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Number 1825

Forecasting Farm Income:

Documenting USDA's Economic Model

Robert Dubman
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Charles Dodson

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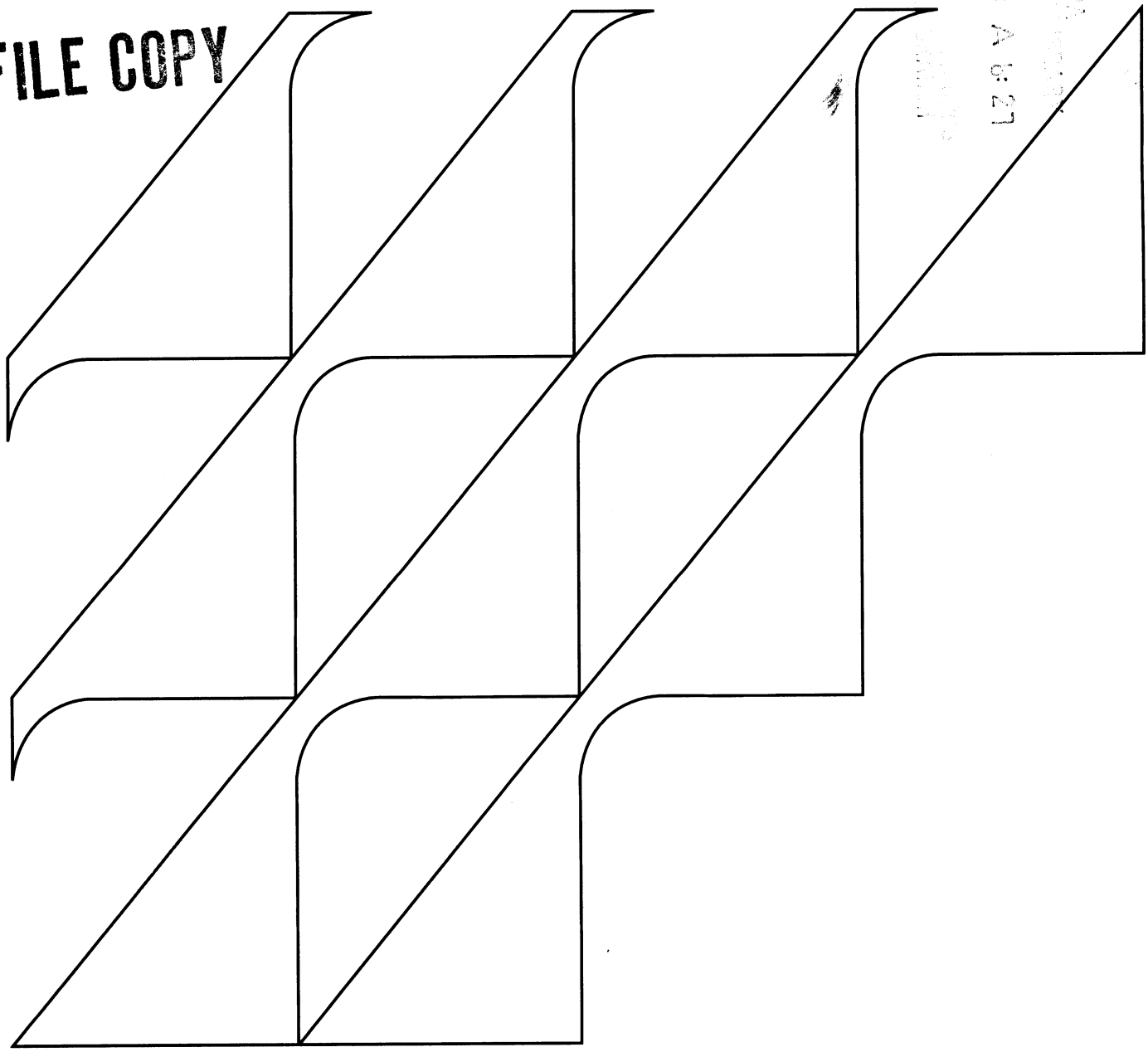

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Forecasting Farm Income: Documenting USDA's Economic Model. By Robert Dubman, Robert McElroy, and Charles Dodson. Agriculture and Rural Economy Division, Economic Research Service, U.S. Department of Agriculture. Technical Bulletin Number 1825.

Abstract

Net cash and net farm income are the principal measures of the financial condition of the U.S. farm sector and are a major component of the National Income and Product Accounts of the U.S. Department of Commerce. The U.S. Department of Agriculture's farm income forecasting model is an accounting model for forecasting crop and livestock receipts for 32 individual commodities, government program payments for each program commodity, and expenses for 21 inputs, such as feed, seed, fertilizer, interest, and labor. This report describes the components and equations in the model.

Keywords: Farm income, forecasting, agricultural finance, modeling

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Summary

The Economic Research Service is publishing for the first time its model for forecasting the income earned by the U.S. farm sector, along with all the associated components of income. This report describes the major components of the model with examples. The appendix lists, in verbal style, most of the approximately 1,000 equations used in the model.

By seeing the methods and the equations underlying the ERS farm income forecasts, users of the series should have a better grasp of the work that goes into the forecasts and be better able to judge their reliability. This report is aimed at researchers familiar with farm income accounting procedures, but includes easy-to-read descriptions of each component of the forecasting model.

Forecasting Farm Income:
Documenting USDA's Economic Model

Robert Dubman
Robert McElroy
Charles Dodson

Introduction

The Economic Research Service (ERS) of the U.S. Department of Agriculture (USDA) forecasts net cash and net farm income as major indicators of the financial condition of the U.S. farm sector. Net farm income, which includes both cash and noncash income and expenses, measures the net value of goods and services generated by farm operations during a given calendar year (see *Major Statistical Series of the U.S. Department of Agriculture: Farm Income*). Net cash income measures the calendar-year cash earnings from farms. These forecasts are widely used. The U.S. Department of Commerce includes USDA forecasts of net farm income in their forecasts of U.S. gross domestic product (GDP). The farm income forecasts are used by the farm equipment industry, farm banks, and other farm-related industries to formulate business plans. State and local governments also use USDA farm income forecasts for forecasting personal and real property tax receipts. Thus, interest in USDA's farm income forecasts transcends the farming community.

This report provides documentation for the ERS model for forecasting the income earned by production agriculture, along with all the associated components of income. The report has two sections: a description of the major components of the model with examples, and an appendix listing most of the approximately 1,000 equations used in the model.

USDA has issued farm financial forecasts for many years, but the methods and data behind the forecasts have never been published. The procedures and the equations underlying the ERS farm income forecasts should provide users of the series with a better understanding of how the forecasts are made and allow a better assessment of their reliability.

The ERS farm income forecasting model is an accounting model designed to align with official ERS farm income estimates published annually in *Economic Indicators of the Farm Sector: National Financial Summary*. The model focuses entirely on the farm sector, including components for cash receipts, net Commodity Credit Corporation (CCC) loans, direct Government payments, farm-related income, nonmoney income, and cash and noncash expenses.

Cash receipts are forecast for 21 crops and 11 livestock commodities. Net CCC loans, an addition to open-market sales, are forecast for 9 crops, and the values of changes in farm inventories are forecast for 17 crops and 4 livestock commodities. Quarterly marketing patterns are incorporated to project forecasts of crop-year production into calendar-year quarterly sales, the timeframe used in the income accounts. Cash expense levels combine price and price index forecasts of the major production inputs with production forecasts for crop and livestock commodities. Expected prices and production are provided by USDA commodity analysts. As new data become available, forecasts are updated monthly and published quarterly.

Cash Receipts

Cash receipts include open-market sales plus the net value of CCC loans for those commodities that are part of the Federal commodity loan program. Crop and livestock cash receipt forecasts are developed quarterly to reflect price changes throughout the calendar year. While livestock production and sales occur monthly, most major crops are harvested only once each year. Storable crops, such as wheat, corn, and dry beans, can be sold all at once or stored for later sale at the producer's discretion. To forecast these periodic crop sales, recent historical marketing patterns for each crop are incorporated to apportion the year's production throughout the crop's marketing year. Since the ERS income accounts are on a calendar-year basis, this apportioning will move some sales of a particular year's production into that year's sales and some into the next calendar year's sales. Preliminary quarterly cash receipt estimates replace the forecasts as they become available, usually about 3 months after the end of each quarter. The preliminary estimates are later revised in the model and published in *Economic Indicators of the Farm Sector: National Financial Summary*.

Commodity Categories in the Net Farm Income Model

Food grains	Feed crops	Oil crops
Wheat	Corn	Soybeans
Rice	Sorghum	Peanuts
	Barley	Sunflower
	Oats	Flaxseed
	Hay	

Other crops	
Cotton lint	Cottonseed
Potatoes	Dry beans
Tobacco	Vegetables and melons
Fruits and nuts	Greenhouse and nursery
Miscellaneous	

Meat animals	Poultry and eggs	Dairy
Cattle	Broilers	Milk
Calves	Other chicken	Other dairy
Hogs	Turkeys	
Sheep and lambs	Eggs	
	Other poultry	

Other livestock
Miscellaneous

Open-Market Crop Sales

Open-market sales are cash receipts *excluding* the net value of CCC loans. Corn is a typical spring-seeded crop, harvested in the late summer and early fall and marketed both in the year of production and throughout much of the next year. While most crops can be stored and marketed over long periods of time, the farm income forecasting model assumes all corn production is sold during the marketing year.

First-quarter (Q1)[1] open-market corn sales are from corn harvested the previous year. At harvest, part may be used on the farm, part sold, and part put under loan; the rest will be disposed of over the next four or five quarters. Using 1993 as an example, each quarter's sales are:

*1993 sales in Q1 = {[Production in 1992] * [percent of 1992 production not used on farm] * [average percent of 1992's production marketed in Q1 of 1993] - [net quantity placed under CCC loan in Q1 of 1993]} * [price forecast for Q1 of 1993].*

*1993 sales in Q2 = {[Production in 1992] * [percent of 1992 production not used on farm] * [average percent of 1992's production marketed in Q2 of 1993] - [net quantity placed under CCC loan in Q2 of 1993]} * [price forecast for Q2 of 1993].*

*1993 sales in Q3 = {[Production in 1992] * [percent of 1992 production not used on farm] * [average percent of last year's (1992) production marketed in Q3 of 1993] + [1993 production] * [percent of 1993 production not used on farm] * [average percent of the current year's (1993) production marketed in Q3 of 1993] - [net quantity placed under CCC loan in Q3 of 1993]} * [price forecast for Q3 of 1993].*

*1993 sales in Q4 = {[Production in 1992] * [percent of 1992 production not used on farm] * [average percent of last year's (1992) production marketed in Q4 of 1993] + [1993 production] * [percent of 1993 production not used on farm] * [average percent of the current year's (1993) production marketed in Q4] - [net quantity placed under CCC loan in Q4 of 1993]} * [price forecast for Q4 of 1993].*

1993 total open-market sales = Sum of quarterly open-market sales.

This procedure is repeated to forecast open-market sales for the 17 major field crops. However, the lack of data for vegetables, fruits and nuts, greenhouse and nursery products, and miscellaneous crops requires that these commodities be handled differently. These groupings each represent many different commodities, but are forecast as aggregates. For example, historical receipt estimates are published for 36 types of fruits and nuts, but ERS forecasts annual production for only 15 products dominated by citrus.[2] These 15, however, account for the overwhelming majority of total fruit and nut cash receipts. The previous-year total production for these 15 commodities is compared with the forecast total production for the 15 commodities to compute an annual output index of forecast production. This output index measures the expected change in production for the fruit and nut sector. A similar index of fruit prices is also computed. The historical price index is based on estimates provided by USDA's National Agricultural Statistics Service (NASS). NASS reports monthly prices for a market basket of fruits and nuts and publishes a weighted-average all-fruit price index. This index changes with prices and does not reflect quantities available for sale. ERS fruit analysts forecast this index quarterly. The resulting output and price indexes are then used with a base-year estimate of fruit and nut cash receipts (as

[1] Quarters are designated on a calendar-year basis: Q1 = January-March, Q2 = April-June, Q3 = July-September, Q4 = October-December.

[2] Apples, avocados, sweet cherries, cranberries, grapes, peaches, pears, plums and prunes, strawberries, grapefruit, lemons, oranges, almonds, pecans, and walnuts.

published in *Economic Indicators of the Farm Sector: National Financial Summary*) to forecast receipts. A similar procedure is used for vegetables and for greenhouse and nursery products.

CCC Placements, Redemptions, and Net Values

CCC nonrecourse loans are treated as sales to the Government with an option to repurchase. Under a nonrecourse loan program, producers are not obligated to repay the loan. At the end of the loan term, they may forfeit the commodity to CCC and retain the loan proceeds if market prices are below the contract loan rate. Placement and redemption of a CCC loan thus entail two independent decisions, each of which is based on prevailing market conditions at different times. The Internal Revenue Service (IRS) tax regulations support the ERS treatment of nonrecourse loans: IRS considers amounts of money protected against loss through nonrecourse loans not as actual loans, because the money is not at risk.

The net value of CCC loans is forecast for food grains, feed grains, soybeans, and cotton. Annual CCC placements and redemptions are determined as a proportion of total production based on past statistical relationships with the ratio of loan rate to season-average price and the proportion placed of last season's production. For example, annual placements and redemptions for corn as a proportion of total production are determined as:

*Annual placements for corn as a proportion of production = -0.586 + 0.54688 * [corn loan rate/corn season-average price] + 0.63627*[corn placements last season/corn production last season];*

*Annual redemptions for corn as a proportion of production = -0.375 + 1.0635 * [corn season-average price/corn loan rate].*

Placement and redemption rates are not allowed to be greater than 1 nor less than 0.05. The total quantity of corn placed and redeemed from the CCC is subsequently determined by multiplying the proportions from the above equations by annual production.

Since forecasts are made quarterly, annual placements and redemptions must be allocated among quarters. Quarterly placement and redemption patterns are estimated based on historical averages obtained from *Economic Indicators of the Farm Sector: National Financial Summary*. For example, for 1992 and 1993, annual placements and redemptions for corn were distributed among quarters using the proportions in table 1.

Table 1—Distribution of corn placements and redemptions over a calendar year

Quarter	Placements	Redemptions
	Percent	
1	39	27
2	2	32
3	1	34
4	58	7

Net quarterly CCC quantities are determined as placements less redemptions. Net CCC loan value is then the loan rate times net quantity. Crop receipts are the sum of open-market sales and the net CCC loan value.

Livestock Cash Receipts

Meat animals, poultry and eggs, and other livestock cash receipts differ from most crop receipts in that a price-times-quantity value is not used. Rather, the model starts with the most recent official USDA estimates (as opposed to forecasts) as a base year. Livestock receipts are then projected by adjusting these base-year estimates for changes in price and quantity. Indexing is used with livestock because of an inconsistency between price and quantity forecasts as provided by USDA livestock analysts and the cash receipt estimates required in the model. The quantity and price forecasts developed by livestock analysts are on a carcass-weight or slaughter basis, while USDA's official cash receipt estimates in the income accounts measure animals sold (excluding intrastate sales of feeder and breeding livestock) on a liveweight basis.

Carcass weight converted to liveweight would add the additional assumption that historical conversion factors do not change. ERS livestock analysts recommend indexing by ratios of carcass weights and carcass-weight prices times a base-year cash receipt estimate, because carcass-weight forecasts are based on monthly surveys of federally inspected slaughter.

For example, hog receipts for the first quarter of 1993 are:

*1993 receipts in Q1 = [Q1 1993 forecast slaughter] / [Q1 base-year actual slaughter] * [Q1 1993 forecast farm price] / [Q1 actual farm price in the base year] * [published hog cash receipts in Q1 of the base year].*

The other three quarters are forecast in the same manner, and the four quarterly estimates are summed to get annual hog cash receipts.

Dairy receipts are handled the same as major field crops. Quarterly price and production forecasts provided by ERS dairy analysts are entirely consistent with cash receipt definitions and methodology, and are multiplied together to derive quarterly dairy cash receipts.

Direct Government Payments

The most common types of direct Government payments are deficiency and diversion payments, conservation reserve rental payments, and disaster payments. Payments are made to agricultural producers for participating in farm programs established and defined in Federal legislation. To participate in these programs, producers are usually required to set aside part of their land and not produce the program crop on that land. Producers may have to meet requirements relating to conservation of the set-aside land. These compliance procedures can change with each Farm Act. USDA's Agricultural Stabilization and Conservation Service (ASCS) is charged with administering these programs. The provisions of the various programs are discussed in detail in the ERS series of reports on Background for the 1990 Farm Legislation. (See ERS Staff Reports AGES 89-41, 42, 46, 47, 49, 56, 62, 65, and 67, and AIB-602.) Payments are forecast for wheat, rice, feed grains, and cotton. Payments for conservation reserve, disaster, reserve storage, and other programs are exogenous to the forecasting model.

Deficiency Payments

Deficiency payments are made for wheat, rice, corn, grain sorghum, barley, oats, and all cotton. Target prices are set by each succeeding farm legislation. Loan rates, advance payments, and set-aside requirements vary yearly and are announced by the Secretary of Agriculture prior to planting. The fixed rates are entered in the model when they are announced.

Corn payments consist of an advance payment, a 5-month payment, and a 12-month Findley payment. USDA crop analysts forecast yields, season-average and 5-month prices, and participation rates. The mechanics of the legislation for each program crop are modeled, using the fixed loan rates and set-asides and the updated forecasts from crop analysts to forecast total crop-year payments. Crop-year payments are then distributed to calendar years and quarters.

Conservation Reserve

Congress established the Conservation Reserve Program (CRP) in the 1985 Food Security Act. The CRP is a voluntary long-term cropland retirement program in which USDA pays participants (farm owners or operators) an annual per-acre rent in exchange for retiring highly erodible cropland for 10 years.

