TB 1426 (1970) USDA TECHNICAL BULLETINS UPDATA
A DYNAMIC PRICE-OUTPUT MODEL OF THE BEEF AND PORK SECTORS
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a dynamic price-output model of the beef and pork sectors

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Washington, D.C. 20250 September 1970

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402

SUMMARY

A price-output model of the beef and pork sectors of the livestock meat economy has been successfully constructed and its ability to reproduce price and output decisions validated on the basis of quarterly data of the 1955-70 period.

By altering its structure, the model may be used in either of two ways: 1) to project prices and outputs to future periods, and 2) to simulate the results of the imposition of policy constraints over either the historical or projection period. The model portrays economic activity satisfactorily, providing the quarterly data of the historical period are reproduced with acceptable accuracy.

Since the model is recursive, the only data given it were the initial conditions existing on and prior to July 1, 1955, with the exception of the exogenous variables (population, income, corn price, etc.). Operating characteristics were introduced as needed throughout the validation process to negate error buildup and to improve estimates involving unique situations. The overall error of the validated model for the 15-year period is in the 2 to 4-percent range.

In general, the model may be used to simulate the effects of structural change introduced into the model, changes in values of exogenous variables, or changes in initial values of lagged endogenous variables over the historical period. In addition, the model may be initialized as of the current date, say July 1, 1970, and projected to any year desired.

Simulation of the economic activity of sectors of the livestock industry, such as this model provides, is an economical procedure for comparing alternatives in the design of public and private goals.

A DYNAMIC PRICE-OUTPUT MODEL OF THE BEEF AND PORK SECTORS

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INTRODUCTION

Changes in market organization and technology have transformed the U.S. livestock-meat economy into a complex national network of physical movements of livestock and meat, and flows of information in the vertical coordination system. While certain regional advantages (and disadvantages) in livestock production and slaughter are functions of climate and local input availability, many other regional and national economic characteristics stem from institutional forces. While some of these institutional forces may be rooted in the regional and subregional markets of earlier days, many of our contemporary institutions are national in scope, thereby giving rise to a national livestock market.

The maze of combinations of alternative production, processing, and distribution channels through which livestock and meat products find their way from producer to consumer are interconnected within the national market, but are still uniquely defined by local institutional characteristics. The number of these coordinative combinations almost defies description. But with today's communications network, a production and marketing decision in one part of the economy makes an impact on all segments of the livestock-meat economy.

Research efforts must be directed toward investigating the effects of one sector or portions of a sector upon the entire market for the commodity. Recent advances in automatic data processing have made it possible to construct rather large, comprehensive models of sectors of an economy representing the aggregative price-output decisions and information feedback from the consumer to producer. Such a model, constructed to represent the production and market activity of a commodity, can be operated on a computer to simulate aggregate production and marketing activity over several time periods.

Accordingly, the central objective of this research was to construct a price-output model of the beef and pork sectors of the livestock meat economy and to validate it by testing its ability to reproduce price and output decisions of a recent historical period. The model can then be used in two ways. First, the structure of the model can be altered or policy constraints can be imposed and the results of this new structure simulated over the historical period. Alternatively, the model may be used to project prices and outputs in future periods. In this case, the structure of the model may be altered and the resulting prices and outputs compared with those of the base projection. The model presented here is an extension of earlier work of the author under the guidance of W.R. Maki (11).[1] Earlier work of Maki in forecasting livestock prices and basic livestock inventories is presented in two journal articles (10, 12). Considerable price and output forecasting has been undertaken throughout the profession for some time (1, 2, 3, 6, 7, 8, 9, 15, 16). However, only a few attempts have been made to cast individual relationships into an ordered framework where the output of one relationship becomes input to others.

Basic Concepts and Definitions

The economic structure of the livestock meat economy can be differentiated from its market structure. The economic structure, in this study, refers to the relationships among such variables as production, consumption, and prices in a comprehensive system of interdependent events. Market structure includes those attributes of an industry that are related in a causal sense to market behavior or conduct: for example, the number, size, and geographical distribution of firms, the degree of specialization or diversification, the economies of size, restrictions to entry, and the quality of market information. The market structure, which is largely a function of institutional forces, conditions the economic structure. Therefore, the numerical values estimated for the parameters of the economic structure of a model over a particular period are indeed conditioned by the market structure under which this economy functioned. If market structure changed, as it did, over the period for which functional relationships were fitted, then the economic structure represents an average effect of the market structure of that period. This aggregative model does not deal explicitly with market structure.

Variables are classified into three types in this report. Endogenous variables are those whose values are determined within the model. Lagged endogenous variables are endogenous variables whose values are determined by the model in a prior time period or values of the variables in periods which existed prior to the start of the model development. Exogenous variables are those whose values are determined outside the model.

Two types of relationships are contained in the model--identities and functional relations. Identities specify an exact relationship between variables with no error or disturbance term. A functional relation is not necessarily exact, but typically is somewhat blurred by random disturbances. Functional relationships are further subdivided into behavioral and technical relations. Technical relations are the relationships between two fixed quantities; they are essentially engineering data. Behavioral relations describe consequences of human behavior in decision-making.

1/ Underscored numbers in parentheses refer to the Selected References, p.37.

A model is said to be recursive when each endogenous variable in the model is solely a function of either lagged endogenous variables, exogenous variables, or both. If an endogenous variable of the current time period is used as a predetermined variable in another behavior relation of the same time period, the recursive relationship can be maintained if the functions are ordered in the proper sequence. For example, quantities may be determined as a function of lagged endogenous and exogenous variables, and these estimated quantities may then become predetermined endogenous variables in demand equations determining price.

Simulation is a process of conducting experiments on a model. The object of simulation is to change the values of initial conditions, exogenous variables or the relationships embodied in the model, and then to trace out the effect of these changes on the time path of the endogenous variables. The simulated values of the endogenous variables are then compared with the values generated in the validation run of the model. The model is validated when it is able to reproduce the historical time paths of the endogenous variables with acceptable accuracy. The recursive model of the beef and pork sectors of the livestock-meat economy presented in this report is an extension of the earlier work reported by Maki and Crom (11) but differs from the earlier model in three ways: First, the calendar quarter of the year is chosen as the unit of time measurement as opposed to the earlier semiannual model. The quarter presents a more refined detailed description of temporal economic activity, yet it is long enough to be free from fluctuations due to very short-run random events. Second, the structure of the beef sector is now further subdivided into the cattle feeding (fed beef) subsector and the remainder of the beef subsector (nonfed beef subsector). Finally, the model incorporates economic events of the 1955-70 period; the earlier model was developed only through 1964.

A listing of all endogenous and exogenous variable names consistent with the Fortran computer language is presented in table 1.

ECONOMIC STRUCTURE OF THE BEEF AND PORK SECTORS

In developing the model, a basic economic structure was diagramed to show the causal ordering of prices and outputs throughout the livestock-meat economy. This structure was essentially a set of hypotheses to be tested; the acceptance of these hypotheses was based on the significance of these variables in explaining functionally the dependent variables in question. The final structure is presented in figure 1. The basic concept underlying this recursive economic structure was the time-honored cobweb theorem. That is to say, components of per capita consumption were estimated and aggregated; this output was priced at the appropriate level; derived demands were established through margin relationships; and subsequent production in light of these primary market prices was then determined, thus maintaining the recursiveness of the system.

Table 1.--Description of variables

Fortran variable name	Unit of measure	Description
		Endogenous variables
H21	1,000 head	Other[1] calves less than 1 year old on hand Jan. 1.
H22R	1,000 head	Other heifers 1-2 years old on hand Jan. 1, not on feed.
H23	1,000 head	Other cows and heifers over 2 years old on hand Jan. 1.
CBCS	1,000 head	Commercial beef cow slaughter (annual).
$XMFC_j$	1,000 head	Marketings of fed cattle, 39 States
$AWTF_j$	pounds	Average weight of cattle grading Prime, Choice and Good at selected markets.
$CSFC_j$	mil. lb.	(MFC_j x $AWTF_j$)
BPF_j	mil. lb.	Commercial fed beef production, carcass weight.
$XMNFC_j$	mil. lb.	Other (nonfed) commercial cattle slaughter, liveweight.
$BPNF_j$	mil. lb.	Other (nonfed) commercial beef production, carcass weight.
$AWTNF_j$	pounds	Average weight of nonfed commercial cattle slaughter.
XIB_j	mil. lb.	Beef imports, carcass weight.
XB_j	mil. lb.	Beef exports, carcass weight.
$PCFBC_j$	pounds	Per capita civilian consumption of fed beef, carcass weight.
$PNFBS_j$	pounds	Per capita civilian supply of other (nonfed) beef for consumption, carcass weight.
CHS_j	mil. lb.	Commercial hog slaughter, liveweight.
PP_j	mil. lb.	Commercial pork production, carcass weight.
XIP_j	mil. lb.	Pork imports, carcass weight.
XP_j	mil. lb.	Pork exports, carcass weight.
$PCPS_j$	pounds	Per capita civilian supply of pork available for consumption.

1/ Other than dairy.

Table 1.--Description of variables--Continued

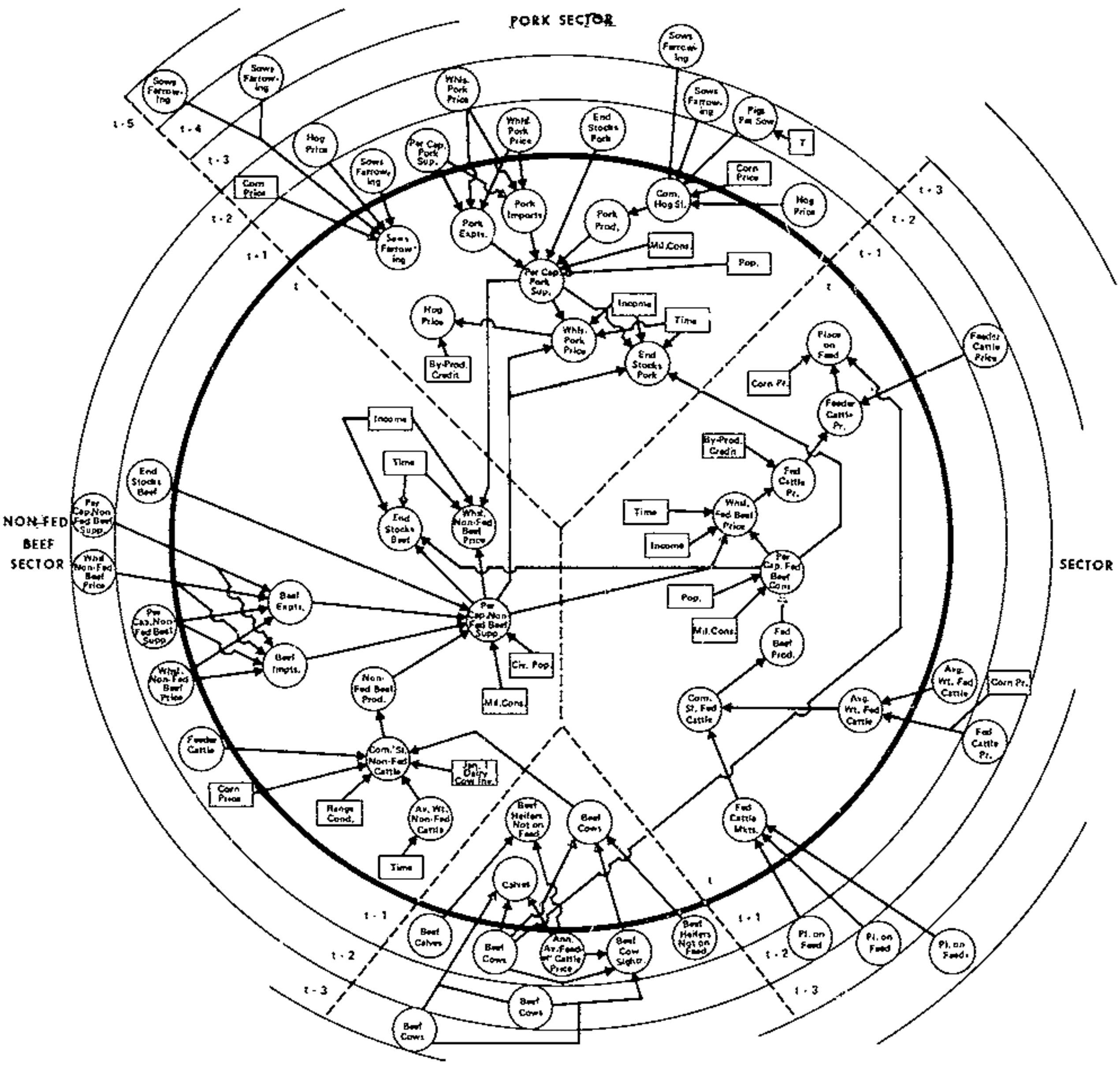
Fortran variable name	Unit of measure	Description
$PRFBW_j$	dollars	Wholesale price per 100 lb. of Choice-grade beef carcasses. Weighted average of prices at New York, Chicago, Los Angeles, San Francisco, and Seattle (LCL)
$PRNFB_j$	dollars	Price per 100 lb. of utility-grade cow beef prices at New York City.
$PRPW_j$	dollars	Weighted average of wholesale prices of individual pork products at Chicago.
ESB_j	mil. lb.	Ending stocks of beef, carcass weight.
ESP_j	mil. lb.	Ending stocks of pork, carcass weight.
$PRFBL_j$	dollars	Weighted average price of Choice-grade steers at 20 markets.
$PRPL_j$	dollars	Weighted average price of barrows and gilts at 8 markets.
$PRFC_j$	dollars	Price per 100 lb. of Good-and Choice-grade 500-800 lb. feeder steers at Omaha.
SF_j	1,000 head	Sows farrowing (quarters are Dec.-Feb., March-May, June-Aug. and Sept.-Nov.)
PL_j	1,000 head	Placements of cattle on feed in 39 States.
		Exogenous variables
H13	1,000 head	Dairy cows 2 years old and older on hand Jan. 1.
$PSPS_j$	head	Pigs saved per sow.
PRC_j	dollars	Price of No. 3 corn at Chicago.
$XMILB_j$	mil. lb.	Military consumption of beef, carcass weight.
$XMILP_j$	mil. lb.	Military consumption of pork, carcass weight.
CN_j	mil. lb.	U.S. civilian population.
$RNGE_j$	units	Index of range conditions in 17 Western states.

Table 1.--Description of variables--Continued

Fortran variable name	Unit of measure	Description
T_j	units	Time (T=1 in 3rd quarter, 1955)
DPH_j	percent	Ratio of commercial pork production to commercial hog slaughter.
Y_j	dollars	Per capita disposable personal income.
$BPCB_j$	dollars	Byproduct credit for beef, per 100 lb., liveweight.
$BPCP_j$	dollars	Byproduct credit for pork per 100 lb., liveweight

FIGURE 1

QUARTERLY MODEL OF BEEF AND PORK SECTORS OF THE LIVESTOCK—MEAT ECONOMY



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In figure 1, endogenous variables are depicted by circles while exogenous variables are depicted as rectangles. Causal ordering is indicated by the direction of the arrows. The lagging of values of variables are indicated by concentric circles. Current period values are inside the center circle (heavy line). Each succeeding concentric circle depicts a time lag of one quarter. The pie at the bottom of the figure contains the January 1 inventory structure; here, each concentric circle depicts a time lag of 1 year.

Beef Cattle Sector

Beef calves on hand January 1 are determined from the calf-crop (derived from the beef cow inventory the previous year) and the average annual feeder cattle price. The inventory of beef heifers for herd replacement (not those on feed) which makes up the future input to cow inventories depends on the number of beef calves on hand a year earlier and the feeder cattle price. Beef cow slaughter throughout the previous year is determined by the number of beef cows slaughtered from previous inventories and the feeder cattle price. The number of beef cows on hand January 1 is then a function of the previous year's inventory plus inputs from heifers on hand the previous year minus the outflow of cows in the inventory through cow slaughter.

In the fed beef subsector, the fed cattle marketed any quarter is determined by the placements of cattle on feed in previous quarters. These cattle form the basis of commercial slaughter of fed cattle. Commercial slaughter of fed cattle on a liveweight basis is, of course, affected by the average weight of fed cattle slaughtered, which, in turn, depends to some extent on the beef-corn ratio at the time the cattle were placed on feed (indicated here as a two-quarter lag). The beef-corn ratio plays an important role in determining the feeding program and the weight of cattle put on feed. Military consumption is then subtracted from fed beef production and the remaining quantity converted to a per capita consumption basis. The wholesale price of fed beef is considered to be a function of per capita consumption, per capita consumer income, the per capita supply of nonfed beef available, and a trend term representing a shift in consumer demand. Cattle prices, on a liveweight basis at primary markets, are subsequently derived from the wholesale price and the byproduct value (considered exogenous to this study). Feeder cattle prices are subsequently determined by fed cattle prices, but are also conditioned by earlier feeder cattle price levels which form part of the gross feeding margin realized from cattle just sold. Finally, placements in the next period are drawn from inventories of feeder cattle on hand January 1 subject to changes in feeder cattle and corn prices.

In the nonfed subsector of the beef economy, commercial slaughter on a liveweight basis depends on both beef cow slaughter and dairy cow cull.

In addition to cow cull, this slaughter is affected by the status of range conditions in the Western States (indicating the carrying capacity of the range), corn prices (representing the cost of feed inputs), feeder cattle prices, and average weights. In addition to seasonal variation, average weights of nonfed cattle have shown an upward trend over time. Foreign trade is hypothesized to take place primarily in the nonfed beef sector. Both imports and exports are shown to be functions of previous values of nonfed beef supplies and wholesale prices. The per capita supply available for consumption is then determined as a summation of nonfed production, military consumption, imports, exports, and beginning stocks divided by civilian population. Ending stocks are still included in supply inasmuch as they theoretically could be consumed at a price. The wholesale price is then determined as a function of per capita nonfed beef supply, per capita supply, and per capita fed beef consumption (supply). Exogenous variables determining wholesale prices of nonfed beef are time (representing shifts in consumer tastes) and income. Ending stocks are determined simultaneously with the wholesale prices.

Pork Sector

The pork sector differs from the beef sector in that January 1 inventories are not reported for breeding stock. The inventory is represented by the number of sows farrowing. Farrowings are wholly a function of lagged variables. The previous period's sow farrowings are adjusted by the corn-hog ratio existing at breeding time. Commercial hog slaughter is a function of lagged values of sows farrowing and pigs saved per sow, and a lagged corn-hog ratio. Pork imports and exports, although minor, are hypothesized as functions of the wholesale pork price and earlier per capita supply. Imports, exports, and ending stock minus military consumption are added to domestic pork production to determine per capita supply for consumption. This becomes an initial input into the price equation along with per capita supplies of nonfed beef, consumer income, and a trend term as proxy for consumer taste. Ending stocks are determined simultaneously with pork price, as in the case of beef. Finally, live hog prices are a function of the wholesale price and the byproduct credit.

ESTIMATION OF BASIC BEHAVIORAL RELATIONSHIPS

The basic functional relationships embodied in the model were estimated initially by ordinary least-squares procedures. In general, the data used for estimating the least-squares relationships covered the 1955-66 period; relationships for which different time periods were used are indicated individually. In choosing among alternative behavioral relations, the selection was generally made on the basis of ability to explain variance (R^2) and the level of significance of the coefficients.

In general, coefficients were accepted if they were of the right economic sign and if they were significantly different from zero at the 10-percent level. However, some relationships were used where significance occurred only at the 25-percent level. When a set of seasonal dummy variables was used, the entire set of coefficients was employed regardless of their individual significance.

Marketings, Commercial Slaughter, and Meat Production

Functions estimated for domestic production are presented individually for the fed beef subsector, the nonfed beef subsector, and the hog sector. After several different formulations had been tried, it was decided to estimate domestic production of meat on a carcass weight basis.

Fed beef subsector: Marketings of fed cattle from feedlots in the United States (39 States) were estimated in 1,000-head units. The average weight of fed cattle was subsequently estimated with the product of weight and head indicating commercial slaughter of fed beef (liveweight equivalent); the last term is an identity. Inasmuch as the original data development involved the assumption of a 60-percent dressing percentage for all fed beef, liveweight commercial slaughter was converted to a carcass weight basis using the coefficient of 0.6.

Marketings of fed beef cattle in the United States were estimated separately for each quarter because the explanatory variable used involved differing time lags. The quarterly marketing functions (equations 1-4) were developed from data on placements and marketings from mid-1957 through mid-1968.

$$MFC1_t = 514.0 + \underset{(0.008)}{0.3748}\ PL(\Sigma\ 1, 2, 3)_{t-1} \qquad R^2 = .99 \tag{1}$$

$$MFC2_t = -441.0 + \underset{(0.016)}{0.3340}\ PL(\Sigma\ 3, 4)_{t-1} + 1)_t \qquad R^2 = .99 \tag{2}$$

$$MFC3_t = 676.0 + \underset{(0.022)}{0.5426}\ PL(\Sigma\ 1, 2)_t \qquad R^2 = .99 \tag{3}$$

$$MFC4_t = 501.0 + \underset{(0.011)}{0.3441}\ PL(\Sigma\ 1, 2, 3)_t \qquad R^2 = .99 \tag{4}$$

In each case, 11 observations were involved. In the first quarter of the year, marketings of fed cattle were a function of cattle placed on feed the first three quarters of the previous year. Initially, placements from each quarter were used as separate explanatory variables, but owing to high intercorrelation, the three variables were summed into one explanatory variable. Although several different combinations of lagged quarters were tried, the combination used explained the highest percentage of the variance in the dependent variable. This average lag in the time span of the explanatory variable indicates the approximate length of time on feed. Economic indicators of lagged steer prices and beef-corn ratios were not considered significant.

Marketings in the second quarter (equation 2) employ an average two-quarter lag in placements, while the third-quarter marketings are best estimated by considering only placements of the previous two quarters. Evidently, the bulk of variation in third-quarter marketings comes from variations of placements in the first two quarters of the year. This seems logical because fed cattle marketed during the summer are usually placed on feed to shorten the feeding period.

Marketings in the fourth quarter (equation 4) employ the same placements variable as used in the first quarter of the year. Again, variation in placements in this period is evidently most significantly associated with variations in marketings during the fourth quarter.

Functions for estimating the average weight of fed cattle employ a lagged dependent variable relationship (equations 5-8).

$$AWTF1_t = -204.0 + \underset{(0.251)}{1.1362}\ AWTF4_{t-1} + \underset{(2.32)}{3.64}\ (PRFBL3/PRC3)_{t-1} \qquad (5)$$

$$R^2 = 85$$

$$AWTF2_t = 271.0 + \underset{(0.122)}{0.6958}\ AWTF1_t + \underset{(1.13)}{2.24}\ (PRFBL4/PRC4)_{t-1} \qquad (6)$$

$$R^2 = 91$$

$$AWTF3_t = 280.0 + \underset{(0.170)}{0.6599}\ AWTF2_t + \underset{(1.35)}{2.84}\ (PRFBL1/PRC1)_t \qquad (7)$$

$$R^2 = 87$$

$$AWTF4_t = 478.0 + \underset{(0.174)}{0.5304}\ AWTF3_t + \underset{(.186)}{1.61}\ (PRFBL2/PRC2)_t \qquad (8)$$

$$R^2 = 75$$

The values of the dependent variable in the previous quarter is adjusted by the value of the beef-corn ratio two quarters earlier. This beef-corn ratio was the one existing at the time most of the cattle were placed on feed. Feeding programs are planned to carry cattle to heavier weights when the ratio is high at the time cattle are put into feedlots; conversely, low beef-corn ratios encourage a lighter weight feeding program. The coefficient of the lagged dependent variable is greater or less than unity as the average seasonal pattern over the historical period changed. In other words, during the 1957-68 period average weights in the first quarter increased over those in the fourth quarter. Still, the average weight in the second quarter was usually lighter than the average weight in the first quarter.

Nonfed beef subsector: Commercial slaughter (marketings) of cattle not on feed includes all other cattle slaughtered. This variable was estimated on a liveweight basis with the average weight of nonfed cattle being one of the explanatory variables. In developing the function, the average cull rate of dairy cows and the seasonally adjusted average cull rate of beef cows was used to delete this cow cull from nonfed cattle slaughter. The residual was then estimated as a function of the other variable, and the results were then recombined into one function. Thus, the residual nonfed cattle slaughter is a function of the corn price and feeder cattle price lagged one quarter, conditions of ranges in the Western States, the average weight of nonfed marketings, and seasonal adjustment factors.

$$MNFC_{(j)t} = -770.27 + 0.0625\ H13_t + (J)\ {*}H23_t + \underset{(405.67)}{1568.51}\ PRC_{(j-1)t}$$

$$\underset{(12.123)}{-84.9651}\ PRFC_{(j-1)t} + \underset{(8.235)}{24.05}\ RNGE_{(j)t} - \underset{(2.509)}{0.3942}\ AWTNF_{(j)t}$$

$$-208.81\ W1 - 146.34\ W2 - 318.89\ W3$$

$$R^2 = .81 \qquad (9)$$

*j = 1 = 0.0389	j = 3 = 0.0490
j = 2 = 0.0370	j = 4 = 0.0430
	.1670

The function for estimating the average weight of nonfed cattle is:

$$AWTNF_{(j)t} = 915.0 + \underset{(0.133)}{0.783}\ T_{(j)t} - \underset{(4.77)}{1.41}\ W1 - \underset{(4.77)}{21.65}\ W2 - \underset{(4.77)}{19.40}\ W3 \qquad (10)$$

$$R^2 = 64$$

Although many economic variables and production variables were considered, the average weight of nonfed cattle appeared to be best explained as a function of a trend term and seasonal factors. Equation 11, an identity, indicates that the dressing percentage of nonfed cattle varied only seasonally.

$$DPNFB_{(j)t} \equiv 0.512\ W1 + 0.524\ W2 + 0.526\ W3 + 0.511\ W4 \qquad (11)$$

Dressout coefficients were somewhat higher during the spring and summer when cattle are in better flesh.

Hog sector: Commercial hog slaughter (equation 12) was also estimated on a liveweight basis.

$$CHS_{(j)t} = -4145.98 + \underset{(0.0358)}{0.5273}\ SF_{(j-2)t} + \underset{(0.0408)}{0.1721}\ SF_{(j-3)t} \qquad (12)$$

$$-\underset{(12.439)}{54.0487}\ PRPL_{(j-1)t} - \underset{(324.422)}{719.5827}\ PRC_{(j-1)t}$$

$$+\underset{(308.070)}{1168.7608}\ PSPS_{(j-2)t}$$

$$R^2 = 0.87$$

Commercial slaughter is a function of pigs produced from sows farrowing two and three quarters previously. The coefficient on the sows farrowing variable lagged three quarters is approximately one-third the size of the coefficient on the sows farrowing variable lagged two quarters. The lower value of this coefficient is probably due to the fact that the three-quarter lag in the explanatory variable estimates slaughter coming from cull sows plus a few hogs which took an above average time to finish. Hog slaughter estimated by sow farrowings lagged two quarters represents most of the barrow and gilt slaughter.

The hog-corn price relationship is divided into the separate effects of the hog price lagged one quarter and the corn price lagged one quarter rather than the more conventional ratio of hog-to-corn price. In this relationship, the magnitude of the coefficient on the corn price is approximately 10 times larger than the coefficient on the hog price variable because of the relationship of the magnitude of the mean values of these two variables. Both variables carry a negative sign. An increase in the price of corn reduces slaughter weights the next period as production costs are raised. An increase (decrease) in the hog price increases (decreases) gilt retention and also affects sow cull.

