168, G3, 0.7859951, G4, -2.15914;
PARAM H0, 0.03461183, H1, -0.02594944, H2,0.9333837, H3, 0.2434844,
H4,0.02898729 , H5,-0.8942856 ;
PARAM I0, -0.01134207, I1,-0.0220852 , I2,0.2887513 , I3,0.2471680, I4, 0.002280063,
I5, -0.1692295 ;
PARAM J0, 0.2634232, J1,-0.004378458 , J2,-0.002831092 , J3,0.2490913 ,
J4,0.6132352 , J5, 0.09797321, J6, -0.6231662, J7, 0.0172977;
PARAM K0,0.3747096, K1,-0.1438645 , K2,0.06809512 , K3,-1.699113 , K4,0.8274489
, K5, 0.1425209, K6, 2.667295;
CONST WHOHO, 100, WPKHO, .6, WQNHO, 0, WPOHO, 1, WWXHO, 1, QPKHO,
1.3182, QQNHO, 0, WHOPK, 20, WPKPK, 8, WQNPK,4, WPOPK, 1, WWXPK, 1,
QPKPK, 0, QQNPK, 0, WHOPO, 25, WPKPO, .8, WQNPO, 0, WPOPO, 1.65,
WWXPO, 1, QPKPO, 0, QQNPO, 2.5357;
?
?
?  SIML THE BIG GROUP
SIML (TAG=S, ENDOG=(QHF, QWX,  PQND, AHCA, AHCB, AHC, QHP, PWXD,
QPK, QQN, PHFD, IHM, FHOPMT,  FPKPMT, FPOPMT, PHSFARD, QWXM,
QSHPM, QPKCOL, QQNCOL, PHMAXD), MAXIT=20, NOPRNDAT, NOPRNSIM,
DYNAM) HONSUP, WAXSUP,  QQNPR, ALLOCA, ALLOCB, ALLOC1, ALLOC2,
WAXDMD, PPKDMD, QQNDMD, HONDMD, IMPDMD, HONPROF, PPKPROF,
POLPROF, PRICE21,  PRICE23, QUANT21, QUANT22, QUANT24, QUANT25;
?
?  RENAMING THE OUTPUT OF THIS SIMULATION
PQHF=QHFS;
PQWX=QWXS;
PPQND=PQNDS;
PAHCA=AHCAS;
PAHCB=AHCBS;
PAHC=AHCS;
PQHP=QHPS;
PPWXD=PWXDS;
PQPK=QPKS;
PQQN=QQNS;
PPHFD=PHFDS;
PIHM=IHMS;
PFHOPMT=FHOPMTS;
PFPKPMT=FPKPMTS;
```

```
PFPOPMT=FPOPMTS;
PPHSFARD=PHSFARDS;
PQWXM=QWXMS;
PQSHPM=QSHPMS;
PQPKCOL=QPKCOLS;
PQQNCOL=QQNCOLS;
PPHMAXD=PHMAXDS;
?
PIH=PIHM*M;
?
?------------------------------------------------------------------
?   BLOCK 3
?
PRINT I;
L0=-.2946686;
L1=1.179081;
L2=.9439934;
L3=-.2498637;
L4=0.005805494;
L5=-5.048632;
M0=0.4227957;
M1=-0.04269399;
M2=0.2130593;
M3=-.9930014;
M4=-0.01190572;
?   EQUATIONS
?
PPHMAXDX=PPHMAXD-PPHMAXD(-1);
?
PQDHMM = (1/(1-L1*M1))* (L0 + L1*M0  +L1*M1*PIHM - L1*M1*EH/M +
L1*M2*DUM73+ (L1*M3+L5)*PDMPHSDF+L1*M4*TRND73 - L1*PPHRDF(-1)+
L2*PQSHPM+ L3*PPHMAXDX + L4* TRND);
PDHM = PQDHMM  +PIHM - EH/M;
PPHRDF = M0 + M1*PDHM + M2*DUM73+M3*PDMPHSDF+M4*TRND73;
PPHRDFX = PPHRDF - PPHRDF(-1);
PDH = PDHM * M;
PSHPF = PSHPF(-1) + PQHP + PIH - EH - PDH;
?
ENDDO;
?
?
SMPL 1985 1995;
PRINT  PFACMT2, PDMPHSDF, PPPKD, PCOL, PPPOD;
PRINT PQHF, PQWX, PPQND, PAHCA, PAHCB, PAHC;
PRINT PQHP, PPWXD, PQPK, PQQN, PPHFD, PIHM;
PRINT PFHOPMT, PFPKPMT, PFPOPMT, PPHSFARD, PQWXM;
PRINT PQSHPM, PQPKCOL, PQQNCOL, PPHMAXD, PIH;
PRINT PPHMAXDX, PQSHPM;
PRINT PQDHMM, PDHM, PPHRDF, PPHRDFX, PDH, PSHPF;
?
STOP; END;
```

APPENDIX C

COMPUTER PROGRAM FOR

SCENARIO 2 - Ineffective Federal Support Program

Appendix C: Computer Program for Scenario 2 - Ineffective Federal Support Program

```
NAME LSW 'SCENARIO 2";
?   INEFFECTIVE FEDERAL SUPPORT PROGRAM
?
?
?
FREQ A;
SMPL 1950 1984;
IN NEWHON;
SMPL 1950 1984;
?
SMPL 1983 1983;
PFHOPMT=FHOPMT;
PFPKPMT=FPKPMT;
PFPOPMT=FPOPMT;
?
SMPL 1984 1984;
PCOL=COL;
PFHOPMT=FHOPMT;
PFPKPMT=FPKPMT;
PFPOPMT=FPOPMT;
PPHFD=PHFD;
PPHRDF=PHRDF;
PDHM=DHM;
PSHPF=SHPF;
PPHMAXD=PHMAXD;
PPPOD=PPOD;
?
SMPL 1985 2009;
?   THESE EXOGENOUS VARIABLES ARE SET TO 1984 VALUES
PHSD=0.28423;
DUM73=1;
TRND=35;
TRND73=12;
CPOPXD=24.82117;
CHOPXD=29.61123;
CPKPXD=41.35723;
QPO=1386.1;
WXHOR=0.02336;
PWXID=0.66924;
PHID=0.16069;
M=237.0;
EH=7.5;
ICHPD=121.33909;
DUM65=1;
?
PDMPHSDF=.04018;
?
SMPL 1985 2009;
?   THESE SUPPORT VARIABLES ARE SET TO MAKE THE SUPPORT
?   PROGRAM INEFFECTIVE
PHSD=0.000;
```