ERS forecasts CRP rental payments based on reported ASCS enrollments. Entrance into the CRP is only allowed during announced signup periods. Bids on rental rates are taken and the Secretary of Agriculture announces a final official rate after the signup period. When this announcement is made, the forecasting model multiplies the rate by the accepted acres to get a preliminary payment. After disbursals are announced a few months later, the preliminary payment is adjusted.

Disaster Assistance

Annual disaster payments can vary from zero to several billion dollars and are designed to reimburse farmers for unusual losses mostly due to weather. Feed and livestock emergency assistance are not included. Since disaster payments vary greatly, they are not forecast. When disasters occur, the Secretary of Agriculture announces a maximum amount available for the program and producers are given a time limit to apply. In the farm income forecasting model, disaster assistance is included in Government payments only when an amount is announced and in the year that ASCS estimates the disbursals will be made.

Reserve Storage and Other Programs

Reserve storage payments are based on enrollments in the farmer owned reserve and revised when actual payments are known.

The dairy termination, tobacco, sugar, and wool and mohair programs are included under the "other program" category. These payments, like reserve storage payments, are not forecast but set at their most recent levels and updated when ASCS reports payments under these programs.

Value of the Change in Farm Inventories

The ERS net farm income series (as opposed to the net *cash* income series) is designed to measure the market value of current calendar-year production. ERS estimates of cash receipts may be more or less than the value of current-year production, however. Cash receipts include the value of commodities produced in earlier calendar years and sold in the current year. The value of commodities produced in the current year and stored for use in later years is excluded. Current-year net farm income is estimated by adjusting the value of changes in producer-owned inventories to other gross income components of the net farm income and production transaction series. Commodities stored under CCC loan are not included in this adjustment because they are treated as sales in the cash receipts components.

When the quantity of current-year production stored for later use is larger than the quantity of previous years' production sold during the current year, the value of the inventory adjustment is positive. In this case, net farm income is greater than it would have been without the positive inventory adjustment. The value of changes in inventories can be positive or negative.

The ERS procedure puts net farm income on a current-year basis and is consistent with estimates for other sectors prepared by the U.S. Department of Commerce for its National Income and Product Accounts.

Indexes of Prices Received and Paid

Prices-received indexes are used in the model for forecasting only fruit and nut, vegetable, and the miscellaneous "other" crop and livestock cash receipts. However, the entire prices-received series of 15 categories is forecast as part of the model for use by other economists and policymakers. The prices-paid indexes are an integral part of forecasting production expenses.

Prices-received/paid indexes have a long history. In 1866, USDA began collecting prices received by farmers for 10 crops; 6 species of livestock were added in 1867. NASS currently estimates monthly prices received for nearly 60 crop and livestock commodities and annual or marketing-year average prices for 35 additional commodities. Prices-received indexes are prepared with both 1977 and 1910-14 base years using a market-basket mix of the primary commodities as measured during the 1971-73 period.

Prices-Received Index Categories

All crops	All livestock
Food grains	Meat animals
Feed grains/hay	Dairy products
Feed grains	Poultry and eggs
Cotton	
Tobacco	All farm products
Oil crops	
Fruit, all	
Vegetables, all	
Potatoes and dry beans	

Data on prices paid by farmers were first collected in 1921 and included 86 farm production and family living items. The prices-paid index is for the same base years as prices received and is currently based on quarterly surveys of prices paid for 180 production inputs. Both series are published monthly in aggregate form in *Agricultural Prices*, and detailed annually in *Agricultural Prices–Annual Summary*.

The prices-received index is strictly a price index and is not influenced by changes in commodity production. The weights used by NASS to estimate the index are fixed from a 1971-73 market basket of commodities sold.

With the exception of fruit and vegetables, quarterly prices of all components of each aggregated group are available from their use in forecasting cash receipts. The most recent NASS estimates are a base from which the forecast prices and weights are used as movers.[3] ERS commodity analysts provide fruit and vegetable price indexes outside of the farm income forecasting model.

The various indexes of prices paid form the price components in the price-times-quantity relationships that make up total expenses. ERS economists have spent years analyzing the relationships behind input prices. Econometric equations have been devised using commodity input prices, land values, and several macroeconomic variables such as the consumer price

[3] When aggregate indexes are used in the farm income forecasting model, the NASS weights are usually kept. However, weights are converted to integers and divided at the end of the equation for the computational advantage of integer arithmetic.

Prices-Paid Index Categories

Feed
Feeder livestock
Seed
Fertilizer
Agricultural chemicals
Fuels and energy
Farm and motor supplies
Autos and trucks
Tractors and self-propelled machinery
Other farm machinery
Building and fencing
Services and cash rent
All production items
Farm origin items
Nonfarm origin items
Interest
Farmland taxes
Farm wage rates
Production items, interest, taxes and wage rates
Parity index

index, world oil prices, and bond rates. NASS surveys 180 inputs for prices, which are aggregated into 20 categories.

In the case of feed and feeder livestock, NASS uses a market-basket approach with weights for its estimate. ERS forecasts use the same procedure as with most of the prices received, creating movers from the weights and with forecast prices of each feedstuff and each livestock species. The seed index uses an exponential relationship of forecast acres planted to major crops and the GDP price deflator for the forecast year compared with the most current base year as the mover, applying the result to the base-year actual seed index estimate.

Price indexes of manufactured inputs such as chemicals, fuels, and machinery tend to be functions of nonagricultural factors. To reflect rapidly changing conditions, these indexes must be functions of exogenous variables, for which forecasts are regularly updated. Economists in the ERS Resources and Technology Division have derived relationships to forecast the price indexes of many of these expense components. Fuels and energy, for example, are forecast as an exponential function of the forecast price of world oil. Auto and truck prices are modeled as a logarithmic function of the change in the consumer price index. Land values, wholesale and consumer price indexes, and bond rates are other variables used in forecasting the indexes.

Capital Expenditures

Capital expenditures represent gross additions to the capital stock used by farm producers in production activities. Expenditures may be for new or used items or for improvements to previously owned capital items. Purchases may be used to expand productive capacity or to maintain existing capacity. ERS analysts use capital expenditure estimates to estimate depreciation and to calculate net cash flow. Depreciation is the major expense subtracted from gross cash income to derive net farm income. Capital expenditures are forecast for tractors, trucks, automobiles, other machinery, farm service buildings, and operator dwellings.

Time-series analysis shows that machinery expenditures are a linear function of farm numbers, acres planted, cash receipts, and the prime rate. Building expenditures are a linear function of acreage, receipts, and the combined total debt of the farm and operator households. In both cases, the forecasting equations create movers that are used to adjust the published base-year capital expenditure estimate.

Farm Production Expenses

Quarterly price forecasts are available for farm receipts, and with quarterly marketing patterns, annual production can be allocated to each quarter, providing great detail on changes in the price and quantity relationships. With expenses, however, USDA estimates are derived from reported expense data and not on a price-times-quantity basis. This makes it impossible to separate price effects from quantity effects. Therefore, prices-paid indexes are the major movers for forecasting expenses. Acreage and production can approximate quantity changes for certain expense items like feed, seed, feeder livestock, agricultural chemicals, and labor, with the implicit assumption of no factor substitution or technological change. Interest rates are forecast by balance sheet analysts to assist in interest expense forecasts. All expense forecasts take the most current official estimate as a base year and derive the expected annual change from a combination of relevant quantity changes (like acreage and production in the case of feed, feeder livestock, seed, chemicals, and fuels) and relevant price changes.

For example, seed expenses are forecast using price and quantity data for 11 field crops. Cost-of-production data are available for eight of these crops. For these eight, a cost-per-acre forecast can be multiplied by forecast acres planted. For minor oilseeds and potatoes, a commercial seed price, a

seeding rate as measured by actual producer surveys, and a forecast of planted acres are multiplied together. A weighted average of forecast-year seed expenses and most recent published seed expenses is made for the 11 crops and is multiplied by the total published seed expenses for all crops to forecast total seed expenses for the forecast year.

For feed expenses, quarterly corn and hay prices are combined with beef, hog, poultry, and dairy numbers to derive a mover for published total feed expenses.

The prices-paid index forecast is used for fertilizer expenses. The ratio of the fertilizer price index in the forecast year to the index in the base year plus the percent change in total crop acres planted is multiplied by the base-year estimate of total fertilizer expenses. The remaining expense accounts are forecast using these methods or a combination of them. In some cases, several price indexes are combined and weighted.

Like depreciation, operator dwelling expenses are subtractions from gross cash income used to derive net farm income. The farm operator has expenses relating to his or her dwelling in the form of interest, taxes, repairs, and insurance. Forecasts of the prices-paid indexes are the main movers for these expenses. ERS forecasts expenses for 20 input categories.

Nonmoney and Farm-Related Income

Some goods and services produced with farm assets are not marketed but are consumed on the farms or ranches where produced. The net farm income and production transactions series include two nonmoney income accounts: the value of home consumption and the gross imputed rental value of dwellings. The farm-related income series contains estimates for cash income earned by farming and ranching operations from sources other than the production of agricultural commodities. The major components of farm-related income are machine hire, customwork, and forest product sales.

Nonmoney and farm-related income are difficult to forecast since the component variables are not available. Survey data show that home consumption is typically made up of 20 percent crop products and 80 percent livestock products. The forecasting equation uses these weights and total crop and livestock cash receipts as forecast in the model. The rental value of dwellings is a function of total real estate assets as forecast by balance sheet analysts. The three components of farm-related income are forecast separately using either price indexes, cash receipts, macroeconomic variables, or a combination.

Expense Categories

Farm-origin inputs
- Feed
- Livestock
- Seed

Manufactured inputs
- Fertilizer
- Fuels and oils
- Electricity
- Pesticides

Total interest charges
- Short-term interest
- Real estate interest

Other operating expenses
- Repair and maintenance
- Labor expenses
- Machine hire and customwork
- Animal health
- Marketing, storage, and transportation
- Miscellaneous operating expenses

Other overhead expenses
- Capital consumption
- Taxes
- Net rent to nonoperator landlords

Noncash expenses
- Operator dwelling expenses
  - Interest
  - Taxes
  - Repairs
  - Insurance
- Labor perquisites

Net Income Statements

Forecasts of income and expense components are used to derive gross and net income forecasts for the farm sector:

Gross cash income = Cash receipts + direct payments + farm-related income.

Net cash income = Gross cash income - cash expenses.

Gross farm income = Gross cash income + nonmoney income + value of the net change in inventories.

Net farm income = Gross farm income - total production expenses.

Real net incomes are the net cash and net farm income forecasts deflated by the implicit GDP deflator as forecast by macroeconomic analysts.

Farm Output Indexes

Output indexes are forecast for the same 15 general crop and livestock categories published annually in *Economic Indicators of the Farm Sector: Production and Efficiency Statistics*. The farm income forecasting model uses forecast changes in production to adjust the base index as published in *Production and Efficiency Statistics*. In the case of a composite output index such as red meats, production forecasts for beef, veal, pork, and sheep and lambs are weighted to match the definition of the published index.

Seasonally Adjusted Cash Receipts

Seasonally adjusted receipt forecasts are included by the U.S. Department of Commerce in the gross domestic product estimates of the National Income and Product Accounts. Crop open-market sales, livestock receipts, and net CCC payments are seasonally adjusted from quarterly patterns of the previous 3 years. Crop open-market sale and livestock receipt adjustments are based on the historical ratio of each quarter to the annual receipts. Since net CCC payments can be negative, an additive adjustment is used rather than a ratio. Net CCC adjustments are based on the historical difference of each quarter to the annual total. The majority of terms in the rather long equations are to ensure that the average of seasonally adjusted quarterly estimates equals the unadjusted annual total.

Regional Income Forecasts

Cash income by major production region is forecast based on distributors of each cash income and expense component. These distributors are 3-year moving averages of State-level estimates as a percentage of total U.S. estimates. States are aggregated to form 5 or 10 U.S. production regions. Cash receipts for crops are aggregated into food grains, feed grains, oilseeds, cotton, tobacco, fruits and nuts, vegetables, greenhouse, and other crops. Livestock receipts are categorized as red meats, poultry, dairy, and other livestock. Government payment distributors are estimated for the major programs. Each expense account is distributed separately. These percent distributors can then be used with the U.S. forecasts of the aggregated components to distribute the national forecasts to the regional level.

Income by Type of Farm and Sales Class

These analyses are similar to the regional analysis in that distributors are applied to national forecasts to get farm type and sales class forecasts. The distributors are 3-year moving averages based on data from USDA's annual Farm Costs and Returns Survey. Each of some 12,000 observations in the survey is assigned a farm type code based on Standard Industrial Classification codes. These definitions require that at least 50 percent of an operation's value of production come from a particular commodity or group of commodities.

For the sales class distributors, survey observations are subset by reported total sales. Total U.S. survey receipts, payments, and expenses for the same categories used in the regional analysis are then distributed among the farm types and sales classes currently published. These percentages of each income and expense component are then averaged over the most current 3 years and multiplied by the U.S.-level forecasts for each component.

Reliability of Forecasts

An error analysis covering the past 8 years compared the forecasts published 18 months before the official estimates in the *National Financial Summary* and subsequent revisions over 6 quarters with the final estimates to determine the proportional differences by income component. Bottom-line net cash income was underestimated an average of 16 percent annually, ranging from $2.1 billion to $13.7 billion. Net farm income was off an average of 14 percent, underestimated 6 out of the 8 years. The major sources of this error were a 24-percent error in forecasting direct payments, a 34-percent error in farm-related income, and a 115-percent error in the value of the change in inventories (used in forecasting net farm income only). Receipt and expense forecasts were much more reliable, with errors of only 4-5 percent, and were overestimated as often as underestimated. After 4 quarters, the forecasts of net cash income improve to within 6 percent of the final estimate.

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Subscript Definitions

t = calendar year
Q = calendar-year quarter
y = crop year or marketing year that spans 2 calendar years

For example:

$[\text{Wheat percent marketed}]_{t-1,Q2}$ is the percent of wheat produced for sale in the previous calendar year t-1 but marketed in the second quarter Q2 of the current calendar year t.

$[\text{Corn payments}]_{y,t}$ are Government payments for corn produced in the current crop year y (that spans calendar years t-1 and t) paid in calendar year t.

$[\text{Hog farm price}]_{Q4,t-1}$ is the price of hogs in the fourth quarter Q4 of the previous calendar year t-1.

Appendix: Forecasting Equations

Open-Market Crop Sales

$$[\text{Wheat open-market sales}]_{Q1} = ([\text{Wheat production}]_{t-1} * [\text{Wheat percent sold}]_{t-1} * [\text{Wheat percent marketed}]_{t-1,Q1} - [\text{Wheat net CCC quantity}]_{Q1}) * [\text{Wheat price}]_{Q1}$$

$$[\text{Wheat open-market sales}]_{Q2} = ([\text{Wheat production}]_{t-1} * [\text{Wheat percent sold}]_{t-1} * [\text{Wheat percent marketed}]_{t-1,Q2} + [\text{Wheat production}]_{t} * [\text{Wheat percent sold}]_{t} * [\text{Wheat percent marketed}]_{t,Q2} - [\text{Wheat net CCC quantity}]_{Q2}) * [\text{Wheat price}]_{Q2}$$

$$[\text{Wheat open-market sales}]_{Q3} = ([\text{Wheat production}]_{t} * [\text{Wheat percent sold}]_{t} * [\text{Wheat percent marketed}]_{t,Q3} - [\text{Wheat net CCC quantity}]_{Q3}) * [\text{Wheat price}]_{Q3}$$

$$[\text{Wheat open-market sales}]_{Q4} = ([\text{Wheat production}]_{t} * [\text{Wheat percent sold}]_{t} * [\text{Wheat percent marketed}]_{t,Q4} - [\text{Wheat net CCC quantity}]_{Q4}) * [\text{Wheat price}]_{Q4}$$

$$[\text{Wheat open-market sales}]_{t} = [\text{Wheat open-market sales}]_{Q1} + [\text{Wheat open-market sales}]_{Q2} + [\text{Wheat open-market sales}]_{Q3} + [\text{Wheat open-market sales}]_{Q4}$$

$$[\text{Rice open-market sales}]_{Q1} = ([\text{Rice production}]_{t-1} * [\text{Rice percent marketed}]_{t-1,Q1} - [\text{Rice net CCC quantity}]_{Q1}) * [\text{Rice price}]_{Q1}$$

$$[\text{Rice open-market sales}]_{Q2} = ([\text{Rice production}]_{t-1} * [\text{Rice percent marketed}]_{t-1,Q2} - [\text{Rice net CCC quantity}]_{Q2}) * [\text{Rice price}]_{Q2}$$

$$[\text{Rice open-market sales}]_{Q3} = ([\text{Rice production}]_{t-1} * [\text{Rice percent marketed}]_{t-1,Q3} + [\text{Rice production}]_{t} * [\text{Rice percent marketed}]_{t,Q3} - [\text{Rice net CCC quantity}]_{Q3}) * [\text{Rice price}]_{Q3}$$

$$[\text{Rice open-market sales}]_{Q4} = ([\text{Rice production}]_{t} * [\text{Rice percent marketed}]_{t,Q4} - [\text{Rice net CCC quantity}]_{Q4}) * [\text{Rice price}]_{Q4}$$

$$[\text{Rice open-market sales}]_{t} = [\text{Rice open-market sales}]_{Q1} + [\text{Rice open-market sales}]_{Q2} + [\text{Rice open-market sales}]_{Q3} + [\text{Rice open-market sales}]_{Q4}$$