Pigs saved per sow enters into the commercial slaughter relationship because this function needs a variable to indicate productivity per sow. In developing the model, pigs saved per sow is treated as an exogenous variable; in a projection period it can be estimated using a function of the form $Y = ae^{bt}$. This function is easily estimated in natural logarithms:

$$\ln \ PSPS_{(j)t} = \underset{}{1.93641} + \underset{(0.00012)}{0.0013} \ T \qquad (13)$$

$$R^2 = 0.68$$

While developing the model, this coefficient was considered as an exogenous variable and reported data were used. The relationship presented in natural logarithms could be used in a projections period:

$$\ln \ DPH_{(j)t} = 4.02091 + \underset{(0.00018)}{0.00226} \ T \qquad (14)$$

$$R^2 = 0.80$$

The dressing percentage of hogs, which is used to convert commercial hog slaughter to pork production on a carcass weight basis, follows the same functional form as pigs saved per sow.

Imports and Exports

Imports and exports of beef are not separated into fed and nonfed beef components under the assumption that about all foreign trade in beef is of a quality grade less than "Good." A considerable portion of our beef exports does consist of fed beef going to foreign markets patronized by American nationals. However, given the rather small magnitude of this variable, it is expedient to compute it as a nonfed item. Imports and exports of pork are of a considerably less magnitude than imports of beef. Nonetheless, it is necessary to include them as part of the total supply picture. Moreover, the volume of pork imports has been increasing in recent years.

Imports of beef (equation 15) are estimated as a function of the average price of commercial cow beef during the previous two quarters and the average per capita supply of nonfed beef in the past two quarters.

$$IB_{(j)t} = 761.34 - \underset{(37.67)}{172.0W} \ \underset{(4.18)}{-3.344} \left((PRNFB_{(j-1)t} + PRNFB_{(j-2)t})/2.0 \right) \qquad (15)$$

$$\underset{(15.52)}{-37.585} \left((PNFBS_{(j-1)t} + PNFBS_{(j-2)t})/2.0 \right) \qquad R^2 = 0.64$$

The price variable carries the wrong economic sign. However, since it was not a statistically significant variable, its sign was not of great concern. The variable was left in the equation as opposed to a less satisfactory procedure of incorporating it in the intercept at its average value. The lagged supply variable is consistent in its negative effect on imports. As domestic production of nonfed beef increases, importers are signaled to decrease their orders for imported products. The dummy variable, W, has a value of 1 for 1955 through the first quarter of 1958. Beef imports were at a considerably lower level during this time and suddenly shifted upward as the rapid rise in demand for fed beef reduced the available supply of nonfed products.

Exports of beef were considered a function of the same variables as imports:

$$XB_{(j)t} = \underset{}{-0.65} \underset{(3.36)}{-1.86W} \underset{(0.37)}{-0.686} \left(\left(PRNFB_{(j-1)t} + PRNFB_{(j-2)t}\right)/2.0\right) \quad (16)$$

$$+\underset{(1.38)}{3.977} \left(\left(PNFBS_{(j-1)t} + PNFBS_{(j-2)t}\right)/2.0\right)$$

$$R^2 = 0.45$$

In this case, the signs associated with the coefficients are consistent with economic logic. When the lagged wholesale price of beef increases, the supply of beef available for export falls as the profitability of exporting is reduced. Conversely, an increase in the supply of domestic beef increases the amount which can be exported.

Imports and exports of pork are estimated as a function of similar variables--the average two-quarter lagged price of wholesale pork products, the per capita supply of pork lagged one quarter, and a trend term. In these functions (equations 17 and 18), the positive coefficient on the lagged price indicates that, as domestic price increases, imports of pork stimulate increased orders while high domestic prices reduce the amount of pork supplied for export.

$$IP_{(j)t} = -92.56 + \underset{(0.36)}{1.916} \left(\left(PRPW_{(j-1)t} + PRPW_{(j-2)t}\right)/2.0\right) \quad (17)$$

$$+\underset{(0.10)}{0.928}\, T_{(j)t} + \underset{(1.08)}{2.605}\, PCPS_{(j-1)t}$$

$$R^2 = 0.79$$

$$XP_{(j)t} = \underset{}{-2.40} \underset{(0.56)}{-0.18} \left(\left(PRPW_{(j-1)t} + PRPW_{(j-2)t} \right) / 2.0 \right) \quad (18)$$

$$\underset{(0.11)}{+0.285}\ T_{(j)t} \underset{(2.10)}{+ 2.85}\ PCPS_{(j-1)t} \underset{(6.30)}{- 6.44}\ W1$$

$$\underset{(5.03)}{-7.48}\ W2 \underset{(3.94)}{- 10.18}\ W3$$

$$R^2 = 0.35$$

The positive sign on the trend term in both equations indicates a temporal increase in foreign trade in pork. The positive sign on the lagged domestic supply of pork in the export equation indicates that larger domestic production stimulates pork exports. The positive sign on the import function, although statistically significant, appears to be contrary to economic reasoning. This lagged positive value may be associated with a rather high intercorrelation with the price variable or it may be associated with a trend in both variables. The set of dummy variables on the export function indicates a statistically significant amount of seasonal variation, especially in the third quarter.

Per Capita Supply Available for Consumption

Per capita supply available for consumption is equivalent to per capita consumption with the exception that ending stocks have not been excluded. Theoretically, a price exists which will clear the market of all products offered for sale including stocks. Therefore, ending stocks and price are jointly determined (see discussion pp. 17-19) from the entire supply available.

In the case of fed beef supplies, the per capita supply available for consumption is considered identically equal to per capita consumption in that an explicit assumption is made that stocks of fed beef consist only of those in the consumer distribution "pipeline." Therefore, the term "per capita consumption" is used for fed beef in the model. Equation 19 shows per capita fed beef consumption as identically equal to fed beef production minus 50 percent of military consumption. Military consumption of beef is assumed to be divided equally between fed and nonfed beef products.

A per capita figure is derived by dividing total quantity by civilian population.

$$PCFBC_{(j)t} \equiv (BPF_{(j)t} - 0.5\ MILB_{(j)t}) / CN_{(j)t} \quad (19)$$

$$PNFBS_{(j)t} \equiv ((ESB_{(j-1)t} + BPNF_{(j)t} + IB_{(j)t} - XB_{(j)t} -0.5\ MILB_{(j)t})/CN_{(j)t} \quad (20)$$

$$PCPS_{(j)t} \equiv (ESP_{(j-1)t} + PP_{(j)t} + IP_{(j)t} - XP_{(j)t} - MILP_{(j)t})/CN_{(j)t} \quad (21)$$

Alternatively, the per capita supply of nonfed beef available for consumption is equivalent to the beginning stocks of the period (ending stocks of the previous quarter) plus domestic production and imports, minus exports and 50 percent of military consumption. This quantity is again divided by civilian population to achieve a per capita basis.

The per capita supply of pork available for consumption considers the same variables as in the case of nonfed beef. Of course, all military consumption is excluded from this relation.

Wholesale Market Demand and Ending Stocks

The wholesale rather than the retail market is chosen as the appropriate pricing level. Consumers patronizing retail stores are price takers and quantity adjusters; their demand is reflected through the quantities they purchase. Since the buyers representing retail distribution organizations bargain with salesmen representing meat packers and meat processors, the wholesale market level probably represents a true interaction of supply and demand forces in a bargaining sense.

In the preceding section, joint determination of prices and ending stock was discussed. Therefore, a simultaneous system of five just-identified equations (22-26, or appendix B) was developed. The endogenous variables are the wholesale price of fed beef, the wholesale price of commercial cow beef, the composite wholesale pork price, ending stocks of beef, and ending stocks of pork. The per capita supplies available for consumption of fed beef, nonfed beef, and pork enter into the system as predetermined endogenous variables along with the exogenous variables of income and a trend term representing consumer taste. An additional set of dummy variables was employed to differentiate between seasons of the year by shifting the value of the constant term. The structural equations derived from the reduced form system are presented in appendix B. These coefficients may be useful in deriving direct and cross price and income elasticities. The estimating equations for prices and ending stocks presented here are the reduced form system omitting certain insignificant variables. The per capita supply of pork was omitted from the fed beef price equation and the per capita supply of fed beef was omitted from the other two price equations. These variables were omitted either because of a rather low significance in a statistical sense or because of a sign different from that expected from economic theory.

In obtaining the initial least-squares fit, income, consumption of fed beef, and ending stocks of beef were used in deviation-from-trend form. This eliminated the problem of high intercorrelation with the trend term. The trends were then reincorporated into the coefficients after the initial fit by least squares. Thus, a standard error cannot be reported for the trend term.

Price of fed beef carcasses, commercial cow beef carcasses, and value of wholesale pork products: The wholesale prices of these three products are estimated by equations 22, 23, and 24. They are estimated as functions of the predetermined per capita supplies available for consumption, income, trend (representing long-time consumer demand), and seasonal intercept shifters.

$$PRFBW_{(j)t} = 68.30 - \underset{(0.405)}{3.3237}\, PCFBC_{(j)t} - \underset{(0.371)}{3.1563}\, PNFBS_{(j)t} \tag{22}$$

$$+ \underset{(0.005)}{0.02253}\, Y_{(j)t} + 0.1106\, T_{(j)t} - \underset{(0.95)}{0.94}\, W1$$

$$- \underset{(0.83)}{0.21}\, W2 + \underset{(0.68)}{3.06}\, W3$$

$$R^2 = 0.83$$

$$PRNFB_{(j)t} = 81.54 - \underset{(0.499)}{4.4403}\, PNFBS_{(j)t} - \underset{(0.275)}{1.1698}\, PCPS_{(j)t} \tag{23}$$

$$+ \underset{(0.007)}{0.01112}\, Y_{(j)t} - 0.2363\, T_{(j)t} - \underset{(1.11)}{6.61}\, W1$$

$$- \underset{(1.05)}{3.94}\, W2 + \underset{(1.16)}{0.53}\, W3$$

$$R^2 = 0.80$$

$$PRPW_{(j)t} = 49.36 - \underset{(0.445)}{0.9945}\, PNFBS_{(j)t} - \underset{(0.245)}{3.3264}\, PCPS_{(j)t} \tag{24}$$

$$+ \underset{(0.006)}{0.03727}\, Y_{(j)t} - 0.6021\, T_{(j)t} - \underset{(1.00)}{2.76}\, W1$$

$$- \underset{(0.94)}{4.94}\, W2 - \underset{(1.03)}{4.61}\, W3$$

$$R^2 = 0.91$$

The high degree of price flexibility, particularly on the own-price supply relation, is interesting. An increase in the per capita supply of nonfed beef appears to have an almost equal effect as an increase or decrease in the per capita consumption (supply) of fed beef on the Choice-grade carcass price. The wholesale price of pork products seems to be influenced more by consumer incomes than are the beef prices. This income effect is estimated after allowing for long-term shifts in consumer tastes (which are positive in the case of fed beef and negative in the case of manufacturing beef and pork products).

Ending stocks of beef and pork: Functions estimating ending stocks are shown in equations 25 and 26.

$$ESB_{(j)t} = \underset{}{-430.82} + \underset{(7.43)}{26.26}\ PCFBC_{(j)t} + \underset{(4.99)}{17.91}\ PNFBS_{(j)t} \tag{25}$$

$$+ \underset{(3.78)}{10.27}\ PCPS_{(j)t} - \underset{(0.076)}{0.0115}\ Y_{(j)t} - 0.7872\ T_{(j)t}$$

$$- \underset{(14.2)}{28.0\ W1} - \underset{(14.4)}{46.7\ W2} - \underset{(14.1)}{39.6\ W3}$$

$$R^2 = 0.80$$

$$ESP_{(j)t} = -852.91 + \underset{(8.33)}{19.20}\ PCFBC_{(j)t} + \underset{(5.60)}{18.56}\ PNFBS_{(j)t} \tag{26}$$

$$+ \underset{(4.24)}{42.50}\ PCPS_{(j)t} - \underset{(0.085)}{0.0010}\ Y_{(j)t} - 3.37\ T_{(j)t}$$

$$+ \underset{(15.91)}{111.2\ W1} + \underset{(16.17)}{120.4\ W2} + \underset{(15.78)}{5.0\ W3}$$

$$R^2 = 0.95$$

Income appears in these equations because it is part of the reduced form system. Its effect is minimal and the statistical significance is inconsequential. A price increase for any of the three commodities results in an increase in stock. The negative coefficient on the trend term indicates that there is a decline in stocks over time, probably due to efficiencies in the "pipeline." Ending stocks of pork also exhibit considerably more seasonal fluctuation than ending stocks of beef. This probably stems from a need to store certain pork products for consumption which differs from seasonal production.

Primary Market Demand

The prices of Choice-grade steers, barrows and gilts, and feeder steers are considered in this subsection, which might also be called a section on margin relations. The functions are estimated statistically; however, these prices could be derived by subtracting a marketing margin from the liveweight equivalent of the wholesale price.

Prices of Choice steers and barrows and gilts: The estimating equations for live animal prices are:

$$PRFBL_{(j)t} = \underset{}{-4.51} + \underset{(0.020)}{0.6393}\ PRFBW_{(j)t} + \underset{(0.235)}{0.8018}\ BPCB_{(j)t} \qquad (27)$$

$$R^2 = 0.98$$

$$PRPL_{(j)t} = -7.69 + \underset{(0.026)}{0.4864}\ PRPW_{(j)t} + \underset{(0.304)}{1.1967}\ BPCP_{(j)t} \qquad (28)$$

$$R^2 = 0.98$$

The price of Choice steers at 20 major terminal markets and the price of barrows and gilts at eight markets are estimated as functions of the wholesale prices and the national estimate of the byproduct credit. The byproduct credit is taken as an exogenous variable because byproduct prices are determined in a large part by exogenous demand factors (e.g., the demand for shoes).

Feeder animal prices: Individual functions for each quarter were estimated for feeder steer prices (Good and Choice 500-800 pound steers are used as a specific quality level). These equations were estimated by quarters since range conditions are not used in the winter (first) quarter and, additionally, the coefficient on the Choice steer price varies by a substantial amount between quarters. The feeder steer price (equations 29-32) is estimated as a function of the Choice steer price, the range conditions where applicable, and a gross price margin on steers just marketed.

$$PRFC_{1t} = -5.33 + \underset{(0.134)}{1.4322}\ PRFBL_{1t} - \underset{(0.070)}{0.2329}\ APM_{1t} \qquad (29)$$

$$R^2 = 0.95$$

$$PRFC_{2t} = -15.64 + \underset{(0.137)}{1.4540}\ PRFBL_{2t} - \underset{(0.049)}{0.2729}\ APM_{2t} + \underset{(0.083)}{0.1534}\ RNGE_{2t} \quad (30)$$

$$R^2 = 0.97$$

$$PRFC_{3t} = -23.74 + \underset{(0.213)}{1.7175}\ PRFBL_{3t} + \underset{(0.080)}{0.1649}\ RNGE_{3t} - \underset{(0.066)}{0.3104}\ APM_{3t} \quad (31)$$

$$R^2 = 0.94$$

$$PRFC_{4t} = -13.79 + \underset{(0.165)}{1.4215}\ PRFBL_{4t} + \underset{(0.059)}{0.110}\ RNGE_{4t} - \underset{(0.067)}{0.2432}\ APM_{4t} \quad (32)$$

$$R^2 = 0.95$$

The gross price margin (APM) is calculated as an identity weighting the current selling price of Choice steers and the price of feeder animals lagged two quarters. This gross price margin accounts for the 400-pound gain that would be put on a hypothetical 650-pound feeder steer during an average feeding period.

$$APM_{(j)t} \equiv 2.625\ PRFBL_{(j)t} - 1.625\ PRFC_{(j-2)t} \quad (33)$$

The coefficient on the Choice steer price is greater than 1.0, indicating the capitalization of the value of the initial weight of the feeder animal values at the price of the finished product into the feeder price. The coefficient on range conditions is positive, indicating that as range conditions improve the rancher is in a better bargaining position to hold his cattle for a higher price. The negative sign on the price margin indicates that it functions essentially as an adjusting factor which can be interpreted to mean that, if the price margin is good, feeders tend to expect a less favorable situation to exist in the next feeding period because more people probably will be feeding cattle. Alternatively, a resulting poor price margin may be interpreted as an expectation of better profits for the next batch of cattle.

Supply Response and Livestock Inventories

The feedback of prices into subsequent production decisions, which preserves the recursiveness of the system, comes in the following set of production equations. Once the production decision is made and breeding stock is retained, subsequent production and slaughter of livestock is only a matter of the biologic gestation period and feeding process. Supply response in the hog sector can be measured only in terms of sows farrowing, because a January 1 inventory of breeding stock is no longer reported. In the case of fed cattle, supply response is measured in terms of placements of cattle on feed. Total supply response in the entire beef cattle sector is measured in terms of the January 1 inventory of breeding stock.

Sows farrowing: The estimating equation employs a lagged dependent variable relationship augmented by the year-to-year change in the dependent variable during the previous quarter:

$$SF_{(j)t} = -82.67 + \underset{(0.039)}{0.89764}\ SF_{(j)(t-1)} + \underset{(12.75)}{45.175}\ PRPL_{(j-2)t} \quad (34)$$

$$\underset{(276.9)}{-317.48}\ PRC_{(j-2)t} + \underset{(0.113)}{0.3354}\ SF_{(j-1)t} - \underset{(0.113)}{0.3354}\ SF_{(j-1)(t-1)}$$

$$R^2 = 0.95$$

This relationship makes use of the serial correlation in the data. The economic explanatory variable of hog price and corn price explains about two-thirds of the variance in sows farrowing. Obviously, an increase in hog prices leads to an increase in sows farrowing, whereas an increase in feed prices (represented by the price of corn) leads to a reduction in sows farrowing. The combination of lagged values of the dependent variables is simply mechanical and represents no economic response. Numerous other economic variables were tested, but none were found that reduced the unexplained variance by a significant amount over and above the hog-corn ratio.

Cattle: Placements of cattle on feed in 39 States are estimated separately by quarter using equations 35-38.

$$PL_{1t} = -5539.0 + \underset{(0.020)}{0.2488}\ H23_{t-1} + \underset{(32.21)}{86.20}\ (PRFBL_{1t}/PRC_{1t}) \quad (35)$$

$$R^2 = 0.98$$

$$PL_{2t} = -5233.0 + \underset{(0.018)}{0.2490}\ H21_{t} + \underset{(25.99)}{96.61}\ PRFBL_{2t} \quad (36)$$

$$R^2 = 0.98$$

$$PL_{3t} = -4589.0 + \underset{(0.019)}{0.3011}\ H21_{t} + \underset{(48.88)}{75.14}\ (PRFBL_{3t}/PRC_{3t}) \quad (37)$$

$$R^2 = 0.98$$

$$PL_{4t} = -3638.0 + \underset{(0.020)}{0.2728}\ H23_t + \underset{(33.75)}{97.83}\ (PRFBL_{4t}/PRC_{4t}) \quad (38)$$

$$R^2 = 0.98$$

These equations are estimated separately for each quarter because different lagged inventory variables are employed for each quarter. In the first and fourth quarters, the appropriate lagged value of the beef cow inventory is used as the major explanatory variable. Here, the beef cow inventory acts as a proxy for the beef calf crop. This inventory relation is subsequently conditioned by the current beef-corn ratio. In the spring and summer quarters, the lagged inventory relation is the January 1 number of calves less than 1-year old. In these seasons of the year, placements come from older cattle as opposed to calf placements. Again the beef-corn ratio is employed in the summer quarter. However, the steer price alone yielded a better estimate in the second quarter than did the beef-corn ratio.

January 1 beef cattle inventories: The yearend inventory of beef calves less than 1 year of age is based on the current year's calf crop using the previous yearend beef cow inventory as an indicator of calves born:

$$H21_t = -5632.0 + \underset{(0.034)}{0.8888}\ H23_{t-1} + \underset{(0.211)}{0.5968}\ \Delta^2\ H23_{t-1} \quad (39)$$

$$+\underset{(49.49)}{121.22}\ PRFCA_{t-1}$$

$$R^2 = 0.99$$

The calf inventory also increases or decreases with the rate of change in the beef-cow inventory (the second difference of beef-cow numbers) and the annual average feeder calf price. As feeder prices increase, more calves are either retained for feeding or for the breeding herd.

The January 1 inventory of beef heifers 1-2 years old is based on the previous January 1 calf inventory, but varies directly with the annual average feeder price:

$$H22R_t = -117.60 + \underset{(0.006)}{0.27791}\ H21_{t-1} + \underset{(5.93)}{57.5855}\ PRFCA_{t-1} + \underset{(71.95)}{809.74}\ W \quad (40)$$

$$R^2 = 0.99$$

Replacements for the herd are increased as prices rise. A dummy variable (W) was used in 1955 to improve the general fit of the equation.

Commercial beef cow slaughter during the year was developed in a two-step procedure:

$$CBCS_t = 536.0 + \left\{\begin{matrix}0.1670\\0.1428\end{matrix}\right\} H23_t - \underset{(0.104)}{1.0636}\ \Delta^2 H23_t - \underset{(24.97)}{39.39}\ PRFCA_t \qquad (41)$$

$$+\underset{(0.195)}{0.8412}\ W\Delta^2 H23_t$$

$$R^2 = 0.95$$

An average cull rate of 0.167 from the January 1 beef-cow inventory was subtracted from total cow slaughter from 1955 through 1960 and an average cull of 0.1428 was subtracted thereafter. Inspection of the data revealed a shift in the average cull rate after 1960. The residual slaughter (a positive or negative quantity) was then estimated as a function of the second difference of the beef-cow inventory and the current year's feeder price. The inverse variation of this residual with the rate of change in the inventory is logical. A cow cull greater than average occurs when the inventory is increasing at a decreasing rate (a negative second difference). On the other hand, the cow cull will be below average when the inventory is being built at an increasing rate (a positive second difference). Finally, cow cull is reduced somewhat as feeder calf prices increase. The dummy variable W takes on a value of 1.0 when the annual average feeder price exceeds $28.00.

Given the estimates of heifer replacement and beef-cow slaughter, the January 1 beef-cow inventory may be estimated as an identity. A 4-percent death loss is assumed on the beginning inventory.

$$H23_t = 0.96\ H23_{t-1} + H22R_{t-1} - CBCS_{t-1} \qquad (42)$$

EMPIRICAL DEVELOPMENT OF THE MODEL

The quarterly estimating equations and identities outlined in the previous section were incorporated into a computer program using the Fortran IV computer language. These equations were ordered to maintain the recursive mechanism of the system. The program commences by estimating relationships for the third quarter followed by the fourth quarter, the January 1 inventory estimates, the first quarter, and completes 1-year's estimates with the second quarter. The program was written to commence as of a July 1 "third quarter" so that the most recent January 1 inventory estimate available in mid-February would enter into the relationships as available data. In fact, many livestock production decisions are made during the summer months with ensuing production activity carried out during the fall, winter, and spring.

In developing the model, an initial computer run was made commencing with the values of lagged endogenous variables as of July 1, 1955. The model was operated over a 13-year period to June 30, 1968. Throughout these 13 annual iterations over four quarters, the output of one period becomes the lagged endogenous values of the next period. Exogenous variables as described in tables 10-12 of appendix A are available for each time period.

The completed price-output computer model is shown in appendix D. The development of the model, including the addition of numerous operating rules, is discussed in subsequent sections. Still, the reader might with to glance at the model at this time to familiarize himself with the general structure of the computer model.

Initial Performance of the Model

The initial estimates of the model as operated for the first time is illustrated by the dashed lines in figure 2. Twelve variables were selected from the 25 estimated to illustrate the predictive ability of the initial run. The dashed lines indicate the deviation of the predicted values from the historical data.

As the program progressed through time, more error of a cumulative nature occurred. Several variables indicated a countercyclical performance in later years; in some cases, an upward trend in the error is evident. However, during the initial stages of building the model, it was encouraging that the error buildup did not reach magnitudes which produced estimates completely out of the relevant range. Despite the final estimates being some 13 years away from any reported endogenous data, price estimates were still within the historical range of the data.

Developmental Procedures

The objective of the computer model of the livestock-meat economy is to approximate its price and output performance (the data) of the historical period. After the initial run, the model was allowed to progress first 2 years, then 3 years, and so on up to June 30, 1970. At the first sign of a substantial error in the estimate of a variable, the situation was examined to determine the cause of this error buildup. At this point, an operating rule was introduced into the model based on an economically logical behavioral relationship which could be postulated to have caused the prediction error. For example, at very low prices, supply response may not fall as rapidly as when prices are in the middle of the historical range.

When an operating rule was introduced, estimation of the endogenous variables was recommenced as of July 1, 1955, in every case. The model was then operated until a new error of substantial magnitude appeared. At that point, a new operating characteristic was introduced and the model was again restarted as of July 1, 1955.