```
PDMPHSDF=0;
?
?   NOW LETS GET STARTED WITH THE SIMULATION
DO I=1985 TO 1995;
SMPL I I;
?---------------------------------------------------------------------------
?   BLOCK 1--THE INITIAL SET OF EQUATIONS
A0=139.6578;
A1=.9033466;
A2=242.2987;
C0=11.06271;
C1=0.4232625;
C2=0.004378899;
C3=-0.001536991;
C4=3.710412;
C5=-0.1907491;
D0=0.1941980;
D1=9.441638;
?
PFACMT2=(1/6)*(PFHOPMT(-1)+PFPKPMT(-1)+PFPOPMT(-1)+PFHOPMT(-
2)+PFPKPMT(-2)+PFPOPMT(-2));
?
? PDMPHSDF=POS(PHSD-PPHFD(-1));
?
PPPKD=D0+D1*PPHFD(-1);
PCOL=A0+A1*PCOL(-1)+A2*PFACMT2;
PPPOD=C0+C1*PPPOD(-1)+C2*QPO+C3*PCOL(-1)+C4*PPHMAXD(-
1)+C5*TRND;
?---------------------------------------------------------------------------
?   BLOCK 2--THE BIG GROUP
FRML HONSUP    QHF = B0 + B1*PCOL + B2*FHOPMT + B3*FPKPMT +
B4*FPOPMT+B5*PDMPHSDF;
IDENT WAXSUP  QWX = WXHOR*QHF;
FRML QQNPR      PQND = E0 + E1* PPPKD + E2*QQNCOL;
IDENT ALLOCA  AHCA=F0+F1*PHSFARD;
IDENT ALLOCB  AHCB=1-POS(1-AHCA);
IDENT ALLOC1  AHC=POS(AHCB);
IDENT ALLOC2 QHP=(1-AHC)*QHF;
FRML WAXDMD   PWXD = G0 + G1*QWXM+ G2*PFHOPMT(-1) + G3*PWXID +
G4*PDMPHSDF;
FRML PPKDMD    QPK = PCOL*(H0 + H1*PPPKD + H2*QQNCOL + H3 *
PPHMAXD(-1) + H4*DUM65+H5*PDMPHSDF);
FRML QQNDMD    QQN =PCOL*(I0+ I1* PQND+ I2*QPKCOL + I3*PPHMAXD(-1)
+ I4*TRND + I5* PDMPHSDF);
FRML HONDMD    PHFD = J0 +J1* QSHPM + J2*ICHPD + J3*PPHRDF(-1) + J4 *
PHID + J5*DUM73 + J6*PDMPHSDF + J7*PDHM(-1);
FRML IMPDMD    IHM = K0 +K1 * QSHPM+ K2* PPHRDF(-1)+ K3*PHID +
K4*PHMAXD + K5* DUM73 + K6*PDMPHSDF;
```

```
IDENT HONPROF
FHOPMT=(PHMAXD*WHOHO+PWXD*WWXHO+PPPOD*WPOHO+PPPKD*WPK
HO+PQND*WQNHO) / (PPPKD*QPKHO+PQND*QQNHO + CHOPXD);
IDENT PPKPROF  FPKPMT=
(PHMAXD*WHOPK+PWXD*WWXPK+PPPOD*WPOPK+PPPKD*WPKPK+PQND*
WQNPK) / (PPPKD*QPKPK+PQND*QQNPK+CPKPXD);
IDENT POLPROF  FPOPMT=
(PHMAXD*WHOPO+PWXD*WWXPO+PPPOD*WPOPO+PPPKD*WPKPO+PQND*
WQNPO) / (PPPKD*QPKPO+PQND*QQNPO+CPOPXD);
IDENT PRICE21     PHSFARD =PHSD/PHFD;
IDENT PRICE23    PHMAXD=PHFD+POS(PHSD-PHFD);
IDENT QUANT21   QWXM=QWX/M;
IDENT QUANT22   QSHPM = (QHP+PSHPF(-1))/M;
IDENT QUANT24    QPKCOL=QPK/PCOL;
IDENT QUANT25    QQNCOL=QQN/PCOL;
?
PARAM B0, 121.9352, B1, 0.0495234, B2, 117.2318, B3, -73.47820,  B4, -230.1567,
B5, -867.2041;
PARAM  E0, -.2291193, E1, 0.8651651, E2,3.045417 ,  F0, -1.217034, F1, 1.441219;
PARAM G0, 0.1514005, G1, -5.713230, G2, 0.05483168, G3, 0.7859951, G4, -2.15914;
PARAM H0, 0.03461183, H1, -0.02594944,  H2,0.9333837, H3, 0.2434844,
H4,0.02898729 , H5,-0.8942856 ;
PARAM I0, -0.01134207, I1,-0.0220852 , I2,0.2887513 , I3,0.2471680, I4, 0.002280063,
I5, -0.1692295 ;
PARAM J0, 0.2634232, J1,-0.004378458 , J2,-0.002831092 , J3,0.2490913 ,
J4,0.6132352 , J5, 0.09797321, J6, -0.6231662, J7, 0.0172977;
PARAM K0,0.3747096, K1,-0.1438645 , K2,0.06809512 , K3,-1.699113 , K4,0.8274489
, K5, 0.1425209, K6, 2.667295;
CONST WHOHO, 100, WPKHO, .6, WQNHO, 0, WPOHO, 1, WWXHO, 1, QPKHO,
1.3182, QQNHO, 0, WHOPK, 20, WPKPK, 8, WQNPK,4, WPOPK, 1, WWXPK, 1,
QPKPK, 0, QQNPK, 0, WHOPO, 25, WPKPO, .8, WQNPO, 0, WPOPO, 1.65,
WWXPO, 1, QPKPO, 0, QQNPO, 2.5357;
?
?
?  SIML THE BIG GROUP
SIML (TAG=S, ENDOG=(QHF, QWX,  PQND, AHCA, AHCB, AHC, QHP, PWXD,
QPK, QQN, PHFD, IHM, FHOPMT,  FPKPMT, FPOPMT, PHSFARD,  QWXM,
QSHPM, QPKCOL, QQNCOL, PHMAXD), MAXIT=20, NOPRNDAT, NOPRNSIM,
DYNAM)  HONSUP, WAXSUP,  QQNPR, ALLOCA, ALLOCB, ALLOC1, ALLOC2,
WAXDMD, PPKDMD, QQNDMD, HONDMD, IMPDMD, HONPROF, PPKPROF,
POLPROF, PRICE21,  PRICE23, QUANT21, QUANT22, QUANT24, QUANT25;
?
?  RENAMING THE OUTPUT OF THIS SIMULATION
PQHF=QHFS;
PQWX=QWXS;
PPQND=PQNDS;
PAHCA=AHCAS;
PAHCB=AHCBS;
PAHC=AHCS;
PQHP=QHPS;
```

```
PPWXD=PWXDS;
PQPK=QPKS;
PQQN=QQNS;
PPHFD=PHFDS;
PIHM=IHMS;
PFHOPMT=FHOPMTS;
PFPKPMT=FPKPMTS;
PFPOPMT=FPOPMTS;
PPHSFARD=PHSFARDS;
PQWXM=QWXMS;
PQSHPM=QSHPMS;
PQPKCOL=QPKCOLS;
PQQNCOL=QQNCOLS;
PPHMAXD=PHMAXDS;
?
PIH=PIHM*M;
?
?
?-------------------------------------------------------------------
?   BLOCK 3
?
PRINT I;
L0=-.2946686;
L1=1.179081;
L2=.9439934;
L3=-.2498637;
L4=0.005805494;
L5=-5.048632;
M0=0.4227957;
M1=-0.04269399;
M2=0.2130593;
M3=-.9930014;
M4=-0.01190572;
?   EQUATIONS
?
PPHMAXDX=PPHMAXD-PPHMAXD(-1);
?
PQDHMM = (1/(1-L1*M1))* (L0 + L1*M0  +L1*M1*PIHM - L1*M1*EH/M +
L1*M2*DUM73+ (L1*M3+L5)*PDMPHSDF+L1*M4*TRND73 - L1*PPHRDF(-1)+
L2*PQSHPM+ L3*PPHMAXDX + L4* TRND);
PDHM = PQDHMM  +PIHM - EH/M;
PPHRDF = M0 + M1*PDHM + M2*DUM73+M3*PDMPHSDF+M4*TRND73;
PPHRDFX = PPHRDF - PPHRDF(-1);
PDH = PDHM * M;
PSHPF = PSHPF(-1) + PQHP + PIH - EH - PDH;
?
ENDDO;
?
?
SMPL 1985 1995;
```