$$[\text{Rye open-market sales}]_{Q1} = ([\text{Rye production}]_{t-1} * [\text{Rye percent sold}]_{t-1} * [\text{Rye percent marketed}]_{t-1,Q1} - [\text{Rye net CCC quantity}]_{Q1}) * [\text{Rye price}]_{Q1}$$

$$[\text{Rye open-market sales}]_{Q2} = ([\text{Rye production}]_{t-1} * [\text{Rye percent sold}]_{t-1} * [\text{Rye percent marketed}]_{t-1,Q2} + [\text{Rye production}]_{t} * [\text{Rye percent sold}]_{t} * [\text{Rye percent marketed}]_{t,Q2} - [\text{Rye net CCC quantity}]_{Q2}) * [\text{Rye price}]_{Q2}$$

$$[\text{Rye open-market sales}]_{Q3} = ([\text{Rye production}]_{t} * [\text{Rye percent sold}]_{t} * [\text{Rye percent marketed}]_{t,Q3} - [\text{Rye net CCC quantity}]_{Q3}) * [\text{Rye price}]_{Q3}$$

$$[\text{Rye open-market sales}]_{Q4} = ([\text{Rye production}]_{t} * [\text{Rye percent sold}]_{t} * [\text{Rye percent marketed}]_{t,Q4} - [\text{Rye net CCC quantity}]_{Q4}) * [\text{Rye price}]_{Q4}$$

$$[\text{Rye open-market sales}]_{t} = [\text{Rye open-market sales}]_{Q1} + [\text{Rye open-market sales}]_{Q2} + [\text{Rye open-market sales}]_{Q3} + [\text{Rye open-market sales}]_{Q4}$$

$$[\text{Food grains open-market sales}]_{t} = [\text{Wheat open-market sales}]_{t} + [\text{Rice open-market sales}]_{t} + [\text{Rye open-market sales}]_{t}$$

$$[\text{Corn open-market sales}]_{Q1} = ([\text{Corn production}]_{t-1} * [\text{Corn percent sold}]_{t-1} * [\text{Corn percent marketed}]_{t-1,Q1} - [\text{Corn net CCC quantity}]_{Q1}) * [\text{Corn price}]_{Q1}$$

$$[\text{Corn open-market sales}]_{Q2} = ([\text{Corn production}]_{t-1} * [\text{Corn percent sold}]_{t-1} * [\text{Corn percent marketed}]_{t-1,Q2} - [\text{Corn net CCC quantity}]_{Q2}) * [\text{Corn price}]_{Q2}$$

$$[\text{Corn open-market sales}]_{Q3} = ([\text{Corn production}]_{t-1} * [\text{Corn percent sold}]_{t-1} * [\text{Corn percent marketed}]_{t-1,Q3} + [\text{Corn production}]_{t} * [\text{Corn percent sold}]_{t} * [\text{Corn percent marketed}]_{t,Q3} - [\text{Corn net CCC quantity}]_{Q3}) * [\text{Corn price}]_{Q3}$$

$$[\text{Corn open-market sales}]_{Q4} = ([\text{Corn production}]_{t} * [\text{Corn percent sold}]_{t} * [\text{Corn percent marketed}]_{t,Q4} - [\text{Corn net CCC quantity}]_{Q4}) * [\text{Corn price}]_{Q4}$$

$$[\text{Corn open-market sales}]_{t} = [\text{Corn open-market sales}]_{Q1} + [\text{Corn open-market sales}]_{Q2} + [\text{Corn open-market sales}]_{Q3} + [\text{Corn open-market sales}]_{Q4}$$

$$[\text{Sorghum open-market sales}]_{Q1} = ([\text{Sorghum production}]_{t-1} * [\text{Sorghum percent sold}]_{t-1} * [\text{Sorghum percent marketed}]_{t-1,Q1} - [\text{Sorghum net CCC quantity}]_{Q1}) * [\text{Sorghum price}]_{Q1}$$

$$[\text{Sorghum open-market sales}]_{Q2} = ([\text{Sorghum production}]_{t-1} * [\text{Sorghum percent sold}]_{t-1} * [\text{Sorghum percent marketed}]_{t-1,Q2} - [\text{Sorghum net CCC quantity}]_{Q2}) * [\text{Sorghum price}]_{Q2}$$

$$[\text{Sorghum open-market sales}]_{Q3} = ([\text{Sorghum production}]_{t-1}*[\text{Sorghum percent sold}]_{t-1}*[\text{Sorghum percent marketed}]_{t-1,Q3} + [\text{Sorghum production}]_t*[\text{Sorghum percent sold}]_t*[\text{Sorghum percent marketed}]_{t,Q3} - [\text{Sorghum net CCC quantity}]_{Q3})*[\text{Sorghum price}]_{Q3}$$

$$[\text{Sorghum open-market sales}]_{Q4} = ([\text{Sorghum production}]_t*[\text{Sorghum percent sold}]_t*[\text{Sorghum percent marketed}]_{t,Q4} - [\text{Sorghum net CCC quantity}]_{Q4})*[\text{Sorghum price}]_{Q4}$$

$$[\text{Sorghum open-market sales}]_t = [\text{Sorghum open-market sales}]_{Q1} + [\text{Sorghum open-market sales}]_{Q2} + [\text{Sorghum open-market sales}]_{Q3} + [\text{Sorghum open-market sales}]_{Q4}$$

$$[\text{Barley open-market sales}]_{Q1} = ([\text{Barley production}]_{t-1}*[\text{Barley percent sold}]_{t-1}*[\text{Barley percent marketed}]_{t-1,Q1} - [\text{Barley net CCC quantity}]_{Q1})*[\text{Barley price}]_{Q1}$$

$$[\text{Barley open-market sales}]_{Q2} = ([\text{Barley production}]_{t-1}*[\text{Barley percent sold}]_{t-1}*[\text{Barley percent marketed}]_{t-1,Q2} + [\text{Barley production}]_t*[\text{Barley percent sold}]_t*[\text{Barley percent marketed}]_{t,Q2} - [\text{Barley net CCC quantity}]_{Q2})*[\text{Barley price}]_{Q2}$$

$$[\text{Barley open-market sales}]_{Q3} = ([\text{Barley production}]_t*[\text{Barley percent sold}]_t*[\text{Barley percent marketed}]_{t,Q3} - [\text{Barley net CCC quantity}]_{Q3})*[\text{Barley price}]_{Q3}$$

$$[\text{Barley open-market sales}]_{Q4} = ([\text{Barley production}]_t*[\text{Barley percent sold}]_t*[\text{Barley percent marketed}]_{t,Q4} - [\text{Barley net CCC quantity}]_{Q4})*[\text{Barley price}]_{Q4}$$

$$[\text{Barley open-market sales}]_t = [\text{Barley open-market sales}]_{Q1} + [\text{Barley open-market sales}]_{Q2} + [\text{Barley open-market sales}]_{Q3} + [\text{Barley open-market sales}]_{Q4}$$

$$[\text{Oats open-market sales}]_{Q1} = ([\text{Oats production}]_{t-1}*[\text{Oats percent sold}]_{t-1}*[\text{Oats percent marketed}]_{t-1,Q1} - [\text{Oats net CCC quantity}]_{Q1})*[\text{Oats price}]_{Q1}$$

$$[\text{Oats open-market sales}]_{Q2} = ([\text{Oats production}]_{t-1}*[\text{Oats percent sold}]_{t-1}*[\text{Oats percent marketed}]_{t-1,Q2} + [\text{Oats production}]_t*[\text{Oats percent sold}]_t*[\text{Oats percent marketed}]_{t,Q2} - [\text{Oats net CCC quantity}]_{Q2})*[\text{Oats price}]_{Q2}$$

$$[\text{Oats open-market sales}]_{Q3} = ([\text{Oats production}]_t*[\text{Oats percent sold}]_t*[\text{Oats percent marketed}]_{t,Q3} - [\text{Oats net CCC quantity}]_{Q3})*[\text{Oats price}]_{Q3}$$

$$[\text{Oats open-market sales}]_{Q4} = ([\text{Oats production}]_t*[\text{Oats percent sold}]_t*[\text{Oats percent marketed}]_{t,Q4} - [\text{Oats net CCC quantity}]_{Q4})*[\text{Oats price}]_{Q4}$$

$$[\text{Oats open-market sales}]_t = [\text{Oats open-market sales}]_{Q1} + [\text{Oats open-market sales}]_{Q2} + [\text{Oats open-market sales}]_{Q3} + [\text{Oats open-market sales}]_{Q4}$$

$$[\text{Hay open-market sales}]_{Q1} = ([\text{Hay production}]_{t-1}*[\text{Hay percent sold}]_{t-1}*[\text{Hay percent marketed}]_{t-1,Q1}*[\text{Hay price}]_{Q1}$$

$$[\text{Hay open-market sales}]_{Q2} = ([\text{Hay production}]_{t-1}*[\text{Hay percent sold}]_{t-1}*[\text{Hay percent marketed}]_{t-1,Q2} + [\text{Hay production}]_t*[\text{Hay percent sold}]_t*[\text{Hay percent marketed}]_{t,Q2})*[\text{Hay price}]_{Q2}$$

$$[\text{Hay open-market sales}]_{Q3} = ([\text{Hay production}]_t*[\text{Hay percent sold}]_t*[\text{Hay percent marketed}]_{t,Q3}*[\text{Hay price}]_{Q3}$$

$$[\text{Hay open-market sales}]_{Q4} = ([\text{Hay production}]_t*[\text{Hay percent sold}]_t*[\text{Hay percent marketed}]_{t,Q4}*[\text{Hay price}]_{Q4}$$

$$[\text{Hay open-market sales}]_t = [\text{Hay open-market sales}]_{Q1} + [\text{Hay open-market sales}]_{Q2} + [\text{Hay open-market sales}]_{Q3} + [\text{Hay open-market sales}]_{Q4}$$

$$[\text{Feed crops open-market sales}]_t = [\text{Corn open-market sales}]_t + [\text{Sorghum open-market sales}]_t + [\text{Barley open-market sales}]_t + [\text{Oats open-market sales}]_t + [\text{Hay open-market sales}]_t$$

$$[\text{Soybean open-market sales}]_{Q1} = ([\text{Soybean production}]_{t-1}*[\text{Soybean percent sold}]_{t-1}*[\text{Soybean percent marketed}]_{t-1,Q1} - [\text{Soybean net CCC quantity}]_{Q1})*[\text{Soybean price}]_{Q1}$$

$$[\text{Soybean open-market sales}]_{Q2} = ([\text{Soybean production}]_{t-1}*[\text{Soybean percent sold}]_{t-1}*[\text{Soybean percent marketed}]_{t-1,Q2} - [\text{Soybean net CCC quantity}]_{Q2})*[\text{Soybean price}]_{Q2}$$

$$[\text{Soybean open-market sales}]_{Q3} = ([\text{Soybean production}]_{t-1}*[\text{Soybean percent sold}]_{t-1}*[\text{Soybean percent marketed}]_{t-1,Q3} + [\text{Soybean production}]_t*[\text{Soybean percent sold}]_t*[\text{Soybean percent marketed}]_{t,Q3} - [\text{Soybean net CCC quantity}]_{Q3})*[\text{Soybean price}]_{Q3}$$

$$[\text{Soybean open-market sales}]_{Q4} = ([\text{Soybean production}]_t*[\text{Soybean percent sold}]_t*[\text{Soybean percent marketed}]_{t,Q4} - [\text{Soybean net CCC quantity}]_{Q4})*[\text{Soybean price}]_{Q4}$$

$$[\text{Soybean open-market sales}]_t = [\text{Soybean open-market sales}]_{Q1} + [\text{Soybean open-market sales}]_{Q2} + [\text{Soybean open-market sales}]_{Q3} + [\text{Soybean open-market sales}]_{Q4}$$

$$[\text{Peanut open-market sales}]_{Q1} = ([\text{Peanut production}]_{t-1} * [\text{Peanut percent marketed}]_{t-1,Q1} * [\text{Peanut price}]_{Q1}$$

$$[\text{Peanut open-market sales}]_{Q3} = ([\text{Peanut production}]_t * [\text{Peanut percent marketed}]_{t,Q3} * [\text{Peanut price}]_{Q3}$$

$$[\text{Peanut open-market sales}]_{Q4} = ([\text{Peanut production}]_t * [\text{Peanut percent marketed}]_{t,Q4} * [\text{Peanut price}]_{Q4}$$

$$[\text{Peanut open-market sales}]_t = [\text{Peanut open-market sales}]_{Q1} + [\text{Peanut open-market sales}]_{Q3} + [\text{Peanut open-market sales}]_{Q4}$$

$$[\text{Sunflowerseed open-market sales}]_{Q1} = [\text{Sunflowerseed production}]_{t-1} * [\text{Sunflowerseed percent marketed}]_{t-1,Q1} * [\text{Sunflowerseed price}]_{Q1} * .022$$

$$[\text{Sunflowerseed open-market sales}]_{Q2} = ([\text{Sunflowerseed production}]_{t-1} * [\text{Sunflowerseed percent marketed}]_{t-1,Q2} * [\text{Sunflowerseed price}]_{Q2} * .022$$

$$[\text{Sunflowerseed open-market sales}]_{Q3} = ([\text{Sunflowerseed production}]_{t-1} * [\text{Sunflowerseed percent marketed}]_{t-1,Q3} + [\text{Sunflowerseed production}]_t * [\text{Sunflowerseed percent marketed}]_{t,Q3}) * [\text{Sunflowerseed price}]_{Q3} * .022$$

$$[\text{Sunflowerseed open-market sales}]_{Q4} = [\text{Sunflowerseed production}]_t * [\text{Sunflowerseed percent marketed}]_{t,Q4} * [\text{Sunflowerseed price}]_{Q4} * .022$$

$$[\text{Sunflowerseed open-market sales}]_t = [\text{Sunflowerseed open-market sales}]_{Q1} + [\text{Sunflowerseed open-market sales}]_{Q2} + [\text{Sunflowerseed open-market sales}]_{Q3} + [\text{Sunflowerseed open-market sales}]_{Q4}$$

$$[\text{Flaxseed open-market sales}]_{Q1} = [\text{Flaxseed production}]_{t-1} * [\text{Flaxseed percent marketed}]_{t-1,Q1} * [\text{Flaxseed price}]_{Q1}$$

$$[\text{Flaxseed open-market sales}]_{Q2} = [\text{Flaxseed production}]_{t-1} * [\text{Flaxseed percent marketed}]_{t-1,Q2} * [\text{Flaxseed price}]_{Q2}$$

$$[\text{Flaxseed open-market sales}]_{Q3} = [\text{Flaxseed production}]_t * [\text{Flaxseed percent marketed}]_{t,Q3} * [\text{Flaxseed price}]_{Q3}$$

$$[\text{Flaxseed open-market sales}]_{Q4} = [\text{Flaxseed production}]_t * [\text{Flaxseed percent marketed}]_{t,Q4} * [\text{Flaxseed price}]_{Q4}$$

$$[\text{Flaxseed open-market sales}]_t = [\text{Flaxseed open-market sales}]_{Q1} + [\text{Flaxseed open-market sales}]_{Q2} + [\text{Flaxseed open-market sales}]_{Q3} + [\text{Flaxseed open-market sales}]_{Q4}$$

$$[\text{Oil crops open-market sales}]_t = [\text{Soybean open-market sales}]_t + [\text{Peanut open-market sales}]_t + [\text{Sunflowerseed open-market sales}]_t + [\text{Flaxseed open-market sales}]_t$$

$$[\text{Cotton lint open-market sales}]_{Q1} = ([\text{Cotton lint production}]_{t-1} * .48 * [\text{Cotton lint percent marketed}]_{t-1,Q1} - [\text{Cotton lint net CCC quantity}]_{Q1}) * [\text{Cotton price}]_{Q1}$$

$$[\text{Cotton lint open-market sales}]_{Q2} = ([\text{Cotton lint production}]_{t-1} * .48 * [\text{Cotton lint percent marketed}]_{t-1,Q2} - [\text{Cotton lint net CCC quantity}]_{Q2}) * [\text{Cotton price}]_{Q2}$$

$$[\text{Cotton lint open-market sales}]_{Q3} = ([\text{Cotton lint production}]_{t-1} * .48 * [\text{Cotton lint percent marketed}]_{t-1,Q3} [\text{Cotton lint production}]_t * .48 * [\text{Cotton lint percent marketed}]_{t,Q3} - [\text{Cotton lint net CCC quantity}]_{Q3}) * [\text{Cotton price}]_{Q3}$$

$$[\text{Cotton lint open-market sales}]_{Q4} = ([\text{Cotton lint production}]_t * .48 * [\text{Cotton lint percent marketed}]_{t,Q4} - [\text{Cotton lint net CCC quantity}]_{Q4}) * [\text{Cotton price}]_{Q4}$$

$$[\text{Cotton lint open-market sales}]_t = [\text{Cotton lint open-market sales}]_{Q1} + [\text{Cotton lint open-market sales}]_{Q2} + [\text{Cotton lint open-market sales}]_{Q3} + [\text{Cotton lint open-market sales}]_{Q4}$$

$$[\text{Cottonseed open-market sales}]_{Q1} = [\text{Cottonseed production}]_{t-1} * [\text{Cottonseed percent sold}]_{t-1} * [\text{Cottonseed percent marketed}]_{t-1,Q1} * [\text{Cottonseed price}]_{Q1} / 1000$$

$$[\text{Cottonseed open-market sales}]_{Q3} = [\text{Cottonseed production}]_t * [\text{Cottonseed percent sold}]_t * [\text{Cottonseed percent marketed}]_{t,Q3} * [\text{Cottonseed price}]_{Q3} / 1000$$

$$[\text{Cottonseed open-market sales}]_{Q4} = [\text{Cottonseed production}]_t * [\text{Cottonseed percent sold}]_t * [\text{Cottonseed percent marketed}]_{t,Q4} * [\text{Cottonseed price}]_{Q4} / 1000$$