FIGURE 2

DEVIATION OF PREDICTED VALUES FROM DATA 1955-1970

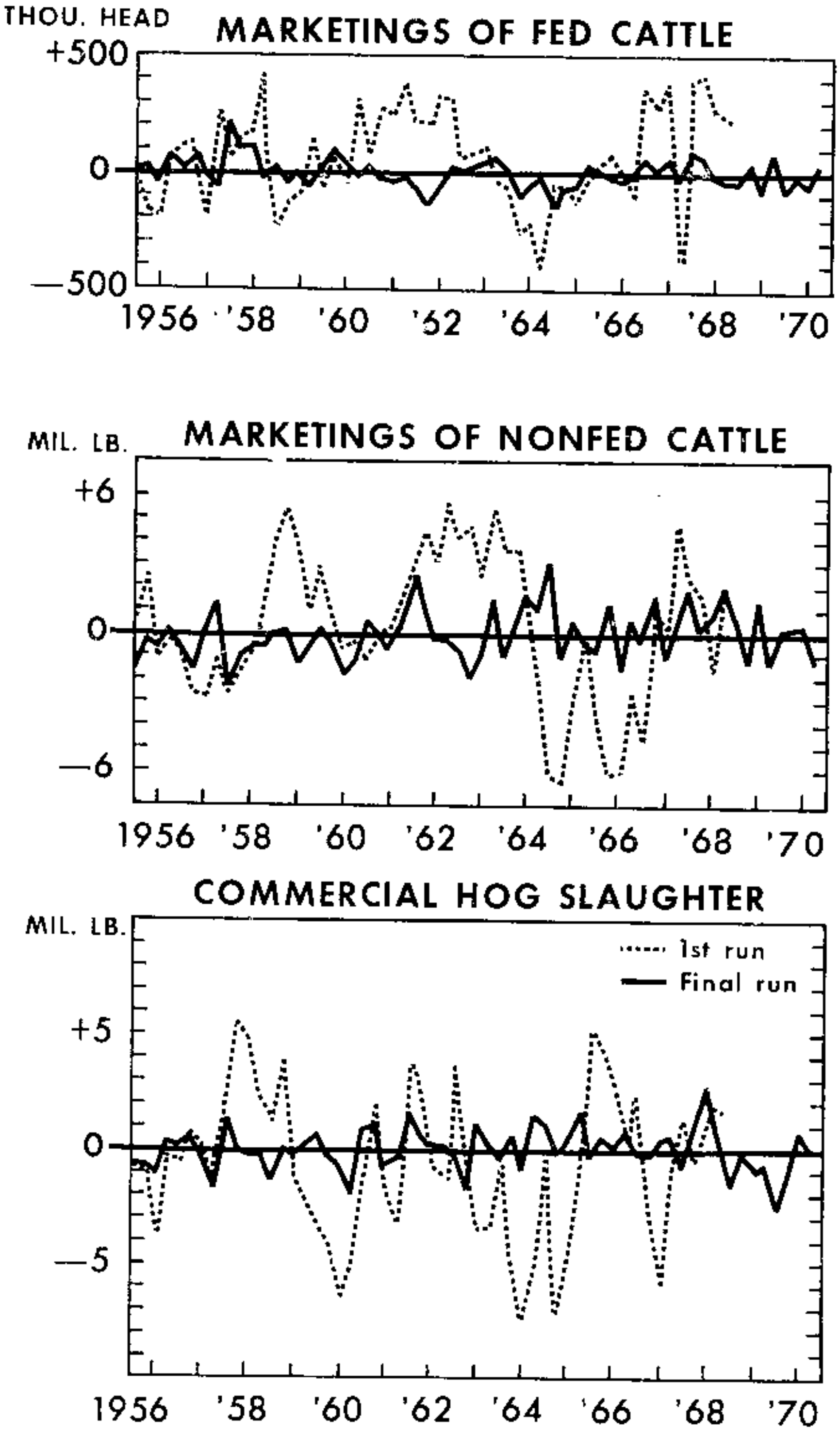

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FIGURE 2

DEVIATION OF PREDICTED VALUES FROM DATA 1955-1970

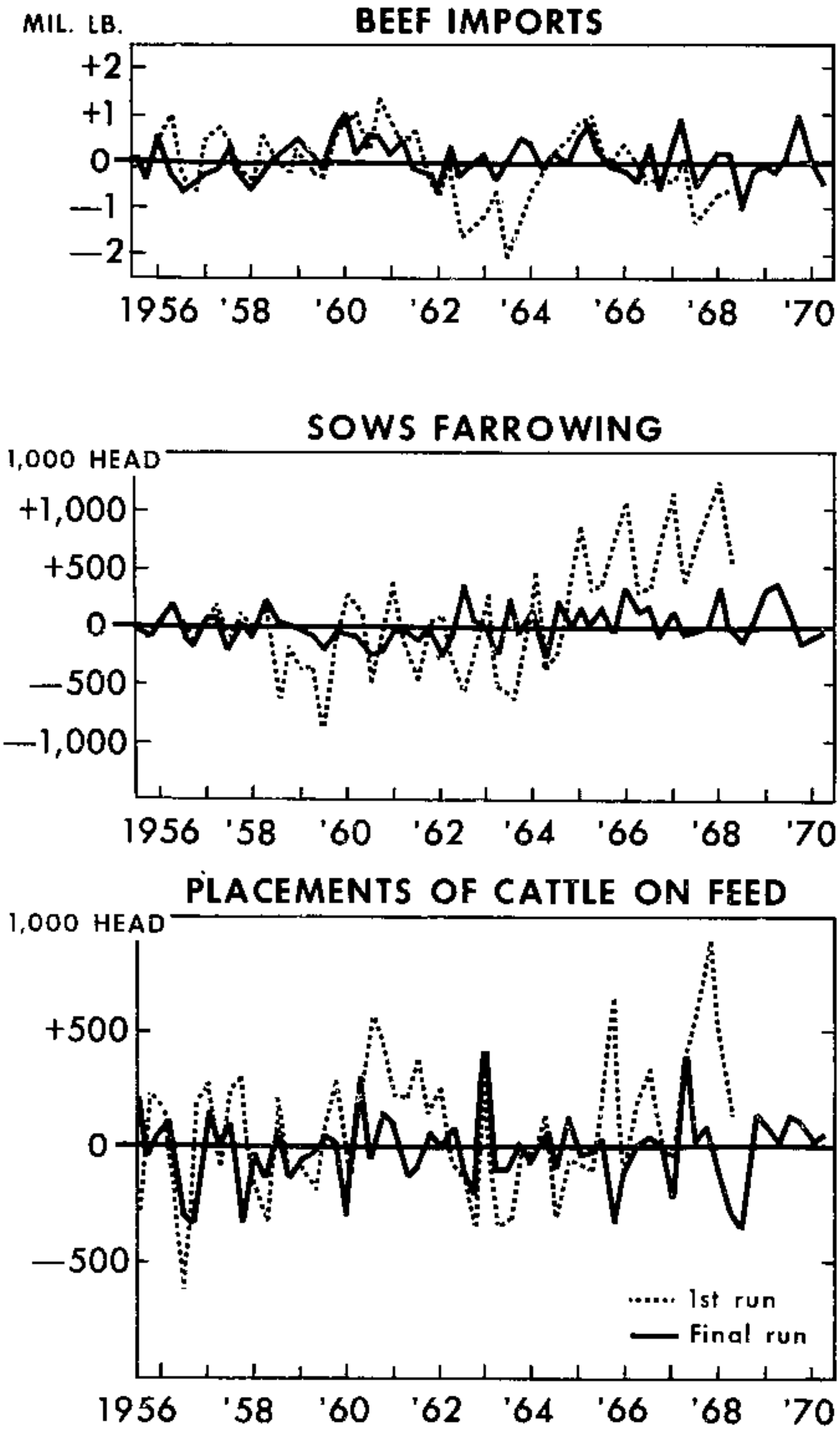

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FIGURE 2

DEVIATION OF PREDICTED VALUES FROM DATA 1955-1970

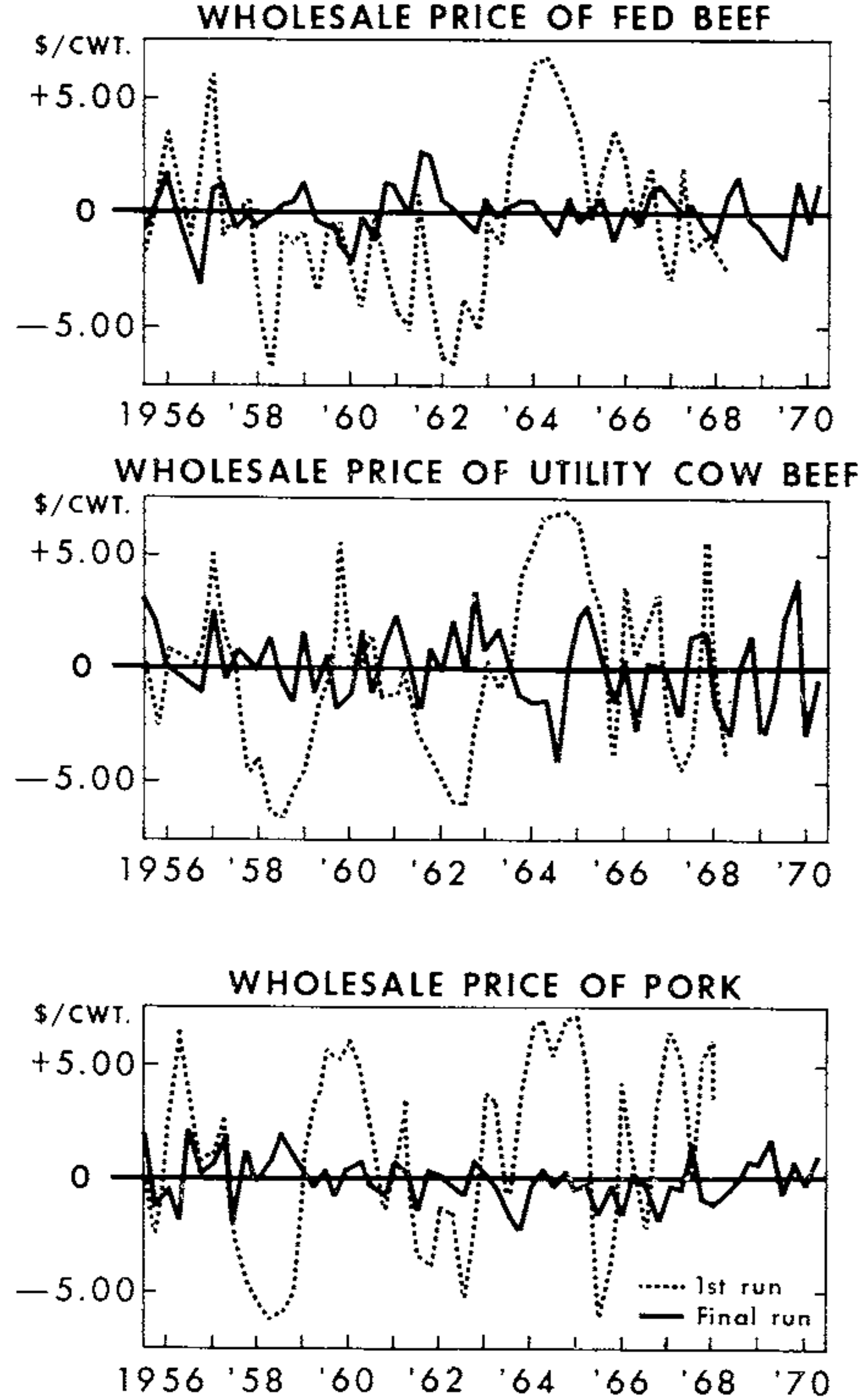

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FIGURE 2

DEVIATION OF PREDICTED VALUES FROM DATA 1955-1970

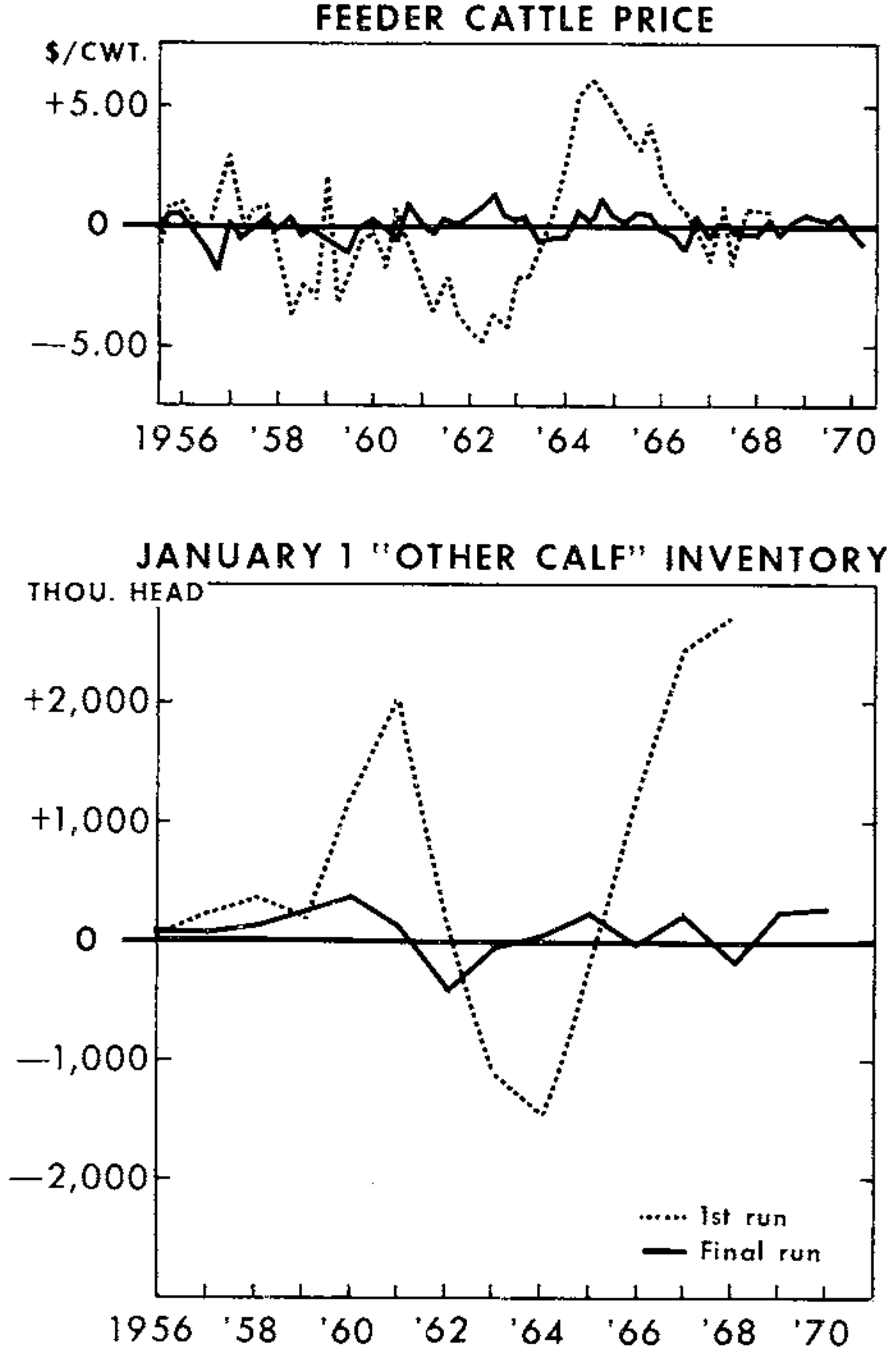

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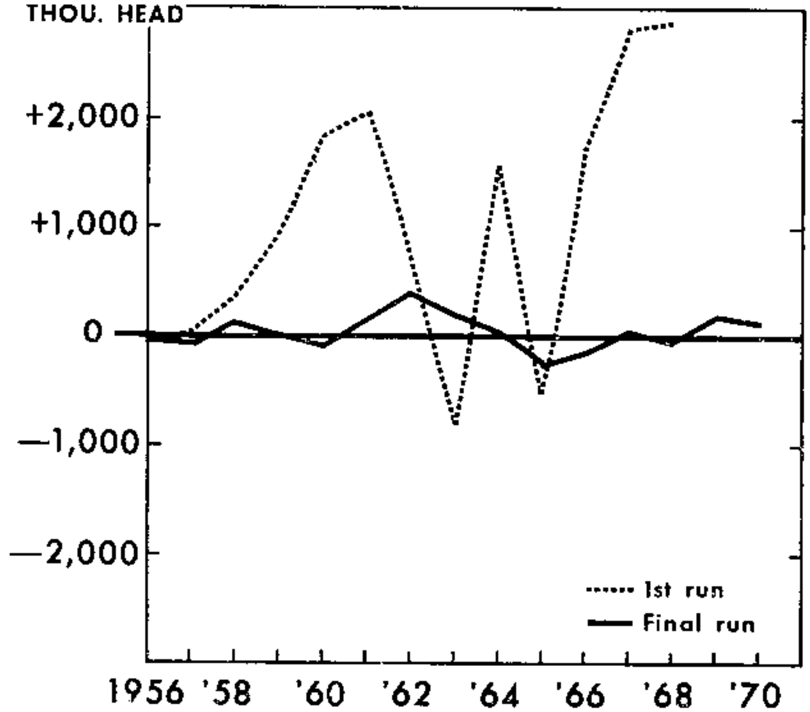
FIGURE 2

DEVIATION OF PREDICTED VALUES FROM DATA 1956-1970

JANUARY 1 BEEF COW INVENTORY



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In some instances, decision rules introduced into the model produced unexpected errors in an earlier period. For example, a new operating rule introduced at an earlier period was the result of a substantial error later on. When this was the case, a different operating characteristic had to be substituted in the earlier period.

In every instance of a change in an operating characteristic or the introduction of a new operating characteristic, the operation of the computer model was restarted as of July 1, 1955. This type of interaction between the researcher and the computer model was continued until all historical data were satisfactorily reproduced to June 30, 1970. A more comprehensive discussion of the problems in adjusting dynamic models was previously published by the author (13).

Operating Rules

Over 100 operating rules were introduced into the model over the 15-year validation period. The incidence of the necessity for introducing these operating characteristics fell approximately as follows: Six operating rules were introduced on the marketings of fed cattle and nine more were introduced on the average weight functions. Approximately 20 rules were introduced on the estimates of nonfed marketings. Slightly more rules were necessary for the nonfed function, since part of the corrections in the fed cattle sector fell back in the placements equations. Sixteen operating rules were introduced on the commercial hog slaughter function; 15 were introduced on the foreign trade equations for beef. Approximately 20 rules were introduced in the wholesale demand functions and two operating rules were necessary on the ending stock equations. No operating characteristics were introduced in the Choice steer and hog price functions, but seven operating rules were introduced on the feeder price functions. Fourteen operating characteristics were introduced on the sows-farrowing equations with a similar number introduced on placements functions for fed cattle. Ten rules were introduced on January 1 inventory relations.

The entire set of operating rules introduced into the model are described in detail in appendix C. The operating rules applied fell into three general categories. One type of operating rule is illustrated by equations 43 and 44:

$$MFC2_t = a + b \cdot \sum PL_{t-k} \qquad (43)$$

$$\text{IF } (PRPL1_{t-1} - PRPL1_t) > 6.00$$

$$MFC2_t = 1.05\ MFC2_t \qquad (44)$$

In the original relationship (equation 43), marketings of fed cattle in the second quarter are estimated as a function of lagged placements.

However, if the price of hogs at eight markets in the first quarter fell by more than $6.00 from year-earlier levels, then equation 44 would be employed wherein marketings in the second quarter are increased by 5 percent. The justification of a change in economic response is that a rather rapid and substantial drop in hog prices induced a shift to some short-fed cattle feeding operations in the second quarter resulting in marketings above that indicated by lagged placements. (Short-fed cattle are those placed and marketed in the same quarter.) The magnitude of the operating characteristic (a 5-percent increase) reflects the fact that this was the amount necessary to adjust the model for the particular error that occurred. In some instances, operating characteristics functioned on more than one occasion in the historical period. In such cases, the researcher was able to develop a generalization for the rule. However, when the rule functioned only once, a general statement could be made. The year(s) in which the operating characteristics functioned are shown in appendix C.

Another type of operating characteristic is illustrated in equations 45 and 46:

$$AWTF3_t = a + b\ AWTF2_t + c\ (PRFBL1/PRC1)_t \qquad (45)$$

IF $(PRC1_t < 1.10)$

$$AWTF3_t = a + b\ AWTF2_t + c'\ (PRFBL1/PRC1)_t \qquad (46)$$

where $c' < c$

In equation 45, the average weight of fed cattle marketed in the third quarter is a function of its lagged value in the second quarter and the beef-corn ratio lagged two quarters (the beef-corn ratio which existed at the time most of the cattle were put on feed). However, if corn prices were quite low, in this case less than $1.10, the program was instructed to shift to equation 46 where a different coefficient is employed. In this case, the value of the new coefficient C' is less than the value of the original coefficient C. This rule (which functioned in both 1962 and 1968) indicated that the high beef-corn ratio (induced by the low corn price) resulted in a tapering off of producer response to the rather high beef-corn ratio. Here, feedlot operators modified the feeding program because they probably did not feel that this kind of a beef-corn ratio would hold for an extended period of time.

A third type of compound adjustment procedure can be illustrated by the wholesale price equation for fed beef in the fourth quarter:

$$PRFBW4_t = a - b\ Q_t + c\ Y_t + c\ T_t \qquad (47)$$

IF $(PCFBC4) > 16.0$ and $(PCPS4) > 18.0$

$$PRFBW4_t = 0.9375\ PRFBW4_t \qquad (48)$$

In general, the wholesale price was estimated as a function of the per capita quantity available, income, and time, as shown in equation 47. The operating characteristic introduced took effect if per capita fed beef consumption was greater than 16.0 pounds per capita and pork supplies were greater than 18.0 pounds per capita. When this situation existed, as it did in 1967 and 1968, equation 48 is used and the price is cut $6\frac{1}{4}$ percent. This cut in price response is based on the combined interaction of a high beef and pork supply reducing the cross-price elasticity. Recall that the per capita pork supply did not normally enter into the beef-price equation.

Validation of the Model

The price-output model was considered a valid representation of the economic activity of the beef and pork sectors when the historical data were reproduced with acceptable accuracy. The deviations of the final simulated values from historical data are shown by the solid line in figure 2.

In general, deviations were minimal. The absolute values of the predicted and historical data are shown in appendix tables 1-10.

Since this is a behavioral model, no attempt was made to obtain simulated values which minimize the error for the entire system. If this were attempted, one would not have constructed a behavioral model of these subsectors. A test statistic similar to a correlation coefficient for evaluating the accuracy of forecasted values was developed by Thiel (13).

$$U = \frac{\sqrt{\frac{\Sigma (P-A)^2}{n}}}{\sqrt{\frac{\Sigma A^2}{n}}} \qquad (49)$$

In a perfect forecast, the value of this statistic would be zero since the value of the numerator would vanish. The values of the test statistic for all of the variables estimated are shown in table 2. In general, errors were in the magnitude of 2-4 percent.

USES AND LIMITATIONS OF THE MODEL

The complete model validated over the 1955-70 period is shown in appendix D using the FORTRAN IV computer language. It may be operated over the historical period by entering the appropriate values of the lagged endogenous variables and the necessary values of exogenous variables. Also, an initial first data card specifying the maximum value of the parameter

K (which controls the number of years (iterations) the program operates) must be specified. If the program is to be initialized at any period other than July 1, 1955, certain control statements for the initial years of the model must be changed. In general, these statements involved adjustment of intercept values fixed by the original least-squares estimates for early years through the use of a dummy variable. These changes were usually operated in the model by "if statements" which specified use of different functions during the first few iterations of the model. Obviously, if the model is initialized at any other date, appropriate lagged values of endogenous variables and appropriate current values of exogenous variables must be read into the computer as data.

Table 2.--Values of "U-statistic" calculated for 1955-70

MFC = 0.0172	PRFBW = 0.0247
AWTF = 0.0064	PRNFB = 0.0474
MNFC = 0.0416	PRPW = 0.0238
AWTNF = 0.0188	ESB = 0.1437
IB = 0.1467	ESP = 0.1150
XB = 0.3074	PRFBL = 0.0265
PCFBC = 0.0173	PRPL = 0.0335
PNFBS = 0.0304	PRFC = 0.0257
CHS = 0.0192	SF = 0.0489
IP = 0.1268	PL = 0.0412
XP = 0.2189	H21 = 0.0089
PCPS = 0.0187	H22R = 0.0124
	CBCS = 0.0398

In general, the model may be used to simulate the effects of structural change introduced into the model, changes in values of exogenous variables, or changes in initial values of lagged endogenous variables over the historical period. In addition, the model may be initialized as of the current date, say July 1, 1970, and projected to any year desired. Values of exogenous variables for the projection period would need to be derived from alternative sources. Usually, independent estimates of population and income can be derived from several Government planning agencies. Values of stochastic exogenous variables such as range conditions probably could be entered at mean seasonal values.

When simulating alternatives, the simulated values should always be compared with the estimated values of the validation run if the simulation is over the historical period. If the simulation is over a projected period, the simulated values should be compared with the simulated base run.

Use as a Projection Model

Because of the recursive structure of this model, it can be used to project values in future periods. The parameters of this model estimated over the historical period quantify the economic activity of that period which developed under the existing market structure. In this case, the existing market structure may be defined as governmental policies, existing institutions, and attitudes of people involved in daily economic activity in the beef and pork sectors. Therefore, this model has the limitations of any other econometric model in that the economic structure which developed under this set of historical institutions and attitudes is projected into the future. This being the case, such a model cannot forecast institutional change. If the user wishes to use the model as a short-term forecasting tool, he should realize that his forecasts may be in error because of fluctuations in prices and outputs introduced by random effects of institutional change. Thus, it is the author's opinion that such a model may be of more value in making longer-run -- rather than short-term -- prognoses of economic activity in the beef and pork sectors.

Since "the past is prologue," projections are more interesting than studies of historical changes in structure. However, initial experiments with this model will be with policy constraints or structural change over the historical period and then projections of apparent significant and timely changes will follow.

Experiments with Policy Constraints

The effects of either governmental or private policy are, by definition, the constraints on or manipulation of the system in an exogenous sense. These policy effects may be introduced through changes in exogenous variables or through limits imposed upon the behavioral aspects of the system.

Experiments which might be performed on this model through changes in values of exogenous data include a change in the price of feed inputs supported through Government action (indicated in the model by a change in the price of corn), or changes in consumer income through some type of income support payments. Shifts in Government purchase programs might be simulated by subtracting the amount of the per capita Government purchase from per capita consumption at a fixed price, allowing the remainder to be priced in the demand equation, and then calculating a new wholesale price as the weighted average of these two prices.

Examples of institutional policy limits might involve a ceiling on imports of beef and pork or specification of a higher level export program. Price-support operations might be introduced into the model by not allowing either wholesale or live prices to fall below a specified level.

Experiments Involving Structural Change

One form of experimenting with a change in structure which might be initiated from institutional change would involve new values of coefficients, constant terms, or both. As mentioned earlier, the model cannot predict changes of this nature, although it can trace out the effects of such changes when they are made in the model. Independent research studies might be designed to specify the exact changes in coefficients or constant terms for tracing out the effects over time. One form of experimentation with structural change might involve making only percentage adjustments in coefficients or constant terms. While this type of experimentation might show the sensitivity of the model, one could not relate results directly to a changed institutional setting.

One very important consideration when simulating the results of experiments on the model is to make the user vitally aware of all changes that were made and of any and all assumptions involved. For example, if an experiment involving a 10-percent increase in corn prices is assumed, the user must be aware of the basis for this assumption. If he agrees, he can accept the results of the simulated situation. If he does not agree, the user may alternatively wish to specify his own set of assumptions.