```
PRINT  PFACMT2, PDMPHSDF, PPPKD, PCOL, PPPOD;
PRINT PQHF, PQWX, PPQND, PAHCA, PAHCB, PAHC;
PRINT PQHP, PPWXD, PQPK, PQQN, PPHFD, PIHM;
PRINT PFHOPMT, PFPKPMT, PFPOPMT, PPHSFARD, PQWXM;
PRINT PQSHPM, PQPKCOL, PQQNCOL, PPHMAXD, PIH;
PRINT PPHMAXDX, PQSHPM;
PRINT PQDHMM, PDHM, PPHRDF, PPHRDFX, PDH, PSHPF;
?
STOP; END;
```

# APPENDIX D

## COMPUTER PROGRAM FOR

## SCENARIO 3- Ineffective Federal Support Program and Increase in Honey Demand

Appendix D: Computer Program for Scenario 3 - Ineffective Federal Support Program and Increase in Honey Demand

```
NAME LSW 'SCENARIO 3";
?  INEFFECTIVE FEDERAL SUPPORT PROGRAM AND INCREASE IN
?  HONEY DEMAND
?
?
?
FREQ A;
SMPL 1950 1984;
IN NEWHON;
SMPL 1950 1984;
?
SMPL 1983 1983;
PFHOPMT=FHOPMT;
PFPKPMT=FPKPMT;
PFPOPMT=FPOPMT;
?
SMPL 1984 1984;
PCOL=COL;
PFHOPMT=FHOPMT;
PFPKPMT=FPKPMT;
PFPOPMT=FPOPMT;
PPHFD=PHFD;
PPHRDF=PHRDF;
PDHM=DHM;
PSHPF=SHPF;
PPHMAXD=PHMAXD;
PPPOD=PPOD;
?
SMPL 1985 2009;
?  THESE EXOGENOUS VARIABLES ARE SET TO 1984 VALUES
PHSD=0.28423;
DUM73=1;
TRND=35;
TRND73=12;
CPOPXD=24.82117;
CHOPXD=29.61123;
CPKPXD=41.35723;
QPO=1386.1;
WXHOR=0.02336;
PWXID=0.66924;
PHID=0.16069;
M=237.0;
EH=7.5;
ICHPD=121.33909;
DUM65=1;
?
PDMPHSDF=.04018;
?
SMPL 1985 2009;
?  THESE SUPPORT VARIABLES ARE SET TO MAKE THE SUPPORT
```

```
?   PROGRAM INEFFECTIVE
PHSD=0;
PDMPHSDF=0;
?
SMPL 1985 2003;
?
?   NOW LETS GET STARTED WITH THE SIMULATION
DO I=1985 TO 1995;
SMPL I I;
?-----------------------------------------------------------------------------
?   BLOCK 1--THE INITIAL SET OF EQUATIONS
A0=139.6578;
A1=.9033466;
A2=242.2987;
C0=11.06271;
C1=0.4232625;
C2=0.004378899;
C3=-0.001536991;
C4=3.710412;
C5=-0.1907491;
D0=0.1941980;
D1=9.441638;
?
PFACMT2=(1/6)*(PFHOPMT(-1)+PFPKPMT(-1)+PFPOPMT(-1)+PFHOPMT(-
2)+PFPKPMT(-2)+PFPOPMT(-2));
?
? PDMPHSDF=POS(PHSD-PPHFD(-1));
?
PPPKD=D0+D1*PPHFD(-1);
PCOL=A0+A1*PCOL(-1)+A2*PFACMT2;
PPPOD=C0+C1*PPPOD(-1)+C2*QPO+C3*PCOL(-1)+C4*PPHMAXD(-
1)+C5*TRND;
?-----------------------------------------------------------------------------
?   BLOCK 2--THE BIG GROUP
FRML HONSUP    QHF = B0 + B1*PCOL + B2*FHOPMT + B3*FPKPMT +
B4*FPOPMT+B5*PDMPHSDF;
IDENT WAXSUP  QWX = WXHOR*QHF;
FRML QQNPR     PQND = E0 + E1* PPPKD + E2*QQNCOL;
IDENT ALLOCA  AHCA=F0+F1*PHSFARD;
IDENT ALLOCB  AHCB=1-POS(1-AHCA);
IDENT ALLOC1  AHC=POS(AHCB);
IDENT ALLOC2 QHP=(1-AHC)*QHF;
FRML WAXDMD    PWXD = G0 + G1*QWXM+ G2*PFHOPMT(-1) + G3*PWXID +
G4*PDMPHSDF;
FRML PPKDMD    QPK = PCOL*(H0 + H1*PPPKD + H2*QQNCOL + H3 *
PPHMAXD(-1) + H4*DUM65+H5*PDMPHSDF);
FRML QQNDMD    QQN =PCOL*(I0+ I1* PQND+ I2*QPKCOL + I3*PPHMAXD(-1)
+ I4*TRND + I5* PDMPHSDF);
FRML HONDMD    PHFD = J0 +J1* QSHPM + J2*ICHPD + J3*PPHRDF(-1) + J4 *
PHID + J5*DUM73 + J6*PDMPHSDF + J7*PDHM(-1);
```

Appendix D: Computer Program for Scenario 3 - Ineffective Federal Support Program and Increase in Honey Demand (continued)

```
FRML IMPDMD     IHM = K0 +K1 * QSHPM+ K2* PPHRDF(-1)+ K3*PHID +
K4*PHMAXD + K5* DUM73 + K6*PDMPHSDF;
IDENT HONPROF
FHOPMT=(PHMAXD*WHOHO+PWXD*WWXHO+PPPOD*WPOHO+PPPKD*WPK
HO+PQND*WQNHO) / (PPPKD*QPKHO+PQND*QQNHO + CHOPXD);
IDENT PPKPROF  FPKPMT=
(PHMAXD*WHOPK+PWXD*WWXPK+PPPOD*WPOPK+PPPKD*WPKPK+PQND*
WQNPK) / (PPPKD*QPKPK+PQND*QQNPK+CPKPXD);
IDENT POLPROF  FPOPMT=
(PHMAXD*WHOPO+PWXD*WWXPO+PPPOD*WPOPO+PPPKD*WPKPO+PQND*
WQNPO) / (PPPKD*QPKPO+PQND*QQNPO+CPOPXD);
IDENT PRICE21     PHSFARD =PHSD/PHFD;
IDENT PRICE23     PHMAXD=PHFD+POS(PHSD-PHFD);
IDENT QUANT21    QWXM=QWX/M;
IDENT QUANT22    QSHPM = (QHP+PSHPF(-1))/M;
IDENT QUANT24     QPKCOL=QPK/PCOL;
IDENT QUANT25     QQNCOL=QQN/PCOL;
?
PARAM B0, 121.9352, B1, 0.0495234, B2, 117.2318, B3, -73.47820,  B4, -230.1567,
B5, -867.2041;
PARAM  E0, -.2291193, E1, 0.8651651, E2,3.045417 ,  F0, -1.217034, F1, 1.441219;
PARAM G0, 0.1514005, G1, -5.713230, G2, 0.05483168, G3, 0.7859951, G4, -2.15914;
PARAM H0, 0.03461183, H1, -0.02594944,  H2,0.9333837, H3, 0.2434844,
H4,0.02898729 , H5,-0.8942856 ;
PARAM I0, -0.01134207, I1,-0.0220852 , I2,0.2887513 , I3,0.2471680, I4, 0.002280063,
I5, -0.1692295 ;
PARAM J0, 0.2634232, J1,-0.004378458 , J2,-0.002831092 , J3,0.2490913 ,
J4,0.6132352 , J5, 0.09797321, J6, -0.6231662, J7, 0.0172977;
PARAM K0,0.3747096, K1,-0.1438645 , K2,0.06809512 , K3,-1.699113 , K4,0.8274489
, K5, 0.1425209, K6, 2.667295;
CONST WHOHO, 100, WPKHO, .6, WQNHO, 0, WPOHO, 1, WWXHO, 1, QPKHO,
1.3182, QQNHO, 0, WHOPK, 20, WPKPK, 8, WQNPK,4, WPOPK, 1, WWXPK, 1,
QPKPK, 0, QQNPK, 0, WHOPO, 25, WPKPO, .8, WQNPO, 0, WPOPO, 1.65,
WWXPO, 1, QPKPO, 0, QQNPO, 2.5357;
?
?
?  SIML THE BIG GROUP
SIML (TAG=S, ENDOG=(QHF, QWX,  PQND, AHCA, AHCB, AHC, QHP, PWXD,
QPK, QQN, PHFD, IHM, FHOPMT,  FPKPMT, FPOPMT, PHSFARD,  QWXM,
QSHPM, QPKCOL, QQNCOL, PHMAXD), MAXIT=20, NOPRNDAT, NOPRNSIM,
DYNAM)  HONSUP, WAXSUP,  QQNPR, ALLOCA, ALLOCB, ALLOC1, ALLOC2,
WAXDMD, PPKDMD, QQNDMD, HONDMD, IMPDMD, HONPROF, PPKPROF,
POLPROF, PRICE21,  PRICE23, QUANT21, QUANT22, QUANT24, QUANT25;
?
?  RENAMING THE OUTPUT OF THIS SIMULATION
PQHF=QHFS;
PQWX=QWXS;
PPQND=PQNDS;
PAHCA=AHCAS;
PAHCB=AHCBS;
```