$$[\text{Cottonseed open-market sales}]_t = [\text{Cottonseed open-market sales}]_{Q1} + [\text{Cottonseed open-market sales}]_{Q3} + [\text{Cottonseed open-market sales}]_{Q4}$$

$$[\text{Cotton open-market sales}]_t = [\text{Cotton lint open-market sales}]_t + [\text{Cottonseed open-market sales}]_t$$

$$[\text{Potato open-market sales}]_{Q1} = [\text{Potato production}]_{t-1} * [\text{Potato percent sold}]_{t-1} * [\text{Potato percent marketed}]_{t-1,Q1} * [\text{Potato price}]_{Q1}$$

$$[\text{Potato open-market sales}]_{Q2} = ([\text{Potato production}]_{t-1} * [\text{Potato percent sold}]_{t-1} * [\text{Potato percent marketed}]_{t-1,Q2} + [\text{Potato production}]_t * [\text{Potato percent sold}]_t * [\text{Potato percent marketed}]_{t,Q2}) * [\text{Potato price}]_{Q2}$$

$$[\text{Potato open-market sales}]_{Q3} = [\text{Potato production}]_t * [\text{Potato percent sold}]_t * [\text{Potato percent marketed}]_{t,Q3} * [\text{Potato price}]_{Q3}$$

$$[\text{Potato open-market sales}]_{Q4} = [\text{Potato production}]_t * [\text{Potato percent sold}]_t * [\text{Potato percent marketed}]_{t,Q4} * [\text{Potato price}]_{Q4}$$

$$[\text{Potato open-market sales}]_t = [\text{Potato open-market sales}]_{Q1} + [\text{Potato open-market sales}]_{Q2} + [\text{Potato open-market sales}]_{Q3} + [\text{Potato open-market sales}]_{Q4}$$

$$[\text{Dry beans open-market sales}]_{Q1} = [\text{Dry beans production}]_{t-1} * [\text{Dry beans percent marketed}]_{t-1,Q1} * [\text{Dry beans price}]_{Q1}$$

$$[\text{Dry beans open-market sales}]_{Q2} = [\text{Dry beans production}]_{t-1} * [\text{Dry beans percent marketed}]_{t-1,Q2} * [\text{Dry beans price}]_{Q2}$$

$$[\text{Dry beans open-market sales}]_{Q3} = ([\text{Dry beans production}]_{t-1} * [\text{Dry beans percent marketed}]_{t-1,Q3} + [\text{Dry beans production}]_t * [\text{Dry beans percent marketed}]_{t,Q3}) * [\text{Dry beans price}]_{Q3}$$

$$[\text{Dry beans open-market sales}]_{Q4} = [\text{Dry beans production}]_t * [\text{Dry beans percent marketed}]_{t,Q4} * [\text{Dry beans price}]_{Q4}$$

$$[\text{Dry beans open-market sales}]_t = [\text{Dry beans open-market sales}]_{Q1} + [\text{Dry beans open-market sales}]_{Q2} + [\text{Dry beans open-market sales}]_{Q3} + [\text{Dry beans open-market sales}]_{Q4}$$

$$[\text{Other vegetable open-market sales}]_{Q1} = ([\text{Vegetable production index}]_t / [\text{Vegetable production index}]_{t-1} + 3)/4 * [\text{Vegetable price index}]_{t,Q1} / [\text{Vegetable price index}]_{t-1,Q1} * [\text{Other vegetable open-market sales}]_{t-1,Q1}$$

$$[\text{Other vegetable open-market sales}]_{Q2} = ([\text{Vegetable production index}]_t / [\text{Vegetable production index}]_{t-1} + 3)/4 * [\text{Vegetable price index}]_{t,Q2} / [\text{Vegetable price index}]_{t-1,Q2} * [\text{Other vegetable open-market sales}]_{t-1,Q2}$$

$$[\text{Other vegetable open-market sales}]_{Q3} = ([\text{Vegetable production index}]_t / [\text{Vegetable production index}]_{t-1} + 3)/4 * [\text{Vegetable price index}]_{t,Q3} / [\text{Vegetable price index}]_{t-1,Q3} * [\text{Other vegetable open-market sales}]_{t-1,Q3}$$

$$[\text{Other vegetable open-market sales}]_{Q4} = ([\text{Vegetable production index}]_t / [\text{Vegetable production index}]_{t-1} + 3)/4 * [\text{Vegetable price index}]_{t,Q4} / [\text{Vegetable price index}]_{t-1,Q4} * [\text{Other vegetable open-market sales}]_{t-1,Q4}$$

$$[\text{Other vegetable open-market sales}]_t = [\text{Other vegetable open-market sales}]_{Q1} + [\text{Other vegetable open-market sales}]_{Q2} + [\text{Other vegetable open-market sales}]_{Q3} + [\text{Other vegetable open-market sales}]_{Q4}$$

$$[\text{All vegetables open-market sales}]_t = [\text{Potato open-market sales}]_t + [\text{Dry beans open-market sales}]_t + [\text{Other vegetable open-market sales}]_t$$

$$[\text{Tobacco open-market sales}]_{Q1} = [\text{Tobacco production}]_{t-1} * [\text{Tobacco percent marketed}]_{t-1,Q1} * [\text{Tobacco price}]_{Q1}$$

$$[\text{Tobacco open-market sales}]_{Q2} = [\text{Tobacco production}]_{t-1} * [\text{Tobacco percent marketed}]_{t-1,Q2} * [\text{Tobacco price}]_{Q2}$$

$$[\text{Tobacco open-market sales}]_{Q3} = [\text{Tobacco production}]_t * [\text{Tobacco percent marketed}]_{t,Q3} * [\text{Tobacco price}]_{Q3}$$

$$[\text{Tobacco open-market sales}]_{Q4} = [\text{Tobacco production}]_t * [\text{Tobacco percent marketed}]_{t,Q4} * [\text{Tobacco price}]_{Q4}$$

$$[\text{Tobacco open-market sales}]_t = [\text{Tobacco open-market sales}]_{Q1} + [\text{Tobacco open-market sales}]_{Q2} + [\text{Tobacco open-market sales}]_{Q3} + [\text{Tobacco open-market sales}]_{Q4}$$

$$[\text{Fruits\&nuts open-market sales}]_{Q1} = (([\text{Fruits\&nuts output index}]_t / [\text{Fruits\&nuts output index}]_{t-1} - 1)/4 + 1) * [\text{Fruit price index}]_{t,Q1} / [\text{Fruit price index}]_{t-1,Q1} * [\text{Fruits\&nuts open-market sales}]_{t-1,Q1}$$

$$[\text{Fruits\&nuts open-market sales}]_{Q2} = (([\text{Fruits\&nuts output index}]_t/[\text{Fruits\&nuts output index}]_{t-1} - 1)/4 + 1) * [\text{Fruit price index}]_{t,Q2}/[\text{Fruit price index}]_{t-1,Q2} * [\text{Fruits\&nuts open-market sales}]_{t-1,Q2}$$

$$[\text{Fruits\&nuts open-market sales}]_{Q2} = (([\text{Fruits\&nuts output index}]_t/[\text{Fruits\&nuts output index}]_{t-1} - 1)/4 + 1) * [\text{Fruit price index}]_{t,Q3}/[\text{Fruit price index}]_{t-1,Q3} * [\text{Fruits\&nuts open-market sales}]_{t-1,Q3}$$

$$[\text{Fruits\&nuts open-market sales}]_{Q2} = (([\text{Fruits\&nuts output index}]_t/[\text{Fruits\&nuts output index}]_{t-1} - 1)/4 + 1) * [\text{Fruit price index}]_{t,Q4}/[\text{Fruit price index}]_{t-1,Q4} * [\text{Fruits\&nuts open-market sales}]_{t-1,Q4}$$

$$[\text{Fruits\&nuts open-market sales}]_t = [\text{Fruits\&nuts open-market sales}]_{Q1} + [\text{Fruits\&nuts open-market sales}]_{Q2} + [\text{Fruits\&nuts open-market sales}]_{Q3} + [\text{Fruits\&nuts open-market sales}]_{Q4}$$

$$[\text{Greenhouse open-market sales}]_{Q1} = (([\text{Greenhouse production index}]_t/[\text{Greenhouse production index}]_{t-1} - 1)/4 + 1) * [\text{Greenhouse price index}]_{t,Q1}/[\text{Greenhouse price index}]_{t-1,Q1} * [\text{Greenhouse open-market sales}]_{t-1,Q1}$$

$$[\text{Greenhouse open-market sales}]_{Q2} = (([\text{Greenhouse production index}]_t/[\text{Greenhouse production index}]_{t-1} - 1)/4 + 1) * [\text{Greenhouse price index}]_{t,Q2}/[\text{Greenhouse price index}]_{t-1,Q2} * [\text{Greenhouse open-market sales}]_{t-1,Q2}$$

$$[\text{Greenhouse open-market sales}]_{Q2} = (([\text{Greenhouse production index}]_t/[\text{Greenhouse production index}]_{t-1} - 1)/4 + 1) * [\text{Greenhouse price index}]_{t,Q3}/[\text{Greenhouse price index}]_{t-1,Q3} * [\text{Greenhouse open-market sales}]_{t-1,Q3}$$

$$[\text{Greenhouse open-market sales}]_{Q2} = (([\text{Greenhouse production index}]_t/[\text{Greenhouse production index}]_{t-1} - 1)/4 + 1) * [\text{Greenhouse price index}]_{t,Q4}/[\text{Greenhouse price index}]_{t-1,Q4} * [\text{Greenhouse open-market sales}]_{t-1,Q4}$$

$$[\text{Greenhouse open-market sales}]_t = [\text{Greenhouse open-market sales}]_{Q1} + [\text{Greenhouse open-market sales}]_{Q2} + [\text{Greenhouse open-market sales}]_{Q3} + [\text{Greenhouse open-market sales}]_{Q4}$$

$$[\text{Other crops open-market sales}]_{Q1} = (([\text{Other crops output index}]_t/[\text{Other crops output index}]_{t-1} - 1)/4 + 1) * [\text{Other crops price index}]_{t,Q1}/[\text{Other crops price index}]_{t-1,Q1} * [\text{Other crops open-market sales}]_{t-1,Q1}$$

$$[\text{Other crops open-market sales}]_{Q2} = (([\text{Other crops output index}]_t/[\text{Other crops output index}]_{t-1} - 1)/4 + 1) * [\text{Other crops price index}]_{t,Q2}/[\text{Other crops price index}]_{t-1,Q2} * [\text{Other crops open-market sales}]_{t-1,Q2}$$

$$[\text{Other crops open-market sales}]_{Q2} = (([\text{Other crops output index}]_t/[\text{Other crops output index}]_{t-1} - 1)/4 + 1) * [\text{Other crops price index}]_{t,Q3}/[\text{Other crops price index}]_{t-1,Q3} * [\text{Other crops open-market sales}]_{t-1,Q3}$$

$$[\text{Other crops open-market sales}]_{Q2} = (([\text{Other crops output index}]_t/[\text{Other crops output index}]_{t-1} - 1)/4 + 1) * [\text{Other crops price index}]_{t,Q4}/[\text{Other crops price index}]_{t-1,Q4} * [\text{Other crops open-market sales}]_{t-1,Q4}$$

$$[\text{Other crops open-market sales}]_t = [\text{Other crops open-market sales}]_{Q1} + [\text{Other crops open-market sales}]_{Q2} + [\text{Other crops open-market sales}]_{Q3} + [\text{Other crops open-market sales}]_{Q4}$$

$$[\text{All crops open-market sales}]_{Q1} = [\text{Wheat open-market sales}]_{Q1} + [\text{Rice open-market sales}]_{Q1} + [\text{Rye open-market sales}]_{Q1} + [\text{Corn open-market sales}]_{Q1} + [\text{Sorghum open-market sales}]_{Q1} + [\text{Barley open-market sales}]_{Q1} + [\text{Oats open-market sales}]_{Q1} + [\text{Hay open-market sales}]_{Q1} + [\text{Soybean open-market sales}]_{Q1} + [\text{Peanut open-market sales}]_{Q1} + [\text{Sunflower open-market sales}]_{Q1} + [\text{Flaxseed open-market sales}]_{Q1} + [\text{Cotton lint open-market sales}]_{Q1} + [\text{Cottonseed open-market sales}]_{Q1} + [\text{Potato open-market sales}]_{Q1} + [\text{Dry beans open-market sales}]_{Q1} + [\text{Other vegetable open-market sales}]_{Q1} + [\text{Tobacco open-market sales}]_{Q1} + [\text{Fruit\&nut open-market sales}]_{Q1} + [\text{Greenhouse open-market sales}]_{Q1} + [\text{Other crops open-market sales}]_{Q1}$$

$$[\text{All crops open-market sales}]_{Q2} = [\text{Wheat open-market sales}]_{Q2} + [\text{Rice open-market sales}]_{Q2} + [\text{Rye open-market sales}]_{Q2} + [\text{Corn open-market sales}]_{Q2} + [\text{Sorghum open-market sales}]_{Q2} + [\text{Barley open-market sales}]_{Q2} + [\text{Oats open-market sales}]_{Q2} + [\text{Hay open-market sales}]_{Q2} + [\text{Soybean open-market sales}]_{Q2} + [\text{Peanut open-market sales}]_{Q2} + [\text{Sunflower open-market sales}]_{Q2} + [\text{Flaxseed open-market sales}]_{Q2} + [\text{Cotton lint open-market sales}]_{Q2} + [\text{Cottonseed open-market sales}]_{Q2} + [\text{Potato open-market sales}]_{Q2} + [\text{Dry beans open-market sales}]_{Q2} + [\text{Other vegetable open-market sales}]_{Q2} + [\text{Tobacco open-market sales}]_{Q2} + [\text{Fruit\&nut open-market sales}]_{Q2} + [\text{Greenhouse open-market sales}]_{Q2} + [\text{Other crops open-market sales}]_{Q2}$$

$$[\text{All crops open-market sales}]_{Q3} = [\text{Wheat open-market sales}]_{Q3} + [\text{Rice open-market sales}]_{Q3} + [\text{Rye open-market sales}]_{Q3} + [\text{Corn open-market sales}]_{Q3} + [\text{Sorghum open-market sales}]_{Q3} + [\text{Barley open-market sales}]_{Q3} + [\text{Oats open-market sales}]_{Q3} + [\text{Hay open-market sales}]_{Q3} + [\text{Soybean open-market sales}]_{Q3} + [\text{Peanut open-market sales}]_{Q3} + [\text{Sunflower open-market sales}]_{Q3} + [\text{Flaxseed open-market sales}]_{Q3} + [\text{Cotton lint open-market sales}]_{Q3} + [\text{Cottonseed open-market sales}]_{Q3} + [\text{Potato open-market sales}]_{Q3} + [\text{Dry beans open-market sales}]_{Q3} + [\text{Other vegetable open-market sales}]_{Q3} + [\text{Tobacco open-market sales}]_{Q3} + [\text{Fruit\&nut open-market sales}]_{Q3} + [\text{Greenhouse open-market sales}]_{Q3} + [\text{Other crops open-market sales}]_{Q3}$$

$$[\text{All crops open-market sales}]_{Q4} = [\text{Wheat open-market sales}]_{Q4} + [\text{Rice open-market sales}]_{Q4} + [\text{Rye open-market sales}]_{Q4} + [\text{Corn open-market sales}]_{Q4} + [\text{Sorghum open-market sales}]_{Q4} + [\text{Barley open-market sales}]_{Q4} + [\text{Oats open-market sales}]_{Q4} + [\text{Hay open-market sales}]_{Q4} + [\text{Soybean open-market sales}]_{Q4} + [\text{Peanut open-market sales}]_{Q4} + [\text{Sunflower open-market sales}]_{Q4} + [\text{Flaxseed open-market sales}]_{Q4} + [\text{Cotton lint open-market sales}]_{Q4} + [\text{Cottonseed open-market sales}]_{Q4} + [\text{Potato open-market sales}]_{Q4} + [\text{Dry beans open-market sales}]_{Q4} + [\text{Other vegetable open-market sales}]_{Q4} + [\text{Tobacco open-market sales}]_{Q4} + [\text{Fruit\&nut open-market sales}]_{Q4} + [\text{Greenhouse open-market sales}]_{Q4} + [\text{Other crops open-market sales}]_{Q4}$$

$$[\text{All crops open-market sales}]_t = [\text{All crops open-market sales}]_{Q1} + [\text{All crops open-market sales}]_{Q2} + [\text{All crops open-market sales}]_{Q3} + [\text{All crops open-market sales}]_{Q4}$$