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Appendix A
Data and Values Predicted
by the Model
(tables 1-11)

Table 1.--Quarterly marketings, average weight, and commercial slaughter of fed beef, 1954-70

Year	Quarter	Marketings (MFC)			Average weight (AWTF)			Commercial slaughter fed beef (CSFC)		
		Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.
		-----	1,000 hd.	---	-----	Pounds	----	----	Mil. lb.	----
1954	3	---	---	---	---	---	---	---	---	---
	4	---	---	---	---	---	---	---	---	---
1955	1	---	---	---	---	---	---	---	---	---
	2	---	---	---	1025	---	---	---	---	---
	3	2700	2705	5	1005	1004	-1	2714	2716	2
	4	2725	2744	19	1032	1036	4	2812	2843	31
1956	1	3013	2958	-55	1044	1050	6	3146	3106	-40
	2	2952	3028	76	1044	1040	-4	3082	3150	68
	3	2619	2661	42	1011	1011	0	2648	2691	43
	4	2747	2821	74	1029	1035	6	2827	2920	93
1957	1	3073	3041	-32	1042	1045	3	3202	3176	-26
	2	2804	2737	-67	1028	1033	5	2883	2828	-55
	3	2784	2990	206	1007	1008	1	2803	2944	141
	4	2624	2747	123	1038	1042	4	2724	2861	137
1958	1	2836	2960	124	1031	1028	-3	2924	3043	119
	2	2837	2805	-32	1035	1032	-3	2936	2895	-41
	3	3150	3176	26	1036	1038	2	3263	3296	33
	4	2964	2933	-31	1087	1078	-9	3222	3161	-61
1959	1	3174	3163	-11	1104	1094	-10	3504	3460	-44
	2	3216	3160	-56	1078	1084	6	3467	3360	-107
	3	3358	3382	24	1064	1064	0	3573	3598	25
	4	3144	3246	102	1072	1078	6	3370	3498	128
1960	1	3501	3504	3	1088	1086	-2	3809	3806	-3
	2	3373	3370	-3	1073	1078	5	3619	3635	16
	3	3454	3470	16	1061	1054	-7	3665	3659	-6
	4	3293	3275	-18	1075	1073	-2	3540	3514	-26
1961	1	3571	3535	-36	1094	1091	-3	3907	3857	-50

--Continued

Table 1.--Quarterly marketings, average weight, and commercial slaughter of fed beef, 1954-70--Continued

Year	Quarter	Marketings (MFC)			Average weight (AWTF)			Commercial slaughter fed beef (CSFC)		
		Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.
	2	3726	3705	-21	1093	1096	3	4073	4062	-11
	3	3627	3572	-55	1073	1072	-1	3892	3829	-63
	4	3636	3503	-133	1074	1081	7	3905	3787	-118
1962	1	3866	3784	-82	1075	1090	15	4156	4164	8
	2	3921	3938	17	1072	1083	11	4203	4264	61
	3	3844	3849	5	1027	1028	1	3948	3958	10
	4	3802	3828	26	1049	1060	11	3988	4057	69
1963	1	4099	4138	39	1087	1088	1	4456	4504	48
	2	4348	4394	46	1096	1091	-5	4765	4794	29
	3	4141	4162	21	1074	1060	-14	4447	4412	-35
	4	4220	4106	-114	1082	1086	4	4566	4461	-105
1964	1	4494	4441	-53	1113	1103	-10	5000	4900	-100
	2	4815	4779	-36	1091	1083	-8	5253	5177	-76
	3	4554	4377	-177	1043	1048	5	4750	4585	-165
	4	4456	4376	-80	1058	1062	4	4714	4648	-66
1965	1	4822	4734	-88	1063	1072	9	5126	5074	-52
	2	4702	4729	27	1046	1045	-1	4918	4943	25
	3	4745	4753	8	1018	1020	2	4830	4848	18
	4	4667	4664	-3	1042	1050	8	4863	4895	32
1966	1	5057	5048	-9	1071	1064	-7	5416	5373	-43
	2	5230	5196	-34	1066	1058	-8	5575	5500	-75
	3	5240	5311	71	1044	1037	-7	5471	5509	38
	4	5081	5115	34	1076	1077	1	5467	5509	42
1967	1	5449	5540	91	1089	1086	-3	5934	6016	82
	2	5780	5776	-4	1080	1068	-12	6242	6170	-72
	3	5409	5524	115	1041	1037	-4	5631	5726	95
	4	5317	5397	80	1056	1057	1	5615	5708	93

--Continued

Table 1.--Quarterly marketings, average weight, and commercial slaughter of fed beef, 1954-70--Continued

Year	Quarter	Marketings (MFC)			Average weight (AWTF)			Commercial slaughter fed beef (CSFC)		
		Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.
1968	1	5858	5847	-11	1065	1075	10	6239	6289	50
	2	5968	5943	-25	1067	1072	5	6368	6373	5
	3	5816	5782	-34	1030	1020	-10	5990	5900	-90
	4	5662	5697	35	1052	1059	7	5956	6032	76
1969	1	6243	6174	-69	1044	1054	10	6518	6505	-13
	2	6090	6133	43	1056	1059	3	6431	6493	32
	3	6282	6210	-72	1035	1044	9	6502	6487	-15
	4	6315	6296	-19	1065	1067	2	6725	6716	-9
1970	1	6490	6416	-74	1088	1104	16	7060	7085	25
	2	6535	6514	-21	1088	1103	15	7110	7187	77

Table 2.--Average weight, commercial slaughter, and beef production from nonfed cattle, 1954-70

Year	Quarter	Average weight (AWTNF)			Marketings (MNFC)			Beef production (BPNF)		
		Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.
			Pounds			Mil. lb.			Mil. lb.	
1954	3	---	---	---	---	---	---	---	---	---
	4	---	---	---	---	---	---	---	---	---
1955	1	---	---	---	---	---	---	---	---	---
	2	---	---	---	---	---	---	---	---	---
	3	881	896	15	3648	3497	-151	1850	1840	-10
	4	907	917	10	3509	3498	-11	1735	1788	53
1956	1	921	916	-5	3061	3022	-39	1561	1547	-14
	2	893	896	3	3166	3182	16	1639	1667	28
	3	885	900	15	3760	3726	-34	1916	1960	44
	4	905	920	15	3993	3807	-186	1952	1946	-6
1957	1	910	919	9	3138	3146	8	1586	1611	25
	2	894	899	5	3186	3311	125	1644	1735	91
	3	892	903	11	3669	3439	-230	1885	1809	-76
	4	921	923	2	3521	3416	-105	1770	1746	-24
1958	1	945	922	-23	2809	2735	-74	1402	1400	-2
	2	916	902	-14	2728	2674	-54	1401	1401	0
	3	908	906	-2	2710	2710	0	1417	1425	8
	4	934	926	-8	2647	2662	15	1356	1360	4
1959	1	926	925	-1	1962	1837	-125	1000	940	-60
	2	931	906	-25	2274	2201	-73	1199	1154	-45
	3	917	909	-8	2420	2444	24	1282	1285	3
	4	945	929	-16	2685	2622	-63	1404	1340	-64
1960	1	938	928	-10	2320	2127	-193	1201	1089	-112
	2	915	909	-6	2545	2392	-153	1344	1254	-90
	3	906	912	6	2960	3006	46	1572	1581	9
	4	932	932	0	2873	2892	19	1478	1478	0

-- Continued

Table 2.--Average weight, commercial slaughter, and beef production from nonfed cattle, 1954-70--Continued

Year	Quarter	Average weight (AWTNF)			Marketings (MNFC)			Beef production (BPNF)		
		Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.
1961	1	930	931	1	2347	2253	-94	1219	1154	-65
	2	915	912	-3	2499	2519	20	1347	1320	-27
	3	927	915	-12	2753	3015	262	1499	1586	87
	4	942	935	-7	2684	2797	113	1399	1429	30
1962	1	935	935	0	2273	2249	-24	1176	1152	-24
	2	888	915	27	2291	2263	-28	1206	1186	-20
	3	931	918	-13	2762	2679	-83	1452	1409	-43
	4	937	938	1	2599	2403	-196	1319	1228	-91
1963	1	935	938	3	2161	2044	-117	1119	1047	-72
	2	908	918	10	2161	2301	140	1160	1206	46
	3	926	921	-5	2661	2560	-101	1441	1346	-95
	4	936	942	6	2675	2685	10	1388	1372	-16
1964	1	934	941	7	2299	2469	170	1222	1264	42
	2	936	921	-15	2705	2817	112	1458	1476	18
	3	931	925	-6	3206	3516	310	1702	1850	148
	4	947	945	-2	3513	3390	-123	1804	1732	-72
1965	1	943	944	1	2709	2762	53	1396	1414	18
	2	926	924	-2	2758	2689	-69	1433	1409	-24
	3	931	928	-3	3485	3407	-78	1813	1792	-21
	4	950	948	-2	3627	3761	134	1840	1922	82
1966	1	933	947	14	2943	2778	-165	1483	1422	-61
	2	912	927	15	2805	2886	81	1446	1512	66
	3	923	931	8	3233	3197	-36	1726	1682	-44
	4	937	951	14	3175	3350	175	1680	1712	32
1967	1	929	950	21	2676	2560	-116	1401	1311	-90
	2	908	931	23	2504	2505	1	1361	1313	-48
	3	938	934	-4	2951	3132	181	1610	1647	37

--Continued

Table 2.--Average weight, commercial slaughter, and beef production from nonfed cattle, 1954-70--Continued

Year	Quarter	Average weight (AWTNF)			Marketings (MNFC)			Beef production (BPNF)		
		Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.
	4	952	954	2	2983	3019	36	1566	1543	-23
1968	1	947	953	6	2481	2550	69	1308	1305	-3
	2	903	934	31	2314	2501	187	1260	1310	50
	3	943	937	-6	3109	3197	88	1723	1682	-41
	4	960	957	-3	3058	2912	-146	1660	1488	-172
1969	1	960	957	-3	2326	2473	147	1232	1266	34
	2	908	937	29	2148	2189	41	1156	1147	-9
	3	929	940	11	2620	2624	4	1452	1380	-72
	4	939	960	23	2517	2527	10	1403	1291	-112
1970	1	932	960	28	1886	1899	13	1039	973	-66
	2	877	940	63	1876	1943	67	1056	1018	-38

Table 3.--Imports and exports of beef, per capita fed beef consumption, and per capita nonfed beef supply for consumption, 1954-70

Year	Qtr.	Beef imports (IB)			Beef exports (XB)			Per capita fed beef consumption (PCFBC)			Per capita nonfed beef supply (PCNFBS)		
		Rptd.	Pred.	Pred. -Rptd.	Rptd.	Pred.	Pred. -Rptd.	Rptd.	Pred.	Pred. -Rptd.	Rptd.	Pred.	Pred. -Rptd.
		- -	Mil. lb.	- -	- -	Mil. lb.	- -	- - -	Pounds	- - -	- - -	Pounds	- - - -
1954	3	---	---	---	---	---	---	---	---	---	---	---	---
	4	---	---	---	---	---	---	---	---	---	---	---	---
1955	1	---	---	---	---	---	---	---	---	---	9.7	---	---
	2	---	---	---	---	---	---	---	---	---	10.1	---	---
	3	75	91	16	15	19	4	9.7	9.7	0	12.1	12.1	0
	4	54	20	-34	16	22	6	10.0	10.1	.1	11.2	11.4	.2
1956	1	46	45	-1	29	25	-4	11.2	11.1	-.1	10.6	10.6	0
	2	46	83	37	17	24	7	10.9	11.1	.2	10.9	11.4	.5
	3	61	35	-26	22	24	2	9.3	9.4	.1	12.3	12.6	.3
	4	58	0	-58	41	27	-14	9.9	10.2	.3	12.2	12.0	-.2
1957	1	59	31	-28	54	29	-25	11.2	11.1	-.1	10.7	10.7	0
	2	79	67	-12	23	25	2	10.0	9.9	-.1	10.9	11.3	.4
	3	97	144	47	18	22	4	9.7	10.2	.5	12.0	11.8	-.2
	4	136	115	-21	17	23	6	9.4	9.9	.5	11.5	11.3	-.2
1958	1	156	44	-112	13	23	10	10.0	10.4	.4	9.6	9.1	-.5
	2	223	189	-34	10	18	8	10.0	9.9	-.1	9.8	9.5	-.3
	3	282	286	4	11	11	0	11.1	11.2	.1	10.2	10.0	-.2
	4	235	261	26	13	11	-2	11.0	10.7	-.3	9.6	9.7	.1
1959	1	209	263	54	11	13	2	11.9	11.7	-.2	7.8	7.5	-.3
	2	283	310	27	12	8	-4	11.7	11.3	-.4	9.2	8.8	-.4
	3	333	327	-6	13	6	-7	12.0	12.1	.1	9.9	9.6	-.3
	4	222	291	69	15	10	-5	11.3	11.7	.4	9.9	9.8	-.1
1960	1	167	279	112	13	14	1	12.7	12.7	0	8.6	8.6	0
	2	189	204	15	13	14	1	12.0	12.0	0	9.2	8.9	-.3
	3	265	317	52	14	11	-3	12.1	12.1	0	10.8	11.1	.3
	4	139	191	52	15	16	1	11.7	11.6	-.1	9.7	10.0	.3
1961	1	167	179	12	15	19	4	12.8	12.7	-.1	8.4	8.1	-.3

--Continued

Table 3.--Imports and exports of beef, per capita fed beef consumption, and per capita nonfed beef supply for consumption, 1954-70--Continued

Year	Qtr.	Beef imports (IB)			Beef exports (XB)			Per capita fed beef consumption (PCFBC)			Per capita nonfed beef supply (PCNFBS)		
		Rptd.	Pred.	Pred. -Rptd.	Rptd.	Pred.	Pred. -Rptd.	Rptd.	Pred.	Pred. -Rptd.	Rptd.	Pred.	Pred -Rptd.
	2	254	304	50	14	11	-3	13.3	13.3	0	9.4	9.5	.1
	3	323	314	-9	14	11	-3	12.6	12.4	-.2	10.6	11.1	.5
	4	277	266	-11	13	18	5	12.7	12.3	-.4	9.9	9.9	0
1962	1	318	258	-60	12	19	7	13.5	13.4	-.1	9.0	8.5	-.5
	2	280	302	22	13	13	0	13.6	13.8	.2	8.8	8.8	0
	3	437	416	-21	12	10	-2	12.7	12.7	0	10.6	10.5	-.1
	4	384	380	-4	14	14	0	12.7	13.0	.3	9.7	9.2	-.5
1963	1	367	379	12	12	14	2	14.2	14.4	.2	8.7	8.5	-.2
	2	351	312	-39	11	11	0	15.2	15.3	.1	8.9	9.0	.1
	3	519	519	0	14	11	-3	14.1	14.0	-.1	11.2	10.8	-.4
	4	414	472	58	15	16	1	14.4	14.1	-.3	10.5	10.6	.1
1964	1	314	360	46	15	21	6	15.7	15.4	-.3	9.3	9.7	.4
	2	319	286	-33	23	21	-2	16.4	16.1	-.3	10.4	10.2	-.2
	3	292	294	2	19	20	1	14.8	14.2	-.6	11.6	12.3	.7
	4	251	248	-3	34	25	-9	14.6	14.4	-.2	11.8	11.2	-.6
1965	1	190	232	42	27	28	1	15.9	15.7	-.2	9.5	9.7	.2
	2	201	275	74	21	22	1	15.1	15.2	.1	9.4	9.6	.2
	3	274	294	20	19	16	-3	14.8	14.8	0	11.3	11.5	.2
	4	258	255	-3	24	19	-5	14.8	14.9	.1	11.4	12.0	.6
1966	1	228	219	-9	22	25	3	16.5	16.4	-.1	9.7	9.4	-.3
	2	290	255	-35	19	20	1	16.9	16.7	-.2	9.6	9.8	.2
	3	353	386	33	20	14	-6	16.6	16.6	0	11.3	11.3	0
	4	312	245	-67	22	17	-5	16.6	16.7	.1	11.0	11.0	0
1967	1	288	322	34	24	19	-5	17.9	18.2	.3	9.7	9.5	-.2
	2	259	352	93	21	16	-5	18.8	18.5	-.3	9.3	9.6	.3
	3	407	360	-47	21	14	-7	16.9	17.2	.3	11.2	11.2	0
	4	359	348	-11	22	16	-6	16.7	17.0	.3	10.4	10.5	.1

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Table 3.--Imports and exports of beef, per capita fed beef consumption, and per capita nonfed beef supply for consumption, 1954-70--Continued

Year	Qtr.	Beef Imports (IB)			Beef exports (XB)			Per capita fed beef consumption (PCFBC)			Per capita nonfed beef supply (PCNFBS)		
		Rptd.	Pred.	Pred. -Rptd.	Rptd.	Pred.	Pred. -Rptd.	Rptd.	Pred.	Pred. -Rptd.	Rptd.	Pred.	Pred. -Rptd.
1968	1	315	332	17	21	17	-4	18.7	18.8	.1	9.2	9.5	.3
	2	345	361	16	22	15	-7	19.0	19.0	0	8.7	9.2	.5
	3	465	364	-101	23	12	-11	17.9	17.6	-.3	11.6	11.4	-.2
	4	375	349	-26	22	15	-7	17.7	18.0	.3	11.0	10.3	-.7
1969	1	334	327	-7	18	17	-1	19.4	19.3	-.1	8.9	9.3	.4
	2	380	362	-18	16	13	-3	19.4	19.3	-.1	8.3	8.3	0
	3	547	557	10	20	8	-12	19.3	19.3	0	10.8	10.8	0
	4	353	453	100	20	9	-11	19.8	19.8	0	9.9	9.9	0
1970	1	497	499	2	22	11	-11	20.8	20.9	.1	8.9	8.7	-.2
	2	356	364	8	24	7	-17	20.8	21.1	.3	8.3	8.1	-.2

Table 4.--Commercial hog slaughter, pork production, and ending stocks of pork, 1954-70

Year	Quarter	Commercial hog slaughter (CHS)			Pork production (PP)			Ending stocks of pork (ESP)		
		Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.
		Mil. lb.			Mil. lb.			Mil. lb.		
1954	3	---	---	---	---	---	---	---	---	---
	4	---	---	---	---	---	---	---	---	---
1955	1	---	---	---	---	---	---	---	---	---
	2	---	---	---	---	---	---	376	---	---
	3	3723	3649	-74	2128	2087	-41	179	191	12
	4	5562	5475	-87	3166	3115	-51	421	388	-33
1956	1	5240	5144	-96	2934	2880	-54	514	485	-29
	2	4100	4143	43	2300	2324	24	394	382	-12
	3	3825	3844	19	2178	2187	9	166	192	26
	4	5064	5109	45	2872	2897	25	280	316	36
1957	1	4470	4463	-7	2522	2517	-5	352	351	-1
	2	4004	3828	-176	2234	2136	-98	277	257	-20
	3	3738	3870	132	2141	2218	77	134	147	13
	4	4695	4695	0	2682	2681	-1	194	209	15
1958	1	4137	4120	-17	2375	2365	-10	224	222	-2
	2	3915	3900	-15	2250	2243	-7	210	198	-12
	3	3879	3739	-140	2254	2172	-82	127	90	-37
	4	4764	4763	-1	2739	2739	0	206	176	-30
1959	1	4824	4806	-18	2790	2778	-12	337	290	-47
	2	4473	4489	16	2568	2577	9	313	284	-29
	3	4440	4505	65	2560	2595	35	163	194	31
	4	5568	5518	-50	3213	3184	-29	264	299	35
1960	1	5118	5029	-89	2979	2927	-52	338	364	26
	2	4590	4384	-206	2667	2547	-120	351	280	-71
	3	4173	4261	88	2419	2472	53	158	168	10
	4	4776	4873	97	2798	2856	58	170	191	21
1961	1	4695	4632	-63	2750	2714	-36	244	254	10

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Table 4.--Commercial hog slaughter, pork production, and ending stocks of pork, 1954-70--Continued

Year	Quarter	Commercial hog slaughter (CHS)			Pork production (PP)			Ending stocks of pork (ESP)		
		Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.
	2	4506	4493	-13	2600	2593	-7	240	282	42
	3	4119	4303	184	2403	2509	106	128	159	31
	4	5067	5132	65	2977	3018	41	200	211	11
1962	1	4872	4885	13	2891	2897	6	280	298	18
	2	4671	4684	13	2749	2754	5	295	301	6
	3	4140	4117	-23	2452	2437	-15	139	119	-20
	4	5299	5115	-184	3137	3028	-109	230	182	-48
1963	1	5083	5186	103	3041	3101	60	333	332	-1
	2	4785	4808	23	2847	2861	14	324	342	18
	3	4458	4415	-43	2660	2636	-24	210	177	-33
	4	5500	5554	54	3315	3349	34	277	289	12
1964	1	5302	5205	-97	3187	3128	-59	411	379	-32
	2	4798	4940	142	2862	2944	82	413	385	-28
	3	4339	4446	107	2606	2668	62	184	204	20
	4	5562	5535	-27	3364	3349	-15	284	291	7
1965	1	4870	4902	32	2961	2980	19	335	330	-5
	2	4255	4416	161	2579	2676	97	224	264	40
	3	3748	3739	-9	2478	2471	-7	126	111	-15
	4	4440	4489	49	2718	2748	30	152	137	-15
1966	1	4226	4234	8	2645	2650	5	217	212	-5
	2	4280	4340	60	2639	2673	34	214	254	40
	3	4215	4211	-4	2617	2615	-2	151	158	7
	4	5185	5168	-17	3229	3220	-9	234	252	18
1967	1	5144	5188	44	3224	3253	29	331	388	57
	2	4607	4674	67	2869	2912	43	293	349	56
	3	4622	4525	-97	2893	2833	-60	203	211	8
	4	5407	5510	103	3391	3455	64	286	288	2

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Table 4.--Commercial hog slaughter, pork production, and ending stocks of pork, 1954-70--Continued

Year	Quarter	Commercial hog slaughter (CHS)			Pork production (PP)			Ending stocks of pork (ESP)		
		Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.
1968	1	5042	5300	258	3197	3360	163	306	408	102
	2	4972	5022	50	3122	3154	32	326	385	59
	3	4754	4592	-162	2998	2893	-105	242	222	-20
	4	5601	5591	-10	3560	3550	-10	296	308	12
1969	1	5226	5126	-100	3353	3286	-67	270	268	-2
	2	4901	4826	-75	3138	3088	-50	312	317	5
	3	4711	4451	-260	2988	2822	-166	174	199	25
	4	5175	5061	-114	3304	3219	-85	218	242	24
1970	1	4743	4816	73	3052	3082	30	266	229	-37
	2	4864	4846	-18	3136	3101	-35	297	325	-28

Table 5.--Imports and exports of pork and per capita pork supply, 1954-70

Year	Quarter	Pork imports (IP)			Pork exports (XP)			Per capita pork supply (PCPS)		
		Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.
		- - -	Mil. lb.	- - -	- - -	Mil. lb.	- - -	- - - -	Pounds	- - - - -
1954	3	---	---	---	---	---	---	14.9	---	---
	4	---	---	---	---	---	---	19.8	---	---
1955	1	---	---	---	---	---	---	19.5	---	---
	2	---	---	---	---	---	---	16.1	---	---
	3	44	31	-13	26	26	0	15.2	14.9	-.3
	4	42	33	-9	35	33	-2	20.1	19.8	-.3
1956	1	41	38	-3	40	42	2	20.1	19.5	-.6
	2	46	26	-20	32	41	9	16.8	16.6	-.2
	3	34	25	-9	29	30	1	15.2	15.2	0
	4	30	33	3	37	35	-2	17.8	18.2	.4
1957	1	39	41	2	44	38	-6	16.4	16.6	.2
	2	38	37	-1	41	33	-8	15.1	14.5	-.6
	3	30	40	10	28	23	-5	14.0	14.4	.4
	4	37	45	8	31	33	2	16.3	16.4	.1
1958	1	42	49	7	31	33	2	14.8	14.9	.1
	2	48	47	-1	29	28	-1	14.3	14.2	-.1
	3	49	54	5	27	23	-4	14.2	13.7	-.5
	4	54	58	4	31	31	0	16.4	16.3	-.1
1959	1	51	60	9	36	33	-3	17.1	16.9	-.2
	2	53	51	-2	32	35	3	16.5	16.3	-.2
	3	42	45	3	37	31	-6	16.2	16.3	.1
	4	40	44	4	38	42	4	19.0	19.0	0
1960	1	46	47	1	35	44	9	18.2	18.0	-.2
	2	51	44	-7	35	41	6	16.7	16.1	-.6
	3	45	46	1	30	32	2	15.4	15.3	-.1
	4	44	49	5	38	40	2	16.4	16.8	.4
1961	1	48	54	6	36	38	2	16.1	16.0	-.1

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Table 5.--Imports and exports of pork and per capita pork supply, 1954-70

Year	Quarter	Pork imports (IP)			Pork exports (XP)			Per capita pork supply (PCPS)		
		Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.
	2	42	54	12	35	35	0	15.6	15.7	.1
	3	44	53	9	33	32	-1	14.4	15.3	.9
	4	53	52	-1	35	41	6	16.9	17.3	.4
1962	1	55	58	3	29	41	12	16.8	16.9	.1
	2	56	58	2	36	39	3	16.4	16.5	.1
	3	50	56	6	31	36	5	14.8	14.8	0
	4	55	56	1	36	41	5	17.6	16.9	-.7
1963	1	57	65	8	51	40	-11	17.4	17.6	.2
	2	56	62	6	51	42	-9	16.9	17.1	.2
	3	53	57	4	41	39	-2	15.8	15.8	0
	4	59	57	-2	65	45	-20	18.5	18.6	.1
1964	1	58	64	6	74	47	-27	18.1	18.0	-.1
	2	55	60	5	60	45	-15	17.1	17.4	.3
	3	57	62	5	40	41	1	15.7	15.9	.2
	4	61	63	2	28	47	19	18.6	18.6	0
1965	1	70	71	1	31	48	17	17.0	17.0	0
	2	87	66	-21	32	43	11	15.3	15.6	-.3
	3	83	69	-14	28	36	8	14.1	14.2	.1
	4	93	78	-15	39	41	2	14.7	14.7	0
1966	1	107	90	-17	30	36	6	14.6	14.4	-.2
	2	98	94	-4	33	34	1	14.8	15.0	.2
	3	79	94	15	32	33	1	14.6	14.8	.2
	4	97	93	-4	45	43	-2	17.4	17.4	0
1967	1	104	97	-7	38	45	7	17.8	18.0	.2
	2	98	91	-7	32	47	15	16.4	16.8	.4
	3	90	86	-4	33	41	8	16.3	16.2	-.1
	4	100	91	-9	43	49	6	18.4	18.6	.2
1968	1	107	98	-9	33	50	17	17.8	18.5	.7

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Table 5.--Imports and exports of pork and per capita pork supply, 1954-70--Continued

Year	Quarter	Pork imports (IP)			Pork exports (XP)			Per capita pork supply (PCPS)		
		Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.
	2	108	92	-16	35	50	15	17.4	17.9	.5
	3	104	93	-11	53	45	-8	16.8	16.5	-.3
	4	97	94	-3	66	51	-15	18.9	19.0	.1
1969	1	92	103	11	57	52	-5	18.1	18.1	0
	2	120	101	-19	53	49	-4	17.2	16.9	-.3
	3	97	103	6	45	42	-3	16.2	15.8	-.4
	4	110	109	-1	68	49	-19	17.3	17.1	-.2
1970	1	120	119	-1	50	47	-3	16.4	16.7	.3
	2	115	121	6	35	44	9	16.8	16.7	-.1

Table 6.--Wholesale prices of choice 600-700 pound carcasses, utility cow carcasses and 100 pounds of pork products

Year	Quarter	(PRFBW) Choice 600-700 lb.			(PRNFB) Utility cow beef			(PRPN) Pork products		
		Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.
		$/ cwt.			$/ cwt.			$/ cwt.		
1954	3	---	---	---	---	---	---	---	---	---
	4	---	---	---	---	---	---	---	---	---
1955	1	---	---	---	24.86	---	---	41.03	---	---
	2	---	---	---	26.67	---	---	43.48	---	---
	3	39.63	38.87	-.76	26.47	29.41	2.94	43.20	45.36	2.16
	4	37.08	37.09	.01	23.87	26.01	2.14	35.60	34.20	-1.40
1956	1	34.15	36.11	1.96	23.32	23.37	.05	34.00	33.13	- .87
	2	35.24	34.62	-.62	26.13	26.05	-.08	42.23	40.07	-2.16
	3	42.32	40.25	-2.07	27.39	26.77	-.62	41.44	43.90	2.46
	4	40.24	37.09	-3.15	26.39	25.27	-1.12	39.14	39.56	.42
1957	1	36.40	37.69	1.29	23.92	26.34	2.42	42.52	43.03	.51
	2	39.65	40.95	1.30	28.94	28.33	-.61	44.97	46.97	2.00
	3	42.62	42.20	-.42	30.00	30.93	.93	49.22	47.31	-1.91
	4	41.83	41.57	-.26	29.23	29.74	.51	43.52	44.79	1.27
1958	1	46.37	45.93	-.44	34.60	34.69	.09	48.65	48.59	-.06
	2	47.43	47.17	-.26	39.08	40.39	1.31	51.94	52.79	.85
	3	45.16	45.30	.14	39.59	38.92	-.67	51.53	53.62	2.09
	4	45.20	45.40	.20	38.15	36.69	-1.46	45.50	46.63	1.13
1959	1	47.53	48.61	1.08	37.45	39.00	1.55	41.56	41.93	.37
	2	47.96	47.55	-.41	38.03	36.93	-1.10	41.61	41.21	-.40
	3	46.31	45.81	-.50	37.19	37.77	.58	39.47	39.87	.40
	4	44.61	43.55	-1.06	34.68	32.70	-1.98	36.31	35.29	-1.02
1960	1	45.78	43.35	-2.43	33.76	32.38	-1.38	37.87	38.44	.57
	2	46.03	46.00	-.03	34.64	36.13	1.49	41.63	42.28	.65
	3	43.39	42.39	-1.00	32.97	31.68	-1.29	43.12	42.58	-.54
	4	42.81	44.29	1.48	33.17	33.99	.82	43.33	42.48	-.85

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Table 6.--Wholesale prices of choice 600-700 pound carcasses, utility cow carcasses and 100 pounds of pork products--Continued