```
PAHC=AHCS;
PQHP=QHPS;
PPWXD=PWXDS;
PQPK=QPKS;
PQQN=QQNS;
PPHFD=PHFDS;
PIHM=IHMS;
PFHOPMT=FHOPMTS;
PFPKPMT=FPKPMTS;
PFPOPMT=FPOPMTS;
PPHSFARD=PHSFARDS;
PQWXM=QWXMS;
PQSHPM=QSHPMS;
PQPKCOL=QPKCOLS;
PQQNCOL=QQNCOLS;
PPHMAXD=PHMAXDS;
?
PIH=PIHM*M;
?
?
?-----------------------------------------------------------------
?   BLOCK 3
?
PRINT I;
L0=-.2946686;
L1=1.179081;
L2=.9439934;
L3=-.2498637;
L4=0.005805494;
L5=-5.048632;
M0=0.4227957;
M1=-0.04269399;
M2=0.2130593;
M3=-.9930014;
M4=-0.01190572;
?   EQUATIONS
?
PPHMAXDX=PPHMAXD-PPHMAXD(-1);
?
?   THESE ARE THE PARAMETERS TO INCREASE HONEY DEMAND
SMPL 1985 1985;
N9=1.08;
SMPL 1986 1986;
N9=1.16;
SMPL 1987 1987;
N9=1.24;
SMPL 1988 1988;
N9=1.32;
SMPL 1989 2003;
N9=1.4;
```

```
SMPL I I;
?
PQDHMM = (1/(1-L1*M1))* (L0 + L1*M0  +L1*M1*PIHM - L1*M1*EH/M +
L1*M2*DUM73+ (L1*M3+L5)*PDMPHSDF+L1*M4*TRND73 - L1*PPHRDF(-1)+
L2*PQSHPM+ L3*PPHMAXDX + L4* TRND);
PDHM = PQDHMM  +PIHM - EH/M;
PPHRDF = M0*N9+ M1*PDHM + M2*DUM73+M3*PDMPHSDF+M4*TRND73;
PPHRDFX = PPHRDF - PPHRDF(-1);
PDH = PDHM * M;
PSHPF = PSHPF(-1) + PQHP + PIH - EH - PDH;
?
ENDDO;
?
?
SMPL 1985 1995;
PRINT  PFACMT2, PDMPHSDF, PPPKD, PCOL, PPPOD;
PRINT PQHF, PQWX, PPQND, PAHCA, PAHCB, PAHC;
PRINT PQHP, PPWXD, PQPK, PQQN, PPHFD, PIHM;
PRINT PFHOPMT, PFPKPMT, PFPOPMT, PPHSFARD, PQWXM;
PRINT PQSHPM, PQPKCOL, PQQNCOL, PPHMAXD, PIH;
PRINT PPHMAXDX, PQSHPM;
PRINT PQDHMM, PDHM, PPHRDF, PPHRDFX, PDH, PSHPF;
?
STOP; END;
```

APPENDIX E

COMPUTER PROGRAM FOR

SCENARIO 4- Ineffective Federal Support Program and

Increase in Price Paid to Producers

Appendix E: Computer Program for Scenario 4 - Ineffective Federal Support Program and Increase in Price Paid to Producers

```
NAME LSW 'SCENARIO 4";
?   INEFFECTIVE FEDERAL SUPPORT PROGRAM AND
?   INCREASE IN PRICE PAID TO PRODUCERS
?
?
?
FREQ A;
SMPL 1950 1984;
IN NEWHON;
SMPL 1950 1984;
?
SMPL 1983 1983;
PFHOPMT=FHOPMT;
PFPKPMT=FPKPMT;
PFPOPMT=FPOPMT;
?
SMPL 1984 1984;
PCOL=COL;
PFHOPMT=FHOPMT;
PFPKPMT=FPKPMT;
PFPOPMT=FPOPMT;
PPHFD=PHFD;
PPHRDF=PHRDF;
PDHM=DHM;
PSHPF=SHPF;
PPHMAXD=PHMAXD;
PPPOD=PPOD;
?
SMPL 1985 2003;
?   THESE EXOGENOUS VARIABLES ARE SET TO 1984 VALUES
PHSD=0.28423;
DUM73=1;
TRND=35;
TRND73=12;
CPOPXD=24.82117;
CHOPXD=29.61123;
CPKPXD=41.35723;
QPO=1386.1;
WXHOR=0.02336;
PWXID=0.66924;
PHID=0.16069;
M=237.0;
EH=7.5;
ICHPD=121.33909;
DUM65=1;
?
PDMPHSDF=.04018;
?
SMPL 1985 2003;
?   THESE SUPPORT VARIABLES ARE SET TO MAKE THE SUPPORT
```

```
?   PROGRAM INEFFECTIVE
PHSD=0;
PDMPHSDF=0;
?
?   THESE ARE THE PARAMETERS TO INCREASE
?   PRICES PAID TO PRODUCERS
SMPL 1985 1985;
N9=1.08;
SMPL 1986 1986;
N9=1.16;
SMPL 1987 1987;
N9=1.24;
SMPL 1988 1988;
N9=1.32;
SMPL 1989 2003;
N9=1.4;
?
SMPL 1985 2003;
?
?   NOW LETS GET STARTED WITH THE SIMULATION
DO I=1985 TO 1995;
SMPL I I;
?---------------------------------------------------------------------------
?   BLOCK 1--THE INITIAL SET OF EQUATIONS
A0=139.6578;
A1=.9033466;
A2=242.2987;
C0=11.06271;
C1=0.4232625;
C2=0.004378899;
C3=-0.001536991;
C4=3.710412;
C5=-0.1907491;
D0=0.1941980;
D1=9.441638;
?
PFACMT2=(1/6)*(PFHOPMT(-1)+PFPKPMT(-1)+PFPOPMT(-1)+PFHOPMT(-
2)+PFPKPMT(-2)+PFPOPMT(-2));
?
? PDMPHSDF=POS(PHSD-PPHFD(-1));
?
PPPKD=D0+D1*PPHFD(-1);
PCOL=A0+A1*PCOL(-1)+A2*PFACMT2;
PPPOD=C0+C1*PPPOD(-1)+C2*QPO+C3*PCOL(-1)+C4*PPHMAXD(-
1)+C5*TRND;
?---------------------------------------------------------------------------
?   BLOCK 2--THE BIG GROUP
FRML HONSUP    QHF = B0 + B1*PCOL + B2*FHOPMT + B3*FPKPMT +
B4*FPOPMT+B5*PDMPHSDF;
IDENT WAXSUP   QWX = WXHOR*QHF;
```