CCC Placements, Redemptions, and Net Values

Wheat

$$[\text{Wheat placements}]_y = \text{MIN}(\text{MAX}(-.2033 + .0646 * [\text{Wheat placements}]_{y-1}/[\text{Wheat production}]_{y-1} + 0.4698 * [\text{Wheat loan rate}]_y/[\text{Wheat price}]_y, 0.05), 1) * [\text{Wheat production}]_t$$

$$[\text{Wheat placements}]_{Q1} = [\text{Wheat percent placed}]_{y-1,Q1} * [\text{Wheat placements}]_{y-1}$$

$$[\text{Wheat placements}]_{Q2} = [\text{Wheat percent placed}]_{y,Q2} * [\text{Wheat placements}]_y$$

$$[\text{Wheat placements}]_{Q3} = [\text{Wheat percent placed}]_{y,Q3} * [\text{Wheat placements}]_y$$

$$[\text{Wheat placements}]_{Q4} = [\text{Wheat percent placed}]_{y,Q4} * [\text{Wheat placements}]_y$$

$$[\text{Wheat placements}]_t = [\text{Wheat placements}]_{Q1} + [\text{Wheat placements}]_{Q2} + [\text{Wheat placements}]_{Q3} + [\text{Wheat placements}]_{Q4}$$

$$[\text{Wheat redemptions}]_y = \text{MIN}(\text{MAX}(-.304 + 0.7795 * [\text{Wheat price}]_y/[\text{Wheat loan rate}]_y, 0), 1) * [\text{Wheat production}]_t$$

$$[\text{Wheat redemptions}]_{Q1} = [\text{Wheat percent redeemed}]_{y-1,Q1} * [\text{Wheat redemptions}]_{y-1}$$

$$[\text{Wheat redemptions}]_{Q2} = [\text{Wheat percent redeemed}]_{y,Q2} * [\text{Wheat redemptions}]_y$$

$$[\text{Wheat redemptions}]_{Q3} = [\text{Wheat percent redeemed}]_{y,Q3} * [\text{Wheat redemptions}]_y$$

$$[\text{Wheat redemptions}]_{Q4} = [\text{Wheat percent redeemed}]_{y,Q4} * [\text{Wheat redemptions}]_y$$

$$[\text{Wheat redemptions}]_t = [\text{Wheat redemptions}]_{Q1} + [\text{Wheat redemptions}]_{Q2} + [\text{Wheat redemptions}]_{Q3} + [\text{Wheat redemptions}]_{Q4}$$

$$[\text{Wheat net CCC quantity}]_{Q1} = [\text{Wheat placements}]_{Q1} - [\text{Wheat redemptions}]_{Q1}$$

$$[\text{Wheat net CCC quantity}]_{Q2} = [\text{Wheat placements}]_{Q2} - [\text{Wheat redemptions}]_{Q2}$$

$$[\text{Wheat net CCC quantity}]_{Q3} = [\text{Wheat placements}]_{Q3} - [\text{Wheat redemptions}]_{Q3}$$

$$[\text{Wheat net CCC quantity}]_{Q4} = [\text{Wheat placements}]_{Q4} - [\text{Wheat redemptions}]_{Q4}$$

$$[\text{Wheat net CCC quantity}]_t = [\text{Wheat placements}]_t - [\text{Wheat redemptions}]_t$$

$$[\text{Wheat net CCC value}]_{Q1} = [\text{Wheat net CCC quantity}]_{Q1} * [\text{Wheat loan rate}]_{y-1}$$

$$[\text{Wheat net CCC value}]_{Q2} = [\text{Wheat net CCC quantity}]_{Q2} * [\text{Wheat loan rate}]_y$$

$$[\text{Wheat net CCC value}]_{Q3} = [\text{Wheat net CCC quantity}]_{Q3} * [\text{Wheat loan rate}]_y$$

$$[\text{Wheat net CCC value}]_{Q4} = [\text{Wheat net CCC quantity}]_{Q4} * [\text{Wheat loan rate}]_y$$

$$[\text{Wheat net CCC value}]_t = [\text{Wheat net CCC value}]_{Q1} + [\text{Wheat net CCC value}]_{Q2} + [\text{Wheat net CCC value}]_{Q3} + [\text{Wheat net CCC value}]_{Q4}$$

Rice

$$[\text{Rice placements}]_y = \text{MIN}(\text{MAX}(-.294 + 0.842 * [\text{Rice loan rate}]_y / [\text{Rice price}]_y, 0.05), 1) * [\text{Rice production}]_t$$

$$[\text{Rice placements}]_{Q1} = [\text{Rice percent placed}]_{y-1,Q1} * [\text{Rice placements}]_{y-1}$$

$$[\text{Rice placements}]_{Q2} = [\text{Rice percent placed}]_{y-1,Q2} * [\text{Rice placements}]_{y-1}$$

$$[\text{Rice placements}]_{Q3} = [\text{Rice percent placed}]_{y,Q3} * [\text{Rice placements}]_y$$

$$[\text{Rice placements}]_{Q4} = [\text{Rice percent placed}]_{y,Q4} * [\text{Rice placements}]_y$$

$$[\text{Rice placements}]_t = [\text{Rice placements}]_{Q1} + [\text{Rice placements}]_{Q2} + [\text{Rice placements}]_{Q3} + [\text{Rice placements}]_{Q4}$$

$$[\text{Rice redemptions}]_y = \text{MIN}(\text{MAX}(-.479 + 0.3661 * [\text{Rice price}]_y / [\text{Rice loan rate}]_y, 0), 1) * [\text{Rice production}]_t$$

$$[\text{Rice redemptions}]_{Q1} = [\text{Rice percent redeemed}]_{y-1,Q1} * [\text{Rice redemptions}]_{y-1}$$

$$[\text{Rice redemptions}]_{Q2} = [\text{Rice percent redeemed}]_{y-1,Q2} * [\text{Rice redemptions}]_{y-1}$$

$$[\text{Rice redemptions}]_{Q3} = [\text{Rice percent redeemed}]_{y,Q3} * [\text{Rice redemptions}]_y$$

$$[\text{Rice redemptions}]_{Q4} = [\text{Rice percent redeemed}]_{y,Q4} * [\text{Rice redemptions}]_y$$

$$[\text{Rice redemptions}]_t = [\text{Rice redemptions}]_{Q1} + [\text{Rice redemptions}]_{Q2} + [\text{Rice redemptions}]_{Q3} + [\text{Rice redemptions}]_{Q4}$$

$$[\text{Rice net CCC quantity}]_{Q1} = [\text{Rice placements}]_{Q1} - [\text{Rice redemptions}]_{Q1}$$

$$[\text{Rice net CCC quantity}]_{Q2} = [\text{Rice placements}]_{Q2} - [\text{Rice redemptions}]_{Q2}$$

$$[\text{Rice net CCC quantity}]_{Q3} = [\text{Rice placements}]_{Q3} - [\text{Rice redemptions}]_{Q3}$$

$$[\text{Rice net CCC quantity}]_{Q4} = [\text{Rice placements}]_{Q4} - [\text{Rice redemptions}]_{Q4}$$

$$[\text{Rice net CCC quantity}]_t = [\text{Rice placements}]_t - [\text{Rice redemptions}]_t$$

$$[\text{Rice net CCC value}]_{Q1} = [\text{Rice net CCC quantity}]_{Q1} * [\text{Rice loan rate}]_{y-1}$$

$$[\text{Rice net CCC value}]_{Q2} = [\text{Rice net CCC quantity}]_{Q2} * [\text{Rice loan rate}]_{y-1}$$

$$[\text{Rice net CCC value}]_{Q3} = [\text{Rice net CCC quantity}]_{Q3} * [\text{Rice loan rate}]_y$$

$$[\text{Rice net CCC value}]_{Q4} = [\text{Rice net CCC quantity}]_{Q4} * [\text{Rice loan rate}]_y$$

$$[\text{Rice net CCC value}]_t = [\text{Rice net CCC value}]_{Q1} + [\text{Rice net CCC value}]_{Q2} + [\text{Rice net CCC value}]_{Q3} + [\text{Rice net CCC value}]_{Q4}$$

Rye

$$[\text{Rye placements}]_y = \text{MIN}(\text{MAX}(-.288 + 0.4667 * [\text{Rye loan rate}]_y / [\text{Rye price}]_y, 0.05), 1) * [\text{Rye production}]_t$$

$$[\text{Rye placements}]_{Q1} = [\text{Rye percent placed}]_{y-1,Q1} * [\text{Rye placements}]_{y-1}$$

$$[\text{Rye placements}]_{Q2} = [\text{Rye percent placed}]_{y-1,Q2} * [\text{Rye placements}]_{y-1}$$

$$[\text{Rye placements}]_{Q3} = [\text{Rye percent placed}]_{y,Q3} * [\text{Rye placements}]_y$$

$$[\text{Rye placements}]_{Q4} = [\text{Rye percent placed}]_{y,Q4} * [\text{Rye placements}]_y$$

$$[\text{Rye placements}]_t = [\text{Rye placements}]_{Q1} + [\text{Rye placements}]_{Q2} + [\text{Rye placements}]_{Q3} + [\text{Rye placements}]_{Q4}$$

$$[\text{Rye redemptions}]_y = \text{MIN}(\text{MAX}(-.362 + 0.8328 * [\text{Rye price}]_y / [\text{Rye loan rate}]_y, 0), 1) * [\text{Rye production}]_t$$

$$[\text{Rye redemptions}]_{Q1} = [\text{Rye percent redeemed}]_{y-1,Q1} * [\text{Rye redemptions}]_{y-1}$$

$$[\text{Rye redemptions}]_{Q2} = [\text{Rye percent redeemed}]_{y-1,Q2} * [\text{Rye redemptions}]_{y-1}$$

$$[\text{Rye redemptions}]_{Q3} = [\text{Rye percent redeemed}]_{y,Q3} * [\text{Rye redemptions}]_y$$

$$[\text{Rye redemptions}]_{Q4} = [\text{Rye percent redeemed}]_{y,Q4} * [\text{Rye redemptions}]_y$$

$$[\text{Rye redemptions}]_t = [\text{Rye redemptions}]_{Q1} + [\text{Rye redemptions}]_{Q2} + [\text{Rye redemptions}]_{Q3} + [\text{Rye redemptions}]_{Q4}$$

$$[\text{Rye net CCC quantity}]_{Q1} = [\text{Rye placements}]_{Q1} - [\text{Rye redemptions}]_{Q1}$$

$$[\text{Rye net CCC quantity}]_{Q2} = [\text{Rye placements}]_{Q2} - [\text{Rye redemptions}]_{Q2}$$

$$[\text{Rye net CCC quantity}]_{Q3} = [\text{Rye placements}]_{Q3} - [\text{Rye redemptions}]_{Q3}$$

$$[\text{Rye net CCC quantity}]_{Q4} = [\text{Rye placements}]_{Q4} - [\text{Rye redemptions}]_{Q4}$$

$$[\text{Rye net CCC quantity}]_t = [\text{Rye placements}]_t - [\text{Rye redemptions}]_t$$

$$[\text{Rye net CCC value}]_{Q1} = [\text{Rye net CCC quantity}]_{Q1} * [\text{Rye loan rate}]_{y-1}$$

$$[\text{Rye net CCC value}]_{Q2} = [\text{Rye net CCC quantity}]_{Q2} * [\text{Rye loan rate}]_{y-1}$$

$$[\text{Rye net CCC value}]_{Q3} = [\text{Rye net CCC quantity}]_{Q3} * [\text{Rye loan rate}]_y$$

$$[\text{Rye net CCC value}]_{Q4} = [\text{Rye net CCC quantity}]_{Q4} * [\text{Rye loan rate}]_y$$

$$[\text{Rye net CCC value}]_t = [\text{Rye net CCC value}]_{Q1} + [\text{Rye net CCC value}]_{Q2} + [\text{Rye net CCC value}]_{Q3}$$

Corn

$$[\text{Corn placements}]_y = \text{MIN}(\text{MAX}(-.526 + .63627 * [\text{Corn placements}]_{y-1} / [\text{Corn production}]_{y-1} + 0.54688 * [\text{Corn loan rate}]_y / [\text{Corn price}]_y, 0.05), 1) * [\text{Corn production}]_t$$

$$[\text{Corn placements}]_{Q1} = [\text{Corn percent placed}]_{y-1,Q1} * [\text{Corn placements}]_{y-1}$$

$$[\text{Corn placements}]_{Q2} = [\text{Corn percent placed}]_{y-1,Q2} * [\text{Corn placements}]_{y-1}$$

$$[\text{Corn placements}]_{Q3} = [\text{Corn percent placed}]_{y,Q3} * [\text{Corn placements}]_y$$

$$[\text{Corn placements}]_{Q4} = [\text{Corn percent placed}]_{y,Q4} * [\text{Corn placements}]_y$$

$$[\text{Corn placements}]_t = [\text{Corn placements}]_{Q1} + [\text{Corn placements}]_{Q2} + [\text{Corn placements}]_{Q3} + [\text{Corn placements}]_{Q4}$$

$$[\text{Corn redemptions}]_y = \text{MIN}(\text{MAX}(-.375 + 1.0635 * [\text{Corn price}]_y / [\text{Corn loan rate}]_y, 0), 1) * [\text{Corn production}]_t$$

$$[\text{Corn redemptions}]_{Q1} = [\text{Corn percent redeemed}]_{y-1,Q1} * [\text{Corn redemptions}]_{y-1}$$

$$[\text{Corn redemptions}]_{Q2} = [\text{Corn percent redeemed}]_{y-1,Q2} * [\text{Corn redemptions}]_{y-1}$$

$$[\text{Corn redemptions}]_{Q3} = [\text{Corn percent redeemed}]_{y,Q3} * [\text{Corn redemptions}]_y$$

$$[\text{Corn redemptions}]_{Q4} = [\text{Corn percent redeemed}]_{y,Q4} * [\text{Corn redemptions}]_y$$

$$[\text{Corn redemptions}]_t = [\text{Corn redemptions}]_{Q1} + [\text{Corn redemptions}]_{Q2} + [\text{Corn redemptions}]_{Q3} + [\text{Corn redemptions}]_{Q4}$$

$$[\text{Corn net CCC quantity}]_{Q1} = [\text{Corn placements}]_{Q1} - [\text{Corn redemptions}]_{Q1}$$

$$[\text{Corn net CCC quantity}]_{Q2} = [\text{Corn placements}]_{Q2} - [\text{Corn redemptions}]_{Q2}$$

$[\text{Corn net CCC quantity}]_{Q3} = [\text{Corn placements}]_{Q3} - [\text{Corn redemptions}]_{Q3}$

$[\text{Corn net CCC quantity}]_{Q4} = [\text{Corn placements}]_{Q4} - [\text{Corn redemptions}]_{Q4}$

$[\text{Corn net CCC quantity}]_{t} = [\text{Corn placements}]_{t} - [\text{Corn redemptions}]_{t}$

$[\text{Corn net CCC value}]_{Q1} = [\text{Corn net CCC quantity}]_{Q1} * [\text{Corn loan rate}]_{y-1}$

$[\text{Corn net CCC value}]_{Q2} = [\text{Corn net CCC quantity}]_{Q2} * [\text{Corn loan rate}]_{y-1}$

$[\text{Corn net CCC value}]_{Q3} = [\text{Corn net CCC quantity}]_{Q3} * [\text{Corn loan rate}]_{y}$

$[\text{Corn net CCC value}]_{Q4} = [\text{Corn net CCC quantity}]_{Q4} * [\text{Corn loan rate}]_{y}$

$[\text{Corn net CCC value}]_{t} = [\text{Corn net CCC value}]_{Q1} + [\text{Corn net CCC value}]_{Q2} + [\text{Corn net CCC value}]_{Q3} + [\text{Corn net CCC value}]_{Q4}$

Sorghum

$[\text{Sorghum placements}]_{y} = \text{MIN}(\text{MAX}(-.318 + 0.5435 * [\text{Sorghum loan rate}]_{y} / [\text{Sorghum price}]_{y}, 0.05), 1) * [\text{Sorghum production}]_{t}$

$[\text{Sorghum placements}]_{Q1} = [\text{Sorghum percent placed}]_{y-1,Q1} * [\text{Sorghum placements}]_{y-1}$

$[\text{Sorghum placements}]_{Q2} = [\text{Sorghum percent placed}]_{y-1,Q2} * [\text{Sorghum placements}]_{y-1}$

$[\text{Sorghum placements}]_{Q3} = [\text{Sorghum percent placed}]_{y,Q3} * [\text{Sorghum placements}]_{y}$

$[\text{Sorghum placements}]_{Q4} = [\text{Sorghum percent placed}]_{y,Q4} * [\text{Sorghum placements}]_{y}$

$[\text{Sorghum placements}]_{t} = [\text{Sorghum placements}]_{Q1} + [\text{Sorghum placements}]_{Q2} + [\text{Sorghum placements}]_{Q3} + [\text{Sorghum placements}]_{Q4}$

$[\text{Sorghum redemptions}]_{y} = \text{MIN}(\text{MAX}(-.450 + 1.0657 * [\text{Sorghum price}]_{y} / [\text{Sorghum loan rate}]_{y}, 0), 1) * [\text{Sorghum production}]_{t}$

$[\text{Sorghum redemptions}]_{Q1} = [\text{Sorghum percent redeemed}]_{y-1,Q1} * [\text{Sorghum redemptions}]_{y-1}$

$[\text{Sorghum redemptions}]_{Q2} = [\text{Sorghum percent redeemed}]_{y-1,Q2} * [\text{Sorghum redemptions}]_{y-1}$

$[\text{Sorghum redemptions}]_{Q3} = [\text{Sorghum percent redeemed}]_{y,Q3} * [\text{Sorghum redemptions}]_{y}$

$[\text{Sorghum redemptions}]_{Q4} = [\text{Sorghum percent redeemed}]_{y,Q4} * [\text{Sorghum redemptions}]_{y}$

$[\text{Sorghum redemptions}]_{t} = [\text{Sorghum redemptions}]_{Q1} + [\text{Sorghum redemptions}]_{Q2} + [\text{Sorghum redemptions}]_{Q3} + [\text{Sorghum redemptions}]_{Q4}$

$[\text{Sorghum net CCC quantity}]_{Q1} = [\text{Sorghum placements}]_{Q1} - [\text{Sorghum redemptions}]_{Q1}$

$[\text{Sorghum net CCC quantity}]_{Q2} = [\text{Sorghum placements}]_{Q2} - [\text{Sorghum redemptions}]_{Q2}$

$[\text{Sorghum net CCC quantity}]_{Q3} = [\text{Sorghum placements}]_{Q3} - [\text{Sorghum redemptions}]_{Q3}$