Year	Quarter	(PRFBW) Choice 600-700 lb.			(PRNFB) Utility cow beef			(PRPN) Pork products		
		Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.
1961	1	44.52	45.89	1.37	33.87	36.26	2.39	43.20	43.71	.51
	2	40.77	40.83	.06	32.53	33.22	.69	41.24	41.65	.41
	3	40.18	42.70	2.52	33.09	31.30	-1.79	43.74	42.17	-1.57
	4	42.22	44.68	2.46	32.92	33.64	.72	41.72	41.89	.17
1962	1	44.33	45.04	.71	33.66	33.67	.01	41.64	41.76	.12
	2	44.00	44.12	.12	33.59	35.55	1.96	41.08	40.65	-.43
	3	45.94	45.74	-.20	34.16	34.15	-.01	45.56	44.80	-.76
	4	47.21	46.26	-.95	33.53	36.79	3.26	42.72	43.51	.79
1963	1	43.14	43.76	.62	32.01	32.87	.86	39.28	39.50	.22
	2	40.41	40.36	-.05	32.23	33.85	1.62	39.00	38.48	-.52
	3	42.49	42.71	.22	31.45	31.59	.14	43.32	41.62	-1.70
	4	40.19	40.55	.36	30.14	28.66	-1.48	39.75	37.43	-2.32
1964	1	38.95	39.42	.47	28.81	27.19	-1.62	38.89	38.44	.45
	2	37.88	37.29	-.59	30.14	28.55	-1.59	38.74	39.12	.38
	3	41.81	41.06	-.75	29.97	25.72	-4.25	42.88	42.67	-.21
	4	40.64	41.17	.53	26.63	26.63	0	39.65	39.71	.06
1965	1	39.75	39.60	-.15	26.60	28.81	2.21	41.34	40.94	-.40
	2	43.53	43.61	.08	30.81	33.51	2.70	46.21	45.88	-.33
	3	44.67	45.45	.78	31.14	32.08	.94	54.16	52.62	-1.54
	4	42.86	41.64	-1.22	30.43	28.96	-1.47	56.20	55.88	-.32
1966	1	44.88	45.07	.19	33.99	34.33	.34	59.16	57.47	-1.69
	2	44.38	44.04	-.34	37.34	34.60	-2.74	53.16	53.18	.02
	3	43.14	44.10	.96	36.62	36.75	.13	55.65	55.55	-.10
	4	42.04	43.16	1.12	34.93	35.05	.12	51.25	49.50	-1.75
1967	1	42.36	42.81	.45	35.34	34.27	-1.07	47.53	47.07	-.46
	2	43.13	42.98	-.15	36.42	34.50	-1.92	47.08	46.53	-.55
	3	46.24	46.49	.25	37.15	38.54	1.39	51.40	52.90	1.50
	4	45.23	44.48	-.75	34.56	36.22	1.66	46.54	45.53	-1.01

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Table 6.--Wholesale prices of choice 600-700 pound carcasses, utility cow carcasses and 100 pounds of pork products--Continued

Year	Quarter	(PRFBW) Choice 600-700 lb.			(PRNFB) Utility cow beef			(PRPN) Pork products		
		Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.
1968	1	45.95	44.92	-1.03	36.22	34.70	-1.52	47.06	45.98	-1.08
	2	46.54	47.43	.89	38.89	36.01	-2.88	48.27	47.40	-.87
	3	47.52	48.98	1.46	38.52	38.48	-.04	50.61	50.32	-.29
	4	46.66	46.09	-.57	36.07	37.41	1.34	47.81	48.40	.59
1969	1	48.13	47.54	-.59	39.43	36.57	-2.86	49.52	50.09	.57
	2	53.92	52.34	-1.58	42.96	41.38	-1.58	51.99	53.54	1.55
	3	53.86	51.92	-1.94	40.75	43.11	2.36	58.74	57.87	-.87
	4	47.60	48.97	1.37	38.60	42.52	3.92	58.80	59.40	.60
1970	1	50.25	49.48	-.77	45.00	41.99	-3.01	61.12	60.97	-.15
	2	52.39	52.56	.17	45.50	44.17	-1.33	57.13	59.93	2.80

Table 7.--Ending stocks of beef, price of choice steers, and price of barrows-gilts, 1954-70

Year	Quarter	Stocks of beef (ESB)			Steer price (PRFBL)			Hog price (PRPL)		
		Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.
		- - -	Mil. lb.	- - -	- - -	$ /cwt.	- - -	- - -	$ /cwt.	- - -
1954	3	---	---	---	---	---	---	---	---	---
	4	---	---	---	24.40	---	---	---	---	---
1955	1	---	---	---	25.13	---	---	19.39	---	---
	2	106	---	---	23.02	---	---	17.92	---	---
	3	110	135	25	22.33	22.12	-.21	16.81	18.12	1.31
	4	205	222	17	20.90	20.65	-.25	12.40	12.50	.10
1956	1	188	260	72	19.47	20.06	.59	12.44	12.02	-.42
	2	136	166	30	20.30	19.39	-.93	16.00	15.68	-.32
	3	117	134	17	23.76	23.13	-.63	16.54	17.60	1.06
	4	244	214	-30	22.68	21.02	-1.66	15.74	15.86	.12
1957	1	180	169	-11	20.84	21.29	.45	17.43	17.73	.30
	2	113	107	-6	22.85	23.57	.72	18.61	19.32	.71
	3	105	129	24	24.30	24.51	.21	20.47	19.80	-.67
	4	134	171	37	24.27	23.90	-.37	17.55	18.27	.72
1958	1	110	101	-9	27.09	26.78	-.31	20.21	20.37	.16
	2	108	69	-39	28.46	27.78	-.68	21.88	22.64	.76
	3	123	114	-9	26.39	26.53	.14	21.62	23.08	1.46
	4	174	160	-14	26.81	26.59	-.22	18.29	19.27	.98
1959	1	171	125	-46	27.96	28.71	.75	16.05	16.40	.35
	2	168	110	-58	28.83	28.47	-.36	16.03	15.98	-.05
	3	171	150	-21	27.62	27.28	-.34	14.29	14.96	.67
	4	202	212	10	26.06	25.37	-.69	12.53	12.74	.21
1960	1	166	178	12	26.53	25.14	-1.39	13.92	14.22	.30
	2	145	126	-19	26.86	26.96	.10	16.29	16.45	.16
	3	162	164	2	25.01	24.58	-.43	17.08	16.85	-.23
	4	170	184	14	25.28	25.76	.48	17.31	16.94	-.37

--Continued

Table 7.--Ending stocks of beef, price of choice steers, and price of barrows-gilts, 1954-70--Continued

Year	Quarter	Stocks of beef (ESB)			Steer price (PRFBL)			Hog price (PRPL)		
		Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.
1961	1	142	144	2	25.99	26.80	.81	17.66	17.81	.15
	2	155	161	6	23.66	23.70	.04	16.67	16.55	-.12
	3	171	169	-2	23.64	24.98	1.34	18.13	16.66	-1.47
	4	200	203	3	24.90	26.14	1.24	16.51	16.39	-.12
1962	1	172	173	1	25.99	26.31	.32	16.66	16.37	-.29
	2	123	165	42	25.91	25.83	-.08	16.06	15.79	-.27
	3	145	157	12	26.98	26.87	-.11	18.54	17.94	-.60
	4	189	201	12	28.31	27.19	-1.12	16.51	17.40	.89
1963	1	190	202	12	24.85	25.38	.53	14.95	15.22	.27
	2	190	209	19	22.89	23.16	.27	15.30	14.55	-.75
	3	220	202	-18	24.41	24.67	.26	17.29	16.19	-1.10
	4	281	269	-12	22.83	23.29	.46	14.72	14.09	-.63
1964	1	271	251	-20	21.86	22.47	.61	14.63	14.62	-.01
	2	287	254	-33	20.94	21.21	.27	14.94	14.99	.05
	3	257	232	-25	23.73	23.69	-.04	16.97	16.88	-.09
	4	315	283	-32	23.38	23.74	.36	15.12	15.62	.50
1965	1	245	244	-1	22.95	22.66	-.29	16.68	16.33	-.35
	2	172	195	23	25.35	25.44	.09	20.43	19.84	-.59
	3	194	210	16	26.19	26.90	.71	23.95	23.18	-.77
	4	260	264	4	25.24	24.42	-.82	25.25	24.81	-.44
1966	1	228	224	-4	26.76	26.80	.04	26.71	26.03	-.68
	2	212	225	13	26.41	26.25	-.16	23.38	23.57	.19
	3	231	257	26	25.42	26.22	.80	24.67	24.68	.01
	4	307	315	8	24.36	25.37	1.01	20.37	20.25	-.12
1967	1	300	306	6	24.51	25.04	.53	19.09	19.74	.65
	2	276	284	8	24.63	25.10	.47	20.58	19.89	-.69
	3	243	278	35	26.45	26.56	.11	21.03	22.31	1.28
	4	275	322	47	25.79	26.00	.21	17.60	17.04	-.56

--Continued

Table 7.--Ending stocks of beef, price of choice steers, and price of barrows-gilts, 1954-70--Continued

Year	Quarter	Stocks of beef (ESB)			Steer price (PRFBL)			Hog price (PRPL)		
		Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.
1968	1	225	242	17	26.21	26.26	.05	18.93	18.58	-.35
	2	199	295	96	26.52	28.02	1.50	19.44	19.30	-.14
	3	242	290	48	27.12	28.94	1.82	20.50	20.58	.08
	4	296	344	48	27.15	27.09	-.06	18.32	19.55	1.23
1969	1	275	243	-32	27.63	28.04	.41	20.29	20.67	.38
	2	256	272	16	31.53	31.36	-.17	22.89	23.11	.22
	3	304	310	6	30.37	31.15	.78	26.76	26.34	-.42
	4	341	361	20	28.10	29.20	1.10	26.82	25.76	-1.16
1970	1	373	334	-39	29.45	29.89	.44	27.50	26.27	-1.23
	2	312	308	-4	31.35	32.10	.75	24.00	26.02	2.02

Table 8.--Price of Good and Choice feeder steers, sows farrowing, and placements of cattle on feed, 1954-70

Year	Quarter	Feeder price (PRFC) Reported	Feeder price (PRFC) Predicted	Feeder price (PRFC) Pred.-Rptd.	Sows farrowing (SF) Reported	Sows farrowing (SF) Predicted	Sows farrowing (SF) Pred.-Rptd.	Placements (PL) Reported	Placements (PL) Predicted	Placements (PL) Pred.-Rptd.
			$/cwt.			1,000 hd.			1,000 hd.	
1954	3	19.00	---	---	2758	---	---	---	---	---
	4	19.25	---	---	2556	---	---	---	---	---
1955	1	21.50	---	---	2497	---	---	2010	---	---
	2	20.87	---	---	5850	---	---	1729	---	---
	3	20.34	20.11	-.23	2965	2963	-2	2565	2781	216
	4	18.65	19.10	.45	2634	2623	-11	4600	4566	-34
1956	1	18.26	18.74	.48	2539	2568	29	2003	2048	45
	2	18.16	17.84	-.32	5116	5251	135	1911	2007	96
	3	19.08	17.97	-1.11	2641	2516	-125	2945	2685	-260
	4	18.53	16.66	-1.87	2540	2354	-186	4678	4379	-299
1957	1	18.95	18.95	0	2387	2435	48	2028	2175	147
	2	21.35	20.91	-.44	4807	4881	74	1931	1960	29
	3	22.63	22.47	-.16	2677	2439	-238	2298	2391	93
	4	22.64	23.03	.39	2435	2459	24	4794	4470	-324
1958	1	25.29	25.15	-.14	2680	2620	-60	2594	2576	-18
	2	27.90	28.22	.32	4601	4814	213	2150	2031	-119
	3	27.88	27.42	-.46	3141	3172	31	2402	2461	59
	4	28.35	28.27	-.08	2746	2754	8	5382	5251	-131
1959	1	28.95	28.61	-.34	3053	2992	-61	2662	2581	-81
	2	30.48	29.67	-.81	4943	4869	-74	2455	2406	-49
	3	29.53	28.35	-1.18	3346	3146	-200	2970	2990	20
	4	26.56	26.49	-.07	2782	2693	-89	5466	5476	10
1960	1	25.92	26.04	.12	2507	2466	-41	2916	2613	- 303
	2	26.56	26.39	-.17	4275	4211	-64	2273	2537	264
	3	24.35	23.80	-.55	3035	2801	-234	2975	2911	-64

--Continued

Table 8.--Price of Good and Choice feeder steers, sows farrowing, and placements of cattle on feed, 1954-70--Continued

Year	Quarter	Feeder price (PRFC)			Sows farrowing (SF)			Placements (PL)		
		Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.
	4	24.37	25.29	.92	2804	2578	-226	5935	6070	135
1961	1	25.47	25.68	.21	2521	2479	-42	2974	3071	97
	2	24.99	24.68	-.31	4497	4464	-33	2380	2267	-113
	3	24.61	24.79	.18	3081	2969	-112	3487	3387	-100
	4	25.01	25.12	.11	2837	2833	-4	6160	6206	46
1962	1	25.33	25.65	.32	2850	2625	-225	3124	3135	11
	2	25.90	26.64	.74	4416	4368	-48	2618	2712	94
	3	26.54	27.98	1.44	3141	3532	391	3933	3821	-112
	4	27.28	27.75	.47	2957	3001	44	6940	6715	-225
1963	1	25.83	26.10	.27	2593	2593	0	3103	3518	415
	2	24.99	25.38	.39	4506	4264	-242	3010	2906	-104
	3	25.20	24.40	-.80	3125	3359	234	4155	4054	-101
	4	23.80	23.17	-.63	2862	2817	-45	6683	6705	22
1964	1	22.94	22.34	-.60	2366	2524	158	3765	3716	-49
	2	21.19	21.60	.41	4230	3987	-243	3015	3105	90
	3	21.07	21.12	.05	2903	3116	213	4554	4440	-114
	4	20.59	21.81	1.22	2622	2660	38	7119	7257	138
1965	1	20.70	21.27	.57	2178	2322	144	3922	3906	-16
	2	23.01	23.10	.09	3712	3753	41	3619	3608	-11
	3	24.40	24.77	.37	2548	2671	123	4569	4582	13
	4	23.93	24.30	.37	2458	2428	-30	7429	7096	-333
1966	1	26.25	26.04	-.21	2221	2562	341	4823	4709	-114
	2	26.91	26.44	-.47	3980	4116	136	3831	3833	2
	3	26.53	25.44	-1.09	3009	3203	194	4823	4868	45
	4	25.89	26.12	.23	2802	2695	-107	7817	7846	29
1967	1	25.30	24.85	-.45	2451	2549	98	4777	4557	-220
	2	25.58	25.78	.20	4140	4091	-49	3991	4378	387

--Continued

Table 8.--Price of Good and Choice feeder steers, sows farrowing, and placements of cattle on feed, 1954-70--Continued

Year	Quarter	Feeder price (PRFC)			Sows farrowing (SF)			Placements (PL)		
		Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.
	3	27.22	27.30	.08	2947	2914	-33	5285	5295	10
	4	25.70	25.45	-.25	2873	2834	-39	8051	8146	95
1968	1	25.27	24.96	-.31	2549	2866	317	5229	5117	-112
	2	26.67	26.84	.17	4131	4116	-15	4575	4294	-281
	3	27.14	26.89	-.25	3162	3025	-137	6042	5691	-351
	4	26.64	26.72	.08	2994	3008	14	8620	8745	125
1969	1	27.46	27.86	.40	2614	2919	305	5230	5332	102
	2	31.50	31.89	.39	3797	3744	-53	5400	5413	-13
	3	31.27	31.64	.37	2939	3058	129	6046	6164	128
	4	30.75	31.23	.48	2790	3048	-258	8955	9079	124
1970	1	31.50	31.18	-.32	2600	2640	40	5365	5602	237
	2	33.00	33.82	.82	4423	4378	-45	5518	5611	93

Table 9.--January 1 inventories of beef cattle, 1953-70

Year (Jan. 1)	Beef calves (H21)			Beef heifers for replacement (H22R)			Beef cows (H23)		
	Reported	Predicted	Pred. -Rptd.	** Reported	Predicted	Pred. -Rptd.	Reported	Predicted	Pred. -Rptd.
	1,000 head			1,000 head			1,000 head		
1953....	17440	---	---	---	---	---	23291	---	---
1954....	17978	---	---	---	---	---	25050	---	---
1955....	18804	---	---	5938	---	---	25659	---	---
1956....	18869	18956	87	5178	5224	46	25371	25330	-41
1957....	18405	18476	71	5162	5117	-45	24534	24478	-56
1958....	18275	18397	122	5114	5188	74	24165	24278	113
1959....	19407	19637	230	5537	5507	-30	25112	25123	11
1960....	20425	20747	322	5787	5910	123	26344	26240	-104
1961....	20814	20925	111	6057	6051	-6	27327	27471	144
1962....	22300	21888	-412	6046	6083	37	28691	29074	383
1963....	23747	23700	-47	6529	6462	-67	30589	30765	176
1964....	25243	25257	14	6906	6939	33	32794	32831	37
1965....	26181	26401	220	7100	7094	-6	34238	33991	-247
1966....	26879	26866	-13	7375	7506	131	34433	34292	-141
1967....	27294	27482	188	7800	7788	-12	34685	34705	20
1968....	27559	27390	-169	7950	7950	0	35405	35391	-14
1969....	27920	28148	228	7820	7954	134	36097	36292	195
1970....	29064	29335	271	8033	8024	-9	37433	37547	114

** Derived series

Table 9a--January 1 inventory of dairy cows, annual commercial beef cow slaughter, and annual average feeder cattle price, 1953-70

Year	Dairy cows (H23) * Reported	Commercial beef cow slaughter (CBSC) ** Reported	Predicted	Pred. -Rptd.	Feeder calf Price (PRFCA) Reported	Predicted	Pred. -Rptd.
	1,000 head	- - - - - -	1,000 head	- - - - -	- - - -	- - - - - -	$ /cwt.
1953....	23549	---	---	---	---	----	---
1954....	23896	5130	---	---	---	---	---
1955....	23000	5000	5241	241	20.34	20.39	.05
1956....	22912	5000	5062	62	18.50	17.80	-.70
1957....	22325	4550	4339	-211	21.39	21.34	-.05
1958....	21265	3200	3372	172	27.35	27.27	-.08
1959....	20132	3300	3385	85	28.88	28.28	-.60
1960....	19527	3750	3629	-121	25.30	25.38	.08
1961....	19271	3600	3350	-250	25.02	25.07	.05
1962....	18963	3000	3229	229	26.26	27.01	.75
1963....	18379	3100	3165	65	24.95	24.76	-.19
1964....	17647	4150	4466	316	21.45	21.72	.27
1965....	16981	5535	5434	-101	23.01	23.36	.35
1966....	15987	5745	5721	-24	26.40	26.01	- .39
1967....	15198	5693	5714	21	25.95	25.84	-.11
1968....	14662	5842	5633	-209	26.43	26.36	-.07
1969....	14123	5195	5248	53	30.25	30.63	.38
1970....	13600						

* Exogenous variable ** Derived series

Table 10.--Exogenous variables, 1954-70

Year	Quarter	Pigs saved per sow	Military consumption		Byproduct credits		Dressing percentage for hogs
			Beef	Pork	Beef	Pork	
		Head	Mil. lb.		$/cwt.		Percent
1954	3	6.50	100	48	2.22	2.85	57.0
	4	6.50	102	63	2.20	2.85	56.5
1955	1	6.90	98	57	2.16	3.29	57.1
	2	6.90	108	66	2.12	3.30	56.6
	3	6.81	96	48	2.22	3.12	57.2
	4	6.81	100	63	1.80	2.96	56.9
1956	1	6.94	96	56	1.85	3.00	56.0
	2	6.94	102	59	2.21	3.23	56.1
	3	7.01	104	52	2.37	3.28	56.9
	4	7.01	102	62	2.27	3.59	56.7
1957	1	7.12	86	56	2.13	3.74	56.4
	2	6.72	82	47	2.37	3.47	55.8
	3	7.06	96	58	2.54	3.73	57.3
	4	7.06	86	52	2.29	3.48	57.1
1958	1	7.05	96	49	2.40	3.69	57.4
	2	7.05	84	46	2.66	3.88	57.5
	3	7.40	92	49	2.60	3.91	58.1
	4	7.17	84	48	2.59	3.57	57.5
1959	1	7.18	84	46	2.67	3.08	57.8
	2	7.08	92	48	3.21	3.02	57.4
	3	6.98	88	46	3.12	2.71	57.6
	4	6.98	84	41	2.54	2.72	57.7
1960	1	7.19	80	46	2.42	2.68	58.2
	2	6.96	96	56	2.57	2.98	58.1
	3	7.02	92	41	2.49	3.19	58.0
	4	7.02	76	40	2.44	3.31	58.6
1961	1	7.18	84	46	2.46	3.53	58.6

--Continued

Table 10.--Exogenous variables, 1954-70--Continued

Year	Quarter	Pigs saved per sow	Military consumption		Byproduct credits		Dressing percentage for hogs
			Beef	Pork	Beef	Pork	
	2	7.02	88	45	2.63	3.32	57.7
	3	7.16	96	54	2.73	3.20	58.3
	4	6.97	92	56	2.60	3.09	58.8
1962	1	6.90	88	53	2.53	3.12	59.3
	2	7.08	88	52	2.66	3.09	58.8
	3	7.23	96	51	2.67	3.20	59.2
	4	7.23	98	54	2.65	3.27	59.2
1963	1	7.15	96	59	2.39	3.08	59.8
	2	7.50	92	49	2.33	2.94	59.5
	3	7.23	96	65	2.34	3.03	59.7
	4	7.43	84	64	2.34	2.98	60.3
1964	1	7.23	112	54	2.21	3.01	60.1
	2	7.23	140	58	2.35	3.04	59.6
	3	7.21	128	65	2.43	3.18	60.0
	4	7.21	114	52	2.41	3.33	60.5
1965	1	7.05	120	54	2.32	3.42	60.8
	2	7.22	140	55	2.58	4.35	60.6
	3	7.28	146	62	2.94	4.40	61.1
	4	7.28	148	70	2.88	4.43	61.2
1966	1	7.32	152	62	3.12	4.81	62.6
	2	7.32	180	62	3.25	4.50	61.6
	3	7.25	176	65	3.16	4.46	62.1
	4	7.25	152	66	2.85	3.22	62.3
1967	1	7.34	168	62	2.72	3.78	62.7
	2	7.34	192	82	2.66	4.12	62.3
	3	7.63	180	63	1.68	3.56	62.6
	4	7.38	212	62	2.59	2.15	62.7
1968	1	7.36	158	69	2.56	3.26	63.4
	2	7.36	186	92	2.76	3.28	62.8

--Continued

Table 10.--Exogenous variables, 1954-70--Continued

Year	Quarter	Pigs saved per sow	Military consumption		Byproduct credits		Dressing percentage for hogs
			Beef	Pork	Beef	Pork	
	3	7.55	156	74	2.67	3.16	63.0
	4	7.55	145	53	2.66	3.08	63.5
1969	1	7.23	153	64	2.69	3.33	64.1
	2	7.23	162	60	3.00	3.90	64.0
	3	7.34	110	48	3.08	4.90	63.4
	4	7.34	130	50	3.00	3.80	63.6
1970	1	7.40	140	60	3.45	3.75	64.0
	2	7.40	150	75	3.75	3.80	64.0

Table 11.--Exogenous variables, 1954-70

Year	Quarter	Civilian population (48 States)	Per capita disposable income	Time	Range condition	Price of No. 3 corn in Chicago
		1,000,000 persons	Dollars	No.	No.	$/cwt.
1954	3	160.0	1590	0	77	1.36
	4	160.3	1598	0	77	1.20
1955	1	161.1	1614	0	69	1.49
	2	161.9	1646	0	67	1.47
	3	162.7	1683	1	79	1.36
	4	163.5	1701	2	77	1.20
1956	1	164.3	1713	3	71	1.27
	2	165.0	1731	4	70	1.50
	3	165.8	1746	5	69	1.55
	4	166.6	1775	6	63	1.33
1957	1	167.3	1785	7	62	1.30
	2	168.0	1799	8	77	1.32
	3	168.8	1815	9	83	1.30
	4	169.7	1807	10	82	1.17
1958	1	170.4	1804	11	81	1.14
	2	171.1	1810	12	86	1.30
	3	171.8	1844	13	83	1.32
	4	172.7	1864	14	84	1.15
1959	1	173.4	1882	15	76	1.19
	2	174.2	1912	16	77	1.29
	3	175.0	1904	17	79	1.23
	4	175.7	1919	18	79	1.10
1960	1	176.4	1929	19	74	1.14
	2	177.1	1943	20	79	1.21
	3	177.8	1944	21	80	1.18
	4	178.6	1932	22	77	1.00
1961	1	179.3	1942	23	74	1.11
	2	180.0	1966	24	76	1.11

--Continued

Table 11.--Exogenous variables, 1954-70--Continued

Year	Quarter	Civilian population (48 States)	Per capita disposable income	Time	Range condition	Price of No. 3 corn in Chicago
	3	180.8	1992	25	79	1.12
	4	181.4	2025	26	79	1.09
1962	1	181.9	2041	27	72	1.09
	2	182.6	2061	28	79	1.14
	3	183.4	2069	29	83	1.11
	4	184.1	2081	30	81	1.10
1963	1	184.8	2105	31	71	1.20
	2	185.5	2119	32	76	1.24
	3	186.1	2144	33	77	1.23
	4	186.8	2173	34	79	1.17
1964	1	187.5	2214	35	72	1.21
	2	188.1	2269	36	74	1.20
	3	188.7	2292	37	74	1.25
	4	189.4	2312	38	77	1.20
1965	1	190.2	2340	39	72	1.28
	2	190.6	2373	40	77	1.34
	3	191.2	2443	41	83	1.29
	4	191.9	2486	42	82	1.17
1966	1	192.5	2525	43	77	1.28
	2	192.6	2543	44	78	1.29
	3	193.3	2613	45	75	1.44
	4	193.5	2656	46	80	1.36
1967	1	194.0	2693	47	72	1.38
	2	194.5	2723	48	74	1.36
	3	195.0	2758	49	83	1.24
	4	195.6	2798	50	79	1.10
1968	1	196.0	2866	51	76	1.12
	2	196.4	2918	52	80	1.14

--Continued

Table 11.--Exogenous variables, 1954-70--Continued

Year	Quarter	Civilian population (48 States)	Per capita disposable income	Time	Range condition	Price of No. 3 corn in Chicago
	3	196.9	2942	53	79	1.07
	4	197.5	2991	54	79	1.11
1969	1	198.0	3014	55	77	1.21
	2	198.6	3065	56	82	1.24
	3	199.2	3140	57	80	1.18
	4	199.9	3171	58	80	1.16
1970	1	200.3	3226	59	77	1.22
	2	201.0	3264	60	78	1.25

Appendix B--Structural Equations for Demand and Stocks Section

$$PRFBW_{jt} = 15.70 + 0.786\ PRNFB_{jt} - 0.298\ PRPW_{jt} - 3.082\ PCFBC_{jt} + 0.025\ Y_{jt} + 0.077\ T_{jt} + 3.16\ W1 + 1.28\ W2 + 1.42\ W3 \quad (A)$$

$$PRNFB_{jt} = 50.03 + 0.232\ PRFBW_{jt} + 0.281\ PRPW_{jt} - 3.433\ PNFBS_{jt} - 0.002\ Y_{jt} - 0.0165\ T_{jt} - 4.70\ W1 - 1.52\ W2 + 1.85\ W3 \quad (B)$$

$$PRPW_{jt} = 29.12 + 0.09\ PRFBW_{jt} + 0.16\ PRNFB_{jt} - 3.05\ PCPS_{jt} + 0.034\ Y_{jt} - 0.545\ T_{jt} - 1.26\ W1 - 3.82\ W2 - 3.46\ W3 \quad (C)$$

$$ESB_{jt} = -5199.0 - 36.66\ PRFBW_{jt} + 129.6\ PRNFB_{jt} - 40.35\ PRPW_{jt} + 438.0\ PNFBS_{jt} + 0.05\ T_{jt} + 570.0\ W1 + 137.0\ W2 - 270.0\ W3 \quad (D)$$

$$ESP_{jt} = -604.0 - 5.35\ PRFBW_{jt} - 1.18\ PRNFB_{jt} + 3.86\ PRPW_{jt} + 55.3\ PCPS_{jt} - 0.70\ T_{jt} + 93.0\ W1 + 130.0\ W2 + 44.0\ W3 \quad (E)$$

APPENDIX C

Operating Rules

The 128 operating rules incorporated in the computer program (appendix D) are listed in the order they appear. They are also identified with the estimating equation number as it appears in the text. The calendar year(s) in which a rule was effective is shown along with the underlying economic basis.