```
FRML QQNPR     PQND = E0 + E1* PPPKD + E2*QQNCOL;
IDENT ALLOCA  AHCA=F0+F1*PHSFARD;
IDENT ALLOCB  AHCB=1-POS(1-AHCA);
IDENT ALLOC1  AHC=POS(AHCB);
IDENT ALLOC2 QHP=(1-AHC)*QHF;
FRML WAXDMD    PWXD = G0 + G1*QWXM+ G2*PFHOPMT(-1) + G3*PWXID +
G4*PDMPHSDF;
FRML PPKDMD    QPK = PCOL*(H0 + H1*PPPKD + H2*QQNCOL + H3 *
PPHMAXD(-1) + H4*DUM65+H5*PDMPHSDF);
FRML QQNDMD    QQN =PCOL*(I0+ I1* PQND+ I2*QPKCOL + I3*PPHMAXD(-1)
+ I4*TRND + I5* PDMPHSDF);
FRML HONDMD    PHFD = J0*N9 +J1* QSHPM + J2*ICHPD + J3*PPHRDF(-1) + J4
* PHID + J5*DUM73 + J6*PDMPHSDF + J7*PDHM(-1);
FRML IMPDMD    IHM = K0 +K1 * QSHPM+ K2* PPHRDF(-1)+ K3*PHID +
K4*PHMAXD + K5* DUM73 + K6*PDMPHSDF;
IDENT HONPROF
FHOPMT=(PHMAXD*WHOHO+PWXD*WWXHO+PPPOD*WPOHO+PPPKD*WPK
HO+PQND*WQNHO) / (PPPKD*QPKHO+PQND*QQNHO + CHOPXD);
IDENT PPKPROF  FPKPMT=
(PHMAXD*WHOPK+PWXD*WWXPK+PPPOD*WPOPK+PPPKD*WPKPK+PQND*
WQNPK) / (PPPKD*QPKPK+PQND*QQNPK+CPKPXD);
IDENT POLPROF  FPOPMT=
(PHMAXD*WHOPO+PWXD*WWXPO+PPPOD*WPOPO+PPPKD*WPKPO+PQND*
WQNPO) / (PPPKD*QPKPO+PQND*QQNPO+CPOPXD);
IDENT PRICE21    PHSFARD =PHSD/PHFD;
IDENT PRICE23    PHMAXD=PHFD+POS(PHSD-PHFD);
IDENT QUANT21    QWXM=QWX/M;
IDENT QUANT22    QSHPM = (QHP+PSHPF(-1))/M;
IDENT QUANT24     QPKCOL=QPK/PCOL;
IDENT QUANT25     QQNCOL=QQN/PCOL;
?
?
PARAM B0, 121.9352, B1, 0.0495234, B2, 117.2318, B3, -73.47820, B4, -230.1567,
B5, -867.2041;
PARAM  E0, -.2291193, E1, 0.8651651, E2,3.045417 , F0, -1.217034, F1, 1.441219;
PARAM G0, 0.1514005, G1, -5.713230, G2, 0.05483168, G3, 0.7859951, G4, -2.15914;
PARAM H0, 0.03461183, H1, -0.02594944, H2,0.9333837, H3, 0.2434844,
H4,0.02898729 , H5,-0.8942856 ;
PARAM I0, -0.01134207, I1,-0.0220852 , I2,0.2887513 , I3,0.2471680, I4, 0.002280063,
I5, -0.1692295 ;
PARAM J0, 0.2634232, J1,-0.004378458 , J2,-0.002831092 , J3,0.2490913 ,
J4,0.6132352 , J5, 0.09797321, J6, -0.6231662, J7, 0.0172977;
PARAM K0,0.3747096, K1,-0.1438645 , K2,0.06809512 , K3,-1.699113 , K4,0.8274489
, K5, 0.1425209, K6, 2.667295;
CONST WHOHO, 100, WPKHO, .6, WQNHO, 0, WPOHO, 1, WWXHO, 1, QPKHO,
1.3182, QQNHO, 0, WHOPK, 20, WPKPK, 8, WQNPK,4, WPOPK, 1, WWXPK, 1,
QPKPK, 0, QQNPK, 0, WHOPO, 25, WPKPO, .8, WQNPO, 0, WPOPO, 1.65,
WWXPO, 1, QPKPO, 0, QQNPO, 2.5357;
?
?
```

```
?   SIML THE BIG GROUP
SIML (TAG=S, ENDOG=(QHF, QWX, PQND, AHCA, AHCB, AHC, QHP, PWXD,
QPK, QQN, PHFD, IHM, FHOPMT, FPKPMT, FPOPMT, PHSFARD, QWXM,
QSHPM, QPKCOL, QQNCOL, PHMAXD), MAXIT=20, NOPRNDAT, NOPRNSIM,
DYNAM) HONSUP, WAXSUP, QQNPR, ALLOCA, ALLOCB, ALLOC1, ALLOC2,
WAXDMD, PPKDMD, QQNDMD, HONDMD, IMPDMD, HONPROF, PPKPROF,
POLPROF, PRICE21, PRICE23, QUANT21, QUANT22, QUANT24, QUANT25;
?
?
?   RENAMING THE OUTPUT OF THIS SIMULATION
PQHF=QHFS;
PQWX=QWXS;
PPQND=PQNDS;
PAHCA=AHCAS;
PAHCB=AHCBS;
PAHC=AHCS;
PQHP=QHPS;
PPWXD=PWXDS;
PQPK=QPKS;
PQQN=QQNS;
?
PPHFD=PHFDS;
?
PIHM=IHMS;
PFHOPMT=FHOPMTS;
PFPKPMT=FPKPMTS;
PFPOPMT=FPOPMTS;
PPHSFARD=PHSFARDS;
PQWXM=QWXMS;
PQSHPM=QSHPMS;
PQPKCOL=QPKCOLS;
PQQNCOL=QQNCOLS;
PPHMAXD=PHMAXDS;
?
PIH=PIHM*M;
?
?
?------------------------------------------------------------------
?   BLOCK 3
?
PRINT I;
L0=-.2946686;
L1=1.179081;
L2=.9439934;
L3=-.2498637;
L4=0.005805494;
L5=-5.048632;
M0=0.4227957;
M1=-0.04269399;
M2=0.2130593;
```

```
M3=-.9930014;
M4=-0.01190572;
?  EQUATIONS
?
PPHMAXDX=PPHMAXD-PPHMAXD(-1);
?
PQDHMM = (1/(1-L1*M1))* (L0 + L1*M0  +L1*M1*PIHM - L1*M1*EH/M +
L1*M2*DUM73+ (L1*M3+L5)*PDMPHSDF+L1*M4*TRND73 - L1*PPHRDF(-1)+
L2*PQSHPM+ L3*PPHMAXDX + L4* TRND);
PDHM = PQDHMM  +PIHM - EH/M;
PPHRDF = M0 + M1*PDHM + M2*DUM73+M3*PDMPHSDF+M4*TRND73;
PPHRDFX = PPHRDF - PPHRDF(-1);
PDH = PDHM * M;
PSHPF = PSHPF(-1) + PQHP + PIH - EH - PDH;
?
ENDDO;
?
?
SMPL 1985 1995;
PRINT  PFACMT2, PDMPHSDF, PPPKD, PCOL, PPPOD;
PRINT PQHF, PQWX, PPQND, PAHCA, PAHCB, PAHC;
PRINT PQHP, PPWXD, PQPK, PQQN, PPHFD, PIHM;
PRINT PFHOPMT, PFPKPMT, PFPOPMT, PPHSFARD, PQWXM;
PRINT PQSHPM, PQPKCOL, PQQNCOL, PPHMAXD, PIH;
PRINT PPHMAXDX, PQSHPM;
PRINT PQDHMM, PDHM, PPHRDF, PPHRDFX, PDH, PSHPF;
?
STOP; END;
```

## APPENDIX F

## COMPUTER PROGRAM FOR

## SCENARIO 5- Ineffective Federal Support Program and Higher Costs of Production

Appendix F: Computer Program for Scenario 5 - Ineffective Federal Support Program and Higher Costs of Production