$[\text{Sorghum net CCC quantity}]_{Q4} = [\text{Sorghum placements}]_{Q4} - [\text{Sorghum redemptions}]_{Q4}$

$[\text{Sorghum net CCC quantity}]_{t} = [\text{Sorghum placements}]_{t} - [\text{Sorghum redemptions}]_{t}$

$[\text{Sorghum net CCC value}]_{Q1} = [\text{Sorghum net CCC quantity}]_{Q1} * [\text{Sorghum loan rate}]_{y-1}$

$[\text{Sorghum net CCC value}]_{Q2} = [\text{Sorghum net CCC quantity}]_{Q2} * [\text{Sorghum loan rate}]_{y-1}$

$[\text{Sorghum net CCC value}]_{Q3} = [\text{Sorghum net CCC quantity}]_{Q3} * [\text{Sorghum loan rate}]_{y}$

$[\text{Sorghum net CCC value}]_{Q4} = [\text{Sorghum net CCC quantity}]_{Q4} * [\text{Sorghum loan rate}]_{y}$

$[\text{Sorghum net CCC value}]_{t} = [\text{Sorghum net CCC value}]_{Q1} + [\text{Sorghum net CCC value}]_{Q2} + [\text{Sorghum net CCC value}]_{Q3} + [\text{Sorghum net CCC value}]_{Q4}$

Barley

$$[\text{Barley placements}]_y = \text{MIN}(\text{MAX}(-.098 + 0.2944 * [\text{Barley loan rate}]_y / [\text{Barley price}]_y, 0.05), 1) * [\text{Barley production}]_t$$

$$[\text{Barley placements}]_{Q1} = [\text{Barley percent placed}]_{y-1,Q1} * [\text{Barley placements}]_{y-1}$$

$$[\text{Barley placements}]_{Q2} = [\text{Barley percent placed}]_{y,Q2} * [\text{Barley placements}]_y$$

$$[\text{Barley placements}]_{Q3} = [\text{Barley percent placed}]_{y,Q3} * [\text{Barley placements}]_y$$

$$[\text{Barley placements}]_{Q4} = [\text{Barley percent placed}]_{y,Q4} * [\text{Barley placements}]_y$$

$$[\text{Barley placements}]_t = [\text{Barley placements}]_{Q1} + [\text{Barley placements}]_{Q2} + [\text{Barley placements}]_{Q3} + [\text{Barley placements}]_{Q4}$$

$$[\text{Barley redemptions}]_y = \text{MIN}(\text{MAX}(-.136 + 1.6588 * [\text{Barley price}]_y / [\text{Barley loan rate}]_y, 0), 1) * [\text{Barley production}]_t$$

$$[\text{Barley redemptions}]_{Q1} = [\text{Barley percent redeemed}]_{y-1,Q1} * [\text{Barley redemptions}]_{y-1}$$

$$[\text{Barley redemptions}]_{Q2} = [\text{Barley percent redeemed}]_{y,Q2} * [\text{Barley redemptions}]_y$$

$$[\text{Barley redemptions}]_{Q3} = [\text{Barley percent redeemed}]_{y,Q3} * [\text{Barley redemptions}]_y$$

$$[\text{Barley redemptions}]_{Q4} = [\text{Barley percent redeemed}]_{y,Q4} * [\text{Barley redemptions}]_y$$

$$[\text{Barley redemptions}]_t = [\text{Barley redemptions}]_{Q1} + [\text{Barley redemptions}]_{Q2} + [\text{Barley redemptions}]_{Q3} + [\text{Barley redemptions}]_{Q4}$$

$$[\text{Barley net CCC quantity}]_{Q1} = [\text{Barley placements}]_{Q1} - [\text{Barley redemptions}]_{Q1}$$

$$[\text{Barley net CCC quantity}]_{Q2} = [\text{Barley placements}]_{Q2} - [\text{Barley redemptions}]_{Q2}$$

$$[\text{Barley net CCC quantity}]_{Q3} = [\text{Barley placements}]_{Q3} - [\text{Barley redemptions}]_{Q3}$$

$$[\text{Barley net CCC quantity}]_{Q4} = [\text{Barley placements}]_{Q4} - [\text{Barley redemptions}]_{Q4}$$

$$[\text{Barley net CCC quantity}]_t = [\text{Barley placements}]_t - [\text{Barley redemptions}]_t$$

$$[\text{Barley net CCC value}]_{Q1} = [\text{Barley net CCC quantity}]_{Q1} * [\text{Barley loan rate}]_{y-1}$$

$$[\text{Barley net CCC value}]_{Q2} = [\text{Barley net CCC quantity}]_{Q2} * [\text{Barley loan rate}]_y$$

$$[\text{Barley net CCC value}]_{Q3} = [\text{Barley net CCC quantity}]_{Q3} * [\text{Barley loan rate}]_y$$

$$[\text{Barley net CCC value}]_{Q4} = [\text{Barley net CCC quantity}]_{Q4} * [\text{Barley loan rate}]_y$$

$$[\text{Barley net CCC value}]_t = [\text{Barley net CCC value}]_{Q1} + [\text{Barley net CCC value}]_{Q2} + [\text{Barley net CCC value}]_{Q3} + [\text{Barley net CCC value}]_{Q4}$$

Oats

$$[\text{Oats placements}]_y = \text{MIN}(\text{MAX}(-.025 + 0.0626 * [\text{Oats loan rate}]_y / [\text{Oats price}]_y, 0.05), 1) * [\text{Oats production}]_t$$

$$[\text{Oats placements}]_{Q1} = [\text{Oats percent placed}]_{y-1,Q1} * [\text{Oats placements}]_{y-1}$$

$$[\text{Oats placements}]_{Q2} = [\text{Oats percent placed}]_{y-1,Q2} * [\text{Oats placements}]_{y-1}$$

$$[\text{Oats placements}]_{Q3} = [\text{Oats percent placed}]_{y,Q3} * [\text{Oats placements}]_y$$

$$[\text{Oats placements}]_{Q4} = [\text{Oats percent placed}]_{y,Q4} * [\text{Oats placements}]_y$$

$$[\text{Oats placements}]_t = [\text{Oats placements}]_{Q1} + [\text{Oats placements}]_{Q2} + [\text{Oats placements}]_{Q3} + [\text{Oats placements}]_{Q4}$$

$$[\text{Oats redemptions}]_y = \text{MIN}(\text{MAX}(-.435 + 0.3006 * [\text{Oats price}]_y / [\text{Oats loan rate}]_y, 0), 1) * [\text{Oats production}]_t$$

$$[\text{Oats redemptions}]_{Q1} = [\text{Oats percent redeemed}]_{y-1,Q1} * [\text{Oats redemptions}]_{y-1}$$

$[\text{Oats redemptions}]_{Q2} = [\text{Oats percent redeemed}]_{y-1,Q2} * [\text{Oats redemptions}]_{y-1}$

$[\text{Oats redemptions}]_{Q3} = [\text{Oats percent redeemed}]_{y,Q3} * [\text{Oats redemptions}]_{y}$

$[\text{Oats redemptions}]_{Q4} = [\text{Oats percent redeemed}]_{y,Q4} * [\text{Oats redemptions}]_{y}$

$[\text{Oats redemptions}]_{t} = [\text{Oats redemptions}]_{Q1} + [\text{Oats redemptions}]_{Q2} + [\text{Oats redemptions}]_{Q3} + [\text{Oats redemptions}]_{Q4}$

$[\text{Oats net CCC quantity}]_{Q1} = [\text{Oats placements}]_{Q1} - [\text{Oats redemptions}]_{Q1}$

$[\text{Oats net CCC quantity}]_{Q2} = [\text{Oats placements}]_{Q2} - [\text{Oats redemptions}]_{Q2}$

$[\text{Oats net CCC quantity}]_{Q3} = [\text{Oats placements}]_{Q3} - [\text{Oats redemptions}]_{Q3}$

$[\text{Oats net CCC quantity}]_{Q4} = [\text{Oats placements}]_{Q4} - [\text{Oats redemptions}]_{Q4}$

$[\text{Oats net CCC quantity}]_{t} = [\text{Oats placements}]_{t} - [\text{Oats redemptions}]_{t}$

$[\text{Oats net CCC value}]_{Q1} = [\text{Oats net CCC quantity}]_{Q1} * [\text{Oats loan rate}]_{y-1}$

$[\text{Oats net CCC value}]_{Q2} = [\text{Oats net CCC quantity}]_{Q2} * [\text{Oats loan rate}]_{y-1}$

$[\text{Oats net CCC value}]_{Q3} = [\text{Oats net CCC quantity}]_{Q3} * [\text{Oats loan rate}]_{y}$

$[\text{Oats net CCC value}]_{Q4} = [\text{Oats net CCC quantity}]_{Q4} * [\text{Oats loan rate}]_{y}$

$[\text{Oats net CCC value}]_{t} = [\text{Oats net CCC value}]_{Q1} + [\text{Oats net CCC value}]_{Q2} + [\text{Oats net CCC value}]_{Q3} + [\text{Oats net CCC value}]_{Q4}$

Soybeans

$[\text{Soybean placements}]_{y} = \text{MIN}(\text{MAX}(-.213 + 0.4226 * [\text{Soybean loan rate}]_{y} / [\text{Soybean price}]_{y}, 0.05), 1) * [\text{Soybean production}]_{t}$

$[\text{Soybean placements}]_{Q1} = [\text{Soybean percent placed}]_{y-1,Q1} * [\text{Soybean placements}]_{y-1}$

$[\text{Soybean placements}]_{Q2} = [\text{Soybean percent placed}]_{y-1,Q2} * [\text{Soybean placements}]_{y-1}$

$[\text{Soybean placements}]_{Q3} = [\text{Soybean percent placed}]_{y,Q3} * [\text{Soybean placements}]_{y}$

$[\text{Soybean placements}]_{Q4} = [\text{Soybean percent placed}]_{y,Q4} * [\text{Soybean placements}]_{y}$

$[\text{Soybean placements}]_{t} = [\text{Soybean placements}]_{Q1} + [\text{Soybean placements}]_{Q2} + [\text{Soybean placements}]_{Q3} + [\text{Soybean placements}]_{Q4}$

$[\text{Soybean redemptions}]_{y} = \text{MIN}(\text{MAX}(-.298 + 0.9155 * [\text{Soybean price}]_{y} / [\text{Soybean loan rate}]_{y}, 0), 1) * [\text{Soybean production}]_{t}$

$[\text{Soybean redemptions}]_{Q1} = [\text{Soybean percent redeemed}]_{y-1,Q1} * [\text{Soybean redemptions}]_{y-1}$

$[\text{Soybean redemptions}]_{Q2} = [\text{Soybean percent redeemed}]_{y-1,Q2} * [\text{Soybean redemptions}]_{y-1}$

$[\text{Soybean redemptions}]_{Q3} = [\text{Soybean percent redeemed}]_{y,Q3} * [\text{Soybean redemptions}]_{y}$

$[\text{Soybean redemptions}]_{Q4} = [\text{Soybean percent redeemed}]_{y,Q4} * [\text{Soybean redemptions}]_{y}$

$[\text{Soybean redemptions}]_{t} = [\text{Soybean redemptions}]_{Q1} + [\text{Soybean redemptions}]_{Q2} + [\text{Soybean redemptions}]_{Q3} + [\text{Soybean redemptions}]_{Q4}$

$[\text{Soybean net CCC quantity}]_{Q1} = [\text{Soybean placements}]_{Q1} - [\text{Soybean redemptions}]_{Q1}$

$[\text{Soybean net CCC quantity}]_{Q2} = [\text{Soybean placements}]_{Q2} - [\text{Soybean redemptions}]_{Q2}$

$[\text{Soybean net CCC quantity}]_{Q3} = [\text{Soybean placements}]_{Q3} - [\text{Soybean redemptions}]_{Q3}$

$[\text{Soybean net CCC quantity}]_{Q4} = [\text{Soybean placements}]_{Q4} - [\text{Soybean redemptions}]_{Q4}$

$[\text{Soybean net CCC quantity}]_{t} = [\text{Soybean placements}]_{t} - [\text{Soybean redemptions}]_{t}$

$[\text{Soybean net CCC value}]_{Q1} = [\text{Soybean net CCC quantity}]_{Q1} * [\text{Soybean loan rate}]_{y-1}$

$[\text{Soybean net CCC value}]_{Q2} = [\text{Soybean net CCC quantity}]_{Q2} * [\text{Soybean loan rate}]_{y-1}$

$[\text{Soybean net CCC value}]_{Q3} = [\text{Soybean net CCC quantity}]_{Q3} * [\text{Soybean loan rate}]_{y}$

$[\text{Soybean net CCC value}]_{Q4} = [\text{Soybean net CCC quantity}]_{Q4} * [\text{Soybean loan rate}]_{y}$

$[\text{Soybean net CCC value}]_{t} = [\text{Soybean net CCC value}]_{Q1} + [\text{Soybean net CCC value}]_{Q2} + [\text{Soybean net CCC value}]_{Q3} + [\text{Soybean net CCC value}]_{Q4}$

Cotton

$[\text{Cotton placements}]_{y} = \text{MIN}(\text{MAX}(-.660 + 0.9938 * [\text{Cotton loan rate}]_{y} / [\text{Cotton price}]_{y}, 0.05), 1) * [\text{Cotton production}]_{t}$

$[\text{Cotton placements}]_{Q1} = [\text{Cotton percent placed}]_{y-1,Q1} * [\text{Cotton placements}]_{y-1}$

$[\text{Cotton placements}]_{Q2} = [\text{Cotton percent placed}]_{y-1,Q2} * [\text{Cotton placements}]_{y-1}$

$[\text{Cotton placements}]_{Q3} = [\text{Cotton percent placed}]_{y,Q3} * [\text{Cotton placements}]_{y}$

$[\text{Cotton placements}]_{Q4} = [\text{Cotton percent placed}]_{y,Q4} * [\text{Cotton placements}]_{y}$

$[\text{Cotton placements}]_{t} = [\text{Cotton placements}]_{Q1} + [\text{Cotton placements}]_{Q2} + [\text{Cotton placements}]_{Q3} + [\text{Cotton placements}]_{Q4}$

$[\text{Cotton redemptions}]_{y} = \text{MIN}(\text{MAX}(-.480 + 0.4487 * [\text{Cotton price}]_{y} / [\text{Cotton loan rate}]_{y}, 0), 1) * [\text{Cotton production}]_{t}$

$[\text{Cotton redemptions}]_{Q1} = [\text{Cotton percent redeemed}]_{y-1,Q1} * [\text{Cotton redemptions}]_{y-1}$

$[\text{Cotton redemptions}]_{Q2} = [\text{Cotton percent redeemed}]_{y-1,Q2} * [\text{Cotton redemptions}]_{y-1}$

$[\text{Cotton redemptions}]_{Q3} = [\text{Cotton percent redeemed}]_{y,Q3} * [\text{Cotton redemptions}]_{y}$

$[\text{Cotton redemptions}]_{Q4} = [\text{Cotton percent redeemed}]_{y,Q4} * [\text{Cotton redemptions}]_{y}$

$[\text{Cotton redemptions}]_{t} = [\text{Cotton redemptions}]_{Q1} + [\text{Cotton redemptions}]_{Q2} + [\text{Cotton redemptions}]_{Q3} + [\text{Cotton redemptions}]_{Q4}$

$[\text{Cotton net CCC quantity}]_{Q1} = [\text{Cotton placements}]_{Q1} - [\text{Cotton redemptions}]_{Q1}$

$[\text{Cotton net CCC quantity}]_{Q2} = [\text{Cotton placements}]_{Q2} - [\text{Cotton redemptions}]_{Q2}$

$[\text{Cotton net CCC quantity}]_{Q3} = [\text{Cotton placements}]_{Q3} - [\text{Cotton redemptions}]_{Q3}$

$[\text{Cotton net CCC quantity}]_{Q4} = [\text{Cotton placements}]_{Q4} - [\text{Cotton redemptions}]_{Q4}$

$[\text{Cotton net CCC quantity}]_{t} = [\text{Cotton placements}]_{t} - [\text{Cotton redemptions}]_{t}$

$[\text{Cotton net CCC value}]_{Q1} = [\text{Cotton net CCC quantity}]_{Q1} * [\text{Cotton loan rate}]_{y-1}$

$[\text{Cotton net CCC value}]_{Q2} = [\text{Cotton net CCC quantity}]_{Q2} * [\text{Cotton loan rate}]_{y-1}$

$[\text{Cotton net CCC value}]_{Q3} = [\text{Cotton net CCC quantity}]_{Q3} * [\text{Cotton loan rate}]_{y}$

$[\text{Cotton net CCC value}]_{Q4} = [\text{Cotton net CCC quantity}]_{Q4} * [\text{Cotton loan rate}]_{y}$

$[\text{Cotton net CCC value}]_{t} = [\text{Cotton net CCC value}]_{Q1} + [\text{Cotton net CCC value}]_{Q2} + [\text{Cotton net CCC value}]_{Q3} + [\text{Cotton net CCC value}]_{Q4}$