Three statistics are calculated to condense identification of the situations they represent.

$$\text{Ƶ}(I) = 0.5 \left[(PRFBL3_t / PRC3_t) + (PRFBL4_t / PRC4_t) \right]$$

$$\text{ƵƵ}(I) = 1.0 \text{ when } PRPW4_t < 40.0$$

$$\text{and } PRPW1_{t-1} < 40.0$$

$$\text{and } PRPW1_{t-2} < 40.0$$

$$Y\text{Ƶ}(I) = 1.0 \text{ when } (PRFCA_{t-1} - PRFCA_t) > 2.75$$

$$\text{and } PRFCA_t < 22.0$$

	Function estimating	Eq. No. in text	Operating rule	Year(s) effective	Economic basis
Third quarter					
(1)	MFC3	3	If $(PRFBW2_t) > 50.0$ and $(PRNFB2_t) > 40.0$ and $(PRPW2_t) > 50.0$ cut estimate 4%	69	Excellent prices of both cattle and hogs results in some cattle being held for further feeding.
(2)	AWTF3	7	If $(PRC3) \leq 1.11$, change coefficient on beef-corn ratio to -1.44.	62 68	A very low corn price as cattle approach marketing weight results in modification of original feeding program based on beef-corn ratio when these cattle were placed on feed in order to use this lower priced feed for new feedlot placements.
(3)	MNFC3	9	If $(PRFC2_{t-2} - PRFC2_t) > 4.00$ or $(PRFC2_{t-1} - PRFC2_t) > 3.10$ add 14% to estimate	59 60 64	When feeder calf prices show a sharp sustained fall, more nonfed cattle are marketed.
(4)	MNFC3	9	If $(RNGE_{t-1} - RNGE3_t) > 7.0$ and If $(RNGE2_t - RNGE3_t) > 2.0$ add 14% to estimate	66	A drought situation in the West is indicated so there is an above average cow cull in the summer.
(5)	MNFC3	9	If $(Z_{t-1}) > 24.0$ cut estimate 10%	63 69	The highly favorable beef-corn ratio two quarters earlier resulted in above average feeder placements with a consequential smaller supply of nonfed cattle available.

	Function estimating	Eq. No. in text	Operating rule	Year(s) effective	Economic basis
(6)	MNFC3	9	If $(H22R_t/H23_t) > 0.215$ <u>and</u> if $(PRNFB2_t) > 36.0$ <u>and</u> if $(PRPW2_t) > 47.0$ <u>add</u> 23% to estimate	68 70	A combination of (1) a greater than average number of heifers available for replacing cows, (2) a good cow beef price the previous quarter, and (3) a good pork price, precluding any incentive to shift out of hogs cause more cows to be culled.
(7)	IB3	15	If $(CBCS_{t-1}) < 3370.0$ <u>and</u> if $(PRNFB1) > 30.0$ <u>raise</u> estimate 30%	62 63	Very low cow slaughter throughout the previous year coupled with a good manufacturing beef price stimulates imports.
(8)	IB3	15	If $(PNFBS4_{t-1}) < 9.5$ <u>raise</u> estimate 24%	63	A very low domestic production of cow beef stimulates imports 6 months later.
(9)	IB3	15	If $(PCPS4_{t-1} + PCPS1_t + PCPS_t) < 45.0$ <u>raise</u> estimate 35%	66	Sustained low pork production generates imports (note cross elasticity in demand function).
(10)	IB3	15	If $(PRNFB2_t) > 40.50$ <u>raise</u> estimate 50%	69	Very high price increases summer imports.
(11)	IB3	15	If $(t) \geq 1967$, <u>raise</u> estimate 25%	67 68	Apparent shift in import levels; no economic basis noted from endogenous variables. (Shift <u>may</u> be due to importer's desire to stay near quota maximum.)

	Function estimating	Eq. No. in text	Operating rule	Year(s) effective	Economic basis
(12)	CH3	12	If $(PRPL2_t) < 13.0$ change coeff. on PRPL2 from -54 to -30	(Designed for other quarters did not operate)	Demand for gilts does not fall in proportion to very low price (as better prices expected) so slaughter is not as large as estimated.
(13)	CH3	12	If $(PRPL2_t) > 23.0$ change coeff. on PRPL2 to -44	66	Demand for gilts does not increase in proportion to very high prices.
(14)	CH3	12	If $(PRPL2_t) > 19.75$ and $(PRPL2_{t-1}) > 19.75$ and $(PRPL2_{t-2}) > 19.75$ Change coeff. on PRPL2 to -37.0	67	Long-term shift to higher price level lowers gilt retention associated with this higher price.
(15)	PRFBW3	22	If $(PCFBC3_t + PNFBS3_t) > 30.0$ cut coeff. on PCFBC3 from -3.324 to -3.25	69	Coefficient damped when beef supply high.
(16)	PRNFB3	23	If $(PCFBC3_t + PNFBS3_t) > 28.0$ change coeff. on PNFBS3 to -3.90	67 68	Cross flexibility of fed beef becomes effective at high total quantity (lowers price flexibility).
(17)	PRNFB3 PRPW3	23 24	If $(PCPS4_{t-1} + PCPS1_t + PCPS2_t) < 45.0$ raise estimate of PRNFB3 12% raise estimate of PRPW3 2%	66	Persistent low pork supply lowers cross-price flexibility in cow beef price and direct price flexibility on pork price.

	Function estimating	Eq. No. in text	Operating rule	Year(s) effective	Economic basis
(18)	PRPW3	24	If $(Y3_t) > 2800.0$ change coeff. on Y to 0.03527 from 0.03727	68 69	Reduced income effect at higher values (due to original "fit" in deviation from trend).
(19)	PRPW3	24	If $(PCPS3_t - PCPS3_{t-1}) > 2.0$ cut estimate 4.75%	59	Sharp supply increase from year earlier causes price (drop) to overreact.
(20)	PRFC3	32	If $(RNGE3_t) > 80.0$ change coeff. from 0.165 to 0.175	57 58 62 65 67 68	Very good range condition enhances rancher's bargaining position.
(21)	PRFC3	32	If $(PRFC3_{t-1} - PRFC4_{t-1}) \geq 1.40$ cut estimate 4%	60 68	Sharp drop in feeder calf prices preceding fall leads to more than usual discount of feeding margin (APM).
(22)	PRFC3	32	If $(PRC2_t - PRC2_{t-1}) \geq 0.13$ cut estimate 4%	65	Sharp increase in spring corn price cuts feedlot placements in spring and thus increases feeder supply in summer.
(23)	SF3	34	If $(PRC1_t) \geq 1.10$ and $(PRPL1_t/PRC1_t) < 17.5$ and $(PRPL2_t > 19.75$ but $(PRPL2_t/PRC2_t) \leq 15.0$ cut estimate 10%	65 67	Medium corn price coupled with continued low profit picture (as shown by hog-corn ratio), despite good second quarter price level, cuts breeding programs.

	Function estimating	Eq. No. in text	Operating rule	Year(s) effective	Economic basis
(24)	SF3	34	If $(PRC1_t) < 1.20$ (and condition above does not hold) raise estimate 20%	58 59 60 61 62 68	Low corn price increases breeding in winter for fall pigs.
(25)	PL3	37	If $(PRC3_t) < 1.20$ and $(PRFBL3_t / PRC3_t) < 22.0$ change coeff. on beef-corn ratio from 75.0 to 60.0	60	Change in placement response (lower) at below average value of beef-corn ratio despite moderate corn price.
(26)	PL3	37	If $(PRPL3_t - PRPL3_{t-1}) > 6.0$ cut estimate 7%	65	Sharp increase in hog price results in shift to hogs.
(27)	PL3	37	If $(PRFBL2_t) > 30.0$ and $(PRFBL3_t) > 30.0$ raise estimate 5%	69	Sustained high price increases summer placements.
			Fourth quarter		
(28)	AWTF4	8	If $(Z_{t-1}) > 24.0$ raise estimate 1.5%	63 69	Some heavier feeding programs initiated in winter and spring in response to very favorable beef-corn ratio.
(29)	AWTF4	8	If $(PCPS4_{t-1} + PCPS1_t + PCPS2_t) < 45.0$ raise estimate 1.5%	66	Persistent low pork supply initiated heavier feeding programs.
(30)	AWTF4	8	Same as 23b cut estimate 2%	69	Cattle marketed lighter before seasonal price decline.

	Function estimating	Eq. No. in text	Operating rule	Year(s) effective	Economic basis
(31)	MNFC4	9	If $(RNGE4_t) > 83.0$ change coeff. to 20 from 24	58	Nonfed production does not increase proportionately to range feed at higher level.
(32)	MNFC4	9	If $(PRC3_t) \leq 1.11$ change coeff. to 1485 from 1568	62 68	Very low corn prices result in more feeding and less nonfed marketing.
(33)	MNFC4	9	If $(Z_{t-1}) > 24.0$ cut estimate 13%	63 69	Very favorable beef-corn ratio stimulated cattle feeding first half of year, resulting in less grass-fed stock for fall cull--also less cow cull.
(34)	MNFC4	9	If $(PRC2_{t-1} - PRC2) \geq 0.13$ raise estimate 15%	65	More feeders were kept as grass cattle in the spring because of sharp increase in feed costs; then sold in fall.
(35)	MNFC4	9	If $(H22R_t/H23_t) > 0.215$ and $(PRNFB3_t) > 38.0$ raise estimate 7%	67 68 69	(See operating rule 6)
(36)	MNFC4	9	If (30) holds and if $(H22R_{t-1}/H23_{t-1}) > 0.22$ raise estimate additional 14%	68	More than average replacement heifers available 2 years in row increases cow cull further.
(37)	IB4	15	If $(PRNFB3_{t-1} - PRNFB3_t) > 6.0$ cut estimate 30%	60	Sharp drop in domestic cow beef price results in diversion of shipments to other countries.

	Function estimating	Eq. No. in text	Operating rule	Year(s) effective	Economic basis
(38)	IB4	15	If ($CBCS_{t-1}$) $\leq$ 3370.0 and ($PRNFB2_t$ $\geq$ 30.0 raise estimate 35%	62 63	(See operating rule 7)
(39)	IB4	15	If (Z_{t-1})> 24.0 raise estimate 25%	63 69	Very favorable beef-corn ratio of last half of year reduces potential nonfed supply early in year and increases import orders which are delivered in fall.
(40)	IB4	15	If (t) $\geq$ 1967 raise estimate 40%	67 68	(See operating rule 11)
(41)	CHS4	12	If ($PRPL3_t$)<13.0 change coeff. to -24 from -54.0 on $PRPL3_t$	(See 10)	(See operating rule 12)
(42)	CHS4	12	If ($PRPL2_{t-1}$)<15.25 and ($PRPL2_t$)<15.25 change coeff. to -24.0 from -54.0 on $PRPL3_t$	64	Low hog price in spring for 2 years leads to expectations of better prices, so proportionately more gilts saved.
(43)	CHS4	12	If ($PRFC3_t$ - $PRFC3_{t-1}$)> 4.90 cut estimate 2.5%	58	Sharp increase in feeder calf price leads to more gilts retained.
(44)	CHS4	12	If ($PRFC3_t$)<1.10 change coeff. to -390 from -720 on $PRC3_t$	68	At very low corn price, slaughter (through increased weights) does not increase proportionately (note the negative sign).

	Function estimating	Eq. No. in text	Operating rule	Year(s) effective	Economic basis
(45)	CHS4	12	If $(PRPL3_t) \geq 24.0$ change coeff. to -33.0 from -54.0 on $PRPL3_t$	66 69	(See operating rule 13)
(46)	CHS4	12	If $(PRPL3_t) > 22.0$ and $(PRPL3_{t-1}) > 22.0$ and $(PRPL3_{t-2}) > 22.0$ change coeff. to -28.0 from -54.0 on $PRPL3_t$	67	Gilt demand does not increase proportionately at consistently high prices.
(47)	PRFBW4	22	If $(PCFBC4_t) > 16.0$ and $(PCPS4_t) > 18.0$ cut estimate 6.25%	67 68	Large supply of pork affects beef price when fed beef supply also high.
(48)	PRNFB4	23	If $(PCFBC4_t + PNFBS4_t) \geq 27.0$ change coeff. on PNFBS to -4.09 from -4.44	61 67 68 69	(See operating rule 16)
(49)	PRPW4	24	If $(Y4_t) > 2790$ change coeff. on Y4 to + 0.03527 from 0.03727	67 68 69	(See operating rule 18)
(50)	PRPW4	24	If $(PCPS4_t - PCPS4_{t-1}) > 2.0$ cut estimate 4.75%	59 66	(See operating rule 19)
(51)	PRFC4	33	If $(RNGE4_t) > 80.0$ change coeff. on RNGE to 0.12 from 0.11	55 56 59 60 61 63 64	(See operating rule 20)

	Function estimating	Eq. No. in text	Operating rule	Year(s) effective	Economic basis
(52)	SF4	34	If $(PRPL2_t) \geq 19.75$ <u>change</u> coeff. on PRPL2 to +35 from 45.	58 65 66 67 69	Supply response reduced at higher price levels.
(53)	SF4	34	If $(PRC2_t) \leq 1.11$ <u>raise</u> estimate 5.6%	61	(See operating rule 24)
(54)	SF4	34	If $(PRC2_t - PRC3_t) \geq 11.0$ <u>raise</u> estimate 13%	67	Sharp seasonal drop in corn price increases farrowings for early winter.
(55)	PL4	38	If $(PRFBL4_t) < 24.50$ <u>and</u> $(PRC3_t - PRC4_t) > 0.10$ <u>change</u> coeff. on (PRFBL4/PRC4) to 70.0 from 98.0	55 56 57 65	If fed cattle price is quite low and corn price has at least modal seasonal drop, placements in response to beef-corn ratio are reduced.
(56)	PL4	38	If $(PRPL3_t) \geq 24.0$ raise estimate 4%	66 69	Some additional shift to cattle feeding as producers feel hog price will be lower (cycle) next year.
(57)	PL4	38	If $(PRFBL3_t) > 28.0$ <u>and</u> $(PRFBL4_t) > 27.0$ <u>raise</u> estimate 4%	68 69	Sustained high fed cattle price induces additional placements of cattle on feed.
----------------	----------------	----------------	----------Annual Inventory System----------	----------------	----------------
(58)	H21	39	If $(Z_{t-1}) > 24.0$ <u>raise</u> estimate 2%	63 69	More calves saved as a result of favorable beef-corn ratio as opposed to slaughter.

	Function estimating	Eq. No. in text	Operating rule	Year(s) effective	Economic basis
(59)	H21	39	If $(Z_{t-1}) \leq 23.0$ and $(CBCS_{t-1}/H23_{t-3}) \leq 0.13$ change coeff. on $H23_{t-3}$ to 0.56684 from 0.59684	68	Beef-corn ratio is not good enough to result in increased inventory and cow herd is getting disproportionately old, so calf crop reduced.
(60)	H21	39	If $(CBCS_t/H23_{t-2}) \leq 0.105$ change coeff, on $H23_{t-2}$ from .597 to .547	70	(See operating rule 67)
(61)	H22R	40	If $(Z_{t-1}) > 24.0$ raise estimate 1.5%	63 69	More heifers retained for herd than usual because of very favorable feeding situation.
(62)	H22R	40	If $(PRFCA_t) > 30.0$ cut estimate 6%	70	More heifers put on feed than usual.
(63)	CBCS	41	If $(Z_t) > 24.0$ cut estimate 18%	62 68 69	Cow cull reduced substantially as very favorable feeding situation results in cows being saved for one more calf.
(64)	CBCS	41	If $(PRFCA_t) < 22.0$ and $(PRFCA_{t-1} - PRFCA_t) > 2.75$ raise estimate 12.5%	64	Low feeder calf price coupled with further decline stimulates cow cull.
(65)	CBCS	41	If $(RNGE3_{t-1} - RNGE3_t) > 7.0$ and $(RNGE2 - RNGE3_t) > 2.0$ raise estimate 7.5%	66	Drought in West increases cow cull.

	Function estimating	Eq. No. in text	Operating rule	Year(s) effective	Economic basis
(66)	CBCS	41	If $(Z_{t-1}) \leq 23.0$ and $(CBCS_t/H23_{t-3}) < 0.13$ change coeff. on $H23_{t-3}$ to -1.03 from -1.06	67	Cull increased if cow herd getting old and beef-corn ratio not exceptional.
(67)	CBCS	41	If $(CBCS_t/H23_{t-2}) \leq 0.105$ change coeff. on $H23_{t-2}$ from -1.06 to -1.01	70	Cow herd aging results in more culling.
(68)	MFC1	1	If $(PRFBW4_{t-1}) > 48.0$ and $(PRNFB4_{t-1}) > 42.0$ and $(PRPW4_{t-1}) > 58.0$ cut estimate 6%	70	(See operating rule 1)
			First Quarter		
(69)	AWTF1	5	If $(PRC1_t) < 1.10$ change coeff. on $(PRFBL3/PRC3)_t$ to 2.94 from 3.64	62	(See operating rule 2)
(70)	AWTF1	5	If $(PRPL3_{t-1}) < 15.00$ cut estimate 15 lbs.	60	Low hog price at time cattle are placed on feed indicates oversupply of pork, so beef supply is restricted through lighter weights.
(71)	AWTF1	5	If $(PRFBL3_{t-1})/PRC_{t-1}) > 27.0$ cut estimate 4%	69	Feeders fear oversupply situation will develop from high prices received in summer, so feed to lighten weight.
(72)	MNFC1	9	If $(PRFC4_t - PRFC4_{t-2}) > 5.75$ cut estimate 12.5%	59 70	Large long-term increase in feeder cattle price results in shift to cattle feeding and consequent reduction in nonfeds.

	Function estimating	Eq. No. in text	Operating rule	Year(s) effective	Economic basis
(73)	MNFC1	9	If $(PRC1_{t} - PRC4_{t-1}) \geq 0.11$ raise estimate 8%	61 66	Sharp seasonal increase in corn price cuts placements of feeders, so more nonfed marketings.
(74)	MNFC1	9	If $(PRNFB4_{t-2} - PRNFB4_{t-1}) > 7.50$ cut estimate 5%	64	Sharp drop in cow beef price reduces cow cull (probably in dairy)
(75)	MNFC1	9	If $(H22R_{t}/H23_{t}) \leq 0.22$ and $(PRNFB4_{t-1}) > 37.25$ or If $(H22R_{t}/H23_{t}) > 0.22$ and $(PRNFB4_{t-1}) > 36.0$ raise estimate 11%	68 69 70	Cow cull increased when either cow beef price very high or cow-beef price is quite good and lots of replacement heifers are available.
(76)	IB1	15	If $(CBCS_{t-1}) < 33.00$ raise estimate 40%	63 64	Low domestic slaughter the previous year results in import increase in following quarters.
(77)	IB1	15	If $(PRNFB3_{t-2} - PRNFB3_{t-1}) > 6.0$ cut estimate 30%	61	Sharp summer price drop from year earlier induces curtailment of import orders two quarters later.
(78)	IB1	15	Same as 68 raise estimate 50%	70	Excellent price level increases imports.
(79)	IB1	15	If $(T) \geq 1967$ raise estimate 45%	67 68 69 70	(See operating rule 11)
(80)	CHS1	12	If $(PRPL4_{t-1}) < 12.60$ change coeff. on $PRPL4_{t-1}$ to -30.0 from -54	56	(See operating rule 12)

	Function estimating	Eq. No. in text	Operating rule	Year(s) effective	Economic basis
(81)	CHS1	12	If $(PRPL4_{t-1}) > 25.0$ change coeff. to -28 from -54	70	(See operating rule 13)
(82)	CHS1	12	If $(PRPL4_{t-2}) > 24.0$ and $(PRPL4_{t-2} - PRPL_{t-1}) > 4.50$ change coeff. to -28 from -54	67	Sharp drop in hog prices from rather high level cuts demand for gilts, so more slaughter.
(83)	CHS1	12	If $(PRFC4_{t} - PRFC4_{t-1}) > 4.25$ cut estimate 6.4%	58 59 70	Sharp increases in feeder cattle price increases gilt retention and lowers slaughter.
(84)	PRNFB1	23	If $(PCFBC1_{t} + PNFBS1_{t}) > 27.0$ change coeff. on $PNFBS1_{t}$ to -4.04 from -4.44	62 68 69 70	(See operating rule 16)
(85)	PRPW1	24	If $(Y1_{t}) > 28.00$ change coeff. on Y to 0.03527	68 69 70	(See operating rule 18)
(86)	PRPW1	24	If $(PCPS1_{t} - PCPS1_{t-1}) > 2.0$ cut estimate 5%	59 67	(See operating rule 19)
(87)	PRPW1 PRFBW1	24 22	If $(ZZ_{t}) = 1.0$ cut PRPW estimate 7% and cut PRFW estimate 5%	64	Persistent low pork prices tend to be hard to overcome, so current beef and pork price is reduced moderately; cross elasticity with fed beef shows in extreme situation.

Function estimating	Eq. No. in text		Operating rule	Year(s) effective	Economic basis
(88)	ESB1	25	If $(PCFBC1_t + PNFBS1_t + PCPS1_t) > 46.5$ cut estimate 25%	68 69	Stocks do not increase proportionaly when combined large supply of beef and pork.
(89)	ESP1	26	If $(PCFBC4_t + PNFBS4_t + PCPS4_t) > 46.5$ cut estimate 30%	69 70	Stocks do not increase proportionaly when there is a combined high supply two successive quarters.
(90)	PRFC1	30	If $(PRFBL1_t) > 25.5$ and $(PRFC3_{t-1} - PRFC4_{t-1})$ 1.75 cut estimate 6%	68	More than average seasonal price drop holds feeder prices down through APM.
(91)	SF1	34	If $(PRPL3_{t-1}) > 26.0$ change coeff. on PRPL3 from +45 to +25	70	Less supply response at very high prices.
(92)	SF1	34	If $(Z_{t-1}) > 24.0$ cut estimate 7%	63 69 70	Excellent cattle feeding profits results in shift to cattle feeding, and fewer sows bred.
(93)	SF1	34	If $(ZZ)_t = 1.0$ cut estimate 7%	64	Sustained low hog prices cut farrowings.
(94)	SF1	34	If $(PRPL3_{t-2} - PRPL3_t) > 7.0$ cut estimate 14%	60	Sharp drop in hog price at breeding time cuts farrowings.
(95)	SF1	34	If $(PRC3_t - PRC2_t) > 0.14$ cut estimate 14%	67	Substantial counter seasonal corn-price increase at breeding time reduces farrowings.

	Function estimating	Eq. No. in text	Operating rule	Year(s) effective	Economic basis
(96)	PL1	35	If $(PRC1_t) \leq 1.10$ change coeff. to 76 from 86 on (PRFBL1/PRC1)	62	Beef-corn ratio is made artifically high by quite low corn price.
(97)	PL1	35	If $(PRFBL1_t/PRC1_t) > 24.5$ change coeff. on (PRFBL1/PRC1) from 86 to 76	70	Less supply response at high value of beef-corn ratio.
(98)	PL1	35	If $(YZ_{t-1}) = 1.0$ cut estimate 6%	61 65	General fall in cattle prices previous year lowers placements.
			Second quarter		
(99)	MFC2	2	If $(PRFBL4_{t-2} - PRFBL4_{t-1}) > 3.80$ and $(PRFBL1_{t-1} - PRFBL1_t) > 2.80$ raise estimate 5.3%	64	A sharp price decline from a year earlier for two successive quarters leads feeders to hold cattle for a better price.
(100)	MFC2	2	If (YZ) = 1.0 cut estimate 4%	65	With general drop in fed cattle prices, there were more early sales of "short-feds" from placements made in third and fourth quarters. Also, cattle not on feed too long could have shifted back to grass in spring.
(101)	MFC2	2	If $(PRFBW1_t) > 46.0$ and $(PRNFB1_t) > 36.0$ and $(PRPW1_t) > 49.0$ cut estimate 3.2%	69 70	Excellent prices of both cattle and hogs result in some cattle being held for further feeding.

Function estimating		Eq. No. in Text	Operating rule	Year(s) effective	Economic basis
(102)	MFC2	2	If $(PRPL1_{t-1}) \geq 23.0$ and $(PRPL1_{t-1} - PRPL1_{t})$ 6.0 raise estimate 5%	67	Big drop in winter hog price leads some producers to shift to "short-fed" cattle.
(103)	AWTF2	6	If $(Z_{t-1}) > 22.9$ and $(PRFBL4_{t-1}/PRC4_{t-1}) > 24.5$ change coeff. on (PRFBL4/PRC4) to 2.54 from 2.24	61 63 69	Very favorable feeding ratio with improvement coming at end of year leads to initiation of heavier weight feeding program.
(104)	AWTF2	6	If (YZ) = 1.0 cut estimate 1.5%	65	As general level of fed cattle prices fall, feeding programs are aimed at lighter weights.
(105)	MNFC2	9	If $(PRC1_{t} - PRC4_{t-1}) \geq 0.11$ raise estimate 8%	61 66	Sharp increase in corn price cuts placements on feed and increases nonfed marketings.
(106)	MNFC2	9	If $(PRC1_{t}) \leq 1.10$ change coeff. on $PRC1_{t}$ to 1430 from 1568	62	Very low winter corn prices results in nonproportional shift in response to input-price change.
(107)	MNFC2	9	If $(PRPL1_{t-1}) > 23.0$ and $(PRPL1_{t-1} - PRPL1_{t}) > 6.0$ cut estimate 10%	67	(See operating rule 102). Increase fed placements lower nonfed marketings.
(108)	MNFC2	9	If $(Z_{t-1}) > 24.0$ cut estimate 8%	63 69 70	(See operating rule 5)

	Function estimating	Eq. No. in text	Operating rule	Year(s) effective	Economic basis
(109)	MNFC2	9	If (YZ) = 1.0 cut estimate 13%	65	When feeder price has been down all of previous year indicating liquidation phase of cycle, nonfed marketings are cut in spring for herd rebuilding.
(110)	IB2	15	If $(PRNFB1_{t-1} - PRNFB1_t) > 6.0$ cut estimate 33%	61	Sharp drop in price which draws imports results in diversion of shipments to other countries.
(111)	IB2	15	If $(T) \geq 1967$ raise estimate 35%	67 68 69 70	(See operating rule 11)
(112)	CHS2	12	If $(PRC1_t) \leq 1.12$ change coeff. to -400 from -720 on $PRC1_t$	61 62 68	At very low corn price, increase in slaughter is not proportional to price change.
(113)	CHS2	12	If $(PRPL1_t) > 26.0$ change coeff. to -32 from -54 on PRPL1	66 70	(See operating rule 13)
(114)	CHS2	12	If $(PRPL1_t > 23.0$ and $(PRPL1_{t-1} - PRPL1_t)$ 6.0 change coeff. to -28 from -54	67	(See operating rule 82)
(115)	PRPW2	24	If $(Y_t) > 2800$ change coeff. on Y to 0.03527 from 0.03727	68 69 70	(See operating rule 18)

Function estimating		Eq. No. in text	Operating rule	Year(s) effective	Economic basis
(116)	PRPW2	24	If $(PCPS2_t - PCPS2_{t-1}) > 2.0$ cut estimate 4.5%	60	(See operating rule 19)
(117)	PRPW2 PRFBW2	24 22	If (ZZ) = 1.0 cut estimate of PRPW2 3% cut estimate of PRFBW2, 3.25%	65	(See operating rule 87)
(118)	PRPW2	24	If $(PRPW1_{t-1} - PRPW1_t) > 10.0$ cut estimate 10%	67	Effect of sharp price drop previous quarter from year earlier level carries into current quarter.
(119)	PRFC2	31	If $(PRFC3_{t-1} - PRFC4_{t-1}) \geq 1.40$ cut estimate 6%	60 68	(See operating rule 90)
(120)	PRFC2	31	If $(PRC2_t - PRC2_{t-1}) \geq 0.13$ cut estimate 6%	65	Sharp increase in corn price leads to buyer resistance when buying feeders.
(121)	SF2	34	If $(PRPL4_{t-1}) < 13.0$ Change coeff. on PRPL4 to 35 from 45	56 60	At low hog prices, producer response to price is changed.
(122)	SF2	34	If $(PRC4_{t-1}) \leq 1.05$ raise estimate 7.5%	61	Producers respond differently to very low corn price.
(123)	SF2	34	If $(PRC4_{t-1} - PRC3_{t-1}) > 0.02$ cut estimate 10%	69	Counterseasonal rise in corn price at breeding time cuts sows bred.