```
NAME LSW 'SCENARIO 5";
?  INEFFECTIVE FEDERAL SUPPORT PROGRAM AND
?  HIGHER COSTS OF PRODUCTION
?
?
?
FREQ A;
SMPL 1950 1984;
IN NEWHON;
SMPL 1950 1984;
?
SMPL 1983 1983;
PFHOPMT=FHOPMT;
PFPKPMT=FPKPMT;
PFPOPMT=FPOPMT;
?
SMPL 1984 1984;
PCOL=COL;
PFHOPMT=FHOPMT;
PFPKPMT=FPKPMT;
PFPOPMT=FPOPMT;
PPHFD=PHFD;
PPHRDF=PHRDF;
PDHM=DHM;
PSHPF=SHPF;
PPHMAXD=PHMAXD;
PPPOD=PPOD;
?
SMPL 1985 2009;
?  THESE EXOGENOUS VARIABLES ARE SET TO 1984 VALUES
PHSD=0.28423;
DUM73=1;
TRND=35;
TRND73=12;
?  THESE ARE ORIGINAL COSTS
? CPOPXD=24.82117;
? CHOPXD=29.61123;
? CPKPXD=41.35723;
?  THESE ARE NEW COSTS
CPOPXD=29.785404;
CHOPXD=35.533476;
CPKPXD=49.628676;
QPO=1386.1;
WXHOR=0.02336;
PWXID=0.66924;
PHID=0.16069;
M=237.0;
EH=7.5;
ICHPD=121.33909;
DUM65=1;
```

```
?
PDMPHSDF=.04018;
?
SMPL 1985 2003;
?   THESE SUPPORT VARIABELS ARE SET TO MAKE THE SUPPORT
?   PROGRAM INEFFECTIVE
PHSD=0;
PDMPHSDF=0;
?
SMPL 1985 2003;
?
?   NOW LETS GET STARTED WITH THE SIMULATION
DO I=1985 TO 1995;
SMPL I I;
?--------------------------------------------------------------------------
?   BLOCK 1--THE INITIAL SET OF EQUATIONS
A0=139.6578;
A1=.9033466;
A2=242.2987;
C0=11.06271;
C1=0.4232625;
C2=0.004378899;
C3=-0.001536991;
C4=3.710412;
C5=-0.1907491;
D0=0.1941980;
D1=9.441638;
?
PFACMT2=(1/6)*(PFHOPMT(-1)+PFPKPMT(-1)+PFPOPMT(-1)+PFHOPMT(-
2)+PFPKPMT(-2)+PFPOPMT(-2));
?
? PDMPHSDF=POS(PHSD-PPHFD(-1));
?
PPPKD=D0+D1*PPHFD(-1);
PCOL=A0+A1*PCOL(-1)+A2*PFACMT2;
PPPOD=C0+C1*PPPOD(-1)+C2*QPO+C3*PCOL(-1)+C4*PPHMAXD(-
1)+C5*TRND;
?--------------------------------------------------------------------------
?   BLOCK 2--THE BIG GROUP
FRML HONSUP    QHF = B0 + B1*PCOL + B2*FHOPMT + B3*FPKPMT +
B4*FPOPMT+B5*PDMPHSDF;
IDENT WAXSUP   QWX = WXHOR*QHF;
FRML QQNPR     PQND = E0 + E1* PPPKD + E2*QQNCOL;
IDENT ALLOCA  AHCA=F0+F1*PHSFARD;
IDENT ALLOCB  AHCB=1-POS(1-AHCA);
IDENT ALLOC1  AHC=POS(AHCB);
IDENT ALLOC2 QHP=(1-AHC)*QHF;
FRML WAXDMD   PWXD = G0 + G1*QWXM+ G2*PFHOPMT(-1) + G3*PWXID +
G4*PDMPHSDF;
```

```
FRML PPKDMD    QPK = PCOL*(H0 + H1*PPPKD + H2*QQNCOL + H3 *
PPHMAXD(-1) + H4*DUM65+H5*PDMPHSDF);
FRML QQNDMD    QQN =PCOL*(I0+ I1* PQND+ I2*QPKCOL + I3*PPHMAXD(-1)
+ I4*TRND + I5* PDMPHSDF);
FRML HONDMD    PHFD = J0 +J1* QSHPM + J2*ICHPD + J3*PPHRDF(-1) + J4 *
PHID + J5*DUM73 + J6*PDMPHSDF + J7*PDHM(-1);
FRML IMPDMD    IHM = K0 +K1 * QSHPM+ K2* PPHRDF(-1)+ K3*PHID +
K4*PHMAXD + K5* DUM73 + K6*PDMPHSDF;
IDENT HONPROF
FHOPMT=(PHMAXD*WHOHO+PWXD*WWXHO+PPPOD*WPOHO+PPPKD*WPK
HO+PQND*WQNHO) / (PPPKD*QPKHO+PQND*QQNHO + CHOPXD);
IDENT PPKPROF  FPKPMT=
(PHMAXD*WHOPK+PWXD*WWXPK+PPPOD*WPOPK+PPPKD*WPKPK+PQND*
WQNPK) / (PPPKD*QPKPK+PQND*QQNPK+CPKPXD);
IDENT POLPROF  FPOPMT=
(PHMAXD*WHOPO+PWXD*WWXPO+PPPOD*WPOPO+PPPKD*WPKPO+PQND*
WQNPO) / (PPPKD*QPKPO+PQND*QQNPO+CPOPXD);
IDENT PRICE21    PHSFARD =PHSD/PHFD;
IDENT PRICE23    PHMAXD=PHFD+POS(PHSD-PHFD);
IDENT QUANT21    QWXM=QWX/M;
IDENT QUANT22    QSHPM = (QHP+PSHPF(-1))/M;
IDENT QUANT24    QPKCOL=QPK/PCOL;
IDENT QUANT25    QQNCOL=QQN/PCOL;
?
PARAM B0, 121.9352, B1, 0.0495234, B2, 117.2318, B3, -73.47820, B4, -230.1567,
B5, -867.2041;
PARAM  E0, -.2291193, E1, 0.8651651, E2,3.045417 , F0, -1.217034, F1, 1.441219;
PARAM G0, 0.1514005, G1, -5.713230, G2, 0.05483168, G3, 0.7859951, G4, -2.15914;
PARAM H0, 0.03461183, H1, -0.02594944, H2,0.9333837, H3, 0.2434844,
H4,0.02898729 , H5,-0.8942856 ;
PARAM I0, -0.01134207, I1,-0.0220852 , I2,0.2887513 , I3,0.2471680, I4, 0.002280063,
I5, -0.1692295 ;
PARAM J0, 0.2634232, J1,-0.004378458 , J2,-0.002831092 , J3,0.2490913 ,
J4,0.6132352 , J5, 0.09797321, J6, -0.6231662, J7, 0.0172977;
PARAM K0,0.3747096, K1,-0.1438645 , K2,0.06809512 , K3,-1.699113 , K4,0.8274489
, K5, 0.1425209, K6, 2.667295;
CONST WHOHO, 100, WPKHO, .6, WQNHO, 0, WPOHO, 1, WWXHO, 1, QPKHO,
1.3182, QQNHO, 0, WHOPK, 20, WPKPK, 8, WQNPK,4, WPOPK, 1, WWXPK, 1,
QPKPK, 0, QQNPK, 0, WHOPO, 25, WPKPO, .8, WQNPO, 0, WPOPO, 1.65,
WWXPO, 1, QPKPO, 0, QQNPO, 2.5357;
?
?
?  SIML THE BIG GROUP
SIML (TAG=S, ENDOG=(QHF, QWX,  PQND, AHCA, AHCB, AHC, QHP, PWXD,
QPK, QQN, PHFD, IHM, FHOPMT,  FPKPMT, FPOPMT, PHSFARD, QWXM,
QSHPM, QPKCOL, QQNCOL, PHMAXD), MAXIT=20, NOPRNDAT, NOPRNSIM,
DYNAM)  HONSUP, WAXSUP,  QQNPR, ALLOCA, ALLOCB, ALLOC1, ALLOC2,
WAXDMD, PPKDMD, QQNDMD, HONDMD, IMPDMD, HONPROF, PPKPROF,
POLPROF, PRICE21,  PRICE23, QUANT21, QUANT22, QUANT24, QUANT25;
?
```