Crop Cash Receipts

$$[\text{Wheat cash receipts}]_{Q1} = [\text{Wheat open-market sales}]_{Q1} + [\text{Wheat net CCC value}]_{Q1}$$

$$[\text{Wheat cash receipts}]_{Q2} = [\text{Wheat open-market sales}]_{Q2} + [\text{Wheat net CCC value}]_{Q2}$$

$$[\text{Wheat cash receipts}]_{Q3} = [\text{Wheat open-market sales}]_{Q3} + [\text{Wheat net CCC value}]_{Q3}$$

$$[\text{Wheat cash receipts}]_{Q4} = [\text{Wheat open-market sales}]_{Q4} + [\text{Wheat net CCC value}]_{Q4}$$

$$[\text{Wheat cash receipts}]_{t} = [\text{Wheat cash receipts}]_{Q1} + [\text{Wheat cash receipts}]_{Q2} + [\text{Wheat cash receipts}]_{Q3} + [\text{Wheat cash receipts}]_{Q4}$$

$$[\text{Rice cash receipts}]_{Q1} = [\text{Rice open-market sales}]_{Q1} + [\text{Rice net CCC value}]_{Q1}$$

$$[\text{Rice cash receipts}]_{Q2} = [\text{Rice open-market sales}]_{Q2} + [\text{Rice net CCC value}]_{Q2}$$

$$[\text{Rice cash receipts}]_{Q3} = [\text{Rice open-market sales}]_{Q3} + [\text{Rice net CCC value}]_{Q3}$$

$$[\text{Rice cash receipts}]_{Q4} = [\text{Rice open-market sales}]_{Q4} + [\text{Rice net CCC value}]_{Q4}$$

$$[\text{Rice cash receipts}]_{t} = [\text{Rice cash receipts}]_{Q1} + [\text{Rice cash receipts}]_{Q2} + [\text{Rice cash receipts}]_{Q3} + [\text{Rice cash receipts}]_{Q4}$$

$$[\text{Rye cash receipts}]_{Q1} = [\text{Rye open-market sales}]_{Q1} + [\text{Rye net CCC value}]_{Q1}$$

$$[\text{Rye cash receipts}]_{Q2} = [\text{Rye open-market sales}]_{Q2} + [\text{Rye net CCC value}]_{Q2}$$

$$[\text{Rye cash receipts}]_{Q3} = [\text{Rye open-market sales}]_{Q3} + [\text{Rye net CCC value}]_{Q3}$$

$$[\text{Rye cash receipts}]_{Q4} = [\text{Rye open-market sales}]_{Q4} + [\text{Rye net CCC value}]_{Q4}$$

$$[\text{Rye cash receipts}]_{t} = [\text{Rye cash receipts}]_{Q1} + [\text{Rye cash receipts}]_{Q2} + [\text{Rye cash receipts}]_{Q3} + [\text{Rye cash receipts}]_{Q4}$$

$$[\text{Food grains cash receipts}]_{t} = [\text{Wheat cash receipts}]_{t} + [\text{Rice cash receipts}]_{t} + [\text{Rye cash receipts}]_{t}$$

$$[\text{Corn cash receipts}]_{Q1} = [\text{Corn open-market sales}]_{Q1} + [\text{Corn net CCC value}]_{Q1}$$

$$[\text{Corn cash receipts}]_{Q2} = [\text{Corn open-market sales}]_{Q2} + [\text{Corn net CCC value}]_{Q2}$$

$$[\text{Corn cash receipts}]_{Q3} = [\text{Corn open-market sales}]_{Q3} + [\text{Corn net CCC value}]_{Q3}$$

$$[\text{Corn cash receipts}]_{Q4} = [\text{Corn open-market sales}]_{Q4} + [\text{Corn net CCC value}]_{Q4}$$

$$[\text{Corn cash receipts}]_{t} = [\text{Corn cash receipts}]_{Q1} + [\text{Corn cash receipts}]_{Q2} + [\text{Corn cash receipts}]_{Q3} + [\text{Corn cash receipts}]_{Q4}$$

$$[\text{Sorghum cash receipts}]_{Q1} = [\text{Sorghum open-market sales}]_{Q1} + [\text{Sorghum net CCC value}]_{Q1}$$

$$[\text{Sorghum cash receipts}]_{Q2} = [\text{Sorghum open-market sales}]_{Q2} + [\text{Sorghum net CCC value}]_{Q2}$$

$$[\text{Sorghum cash receipts}]_{Q3} = [\text{Sorghum open-market sales}]_{Q3} + [\text{Sorghum net CCC value}]_{Q3}$$

$$[\text{Sorghum cash receipts}]_{Q4} = [\text{Sorghum open-market sales}]_{Q4} + [\text{Sorghum net CCC value}]_{Q4}$$

$$[\text{Sorghum cash receipts}]_{t} = [\text{Sorghum cash receipts}]_{Q1} + [\text{Sorghum cash receipts}]_{Q2} + [\text{Sorghum cash receipts}]_{Q3} + [\text{Sorghum cash receipts}]_{Q4}$$

$$[\text{Barley cash receipts}]_{Q1} = [\text{Barley open-market sales}]_{Q1} + [\text{Barley net CCC value}]_{Q1}$$

$$[\text{Barley cash receipts}]_{Q2} = [\text{Barley open-market sales}]_{Q2} + [\text{Barley net CCC value}]_{Q2}$$

$$[\text{Barley cash receipts}]_{Q3} = [\text{Barley open-market sales}]_{Q3} + [\text{Barley net CCC value}]_{Q3}$$

$$[\text{Barley cash receipts}]_{Q4} = [\text{Barley open-market sales}]_{Q4} + [\text{Barley net CCC value}]_{Q4}$$

$$[\text{Barley cash receipts}]_t = [\text{Barley cash receipts}]_{Q1} + [\text{Barley cash receipts}]_{Q2} + [\text{Barley cash receipts}]_{Q3} + [\text{Barley cash receipts}]_{Q4}$$

$$[\text{Oats cash receipts}]_{Q1} = [\text{Oats open-market sales}]_{Q1} + [\text{Oats net CCC value}]_{Q1}$$

$$[\text{Oats cash receipts}]_{Q2} = [\text{Oats open-market sales}]_{Q2} + [\text{Oats net CCC value}]_{Q2}$$

$$[\text{Oats cash receipts}]_{Q3} = [\text{Oats open-market sales}]_{Q3} + [\text{Oats net CCC value}]_{Q3}$$

$$[\text{Oats cash receipts}]_{Q4} = [\text{Oats open-market sales}]_{Q4} + [\text{Oats net CCC value}]_{Q4}$$

$$[\text{Oats cash receipts}]_t = [\text{Oats cash receipts}]_{Q1} + [\text{Oats cash receipts}]_{Q2} + [\text{Oats cash receipts}]_{Q3} + [\text{Oats cash receipts}]_{Q4}$$

$$[\text{Hay cash receipts}]_{Q1} = [\text{Hay open-market sales}]_{Q1}$$

$$[\text{Hay cash receipts}]_{Q2} = [\text{Hay open-market sales}]_{Q2}$$

$$[\text{Hay cash receipts}]_{Q3} = [\text{Hay open-market sales}]_{Q3}$$

$$[\text{Hay cash receipts}]_{Q4} = [\text{Hay open-market sales}]_{Q4}$$

$$[\text{Hay cash receipts}]_t = [\text{Hay cash receipts}]_{Q1} + [\text{Hay cash receipts}]_{Q2} + [\text{Hay cash receipts}]_{Q3} + [\text{Hay cash receipts}]_{Q4}$$

$$[\text{Feed grains cash receipts}]_t = [\text{Corn cash receipts}]_t + [\text{Sorghum cash receipts}]_t + [\text{Barley cash receipts}]_t + [\text{Oats cash receipts}]_t + [\text{Hay cash receipts}]_t$$

$$[\text{Soybean cash receipts}]_{Q1} = [\text{Soybean open-market sales}]_{Q1} + [\text{Soybean net CCC value}]_{Q1}$$

$$[\text{Soybean cash receipts}]_{Q2} = [\text{Soybean open-market sales}]_{Q2} + [\text{Soybean net CCC value}]_{Q2}$$

$$[\text{Soybean cash receipts}]_{Q3} = [\text{Soybean open-market sales}]_{Q3} + [\text{Soybean net CCC value}]_{Q3}$$

$$[\text{Soybean cash receipts}]_{Q4} = [\text{Soybean open-market sales}]_{Q4} + [\text{Soybean net CCC value}]_{Q4}$$

$$[\text{Soybean cash receipts}]_t = [\text{Soybean cash receipts}]_{Q1} + [\text{Soybean cash receipts}]_{Q2} + [\text{Soybean cash receipts}]_{Q3} + [\text{Soybean cash receipts}]_{Q4}$$

$$[\text{Peanut cash receipts}]_{Q1} = [\text{Peanut open-market sales}]_{Q1}$$

$$[\text{Peanut cash receipts}]_{Q2} = [\text{Peanut open-market sales}]_{Q2}$$

$$[\text{Peanut cash receipts}]_{Q3} = [\text{Peanut open-market sales}]_{Q3}$$

$$[\text{Peanut cash receipts}]_{Q4} = [\text{Peanut open-market sales}]_{Q4}$$

$$[\text{Peanut cash receipts}]_t = [\text{Peanut cash receipts}]_{Q1} + [\text{Peanut cash receipts}]_{Q2} + [\text{Peanut cash receipts}]_{Q3} + [\text{Peanut cash receipts}]_{Q4}$$

$$[\text{Sunflowerseed cash receipts}]_{Q1} = [\text{Sunflowerseed open-market sales}]_{Q1}$$

$$[\text{Sunflowerseed cash receipts}]_{Q2} = [\text{Sunflowerseed open-market sales}]_{Q2}$$

$$[\text{Sunflowerseed cash receipts}]_{Q3} = [\text{Sunflowerseed open-market sales}]_{Q3}$$

$$[\text{Sunflowerseed cash receipts}]_{Q4} = [\text{Sunflowerseed open-market sales}]_{Q4}$$

$$[\text{Sunflowerseed cash receipts}]_t = [\text{Sunflowerseed cash receipts}]_{Q1} + [\text{Sunflowerseed cash receipts}]_{Q2} + [\text{Sunflowerseed cash receipts}]_{Q3} + [\text{Sunflowerseed cash receipts}]_{Q4}$$

$$[\text{Flaxseed cash receipts}]_{Q1} = [\text{Flaxseed open-market sales}]_{Q1}$$

$$[\text{Flaxseed cash receipts}]_{Q2} = [\text{Flaxseed open-market sales}]_{Q2}$$

$$[\text{Flaxseed cash receipts}]_{Q3} = [\text{Flaxseed open-market sales}]_{Q3}$$

$$[\text{Flaxseed cash receipts}]_{Q4} = [\text{Flaxseed open-market sales}]_{Q4}$$

$$[\text{Flaxseed cash receipts}]_t = [\text{Flaxseed cash receipts}]_{Q1} + [\text{Flaxseed cash receipts}]_{Q2} + [\text{Flaxseed cash receipts}]_{Q3} + [\text{Flaxseed cash receipts}]_{Q4}$$

$$[\text{Oilseed cash receipts}]_t = [\text{Soybean cash receipts}]_t + [\text{Peanut cash receipts}]_t + [\text{Sunflower cash receipts}]_t + [\text{Flaxseed cash receipts}]_t$$

$$[\text{Cotton lint cash receipts}]_{Q1} = [\text{Cotton lint open-market sales}]_{Q1} + [\text{Cotton lint net CCC value}]_{Q1}$$

$$[\text{Cotton lint cash receipts}]_{Q2} = [\text{Cotton lint open-market sales}]_{Q2} + [\text{Cotton lint net CCC value}]_{Q2}$$

$$[\text{Cotton lint cash receipts}]_{Q3} = [\text{Cotton lint open-market sales}]_{Q3} + [\text{Cotton lint net CCC value}]_{Q3}$$

$$[\text{Cotton lint cash receipts}]_{Q4} = [\text{Cotton lint open-market sales}]_{Q4} + [\text{Cotton lint net CCC value}]_{Q4}$$

$$[\text{Cotton lint cash receipts}]_t = [\text{Cotton lint cash receipts}]_{Q1} + [\text{Cotton lint cash receipts}]_{Q2} + [\text{Cotton lint cash receipts}]_{Q3} + [\text{Cotton lint cash receipts}]_{Q4}$$

$$[\text{Cottonseed cash receipts}]_{Q1} = [\text{Cottonseed open-market sales}]_{Q1}$$

$$[\text{Cottonseed cash receipts}]_{Q2} = [\text{Cottonseed open-market sales}]_{Q2}$$

$$[\text{Cottonseed cash receipts}]_{Q3} = [\text{Cottonseed open-market sales}]_{Q3}$$

$$[\text{Cottonseed cash receipts}]_{Q4} = [\text{Cottonseed open-market sales}]_{Q4}$$

$$[\text{Cottonseed cash receipts}]_t = [\text{Cottonseed cash receipts}]_{Q1} + [\text{Cottonseed cash receipts}]_{Q2} + [\text{Cottonseed cash receipts}]_{Q3} + [\text{Cottonseed cash receipts}]_{Q4}$$

$$[\text{Cotton cash receipts}]_t = [\text{Cotton lint cash receipts}]_t + [\text{Cottonseed cash receipts}]_t$$

$$[\text{Potato cash receipts}]_{Q1} = [\text{Potato open-market sales}]_{Q1}$$

$$[\text{Potato cash receipts}]_{Q2} = [\text{Potato open-market sales}]_{Q2}$$

$$[\text{Potato cash receipts}]_{Q3} = [\text{Potato open-market sales}]_{Q3}$$

$$[\text{Potato cash receipts}]_{Q4} = [\text{Potato open-market sales}]_{Q4}$$

$$[\text{Potato cash receipts}]_t = [\text{Potato cash receipts}]_{Q1} + [\text{Potato cash receipts}]_{Q2} + [\text{Potato cash receipts}]_{Q3} + [\text{Potato cash receipts}]_{Q4}$$

$$[\text{Dry bean cash receipts}]_{Q1} = [\text{Dry bean open-market sales}]_{Q1}$$

$$[\text{Dry bean cash receipts}]_{Q2} = [\text{Dry bean open-market sales}]_{Q2}$$

$$[\text{Dry bean cash receipts}]_{Q3} = [\text{Dry bean open-market sales}]_{Q3}$$

$$[\text{Dry bean cash receipts}]_{Q4} = [\text{Dry bean open-market sales}]_{Q4}$$

$$[\text{Dry bean cash receipts}]_t = [\text{Dry bean cash receipts}]_{Q1} + [\text{Dry bean cash receipts}]_{Q2} + [\text{Dry bean cash receipts}]_{Q3} + [\text{Dry bean cash receipts}]_{Q4}$$

$$[\text{Other vegetable cash receipts}]_{Q1} = [\text{Other vegetable open-market sales}]_{Q1}$$

$$[\text{Other vegetable cash receipts}]_{Q2} = [\text{Other vegetable open-market sales}]_{Q2}$$

$$[\text{Other vegetable cash receipts}]_{Q3} = [\text{Other vegetable open-market sales}]_{Q3}$$

$$[\text{Other vegetable cash receipts}]_{Q4} = [\text{Other vegetable open-market sales}]_{Q4}$$

$$[\text{Other vegetable cash receipts}]_t = [\text{Other vegetable cash receipts}]_{Q1} + [\text{Other vegetable cash receipts}]_{Q2} + [\text{Other vegetable cash receipts}]_{Q3} + [\text{Other vegetable cash receipts}]_{Q4}$$

$$[\text{All vegetables cash receipts}]_t = [\text{Potato cash receipts}]_t + [\text{Dry bean cash receipts}]_t + [\text{Other vegetable cash receipts}]_t$$

$$[\text{Tobacco cash receipts}]_{Q1} = [\text{Tobacco open-market sales}]_{Q1}$$

$$[\text{Tobacco cash receipts}]_{Q2} = [\text{Tobacco open-market sales}]_{Q2}$$

$$[\text{Tobacco cash receipts}]_{Q3} = [\text{Tobacco open-market sales}]_{Q3}$$

$$[\text{Tobacco cash receipts}]_{Q4} = [\text{Tobacco open-market sales}]_{Q4}$$

$$[\text{Tobacco cash receipts}]_{t} = [\text{Tobacco cash receipts}]_{Q1} + [\text{Tobacco cash receipts}]_{Q2} + [\text{Tobacco cash receipts}]_{Q3} + [\text{Tobacco cash receipts}]_{Q4}$$

$$[\text{Fruits\&nuts cash receipts}]_{Q1} = [\text{Fruits\&nuts open-market sales}]_{Q1}$$

$$[\text{Fruits\&nuts cash receipts}]_{Q2} = [\text{Fruits\&nuts open-market sales}]_{Q2}$$

$$[\text{Fruits\&nuts cash receipts}]_{Q3} = [\text{Fruits\&nuts open-market sales}]_{Q3}$$

$$[\text{Fruits\&nuts cash receipts}]_{Q4} = [\text{Fruits\&nuts open-market sales}]_{Q4}$$

$$[\text{Fruits\&nuts cash receipts}]_{t} = [\text{Fruits\&nuts cash receipts}]_{Q1} + [\text{Fruits\&nuts cash receipts}]_{Q2} + [\text{Fruits\&nuts cash receipts}]_{Q3} + [\text{Fruits\&nuts cash receipts}]_{Q4}$$

$$[\text{Greenhouse cash receipts}]_{Q1} = [\text{Greenhouse open-market sales}]_{Q1}$$

$$[\text{Greenhouse cash receipts}]_{Q2} = [\text{Greenhouse open-market sales}]_{Q2}$$

$$[\text{Greenhouse cash receipts}]_{Q3} = [\text{Greenhouse open-market sales}]_{Q3}$$

$$[\text{Greenhouse cash receipts}]_{Q4} = [\text{Greenhouse open-market sales}]_{Q4}$$

$$[\text{Greenhouse cash receipts}]_{t} = [\text{Greenhouse cash receipts}]_{Q1} + [\text{Greenhouse cash receipts}]_{Q2} + [\text{Greenhouse cash receipts}]_{Q3} + [\text{Greenhouse cash receipts}]_{Q4}$$

$$[\text{Other crops cash receipts}]_{Q1} = [\text{Other crops open-market sales}]_{Q1}$$

$$[\text{Other crops cash receipts}]_{Q2} = [\text{Other crops open-market sales}]_{Q2}$$