	Function estimating	Eq. No. in text	Operating rule	Year(s) effective	Economic basis
(124)	SF2	34	If $(PRPL2_{t-1} + PRPL3_{t-1}) >$ 49.0 and $(PRPL4_{t-1} + PRPL1_{t}) >$ 52.0 raise estimate 10%	70	Sustained high price leads to above average supply response.
(125)	PL2	36	If $(PRC2_{t} - PRC2_{t-1}) \geq 0.13$ cut estimate 5%	65	(See operating rule 95)
(126)	PL2	36	If $(PRPL2_{t}) > 23.50$ cut estimate 4%	66 69	Some shift to hogs from cattle feeding at very high hog price.
(127)	PL2	36	If $(PRPL2_{t}) > 22.0$ and $(PRFBL2_{t}) > 30.0$ raise estimate 13%	69 70	Total response is increased when both hog and fed cattle prices above average.
(128)	PL2	36	If $(PRPL2_{t-1}) > 23.0$ and $(PRPL2_{t-1} - PRPL2_{t}) > 3.50$ raise estimate 8.5%	67	Sharp drop in hog prices from high level year earlier causes shift to cattle feeding.

Appendix D
Computer Program

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 QUARTERLY MODEL OF PRICE-OUTPUT DETERMINATION IN BEEF & PORK. CROM
 COMMON    XMFC1(25),XMFC2(25),XMFC3(25),XMFC4(25),PL1(25),PL2(25),
1PL3(25),PL4(25),AWTF1(25),AWTF2(25),AWTF3(25),AWTF4(25),PRFBL1(25)
2,PRFBL2(25),PRFBL3(25),PRFBL4(25),CSFC1(25),CSFC2(25),CSFC3(25),
3CSFC4(25),BPF1(25),BPF2(25),BPF3(25),BPF4(25),XMIFB1(25),XMIFB2(25
4),XMIFB3(25),XMIFB4(25),PCFBC1(25),PCFBC2(25),PCFBC3(25),PCFBC4(25
5),XMNFC1(25),XMNFC2(25),XMNFC3(25),XMNFC4(25),PRFC1(25),PRFC2(25),
6PRFC3(25),PRFC4(25),AWTNF1(25),AWTNF2(25),AWTNF3(25),AWTNF4(25),XI
7B1(25),XIB2(25),XIB3(25),XIB4(25),PRNFB1(25),PRNFB2(25),PRNFB3(25)
8,PRNFB4(25),PNFBS1(25),PNFBS2(25),PNFBS3(25),PNFBS4(25),XB1(25),
9XB2(25),XB3(25),XB4(25),ESB1(25),ESB2(25),ESB3(25),ESB4(25)
 COMMON    CHS1(25),CHS2(25),CHS3(25),CHS4(25),SF1(25),SF2(25),SF3
1(25),SF4(25),PRPL1(25),PRPL2(25),PRPL3(25),PRPL4(25),PP1(25),PP2(
25),PP3(25),PP4(25),XIP1(25),XIP2(25),XIP3(25),XIP4(25),PRPW1(25),
3PRPW2(25),PRPW3(25),PRPW4(25),PCPS1(25),PCPS2(25),PCPS3(25),PCPS4
4(25),XP1(25),XP2(25),XP3(25),XP4(25),ESP1(25),ESP2(25),ESP3(25),
5ESP4(25),PRFBW1(25),PRFBW2(25),PRFBW3(25),PRFBW4(25),PRNFL1(25),PR
6NFL2(25),PRNFL3(25),PRNFL4(25),BPNF1(25),BPNF2(25),BPNF3(25),BPNF4
7(25)
 COMMON    PRFCA(25),H21(25),H22R(25),H23(25),CBCS(25),PRC1(25),
1PRC2(25),PRC3(25),PRC4(25),XMILB1(25),XMILB2(25),XMILB3(25),XMILB4
2(25),CN1(25),CN2(25),CN3(25),CN4(25),RNGE1(25),RNGE2(25),RNGE3(25)
3,RNGE4(25),T1(25),T2(25),T3(25),T4(25),PSPS1(25),PSPS2(25),PSPS3
4(25),PSPS4(25),DPH1(25),DPH2(25),DPH3(25),DPH4(25),XMILP1(25),
5XMILP2(25),XMILP3(25),XMILP4(25),Y1(25),Y2(25),Y3(25),Y4(25),H13
6(25),BPCB1(25),BPCB2(25),BPCB3(25),BPCB4(25),BPCP1(25),BPCP2(25),
7BPCP3(25),BPCP4(25),Z(25),ZZ(25),YZ(25)
 6 READ(5,7) K
 7 FORMAT(I2)
 8 DO 9 J=1,3
 9 READ(5,10)PRFBL2(J),PRFC2(J),PRNFB1(J),PRNFB2(J),PRPL2(J),PRPW1(J)
 1,PRPW2(J),PRFC1(J),PL1(J),PL2(J),SF1(J),SF2(J),SF3(J),SF4(J),AWTF2
 2(J),H21(J),H22R(J),H23(J),PNFBS1(J),PNFBS2(J),PCPS2(J),ESB2(J),ESP
 32(J),PRPL1(J),PRFBL1(J),PCPS1(J),PCPS3(J),PCPS4(J),CBCS(J),PRFC4(J
 4),PRFBL4(J),PRPL3(J),PRFC3(J)
10 FORMAT(8F4.2,7F4.0,3F5.0,5X,/3F4.2,2F4.0,2F4.2,3F3.1,F4.0,4F4.2)
11 DO 12 J=1,K
12 READ(5,13) H13(J),PSPS1(J),PSPS2(J),PSPS3(J),PSPS4(J),PRC1(J),PRC2
 1(J),PRC3(J),PRC4(J),XMILB1(J),XMILB2(J),XMILB3(J),XMILB4(J),XMILP1
 2(J),XMILP2(J),XMILP3(J),XMILP4(J),CN1(J),CN2(J),CN3(J),CN4(J),RNGE
 31(J),RNGE2(J),RNGE3(J),RNGE4(J),T1(J),T2(J),T3(J),T4(J),DPH1(J),
 4DPH2(J),DPH3(J),DPH4(J),Y1(J),Y2(J),Y3(J),Y4(J),BPCB1(J),BPCB2(J),
 5BPCB3(J),BPCB4(J),BPCP1(J),BPCP2(J),BPCP3(J),BPCP4(J)
13 FORMAT(F5.0,4F4.2,4F3.2,8F3.0,4F4.1,7X,/8F2.0,4F4.3,4F4.0,8F3.2)
   CALL TEST (K)
26 WRITE(6,27)
27 FORMAT('1','  MFC3  AWTF3  CSFC3  BPF3   MNFC3     AWTNF3  BPNF3',
 1'     IB3   XB3     PCFBC3     PNFBS3  CHS3     PP3    IP3 XP3 PCPS3')
28 DO 29 I=3,K
29 WRITE(6,30)XMFC3(I),AWTF3(I),CSFC3(I),BPF3(I),XMNFC3(I),AWTNF3(I)
 1,BPNF3(I),XIB3(I),XB3(I),PCFBC3(I),PNFBS3(I),CHS3(I),PP3(I),XIP3(I
 2),XP3(I),PCPS3(I)
30 FORMAT(1H0,F7.0,3X,F5.0,3(2X,F6.0),3X,F5.0,2X,F6.0,2(1X,F5.0),2(5X
 1,F4.1),2F7.0,2(1X,F5.0),3X,F4.1)
31 WRITE(6,32)
32 FORMAT('  PRFBW3     PRNFB3     PRPW3     ESB3     ESP3  PNFBC3  PCPC3'
 1,'    PPFBL3    PRPL3,  PRFC3  PRFBR3    PRPB3     SF3    PL3')
33 DO 34 I=3,K
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34 WRITE(6,35)PRFBW3(I),PRNFB3(I),PRPW3(I),ESB3(I),ESP3(I),PRFBL3(I)
  1,PRPL3(I),PRFC3(I),SF3(I),PL3(I)
35 FORMAT(1H0,3(4X,F5.2),2F7.0,16X,3(3X,F5.2),16X,2F6.0)
36 WRITE(6,37)
37 FORMAT('1','MFC4 AWTF4   CSFC4    BPF4   MNFC4   AWTNF4   BPNF4 ',
  1'   IB4    XB4   PCFBC4   PNFBS4  CHS4    PP4    IP4    XP4   PCPS4')
38 DO 39 I=3,K
39 WRITE(6,40)XMFC4(I),AWTF4(I),CSFC4(I),BPF4(I),XMNFC4(I),AWTNF4(I)
  1,BPNF4(I),XIB4(I),XB4(I),PCFBC4(I),PNFBS4(I),CHS4(I),PP4(I),XIP4(I
  2),XP4(I),PCPS4(I)
40 FORMAT(1H0,F7.0,3X,F5.0,3(2X,F6.0),3X,F5.0,2X,F6.0,2(1X,F5.0),2(5X
  1,F4.1),2F7.0,2(1X,F5.0),3X,F4.1)
41 WRITE(6,42)
42 FORMAT('    PRFBW4    PRNFB4    PRPW4    ESB4    ESP4   PNFBC4    PCPC4'
  1,'   PPFBL4    PRPL4    PRFC4   PRFPR4    PRPB4    SF4    PL4')
43 DO 44 I=3,K
44 WRITE(6,45)PRFBW4(I),PRNFB4(I),PRPW4(I),ESB4(I),ESP4(I),PRFBL4(I)
  1,PRPL4(I),PRFC4(I),SF4(I),PL4(I)
45 FORMAT(1H0,3(4X,F5.2),2F7.0,16X,3(3X,F5.2),16X,2F6.0)
46 WRITE(6,47)
47 FORMAT('1',' MFC1 AWTF1    CSFC1     BPF1    MNFC1   AWTNF1    BPNF1 ',
  1'  IB1    XB1    PCFBC1    PNFBS1    CHS1     PP1    IP1    XP1 PCPS1')
48 DO 49 I=3,K
49 WRITE(6,50)XMFC1(I),AWTF1(I),CSFC1(I),BPF1(I),XMNFC1(I),AWTNF1(I)
  1,BPNF1(I),XIB1(I),XB1(I),PCFBC1(I),PNFBS1(I),CHS1(I),PP1(I),XIP1(I
  2),XP1(I),PCPS1(I)
50 FORMAT(1H0,F7.0,3X,F5.0,3(2X,F6.0),3X,F5.0,2X,F6.0,2(1X,F5.0),2(5X
  2,F4.1),2F7.0,2(1X,F5.0),3X,F4.1)
51 WRITE(6,52)
52 FORMAT('   PRFBW1    PRNFB1     PRPW1    FSB1    ESP1   PNFBC1    PCPC1',
  1'   PPFBL1    PRPL1    PPFC1   PRFBR1    PRPB1    SF1    PL1')
53 DO 54 I=3,K
54 WRITE(6,55)PRFBW1(I),PRNFB1(I),PRPW1(I),ESB1(I),ESP1(I),PRFBL1(I)
  1,PRPL1(I),PRFC1(I),SF1(I),PL1(I)
55 FORMAT(1H0,3(4X,F5.2),2F7.0,16X,3(3X,F5.2),16X,2F6.0)
56 WRITE(6,57)
57 FORMAT('1','   MFC2    AWTF2    CSFC2     BPF2    MNFC2  AWTNF2   BPNF2'
  1,'    IB2    XB2    PCFBC2    PNFBS2    CHS2     PP2     IP2    XP2 PCPS2')
58 DO 59 I=3,K
59 WRITE(6,60)XMFC2(I),AWTF2(I),CSFC2(I),BPF2(I),XMNFC2(I),AWTNF2(I)
  1,BPNF2(I),XIB2(I),XB2(I),PCFBC2(I),PNFBS2(I),CHS2(I),PP2(I),XIP2(I
  2),XP2(I),PCPS2(I)
60 FORMAT(1H0,F7.0,3X,F5.0,3(2X,F6.0),3X,F5.0,2X,F6.0,2(1X,F5.0),2(5X
  1,F4.1),2F7.0,2(1X,F5.0),3X,F4.1)
61 WRITE(6,62)
62 FORMAT('   PRFBW2    PRNFB2    PRPW2    FSB2    ESP2   PNFBC2    PCPC2 ',
  1' PPFBL2    PRPL2    PPFC2   PRFBR2    PRPB2    SF2    PL2')
63 DO 64 I=3,K
64 WRITE(6,65)PRFBW2(I),PRNFB2(I),PRPW2(I),ESB2(I),ESP2(I),PRFBL2(I)
  1,PRPL2(I),PRFC2(I),SF2(I),PL2(I)
65 FORMAT(1H0,3(4X,F5.2),2F7.0,16X,3(3X,F5.2),16X,2F6.0)
66 WRITE(6,67)
67 FORMAT('1','PRFCA H21    H22R    CBCS     H23')
68 DO 69 I=3,K
69 WRITE(6,70)PRFCA(I),H21(I),H22R(I),CBCS(I),H23(I)
70 FORMAT(1H0,3X,F5.2,4F7.0)
98 STOP 99999
99 END
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      SUBROUTINE TEST (K)
      COMMON    XMFC1(25),XMFC2(25),XMFC3(25),XMFC4(25),PL1(25),PL2(25),
     1PL3(25),PL4(25),AWTF1(25),AWTF2(25),AWTF3(25),AWTF4(25),PRFBL1(25)
     2,PRFBL2(25),PRFBL3(25),PRFBL4(25),CSFC1(25),CSFC2(25),CSFC3(25),
     3CSFC4(25),BPF1(25),BPF2(25),BPF3(25),BPF4(25),XMIFB1(25),XMIFB2(25
     4),XMIFB3(25),XMIFB4(25),PCFBC1(25),PCFBC2(25),PCFBC3(25),PCFBC4(25
     5),XMNFC1(25),XMNFC2(25),XMNFC3(25),XMNFC4(25),PRFC1(25),PRFC2(25),
     6PRFC3(25),PRFC4(25),AWTNF1(25),AWTNF2(25),AWTNF3(25),AWTNF4(25),XI
     7B1(25),XIB2(25),XIB3(25),XIB4(25),PRNFB1(25),PRNFB2(25),PRNFB3(25)
     8,PRNFB4(25),PNFBS1(25),PNFBS2(25),PNFBS3(25),PNFBS4(25),XB1(25),
     9XB2(25),XB3(25),XB4(25),ESB1(25),ESB2(25),ESB3(25),ESB4(25)
      COMMON    CHS1(25),CHS2(25),CHS3(25),CHS4(25),SF1(25),SF2(25),SF3
     1(25),SF4(25),PRPL1(25),PRPL2(25),PRPL3(25),PRPL4(25),PP1(25),PP2(3
     25),PP3(25),PP4(25),XIP1(25),XIP2(25),XIP3(25),XIP4(25),PRPW1(25),
     3PRPW2(25),PRPW3(25),PRPW4(25),PCPS1(25),PCPS2(25),PCPS3(25),PCPS4
     4(25),XP1(25),XP2(25),XP3(25),XP4(25),ESP1(25),ESP2(25),ESP3(25),
     5ESP4(25),PRFBW1(25),PRFBW2(25),PRFBW3(25),PRFBW4(25),PRNFL1(25),PR
     6NFL2(25),PRNFL3(25),PRNFL4(25),BPNF1(25),BPNF2(25),BPNF3(25),BPNF4
     7(25)
      COMMON    PRFCA(25),H21(25),H22R(25),H23(25),CBCS(25),PRC1(25),
     1PRC2(25),PRC3(25),PRC4(25),XMILB1(25),XMILB2(25),XMILB3(25),XMILB4
     2(25),CN1(25),CN2(25),CN3(25),CN4(25),RNGE1(25),RNGE2(25),RNGE3(25)
     3,RNGE4(25),T1(25),T2(25),T3(25),T4(25),PSPS1(25),PSPS2(25),PSPS3
     4(25),PSPS4(25),DPH1(25),DPH2(25),DPH3(25),DPH4(25),XMILP1(25),
     5XMILP2(25),XMILP3(25),XMILP4(25),Y1(25),Y2(25),Y3(25),Y4(25),H13
     6(25),BPCB1(25),BPCB2(25),BPCB3(25),BPCB4(25),BPCP1(25),BPCP2(25),
     7BPCP3(25),BPCP4(25),Z(25),ZZ(25),YZ(25)
   14 DO 15 I=4,K
  301 XMFC3(I)=676.0+0.5426*PL2(I-1)+0.5426*PL1(I-1)
  302 IF(I-5)530,303,530
  303 XMFC3(I)=0.925*XMFC3(I)
  530 IF(PRFBW2(I-1)-50.0)304,304,531
  531 IF(PRNFB2(I-1)-40.0)304,304,532
  532 IF(PRPW2(I-1)-50.0)304,304,533
  533 XMFC3(I)=0.96*XMFC3(I)
  304 AWTF3(I)=280.0+0.6599*AWTF2(I-1)+2.84*(PRFBL1(I-1)/PRC1(I-1))
  396 IF(I-7)305,397,305
  397 AWTF3(I)=AWTF3(I)+10.0
  305 IF(PRC3(I)-1.11) 306,306,307
  306 AWTF3(I)=AWTF3(I)-1.44*(PRFBL1(I-1)/PRC1(I-1))
  307 CSFC3(I)=(XMFC3(I)*AWTF3(I))/1000.
  308 BPF3(I)=0.6*CSFC3(I)
  309 XMIFB3(I)=0.5*XMILB3(I)
  310 PCFBC3(I)=(BPF3(I)-XMIFB3(I))/CN3(I)
  311 AWTNF3(I)=895.6+0.7824*T3(I)
  312 XMNFC3(I)=-1089.2+0.0625*H13(I-1)+0.049*H23(I-1)+1568.5*PRC2(I-1)
     1-84.965*PRFC2(I-1)+24.05*RNGE3(I)-0.3947*AWTNF3(I)
  313 IF((PRFC2(I-3)-PRFC2(I-1))-4.00) 314,317,317
  314 IF((PRFC2(I-2)-PRFC2(I-1))-3.10) 315,315,317
  315 IF((RNGE3(I-1)-RNGE3(I))-7.0) 318,318,316
  316 IF((RNGE2(I-1)-RNGE3(I))-2.0) 318,318,317
  317 XMNFC3(I)=1.14*XMNFC3(I)
  318 IF(Z(I-1)-24.00) 320,320,319
  319 XMNFC3(I)=0.90*XMNFC3(I)
  320 IF((H22R(I-1)/H23(I-1))-0.215)323,323,321
  321 IF(PRNFB2(I-1)-36.00) 323,323,20
   20 IF(PRPW2(I-1)-47.0)323,323,322
  322 XMNFC3(I)=1.23*XMNFC3(I)
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323 BPNF3(I)=0.526*XMNFC3(I)
324 XIB3(I)=761.3-1.672*PRNFB1(I-1)-1.672*PRNFB2(I-1)
   1-18.8*PNFBS1(I-1)-18.8*PNFBS2(I-1)
325 XB3(I)=-0.65-0.343*PRNFB1(I-1)-0.343*PRNFB2(I-1)
   1+1.988*PNFBS1(I-1)+1.988*PNFBS2(I-1)
326 IF(I-5) 327,327,328
327 XIB3(I)=XIB3(I)-231.3
    GO TO 330
328 IF(I-6) 329,329,331
329 XIB3(I)=XIB3(I)-112.0
330 XB3(I)=XB3(I)-1.86
331 IF(CBCS(I-1)-3370.0) 332,332,334
332 IF(PRNFB1(I-1)-30.0) 334,333,333
333 XIB3(I)=1.30*XIB3(I)
334 IF(PNFBS4(I-1)-9.5) 335,335,336
335 XIB3(I)=1.24*XIB3(I)
336 IF((PCPS4(I-1)+PCPS1(I-1)+PCPS2(I-1))-45.0) 337,534,534
337 XIB3(I)=1.35*XIB3(I)
534 IF(PRNFB2(I-1)-40.50)338,338,543
543 XIB3(I)=1.50*XIB3(I)
338 IF(I-16) 340,339,339
339 XIB3(I)=1.25*XIB3(I)
340 IF(XIB3(I)) 341,342,342
341 XIB3(I)=0.0
342 PNFBS3(I)=FSB2(I-1)/CN3(I)+BPNF3(I)/CN3(I)+XIB3(I)/CN3(I)-XB3(I)/
   1CN3(I)-XMIFB3(I)/CN3(I)
343 CHS3(I)=-4146.0+0.52726*SF1(I-1)+0.1721*SF4(I-1)-54.05*PRPL2(I-1)
   1-719.58*PRC2(I-1)+1168.76*PSPS1(I-1)
346 IF(PRPL2(I-1)-23.00) 348,347,347
347 CHS3(I)=CHS3(I)+10.0*PRPL2(I-1)
    GO TO 352
348 IF(PRPL2(I-1)-19.75) 352,349,349
349 IF(PRPL2(I-2)-19.75) 352,350,350
350 IF(PRPL2(I-3)-19.75) 352,351,351
351 CHS3(I)=CHS3(I)+17.0*PRPL2(I-1)
352 PP3(I)=DPH3(I)*CHS3(I)
353 XIP3(I)=-92.56+0.958*PRPW1(I-1)+0.958*PRPW2(I-1)+0.93*T3(I)+2.6*
   1PCPS2(I-1)
356 XP3(I)=-12.6-0.09*PRPW1(I-1)-0.09*PRPW2(I-1)+0.286*T3(I)+2.86*
   1PCPS2(I-1)
357 PCPS3(I)=FSP2(I-1)/CN3(I)+PP3(I)/CN3(I)+XIP3(I)/CN3(I)-XP3(I)/CN3
   1(I)-XMILP3(I)/CN3(I)
358 PRFBW3(I)=71.36-3.3237*PCFBC3(I)-3.1563*PNFBS3(I)+0.02253*Y3(I)
   1+0.1106*T3(I)
535 IF((PCFBC3(I)+PNFBS3(I))-30.0)359,359,536
536 PRFBW3(I)=PRFBW3(I)+0.08*PCFBC3(I)
359 PRNFB3(I)=82.07-4.4403*PNFBS3(I)-1.1698*PCPS3(I)+0.01112*Y3(I)
   1-0.2363*T3(I)
360 IF((PCFBC3(I)+PNFBS3(I))-28.0) 362,361,361
361 PRNFB3(I)=PRNFB3(I)+0.55*PNFBS3(I)
362 PRPW3(I)=44.75-0.9945*PNFBS3(I)-3.3264*PCPS3(I)+0.03727*Y3(I)
   1-0.6021*T3(I)
398 IF(I-7)363,399,363
399 PRPW3(I)=PRPW3(I)+3.5
363 IF(Y3(I)-2800.0) 365,365,364
364 PRPW3(I)=PRPW3(I)-0.002*Y3(I)
365 IF((PCPS3(I)-PCPS3(I-1))-2.0) 367,367,366
366 PRPW3(I)=0.9525*PRPW3(I)
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367 IF((PCPS4(I-1)+PCPS1(I-1)+PCPS2(I-1))-45.0) 368,370,370
368 PRNFB3(I)=1.12*PRNFB3(I)
369 PRPW3(I)=1.02*PRPW3(I)
370 FSB3(I)=-470.0+26.26*PCFBC3(I)+17.91*PNFBS3(I)+10.27*PCPS3(I)
   1-0.0115*Y3(I)-0.7872*T3(I)
371 FSP3(I)=-847.9+19.20*PCFBC3(I)+18.56*PNFBS3(I)+42.5*PCPS3(I)
   1-0.001*Y3(I)-3.37*T3(I)
372 PRFBL3(I)=-4.51+0.6393*PRFBW3(I)+0.8018*BPCB3(I)
373 PRPL3(I)=-7.69+0.4864*PRPW3(I)+1.20*BPCP3(I)
374 PRFC3(I)=-23.74+0.9027*PRFBL3(I)+0.165*RNGE3(I)+0.5044*PRFC1(I-1)
375 IF(RNGE3(I)-80.0) 377,377,376
376 PRFC3(I)=PRFC3(I)+0.01*RNGE3(I)
377 IF((PRFC3(I-1)-PRFC4(I-1))-1.39) 378,378,379
378 IF((PRC2(I-1)-PRC2(I-2))-0.13) 380,379,379
379 PRFC3(I)=0.96*PRFC3(I)
380 SF3(I)=-82.67+0.89764*SF3(I-1)+45.175*PRPL1(I-1)-317.48*PRC1(I-1)
   1+0.33541*SF2(I-1)-0.33541*SF2(I-2)
381 IF(PRC1(I-1)-1.10) 386,382,382
382 IF((PRPL1(I-1)/PRC1(I-1))-17.5) 383,383,386
383 IF(PRPL2(I-1)-19.75)388,388,384
384 IF((PRPL2(I-1)/PRC2(I-1))-15.0)385,385,386
385 SF3(I)=0.90*SF3(I)
386 IF(PRC1(I-1)-1.20)387,388,388
387 SF3(I)=1.20*SF3(I)
388 PL3(I)=-4589.0+0.3011*H21(I-1)+75.14*(PRFBL3(I)/PRC3(I))
389 IF(I-5) 390,390,391
390 PL3(I)=PL3(I)+29.86*(PRFBL3(I)/PRC3(I))
391 IF(PRC3(I)-1.20) 392,394,394
392 IF((PRFBL3(I)/PRC3(I))-22.0) 393,394,394
393 PL3(I)=PL3(I)-15.0*(PRFBL3(I)/PRC3(I))
394 IF((PRPL3(I)-PRPL3(I-1))-6.00) 537,537,395
395 PL3(I)=0.93*PL3(I)
537 IF(PRFBL2(I-1)-30.0)400,400,538
538 IF(PRFBL3(I)-30.0)400,400,539
539 PL3(I)=1.05*PL3(I)
400 XMFC4(I)=501.0+0.3441*PL1(I-1)+0.3441*PL2(I-1)+0.3441*PL3(I)
401 AWTF4(I)=478.0+0.5304*AWTF3(I)+1.61*(PRFBL2(I-1)/PRC2(I-1))
451 IF(I-7)402,499,402
499 AWTF4(I)=AWTF4(I)+15.0
402 IF(Z(I-1)-24.00) 403,403,404
403 IF((PCPS4(I-1)+PCPS1(I-1)+PCPS2(I-1))-45.0) 404,540,540
404 AWTF4(I)=1.015*AWTF4(I)
540 IF(PRFBL2(I-1)-30.0)405,405,541
541 IF(PRFBL3(I)-30.0)405,405,542
542 AWTF4(I)=0.98*AWTF4(I)
405 CSFC4(I)=(XMFC4(I)*AWTF4(I))/1000.
406 BPF4(I)=0.6*CSFC4(I)
407 XMIFB4(I)=0.5*XMILB4(I)
408 PCFBC4(I)=(BPF4(I)-XMIFB4(I))/CN4(I)
409 AWTNF4(I)=915.0+0.7824*T4(I)
410 XMNFC4(I)=-770.3+0.0625*H13(I-1)+0.043*H23(I-1)+1568.5*PRC3(I)
   1-84.965*PRFC3(I)+24.05*RNGF4(I)-0.39417*AWTNF4(I)
411 IF(RNGF4(I)-83.0) 413,413,412
412 XMNFC4(I)=XMNFC4(I)-4.0*RNGF4(I)
413 IF(PRC3(I)-1.11) 414,414,415
414 XMNFC4(I)=XMNFC4(I)-183.5*PRC3(I)
415 IF(Z(I-1)-24.00) 417,417,416
416 XMNFC4(I)=0.87*XMNFC4(I)
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417 IF((PRC2(I-1)-PRC2(I-2))-0.13) 419.418.418
418 XMNFC4(I)=1.15*XMNFC4(I)
419 IF((H22R(I-1)/H23(I-1))-0.215)424.424.420
420 IF(PRNFB3(I)-38.00) 424.424.421
421 XMNFC4(I)=1.07*XMNFC4(I)
422 IF((H22R(I-2)/H23(I-2))-0.22) 424.424.423
423 XMNFC4(I)=1.14*XMNFC4(I)
424 BPNF4(I)=0.511*XMNFC4(I)
425 XIB4(I)=761.3-1.672*PRNFB2(I-1)-1.672*PRNFB3(I)
   1-18.8*PNFBS2(I-1)-18.8*PNFBS3(I)
426 XB4(I)=-0.65-0.343*PRNFB2(I-1)-0.343*PRNFB3(I)
   1+1.988*PNFBS2(I-1)+1.988*PNFBS3(I)
427 IF(I-5) 428.428.429
428 XIB4(I)=XIB4(I)-231.3
    GO TO 431
429 IF(I-6) 430.430.432
430 XIB4(I)=XIB4(I)-112.3
431 XB4(I)=XB4(I)-1.86
432 IF((PRNFB3(I-1)-PRNFB3(I))-6.0) 434.434.433
433 XIB4(I)=0.70*XIB4(I)
434 IF(CBCS(I-1)-3370.0) 435.435.437
435 IF(PRNFB2(I-1)-30.0) 437.436.436
436 XIB4(I)=1.35*XIB4(I)
437 IF(Z(I-1)-24.00) 439.439.438
438 XIB4(I)=1.25*XIB4(I)
439 IF(I-16) 441.440.440
440 XIB4(I)=1.40*XIB4(I)
441 IF(XIB4(I)) 442.443.443
442 XIB4(I)=0.0
443 PNFBS4(I)=FSB3(I)/CN4(I)+BPNF4(I)/CN4(I)+XIB4(I)/CN4(I)-XB4(I)/
   1CN4(I)-XMIFB4(I)/CN4(I)
444 CHS4(I)=-4146.0+0.52726*SF2(I-1)+0.1721*SF1(I-1)-54.05*PRPL3(I)
   1-719.58*PRC3(I)+1168.76*PSPS2(I-1)
446 IF(PRPL2(I-2)-15.25) 447.449.449
447 IF(PRPL2(I-1)-15.25) 448.449.449
448 CHS4(I)=CHS4(I)+30.0*PRPL3(I)
449 IF((PRFC3(I)-PRFC3(I-1))-4.90)452.452.450
450 CHS4(I)=0.975*CHS4(I)
452 IF(PRC3(I)-1.10) 453.454.454
453 CHS4(I)=CHS4(I)+330.0*PRC3(I)
454 IF(PRPL3(I)-24.00) 456.455.455
455 CHS4(I)=CHS4(I)+21.0*PRPL3(I)
    GO TO 460
456 IF(PRPL3(I)-22.0) 460.457.457
457 IF(PRPL3(I-1)-22.0) 460.458.458
458 IF(PRPL3(I-2)-22.0) 460.459.459
459 CHS4(I)=CHS4(I)+26.0*PRPL3(I)
460 PP4(I)=DPH4(I)*CHS4(I)
461 XIP4(I)=-92.56+0.958*PRPW2(I-1)+0.958*PRPW3(I)+0.93*T4(I)+2.6*
   1PCPS3(I)
462 XP4(I)=-2.4-0.09*PRPW2(I-1)-0.09*PRPW3(I)+0.286*T4(I)+2.86*PCPS3(I
   1)
463 PCPS4(I)=FSP3(I)/CN4(I)+PP4(I)/CN4(I)+XIP4(I)/CN4(I)-XP4(I)/CN4(I)
   1-XMILP4(I)/CN4(I)
464 PRFBW4(I)=68.30-3.3237*PCFBC4(I)-3.1563*PNFBS4(I)+0.02253*Y4(I)
   1+0.1106*T4(I)
465 IF(PCFBC4(I)-16.0) 468.468.466
466 IF(PCPS4(I)-18.0) 468.468.467
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467 PRFBW4(I)=0.9375*PRFBW4(I)
468 PRNFB4(I)=81.54-4.4403*PNFBS4(I)-1.1698*PCPS4(I)+0.01112*Y4(I)
   1-0.2363*T4(I)
469 IF((PCFBC4(I)+PNFBS4(I))-27.0) 471,470,470
470 PRNFB4(I)=PRNFB4(I)+0.35*PNFBS4(I)
471 PRPW4(I)=49.36-0.9945*PNFBS4(I)-3.3264*PCPS4(I)+0.03727*Y4(I)
   1-0.602*T4(I)
472 IF(Y4(I)-2790.0) 474,474,473
473 PRPW4(I)=PRPW4(I)-0.002*Y4(I)