```
?  RENAMING THE OUTPUT OF THIS SIMULATION
PQHF=QHFS;
PQWX=QWXS;
PPQND=PQNDS;
PAHCA=AHCAS;
PAHCB=AHCBS;
PAHC=AHCS;
PQHP=QHPS;
PPWXD=PWXDS;
PQPK=QPKS;
PQQN=QQNS;
PPHFD=PHFDS;
PIHM=IHMS;
PFHOPMT=FHOPMTS;
PFPKPMT=FPKPMTS;
PFPOPMT=FPOPMTS;
PPHSFARD=PHSFARDS;
PQWXM=QWXMS;
PQSHPM=QSHPMS;
PQPKCOL=QPKCOLS;
PQQNCOL=QQNCOLS;
PPHMAXD=PHMAXDS;
?
PIH=PIHM*M;
?
?
?-------------------------------------------------------------------
?  BLOCK 3
?
PRINT I;
L0=-.2946686;
L1=1.179081;
L2=.9439934;
L3=-.2498637;
L4=0.005805494;
L5=-5.048632;
M0=0.4227957;
M1=-0.04269399;
M2=0.2130593;
M3=-.9930014;
M4=-0.01190572;
?  EQUATIONS
?
PPHMAXDX=PPHMAXD-PPHMAXD(-1);
?
PQDHMM = (1/(1-L1*M1))* (L0 + L1*M0  +L1*M1*PIHM - L1*M1*EH/M +
L1*M2*DUM73+ (L1*M3+L5)*PDMPHSDF+L1*M4*TRND73 - L1*PPHRDF(-1)+
L2*PQSHPM+ L3*PPHMAXDX + L4* TRND);
PDHM = PQDHMM  +PIHM - EH/M;
PPHRDF = M0 + M1*PDHM + M2*DUM73+M3*PDMPHSDF+M4*TRND73;
```

<u>Appendix F: Computer Program for Scenario 5 - Ineffective Federal Support Program and Higher Costs of Production</u> (continued)

```
PPHRDFX = PPHRDF - PPHRDF(-1);
PDH = PDHM * M;
PSHPF = PSHPF(-1) + PQHP + PIH - EH - PDH;
?
ENDDO;
?
?
SMPL 1985 1995;
PRINT  PFACMT2, PDMPHSDF, PPPKD, PCOL, PPPOD;
PRINT PQHF, PQWX, PPQND, PAHCA, PAHCB, PAHC;
PRINT PQHP, PPWXD, PQPK, PQQN, PPHFD, PIHM;
PRINT PFHOPMT, PFPKPMT, PFPOPMT, PPHSFARD, PQWXM;
PRINT PQSHPM, PQPKCOL, PQQNCOL, PPHMAXD, PIH;
PRINT PPHMAXDX, PQSHPM;
PRINT PQDHMM, PDHM, PPHRDF, PPHRDFX, PDH, PSHPF;
?
STOP; END;
```

APPENDIX G

COMPUTER PROGRAM FOR

SCENARIO 6- Ineffective Federal Support Program and Expansion of Honey Exports

Appendix G: Computer Program for Scenario 6 - Ineffective Federal Support Program and Expansion of Honey Exports

```
NAME LSW 'SCENARIO 6";
?   INEFFECTIVE FEDERAL SUPPORT PROGRAM AND
?   EXPANSION OF HONEY EXPORTS
?
?
?
FREQ A;
SMPL 1950 1984;
IN NEWHON;
SMPL 1950 1984;
?
SMPL 1983 1983;
PFHOPMT=FHOPMT;
PFPKPMT=FPKPMT;
PFPOPMT=FPOPMT;
?
SMPL 1984 1984;
PCOL=COL;
PFHOPMT=FHOPMT;
PFPKPMT=FPKPMT;
PFPOPMT=FPOPMT;
PPHFD=PHFD;
PPHRDF=PHRDF;
PDHM=DHM;
PSHPF=SHPF;
PPHMAXD=PHMAXD;
PPPOD=PPOD;
?
SMPL 1985 2009;
?   THESE EXOGENOUS VARIABLES ARE SET TO 1984 VALUES
PHSD=0.28423;
DUM73=1;
TRND=35;
TRND73=12;
CPOPXD=24.82117;
CHOPXD=29.61123;
CPKPXD=41.35723;
QPO=1386.1;
WXHOR=0.02336;
PWXID=0.66924;
PHID=0.16069;
M=237.0;
?   THESE ARE OLD EXPORTS
? EH=7.5;
?   THESE ARE NEW EXPORTS
EH=9;
ICHPD=121.33909;
DUM65=1;
?
PDMPHSDF=.04018;
```

```
?
SMPL 1985 2003;
?   THESE SUPPORT VARIABELS ARE SET TO MAKE THE SUPPORT
?   PROGRAM INEFFECTIVE
PHSD=0;
PDMPHSDF=0;
?
SMPL 1985 2003;
?
?   NOW LETS GET STARTED WITH THE SIMULATION
DO I=1985 TO 1995;
SMPL I I;
?--------------------------------------------------------------------------
?   BLOCK 1--THE INITIAL SET OF EQUATIONS
A0=139.6578;
A1=.9033466;
A2=242.2987;
C0=11.06271;
C1=0.4232625;
C2=0.004378899;
C3=-0.001536991;
C4=3.710412;
C5=-0.1907491;
D0=0.1941980;
D1=9.441638;
?
PFACMT2=(1/6)*(PFHOPMT(-1)+PFPKPMT(-1)+PFPOPMT(-1)+PFHOPMT(-
2)+PFPKPMT(-2)+PFPOPMT(-2));
?
? PDMPHSDF=POS(PHSD-PPHFD(-1));
?
PPPKD=D0+D1*PPHFD(-1);
PCOL=A0+A1*PCOL(-1)+A2*PFACMT2;
PPPOD=C0+C1*PPPOD(-1)+C2*QPO+C3*PCOL(-1)+C4*PPHMAXD(-
1)+C5*TRND;
?--------------------------------------------------------------------------
?   BLOCK 2--THE BIG GROUP
FRML HONSUP    QHF = B0 + B1*PCOL + B2*FHOPMT + B3*FPKPMT +
B4*FPOPMT+B5*PDMPHSDF;
IDENT WAXSUP   QWX = WXHOR*QHF;
FRML QQNPR     PQND = E0 + E1* PPPKD + E2*QQNCOL;
IDENT ALLOCA  AHCA=F0+F1*PHSFARD;
IDENT ALLOCB  AHCB=1-POS(1-AHCA);
IDENT ALLOC1  AHC=POS(AHCB);
IDENT ALLOC2 QHP=(1-AHC)*QHF;
FRML WAXDMD   PWXD = G0 + G1*QWXM+ G2*PFHOPMT(-1) + G3*PWXID +
G4*PDMPHSDF;
FRML PPKDMD    QPK = PCOL*(H0 + H1*PPPKD + H2*QQNCOL + H3 *
PPHMAXD(-1) + H4*DUM65+H5*PDMPHSDF);
```

```
FRML QQNDMD    QQN =PCOL*(I0+ I1* PQND+ I2*QPKCOL + I3*PPHMAXD(-1)
+ I4*TRND + I5* PDMPHSDF);
FRML HONDMD    PHFD = J0 +J1* QSHPM + J2*ICHPD + J3*PPHRDF(-1) + J4 *
PHID + J5*DUM73 + J6*PDMPHSDF + J7*PDHM(-1);
FRML IMPDMD    IHM = K0 +K1 * QSHPM+ K2* PPHRDF(-1)+ K3*PHID +
K4*PHMAXD + K5* DUM73 + K6*PDMPHSDF;
IDENT HONPROF
FHOPMT=(PHMAXD*WHOHO+PWXD*WWXHO+PPPOD*WPOHO+PPPKD*WPK
HO+PQND*WQNHO) / (PPPKD*QPKHO+PQND*QQNHO + CHOPXD);
IDENT PPKPROF  FPKPMT=
(PHMAXD*WHOPK+PWXD*WWXPK+PPPOD*WPOPK+PPPKD*WPKPK+PQND*
WQNPK) / (PPPKD*QPKPK+PQND*QQNPK+CPKPXD);
IDENT POLPROF  FPOPMT=
(PHMAXD*WHOPO+PWXD*WWXPO+PPPOD*WPOPO+PPPKD*WPKPO+PQND*
WQNPO) / (PPPKD*QPKPO+PQND*QQNPO+CPOPXD);
IDENT PRICE21    PHSFARD =PHSD/PHFD;
IDENT PRICE23    PHMAXD=PHFD+POS(PHSD-PHFD);
IDENT QUANT21    QWXM=QWX/M;
IDENT QUANT22    QSHPM = (QHP+PSHPF(-1))/M;
IDENT QUANT24     QPKCOL=QPK/PCOL;
IDENT QUANT25     QQNCOL=QQN/PCOL;
?
PARAM B0, 121.9352, B1, 0.0495234, B2, 117.2318, B3, -73.47820,  B4, -230.1567,
B5, -867.2041;
PARAM  E0, -.2291193, E1, 0.8651651, E2,3.045417 ,  F0, -1.217034, F1, 1.441219;
PARAM G0, 0.1514005, G1, -5.713230, G2, 0.05483168, G3, 0.7859951, G4, -2.15914;
PARAM H0, 0.03461183, H1, -0.02594944,  H2,0.9333837, H3, 0.2434844,
H4,0.02898729 , H5,-0.8942856 ;
PARAM I0, -0.01134207, I1,-0.0220852 , I2,0.2887513 , I3,0.2471680, I4, 0.002280063,
I5, -0.1692295 ;
PARAM J0, 0.2634232, J1,-0.004378458 , J2,-0.002831092 , J3,0.2490913 ,
J4,0.6132352 , J5, 0.09797321, J6, -0.6231662, J7, 0.0172977;
PARAM K0,0.3747096, K1,-0.1438645 , K2,0.06809512 , K3,-1.699113 , K4,0.8274489
, K5, 0.1425209, K6, 2.667295;
CONST WHOHO, 100, WPKHO, .6, WQNHO, 0, WPOHO, 1, WWXHO, 1, QPKHO,
1.3182, QQNHO, 0, WHOPK, 20, WPKPK,.8, WQNPK,4, WPOPK, 1, WWXPK, 1,
QPKPK, 0, QQNPK, 0, WHOPO, 25, WPKPO, .8, WQNPO, 0, WPOPO, 1.65,
WWXPO, 1, QPKPO, 0, QQNPO, 2.5357;
?
?
?   SIML THE BIG GROUP
SIML (TAG=S, ENDOG=(QHF, QWX,  PQND, AHCA, AHCB, AHC, QHP, PWXD,
QPK, QQN, PHFD, IHM, FHOPMT,  FPKPMT, FPOPMT, PHSFARD,  QWXM,
QSHPM, QPKCOL, QQNCOL, PHMAXD), MAXIT=20, NOPRNDAT, NOPRNSIM,
DYNAM)  HONSUP, WAXSUP,  QQNPR, ALLOCA, ALLOCB, ALLOC1, ALLOC2,
WAXDMD, PPKDMD, QQNDMD, HONDMD, IMPDMD, HONPROF, PPKPROF,
POLPROF, PRICE21,  PRICE23, QUANT21, QUANT22, QUANT24, QUANT25;
?
?   RENAMING THE OUTPUT OF THIS SIMULATION
PQHF=QHFS;
```

```
PQWX=QWXS;
PPQND=PQNDS;
PAHCA=AHCAS;
PAHCB=AHCBS;
PAHC=AHCS;
PQHP=QHPS;
PPWXD=PWXDS;
PQPK=QPKS;
PQQN=QQNS;
PPHFD=PHFDS;
PIHM=IHMS;
PFHOPMT=FHOPMTS;
PFPKPMT=FPKPMTS;
PFPOPMT=FPOPMTS;
PPHSFARD=PHSFARDS;
PQWXM=QWXMS;
PQSHPM=QSHPMS;
PQPKCOL=QPKCOLS;
PQQNCOL=QQNCOLS;
PPHMAXD=PHMAXDS;
?
PIH=PIHM*M;
?
?
?------------------------------------------------------------------
?   BLOCK 3
?
PRINT I;
L0=-.2946686;
L1=1.179081;
L2=.9439934;
L3=-.2498637;
L4=0.005805494;
L5=-5.048632;
M0=0.4227957;
M1=-0.04269399;
M2=0.2130593;
M3=-.9930014;
M4=-0.01190572;
?   EQUATIONS
?
PPHMAXDX=PPHMAXD-PPHMAXD(-1);
?
PQDHMM = (1/(1-L1*M1))* (L0 + L1*M0  +L1*M1*PIHM - L1*M1*EH/M +
L1*M2*DUM73+ (L1*M3+L5)*PDMPHSDF+L1*M4*TRND73 - L1*PPHRDF(-1)+
L2*PQSHPM+ L3*PPHMAXDX + L4* TRND);
PDHM = PQDHMM  +PIHM - EH/M;
PPHRDF = M0 + M1*PDHM + M2*DUM73+M3*PDMPHSDF+M4*TRND73;
PPHRDFX = PPHRDF - PPHRDF(-1);
PDH = PDHM * M;
```

Appendix G: Computer Program for Scenario 6 - Ineffective Federal Support Program and Expansion of Honey Exports (continued)

```
PSHPF = PSHPF(-1) + PQHP + PIH - EH - PDH;
?
ENDDO;
?
?
SMPL 1985 1995;
PRINT  PFACMT2, PDMPHSDF, PPPKD, PCOL, PPPOD;
PRINT PQHF, PQWX, PPQND, PAHCA, PAHCB, PAHC;
PRINT PQHP, PPWXD, PQPK, PQQN, PPHFD, PIHM;
PRINT PFHOPMT, PFPKPMT, PFPOPMT, PPHSFARD, PQWXM;
PRINT PQSHPM, PQPKCOL, PQQNCOL, PPHMAXD, PIH;
PRINT PPHMAXDX, PQSHPM;
PRINT PQDHMM, PDHM, PPHRDF, PPHRDFX, PDH, PSHPF;
?
STOP; END;
```

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