474 IF((PCPS4(I)-PCPS4(I-1))-2.0) 476,476,475
475 PRPW4(I)=0.9525*PRPW4(I)
476 FSB4(I)=-430.82+26.26*PCFBC4(I)+17.91*PNFBS4(I)+10.27*PCPS4(I)
   1-0.0115*Y4(I)-0.79*T4(I)
477 FSP4(I)=-852.9+19.20*PCFBC4(I)+18.56*PNFBS4(I)+42.5*PCPS4(I)
   1-0.001*Y4(I)-3.37*T4(I)
478 PRFBL4(I)=-4.51+0.6393*PRFBW4(I)+0.8018*BPCB4(I)
479 PRPL4(I)=-7.69+0.4864*PRPW4(I)+1.2*BPCP4(I)
480 PRFC4(I)=-13.79+0.7831*PRFBL4(I)+0.11*RNGE4(I)+0.3952*PRFC2(I-1)
481 IF(RNGE4(I)-80.0) 483,482,482
482 PRFC4(I)=PRFC4(I)+0.01*RNGE4(I)
483 SF4(I)=-82.67+0.89764*SF4(I-1)+45.175*PRPL2(I-1)-317.48*PRC2(I-1)
   1+0.33541*SF3(I)-0.33541*SF3(I-1)
484 IF(PRPL2(I-1)-19.75) 486,485,485
485 SF4(I)=SF4(I)-10.0*PRPL2(I-1)
486 IF(PRC2(I-1)-1.11) 487,487,488
487 SF4(I)=1.056*SF4(I)
488 IF((PRC2(I-1)-PRC3(I))-0.115) 490,489,489
489 SF4(I)=1.13*SF4(I)
490 PL4(I)=-3638.0+0.2728*H23(I-1)+98.00*(PRFBL4(I)/PRC4(I))
491 IF(PRFBL4(I)-24.50) 492,494,494
492 IF((PRC3(I)-PRC4(I))-0.10) 494,494,493
493 PL4(I)=PL4(I)-28.0*(PRFBL4(I)/PRC4(I))
494 IF(PRPL3(I)-24.00) 496,495,495
495 PL4(I)=1.04*PL4(I)
    GO TO 501
496 IF(PRFBL3(I)-28.00) 501,497,497
497 IF(PRFBL4(I)-27.00) 501,498,498
498 PL4(I)=1.04*PL4(I)
501 PRFCA(I)=0.25*PRFC1(I-1)+0.25*PRFC2(I-1)+0.25*PRFC3(I)+0.25*PRFC4
   1(I)
502 Z(I)=((PRFBL3(I)/PRC3(I))+(PRFBL4(I)/PRC4(I)))/2.0
503 H21(I)=-5632.+1.48551*H23(I-1)-1.19368*H23(I-2)+0.59684*H23(I-3)
   1+121.22123*PRFCA(I)
504 H22R(I)=-1176.+0.27791*H21(I-1)+57.5855*PRFCA(I)
505 IF(I-09) 506,506,510
506 IF(PRFCA(I)-27.00) 507,507,508
507 CBCS(I)=536.-0.89657*H23(I-1)+2.12714*H23(I-2)-1.06357*H23(I-3)
   1-39.3934*PRFCA(I)
    GO TO 512
508 CBCS(I)=536.-0.05534*H23(I-1)+0.44468*H23(I-2)-0.22234*H23(I-3)
   1-39.3934*PRFCA(I)
    GO TO 512
510 CBCS(I)=536.-0.92077*H23(I-1)+2.12714*H23(I-2)-1.06357*H23(I-3)
   1-39.3934*PRFCA(I)
512 IF(Z(I-1)-24.00) 513,513,524
513 IF(PRFCA(I)-22.00) 514,514,515
514 IF((PRFCA(I-1)-PRFCA(I))-2.75) 515,515,518
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515 IF((RNGE3(I-1)-RNGE3(I))-7.0) 520,520,516
516 IF((RNGE2(I-1)-RNGE3(I))-2.0) 520,520,517
517 CBCS(I)=1.075*CBCS(I)
    GO TO 520
518 CBCS(I)=1.125*CBCS(I)
519 Y7(I)=1.0
520 IF(Z(I-1)-23.00) 521,521,509
521 IF((CBCS(I)/H23(I-3))-0.13) 522,522,509
522 CBCS(I)=CBCS(I)+0.04*H23(I-3)
523 H21(I)=H21(I)-0.03*H23(I-3)
    GO TO 509
524 CBCS(I)=0.82*CBCS(I)
525 H22R(I)=1.015*H22R(I)
526 H21(I)=1.02*H21(I)
509 IF((CBCS(I)/H23(I-3))-0.105)511,545,545
511 CBCS(I)=CBCS(I)+0.05*H23(I-3)
544 H21(I)=H21(I)-0.05*H23(I-3)
545 IF(PRFCA(I)-30.00)527,527,546
546 H22R(I)=0.94*H22R(I)
527 H23(I)=0.96*H23(I-1)+1.0*H22R(I-1)-1.0*CBCS(I)
101 XMFC1(I)=514.0+0.3748*PL3(I)+0.3748*PL2(I-1)+0.3748*PL1(I-1)
547 IF(PRFBW4(I)-48.00)102,102,548
548 IF(PRNFB4(I)-42.00)102,102,549
549 IF(PRPW4(I)-58.00)102,102,550
550 XMFC1(I)=0.94*XMFC1(I)
102 AWTF1(I)=-204.0+1.1362*AWTF4(I)+3.64*(PRFBL3(I)/PRC3(I))
103 IF(I-5)104,104,105
104 AWTF1(I)=AWTF1(I)+18.0
105 IF(I-6) 107,106,107
106 AWTF1(I)=AWTF1(I)-20.0
107 IF(PRC1(I)-1.10) 108,109,109
108 AWTF1(I)=AWTF1(I)-0.70*(PRFBL3(I)/PRC3(I))
109 IF(PRPL3(I)-15.0)110,198,198
110 AWTF1(I)=AWTF1(I)-15.0
198 IF((PRFBL3(I)/PRC3(I))-27.0)111,111,199
199 AWTF1(I)=0.96*AWTF1(I)
111 CSFC1(I)=(XMFC1(I)*AWTF1(I))/1000.
112 BPF1(I)=0.6*CSFC1(I)
113 XMIFB1(I)=0.5*XMIIB1(I)
114 PCFBC1(I)=(BPF1(I)-XMIFB1(I))/CN1(I)
115 AWTNF1(I)=913.5+0.7824*T1(I)
116 XMNFC1(I)=-979.1+0.0625*H13(I)+0.038*H23(I)+1568.5*PRC4(I)
   1-84.965*PRFC4(I)+24.05*RNGE1(I)-0.39417*AWTNF1(I)
117 IF((PRFC4(I)-PRFC4(I-2))- 5.75) 119,119,118
118 XMNFC1(I)=0.875*XMNFC1(I)
119 IF((PRC1(I)-PRC4(I))-0.11) 121,120,120
120 XMNFC1(I)=1.08*XMNFC1(I)
121 IF((PRNFB4(I-1)-PRNFB4(I))-7.50) 123,123,122
122 XMNFC1(I)=0.95*XMNFC1(I)
123 IF((H22R(I)/H23(I))-0.22) 124,124,125
124 IF(PRNFB4(I)-37.25) 127,127,126
125 IF(PRNFB4(I)-36.00) 127,127,126
126 XMNFC1(I)=1.11*XMNFC1(I)
127 BPNF1(I)=0.512*XMNFC1(I)
128 XIB1(I)=761.3-1.672*PRNFB3(I)-1.672*PRNFB4(I)-18.8*PNFBS3(I)
   1-18.8*PNFBS4(I)
129 XB1(I)=-0.65-0.343*PRNFB3(I)-0.343*PRNFB4(I)+1.988*PNFBS3(I)
   1+1.988*PNFBS4(I)
```

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130 IF(I-6) 131,131,133
131 XIB1(I)=XIB1(I)-181.3
132 XB1(I)=XB1(I)-1.86
133 IF(CBCS(I)-3300.0) 134,135,135
134 XIB1(I)=1.40*XIB1(I)
135 IF((PRNFB3(I-1)-PRNFB3(I))-6.0) 551,551,136
136 XIB1(I)=0.70*XIB1(I)
551 IF(PRFBW4(I)-48.00)137,137,552
552 IF(PRNFB4(I)-42.00)137,137,553
553 IF(PRPW4(I)-58.00)137,137,554
554 XIB1(I)=1.5*XIB1(I)
137 IF(XIB1(I)) 138,138,139
138 XIB1(I)=0.0
139 IF(I-15) 141,140,140
140 XIB1(I)=1.45*XIB1(I)
141 PNFBS1(I)=ESB4(I)/CN1(I)+BPNF1(I)/CN1(I)+XIB1(I)/CN1(I)-XB1(I)/CN
   11(I)-XMIFB1(I)/CN1(I)
142 CHS1(I)=-4146.0+0.52726*SF3(I)+0.1721*SF2(I-1)-54.05*PRPL4(I)
   1-719.58*PRC4(I)+1168.76*PSPS3(I)
143 IF(PRPL4(I)-12.6) 144,144,145
144 CHS1(I)=CHS1(I)+24.05*PRPL4(I)
    GO TO 151
145 IF(PRPL4(I)-25.00)146,146,148
146 IF(PRPL4(I-1)-24.00)149,149,147
147 IF((PRPL4(I-1)-PRPL4(I))-4.50)149,149,148
148 CHS1(I)=CHS1(I)+26.5*PRPL4(I)
149 IF((PRFC4(I)-PRFC4(I-1))-4.25)151,151,150
150 CHS1(I)=0.936*CHS1(I)
151 PP1(I)=DPH1(I)*CHS1(I)
152 XIP1(I)=-92.56+0.958*PRPW3(I)+0.958*PRPW4(I)+0.93*T1(I)+2.6*PCPS4
   1(I)
153 XP1(I)=-8.84-0.09*PRPW3(I)-0.09*PRPW4(I)+0.286*T1(I)+2.86*PCPS4(I)
154 PCPS1(I)=ESP4(I)/CN1(I)+PP1(I)/CN1(I)+XIP1(I)/CN1(I)-XP1(I)/CN1(I)
   1-XMILP1(I)/CN1(I)
155 PRFBW1(I)=67.36-3.3237*PCFBC1(I)-3.1563*PNFBS1(I)+0.02253*Y1(I)
   1+0.1106*T1(I)
156 PRNFB1(I)=74.93-4.4403*PNFBS1(I)-1.1698*PCPS1(I)+0.01112*Y1(I)
   1-0.2363*T1(I)
157 IF((PCFBC1(I)+PNFBS1(I))-27.0) 159,159,158
158 PRNFB1(I)=PRNFB1(I)+0.40*PNFBS1(I)
159 PRPW1(I)=46.60-0.9945*PNFBS1(I)-3.3264*PCPS1(I)+0.03727*Y1(I)
   1-0.6021*T1(I)
160 IF(Y1(I)-2800.0) 162,162,161
161 PRPW1(I)=PRPW1(I)-0.002*Y1(I)
162 IF((PCPS1(I)-PCPS1(I-1))-2.0) 163,163,169
163 IF(PRPW4(I)-40.0) 164,170,170
164 IF(PRPW1(I-1)-40.0) 165,170,170
165 IF(PRPW1(I-2)-40.0) 166,170,170
166 PRPW1(I)=0.93*PRPW1(I)
167 PRFBW1(I)=0.95*PRFBW1(I)
168 ZZ(I)=1.0
    GO TO 170
169 PRPW1(I)=0.955*PRPW1(I)
170 ESB1(I)=-458.8+26.26*PCFBC1(I)+17.91*PNFBS1(I)+10.27*PCPS1(I)
   1-0.0115*Y1(I)-0.7872*T1(I)
171 ESP1(I)=-741.67+19.20*PCFBC1(I)+18.56*PNFBS1(I)+42.5*PCPS1(I)
   1-0.001*Y1(I)-3.37*T1(I)
172 IF((PCFBC1(I)+PNFBS1(I)+PCPS1(I))-46.5) 174,174,173
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173 FSB1(I)=0.75*FSB1(I)
174 IF((PCFBC4(I)+PNFBS4(I)+PCPS4(I))-46.5) 176,176,175
175 FSP1(I)=0.70*FSP1(I)
176 PRFBL1(I)=-4.51+0.6393*PRFBW1(I)+0.8C18*BPCB1(I)
177 PRPL1(I)=-7.69+0.4864*PRPW1(I)+1.2*BPCP1(I)
178 PRFC1(I)=-5.33+0.8208*PRFBL1(I)+0.3785*PRFC3(I)
179 IF(PRFBL1(I)-25.50) 182,182,180
180 IF((PRFC3(I)-PRFC4(I))-1.75) 182,182,181
181 PRFC1(I)=0.94*PRFC1(I)
182 SF1(I)=-82.67+0.89764*SF1(I-1)+45.175*PRPL3(I)-317.48*PRC3(I)
   1+0.33541*SF4(I)-0.3354*SF4(I-1)
560 IF(PRPL3(I)-26.0)183,561,561
561 SF1(I)=SF1(I)-20.0*PRPL3(I)
183 IF(Z(I)-24.00) 184,184,185
184 IF(ZZ(I)-1.0) 186,185,186
185 SF1(I)=0.93*SF1(I)
186 IF((PRPL3(I-1)-PRPL3(I))-7.0) 187,187,188
187 IF((PRC3(I)-PRC2(I-1))-0.14) 189,189,188
188 SF1(I)=0.86*SF1(I)
189 PL1(I)=-5539.0+0.2488*H23(I-1)+86.2*(PRFBL1(I)/PRC1(I))
190 IF(I-4) 192,192,191
191 IF(PRC1(I)-1.10) 192,192,562
192 PL1(I)=PL1(I)-10.0*(PRFBL1(I)/PRC1(I))
562 IF((PRFBL1(I)/PRC1(I))-24.50)193,193,563
563 PL1(I)=PL1(I)-10.0*(PRFBL1(I)/PRC1(I))
193 IF(YZ(I)-1.0) 201,194,201
194 PL1(I)=0.94*PL1(I)
201 XMFC2(I)=-441.0+0.344*PL3(I)+0.344*PL4(I)+0.344*PL1(I)
202 IF(I-4)203,203,204
203 XMFC2(I)=1.085*XMFC2(I)
204 IF((PRFBL4(I-1)-PRFBL4(I))-3.80) 207,205,205
205 IF((PRFBL1(I-1)-PRFBL1(I))-2.80) 207,207,206
206 XMFC2(I)=1.053*XMFC2(I)
207 IF(YZ(I)-1.00) 209,208,209
208 XMFC2(I)=0.96*XMFC2(I)
209 IF(PRFBW1(I)-46.00) 213,213,210
210 IF(PRNFB1(I)-36.00) 213,213,211
211 IF(PRPW1(I)-49.00) 213,213,212
212 XMFC2(I)=0.968*XMFC2(I)
213 IF(PRPL1(I-1)-23.0) 216,214,214
214 IF((PRPL1(I-1)-PRPL1(I))-6.00) 216,215,215
215 XMFC2(I)=1.05*XMFC2(I)
216 AWTF2(I)=271.0+0.6958*AWTF1(I)+2.24*(PRFBL4(I)/PRC4(I))
217 IF(Z(I)-22.90) 220,220,218
218 IF((PRFBL4(I)/PRC4(I))-24.50) 220,220,219
219 AWTF2(I)=AWTF2(I)+0.3*(PRFBL4(I)/PRC4(I))
    GO TO 222
220 IF(YZ(I)-1.0) 222,221,222
221 AWTF2(I)=0.985*AWTF2(I)
222 CSFC2(I)=(XMFC2(I)*AWTF2(I))/1000.
223 BPF2(I)=0.6*CSFC2(I)
224 XMIFB2(I)=0.5*XMILB2(I)
225 PCFBC2(I)=(BPF2(I)-XMIFB2(I))/CN2(I)
226 AWTNF2(I)=893.+0.7824*T2(I)
227 XMNFC2(I)=-916.6+0.0625*H13(I)+0.037*H23(I)+1568.5*PRC1(I)
   1-84.965*PRFC1(I)+24.05*RNGE2(I)-0.39417*AWTNF2(I)
228 IF((PRC1(I)-PRC4(I))-0.11) 230,229,229
229 XMNFC2(I)=1.08*XMNFC2(I)
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230 IF(PRC1(I)-1.10) 231,231,232
231 XMNFC2(I)=XMNFC2(I)-138.5*PRC1(I)
232 IF(PRPL1(I-1)-23.0) 235,235,233
233 IF((PRPL1(I-1)-PRPL1(I))-6.00) 235,234,234
234 XMNFC2(I)=0.90*XMNFC2(I)
235 IF(Z(I)-24.00) 237,237,236
236 XMNFC2(I)=0.92*XMNFC2(I)
237 IF(Y7(I)-1.0) 239,238,239
238 XMNFC2(I)=0.87*XMNFC2(I)
239 BPNF2(I)=0.524*XMNFC2(I)
240 XIB2(I)=761.3-1.672*PRNFB4(I)-1.672*PRNFB1(I)-18.8*PNFBS4(I)
   1-18.8*PNFBS1(I)
241 XB2(I)=-0.65-0.343*PRNFB4(I)-0.343*PRNFB1(I)+1.988*PNFBS4(I)
   1+1.988*PNFBS1(I)
242 IF(I-5) 243,243,245
243 XIB2(I)=XIB2(I)-181.3
244 XB2(I)=XB2(I)-1.86
    GO TO 253
245 IF(I-6) 246,246,247
246 XIB2(I)=XIB2(I)-81.3
247 IF((PRNFB1(I-1)-PRNFB1(I))-6.0) 249,248,248
248 XIB2(I)=0.67*XIB2(I)
249 IF(XIB2(I)) 250,251,251
250 XIB2(I)=0.0
251 IF(I-15) 253,252,252
252 XIB2(I)=1.35*XIB2(I)
253 PNFBS2(I)=FSB1(I)/CN2(I)+BPNF2(I)/CN2(I)+XIB2(I)/CN2(I)-XB2(I)/CN2
   1(I)-XMIFB2(I)/CN2(I)
254 CHS2(I)=-4146.+0.52726*SF4(I)+0.1721*SF3(I)-54.05*PRPL1(I)-719.58*
   1PRC1(I)+1168.76*PSPS4(I)
255 IF(PRC1(I)-1.12) 256,256,257
256 CHS2(I)=CHS2(I)+319.58*PRC1(I)
257 IF(PRPL1(I)-26.00) 258,258,260
258 IF(PRPL1(I-1)-23.0) 261,259,259
259 IF((PRPL1(I-1)-PRPL1(I))-6.00) 261,260,260
260 CHS2(I)=CHS2(I)+22.00*PRPL1(I)
261 PP2(I)=DPH2(I)*CHS2(I)
262 XIP2(I)=-92.56+0.958*PRPW4(I)+0.958*PRPW1(I)+0.93*T2(I)+2.6*PCPS1
   1(I)
263 XP2(I)=-9.88-0.09*PRPW4(I)-0.09*PRPW1(I)+0.286*T2(I)+2.86*PCPS1(I)
264 PCPS2(I)=FSP1(I)/CN2(I)+PP2(I)/CN2(I)+XIP2(I)/CN2(I)-XP2(I)/CN2(I)
   1-XMILP2(I)/CN2(I)
265 PRFBW2(I)=63.09-3.3237*PCFBC2(I)-3.1563*PNFBS2(I)+0.02253*Y2(I)
   1+0.1106*T2(I)
266 PRNFB2(I)=77.60-4.4403*PNFBS2(I)-1.1698*PCPS2(I)+0.01112*Y2(I)
   1-0.2363*T2(I)
267 PRPW2(I)=44.42-0.9945*PNFBS2(I)-3.3264*PCPS2(I)+0.03727*Y2(I)
   1-0.6021*T2(I)
195 IF(I-6)268,196,268
196 PRNFB2(I)=PRNFB2(I)+4.50
197 PRPW2(I)=PRPW2(I)+5.0
268 IF(Y2(I)-2800.0) 270,270,269
269 PRPW2(I)=PRPW2(I)-0.002*Y2(I)
270 IF((PCPS2(I)-PCPS2(I-1))-2.0) 272,272,271
271 PRPW2(I)=0.955*PRPW2(I)
272 IF(Z7(I)-1.0) 275,273,275
273 PRPW2(I)=0.97*PRPW2(I)
274 PRFBW2(I)=0.9675*PRFBW2(I)
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275 IF((PRPW1(I-1)-PRPW1(I))-10.00) 277,277,276
276 PRPW2(I)=0.90*PRPW2(I)
277 ESB2(I)=-477.52+26.26*PCFBC2(I)+17.91*PNFBS2(I)+10.27*PCPS2(I)
   1-0.0115*Y2(I)-0.7872*T2(I)
278 FSP2(I)=-732.53+19.20*PCFBC2(I)+18.56*PNFBS2(I)+42.5*PCPS2(I)
   1-0.001*Y2(I)-3.37*T2(I)
279 PRFBL2(I)=-4.51+0.6393*PRFBW2(I)+0.8018*BPCB2(I)
280 PRPL2(I)=-7.69+0.4864*PRPW2(I)+1.2*BPCP2(I)
281 PRFC2(I)=-15.64+0.7376*PRFBL2(I)+0.153*RNGE2(I)+0.4435*PRFC4(I)
282 IF((PRFC3(I)-PRFC4(I))-1.39) 283,284,284
283 IF((PRC2(I)-PRC2(I-1))-0.13) 285,284,284
284 PRFC2(I)=0.94*PRFC2(I)
285 SF2(I)=-82.67+0.89764*SF2(I-1)+45.175*PRPL4(I)-317.48*PRC4(I)
   1+0.33541*SF1(I)-0.33541*SF1(I-1)
286 IF(PRPL4(I)-13.0) 287,288,288
287 SF2(I)=SF2(I)-10.0*PRPL4(I)
288 IF(PRC4(I)-1.05) 289,289,555
289 SF2(I)=1.075*SF2(I)
555 IF((PRC4(I)-PRC3(I))-0.02)556,556,557
557 SF2(I)=0.90*SF2(I)
556 IF((PRPL2(I-1)+PRPL3(I))-49.0)290,290,558
558 IF((PRPL4(I)+PRPL1(I))-52.0)290,559,559
559 SF2(I)=1.10*SF2(I)
290 PL2(I)=-5233.0+0.249*H21(I)+96.6*PRFBL2(I)
291 IF(I-4) 292,292,293
292 PL2(I)=PL2(I)+647.0
    GO TO 15
293 IF(I-5)15,294,295
294 PL2(I)=PL2(I)+316.0
295 IF((PRC2(I)-PRC2(I-1))-0.13) 297,296,296
296 PL2(I)=0.95*PL2(I)
297 IF(PRPL2(I)-23.50) 299,299,298
298 PL2(I)=0.96*PL2(I)
299 IF(PRPL2(I)-22.0) 17,17,300
300 IF(PRFBL2(I)-30.0) 17,17,16
 16 PL2(I)=1.13*PL2(I)
 17 IF(PRPL2(I-1)-23.0)15,15,18
 18 IF((PRPL2(I-1)-PRPL2(I))-3.50)15,15,19
 19 PL2(I)=1.085*PL2(I)
 15 CONTINUE
    RETURN
    END
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