$$[\text{Other crops cash receipts}]_{Q3} = [\text{Other crops open-market sales}]_{Q3}$$

$$[\text{Other crops cash receipts}]_{Q4} = [\text{Other crops open-market sales}]_{Q4}$$

$$[\text{Other crops cash receipts}]_{t} = [\text{Other crops cash receipts}]_{Q1} + [\text{Other crops cash receipts}]_{Q2} + [\text{Other crops cash receipts}]_{Q3} + [\text{Other crops cash receipts}]_{Q4}$$

$$[\text{All crops cash receipts}]_{Q1} = [\text{Wheat cash receipts}]_{Q1} + [\text{Rice cash receipts}]_{Q1} + [\text{Rye cash receipts}]_{Q1} + [\text{Corn cash receipts}]_{Q1} + [\text{Sorghum cash receipts}]_{Q1} + [\text{Barley cash receipts}]_{Q1} + [\text{Oats cash receipts}]_{Q1} + [\text{Hay cash receipts}]_{Q1} + [\text{Soybean cash receipts}]_{Q1} + [\text{Peanut cash receipts}]_{Q1} + [\text{Sunflower cash receipts}]_{Q1} + [\text{Flaxseed cash receipts}]_{Q1} + [\text{Cotton lint cash receipts}]_{Q1} + [\text{Cottonseed cash receipts}]_{Q1} + [\text{Potato cash receipts}]_{Q1} + [\text{Dry beans cash receipts}]_{Q1} + [\text{Other vegetable cash receipts}]_{Q1} + [\text{Tobacco cash receipts}]_{Q1} + [\text{Fruit\&nut cash receipts}]_{Q1} + [\text{Greenhouse cash receipts}]_{Q1} + [\text{Other crops cash receipts}]_{Q1}$$

$$[\text{All crops cash receipts}]_{Q2} = [\text{Wheat cash receipts}]_{Q2} + [\text{Rice cash receipts}]_{Q2} + [\text{Rye cash receipts}]_{Q2} + [\text{Corn cash receipts}]_{Q2} + [\text{Sorghum cash receipts}]_{Q2} + [\text{Barley cash receipts}]_{Q2} + [\text{Oats cash receipts}]_{Q2} + [\text{Hay cash receipts}]_{Q2} + [\text{Soybean cash receipts}]_{Q2} + [\text{Peanut cash receipts}]_{Q2} + [\text{Sunflower cash receipts}]_{Q2} + [\text{Flaxseed cash receipts}]_{Q2} + [\text{Cotton lint cash receipts}]_{Q2} + [\text{Cottonseed cash receipts}]_{Q2} + [\text{Potato cash receipts}]_{Q2} + [\text{Dry beans cash receipts}]_{Q2} + [\text{Other vegetable cash receipts}]_{Q2} + [\text{Tobacco cash receipts}]_{Q2} + [\text{Fruit\&nut cash receipts}]_{Q2} + [\text{Greenhouse cash receipts}]_{Q2} + [\text{Other crops cash receipts}]_{Q2}$$

$$[\text{All crops cash receipts}]_{Q3} = [\text{Wheat cash receipts}]_{Q3} + [\text{Rice cash receipts}]_{Q3} + [\text{Rye cash receipts}]_{Q3} + [\text{Corn cash receipts}]_{Q3} + [\text{Sorghum cash receipts}]_{Q3} + [\text{Barley cash receipts}]_{Q3} + [\text{Oats cash receipts}]_{Q3} + [\text{Hay cash receipts}]_{Q3} + [\text{Soybean cash receipts}]_{Q3} + [\text{Peanut cash receipts}]_{Q3} + [\text{Sunflower cash receipts}]_{Q3} + [\text{Flaxseed cash receipts}]_{Q3} + [\text{Cotton lint cash receipts}]_{Q3} + [\text{Cottonseed cash receipts}]_{Q3} + [\text{Potato cash receipts}]_{Q3} + [\text{Dry beans cash receipts}]_{Q3} + [\text{Other vegetable cash receipts}]_{Q3} + [\text{Tobacco cash receipts}]_{Q3} + [\text{Fruit\&nut cash receipts}]_{Q3} + [\text{Greenhouse cash receipts}]_{Q3} + [\text{Other crops cash receipts}]_{Q3}$$

$$[\text{All crops cash receipts}]_{Q4} = [\text{Wheat cash receipts}]_{Q4} + [\text{Rice cash receipts}]_{Q4} + [\text{Rye cash receipts}]_{Q4} + [\text{Corn cash receipts}]_{Q4} + [\text{Sorghum cash receipts}]_{Q4} + [\text{Barley cash receipts}]_{Q4} + [\text{Oats cash receipts}]_{Q4} + [\text{Hay cash receipts}]_{Q4} + [\text{Soybean cash receipts}]_{Q4} + [\text{Peanut cash receipts}]_{Q4} + [\text{Sunflower cash receipts}]_{Q4} + [\text{Flaxseed cash receipts}]_{Q4} + [\text{Cotton lint cash receipts}]_{Q4} + [\text{Cottonseed cash receipts}]_{Q4} + [\text{Potato cash receipts}]_{Q4} + [\text{Dry beans cash receipts}]_{Q4} + [\text{Other vegetable cash receipts}]_{Q4} + [\text{Tobacco cash receipts}]_{Q4} + [\text{Fruit\&nut cash receipts}]_{Q4} + [\text{Greenhouse cash receipts}]_{Q4} + [\text{Other crops cash receipts}]_{Q4}$$

$$[\text{All crops cash receipts}]_{t} = [\text{All crops cash receipts}]_{Q1} + [\text{All crops cash receipts}]_{Q2} + [\text{All crops cash receipts}]_{Q3} + [\text{All crops cash receipts}]_{Q4}$$

Livestock Cash Receipts

$$[\text{Cattle cash receipts}]_{Q1} = [\text{Beef production}]_{t,Q1}/[\text{Beef production}]_{t-1,Q1}*[\text{Cattle farm price}]_{t,Q1}/[\text{Cattle farm price}]_{t-1,Q1}*[\text{Cattle cash receipts}]_{t-1,Q1}$$

$$[\text{Cattle cash receipts}]_{Q2} = [\text{Beef production}]_{t,Q2}/[\text{Beef production}]_{t-1,Q2}*[\text{Cattle farm price}]_{t,Q2}/[\text{Cattle farm price}]_{t-1,Q2}*[\text{Cattle cash receipts}]_{t-1,Q2}$$

$$[\text{Cattle cash receipts}]_{Q3} = [\text{Beef production}]_{t,Q3}/[\text{Beef production}]_{t-1,Q3}*[\text{Cattle farm price}]_{t,Q3}/[\text{Cattle farm price}]_{t-1,Q3}*[\text{Cattle cash receipts}]_{t-1,Q3}$$

$$[\text{Cattle cash receipts}]_{Q4} = [\text{Beef production}]_{t,Q4}/[\text{Beef production}]_{t-1,Q4}*[\text{Cattle farm price}]_{t,Q4}/[\text{Cattle farm price}]_{t-1,Q4}*[\text{Cattle cash receipts}]_{t-1,Q4}$$

$$[\text{Cattle cash receipts}]_{t} = [\text{Cattle cash receipts}]_{Q1} + [\text{Cattle cash receipts}]_{Q2} + [\text{Cattle cash receipts}]_{Q3} + [\text{Cattle cash receipts}]_{Q4}$$

$$[\text{Calves cash receipts}]_{Q1} = [\text{Veal production}]_{t,Q1}/[\text{Veal production}]_{t-1,Q1}*[\text{Calves farm price}]_{t,Q1}/[\text{Calves farm price}]_{t-1,Q1}*[\text{Calves cash receipts}]_{t-1,Q1}$$

$$[\text{Calves cash receipts}]_{Q2} = [\text{Veal production}]_{t,Q2}/[\text{Veal production}]_{t-1,Q2}*[\text{Calves farm price}]_{t,Q2}/[\text{Calves farm price}]_{t-1,Q2}*[\text{Calves cash receipts}]_{t-1,Q2}$$

$$[\text{Calves cash receipts}]_{Q3} = [\text{Veal production}]_{t,Q3}/[\text{Veal production}]_{t-1,Q3}*[\text{Calves farm price}]_{t,Q3}/[\text{Calves farm price}]_{t-1,Q3}*[\text{Calves cash receipts}]_{t-1,Q3}$$

$$[\text{Calves cash receipts}]_{Q4} = [\text{Veal production}]_{t,Q4}/[\text{Veal production}]_{t-1,Q4}*[\text{Calves farm price}]_{t,Q4}/[\text{Calves farm price}]_{t-1,Q4}*[\text{Calves cash receipts}]_{t-1,Q4}$$

$$[\text{Calves cash receipts}]_{t} = [\text{Calves cash receipts}]_{Q1} + [\text{Calves cash receipts}]_{Q2} + [\text{Calves cash receipts}]_{Q3} + [\text{Calves cash receipts}]_{Q4}$$

$$[\text{Hog cash receipts}]_{Q1} = [\text{Pork production}]_{t,Q1}/[\text{Pork production}]_{t-1,Q1}*[\text{Hog farm price}]_{t,Q1}/[\text{Hog farm price}]_{t-1,Q1}*[\text{Hog cash receipts}]_{t-1,Q1}$$

$$[\text{Hog cash receipts}]_{Q2} = [\text{Pork production}]_{t,Q2}/[\text{Pork production}]_{t-1,Q2}*[\text{Hog farm price}]_{t,Q2}/[\text{Hog farm price}]_{t-1,Q2}*[\text{Hog cash receipts}]_{t-1,Q2}$$

$$[\text{Hog cash receipts}]_{Q3} = [\text{Pork production}]_{t,Q3}/[\text{Pork production}]_{t-1,Q3}*[\text{Hog farm price}]_{t,Q3}/[\text{Hog farm price}]_{t-1,Q3}*[\text{Hog cash receipts}]_{t-1,Q3}$$

$$[\text{Hog cash receipts}]_{Q4} = [\text{Pork production}]_{t,Q4}/[\text{Pork production}]_{t-1,Q4}*[\text{Hog farm price}]_{t,Q4}/[\text{Hog farm price}]_{t-1,Q4}*[\text{Hog cash receipts}]_{t-1,Q4}$$

$$[\text{Hog cash receipts}]_{t} = [\text{Hog cash receipts}]_{Q1} + [\text{Hog cash receipts}]_{Q2} + [\text{Hog cash receipts}]_{Q3} + [\text{Hog cash receipts}]_{Q4}$$

$$[\text{Sheep \& lamb cash receipts}]_{Q1} = [\text{Sheep \& lamb production}]_{t,Q1}/[\text{Sheep \& lamb production}]_{t-1,Q1}*[\text{Lamb farm price}]_{t,Q1}/[\text{Lamb farm price}]_{t-1,Q1} *[\text{Sheep \& lamb cash receipts}]_{t-1,Q1}$$

$$[\text{Sheep \& lamb cash receipts}]_{Q2} = [\text{Sheep \& lamb production}]_{t,Q2}/[\text{Sheep \& lamb production}]_{t-1,Q2}*[\text{Lamb farm price}]_{t,Q2}/[\text{Lamb farm price}]_{t-1,Q2} *[\text{Sheep \& lamb cash receipts}]_{t-1,Q2}$$

$$[\text{Sheep \& lamb cash receipts}]_{Q3} = [\text{Sheep \& lamb production}]_{t,Q3}/[\text{Sheep \& lamb production}]_{t-1,Q3}*[\text{Lamb farm price}]_{t,Q3}/[\text{Lamb farm price}]_{t-1,Q3} *[\text{Sheep \& lamb cash receipts}]_{t-1,Q3}$$

$$[\text{Sheep \& lamb cash receipts}]_{Q4} = [\text{Sheep \& lamb production}]_{t,Q4}/[\text{Sheep \& lamb production}]_{t-1,Q4}*[\text{Lamb farm price}]_{t,Q4}/[\text{Lamb farm price}]_{t-1,Q4} *[\text{Sheep \& lamb cash receipts}]_{t-1,Q4}$$

$$[\text{Sheep \& lamb cash receipts}]_{t} = [\text{Sheep \& lamb cash receipts}]_{Q1} + [\text{Sheep \& lamb cash receipts}]_{Q2} + [\text{Sheep \& lamb cash receipts}]_{Q3} + [\text{Sheep \& lamb cash receipts}]_{Q4}$$

$$[\text{Meat animals cash receipts}]_{t} = [\text{Cattle cash receipts}]_{t} + [\text{Calves cash receipts}]_{t} + [\text{Hog cash receipts}]_{t} + [\text{Sheep \& lamb cash receipts}]_{t}$$

$$[\text{Broiler cash receipts}]_{Q1} = [\text{Broiler production}]_{t,Q1}/[\text{Broiler production}]_{t-1,Q1}*[\text{Broiler farm price}]_{t,Q1}/[\text{Broiler farm price}]_{t-1,Q1} *[\text{Broiler cash receipts}]_{t-1,Q1}$$

$$[\text{Broiler cash receipts}]_{Q2} = [\text{Broiler production}]_{t,Q2}/[\text{Broiler production}]_{t-1,Q2}*[\text{Broiler farm price}]_{t,Q2}/[\text{Broiler farm price}]_{t-1,Q2} *[\text{Broiler cash receipts}]_{t-1,Q2}$$

$$[\text{Broiler cash receipts}]_{Q3} = [\text{Broiler production}]_{t,Q3}/[\text{Broiler production}]_{t-1,Q3}*[\text{Broiler farm price}]_{t,Q3}/[\text{Broiler farm price}]_{t-1,Q3} *[\text{Broiler cash receipts}]_{t-1,Q3}$$

$$[\text{Broiler cash receipts}]_{Q4} = [\text{Broiler production}]_{t,Q4}/[\text{Broiler production}]_{t-1,Q4}*[\text{Broiler farm price}]_{t,Q4}/[\text{Broiler farm price}]_{t-1,Q4} *[\text{Broiler cash receipts}]_{t-1,Q4}$$

$$[\text{Broiler cash receipts}]_{t} = [\text{Broiler cash receipts}]_{Q1} + [\text{Broiler cash receipts}]_{Q2} + [\text{Broiler cash receipts}]_{Q3} + [\text{Broiler cash receipts}]_{Q4}$$

$$[\text{Turkey cash receipts}]_{Q1} = [\text{Turkey production}]_{t,Q1}/[\text{Turkey production}]_{t-1,Q1} * [\text{Turkey farm price}]_{t,Q1}/[\text{Turkey farm price}]_{t-1,Q1} * [\text{Turkey cash receipts}]_{t-1,Q1}$$

$$[\text{Turkey cash receipts}]_{Q2} = [\text{Turkey production}]_{t,Q2}/[\text{Turkey production}]_{t-1,Q2} * [\text{Turkey farm price}]_{t,Q2}/[\text{Turkey farm price}]_{t-1,Q2} * [\text{Turkey cash receipts}]_{t-1,Q2}$$

$$[\text{Turkey cash receipts}]_{Q3} = [\text{Turkey production}]_{t,Q3}/[\text{Turkey production}]_{t-1,Q3} * [\text{Turkey farm price}]_{t,Q3}/[\text{Turkey farm price}]_{t-1,Q3} * [\text{Turkey cash receipts}]_{t-1,Q3}$$

$$[\text{Turkey cash receipts}]_{Q4} = [\text{Turkey production}]_{t,Q4}/[\text{Turkey production}]_{t-1,Q4} * [\text{Turkey farm price}]_{t,Q4}/[\text{Turkey farm price}]_{t-1,Q4} * [\text{Turkey cash receipts}]_{t-1,Q4}$$

$$[\text{Turkey cash receipts}]_{t} = [\text{Turkey cash receipts}]_{Q1} + [\text{Turkey cash receipts}]_{Q2} + [\text{Turkey cash receipts}]_{Q3} + [\text{Turkey cash receipts}]_{Q4}$$

$$[\text{Egg cash receipts}]_{Q1} = [\text{Egg production}]_{t,Q1}/[\text{Egg production}]_{t-1,Q1} * [\text{Egg farm price}]_{t,Q1}/[\text{Egg farm price}]_{t-1,Q1} * [\text{Egg cash receipts}]_{t-1,Q1}$$

$$[\text{Egg cash receipts}]_{Q2} = [\text{Egg production}]_{t,Q2}/[\text{Egg production}]_{t-1,Q2} * [\text{Egg farm price}]_{t,Q2}/[\text{Egg farm price}]_{t-1,Q2} * [\text{Egg cash receipts}]_{t-1,Q2}$$

$$[\text{Egg cash receipts}]_{Q3} = [\text{Egg production}]_{t,Q3}/[\text{Egg production}]_{t-1,Q3} * [\text{Egg farm price}]_{t,Q3}/[\text{Egg farm price}]_{t-1,Q3} * [\text{Egg cash receipts}]_{t-1,Q3}$$

$$[\text{Egg cash receipts}]_{Q4} = [\text{Egg production}]_{t,Q4}/[\text{Egg production}]_{t-1,Q4} * [\text{Egg farm price}]_{t,Q4}/[\text{Egg farm price}]_{t-1,Q4} * [\text{Egg cash receipts}]_{t-1,Q4}$$

$$[\text{Egg cash receipts}]_{t} = [\text{Egg cash receipts}]_{Q1} + [\text{Egg cash receipts}]_{Q2} + [\text{Egg cash receipts}]_{Q3} + [\text{Egg cash receipts}]_{Q4}$$

$$[\text{Other poultry cash receipts}]_{Q1} = [\text{Other poultry production}]_{t,Q1}/[\text{Other poultry production}]_{t-1,Q1} * [\text{Other poultry farm price}]_{t,Q1}/[\text{Other poultry farm price}]_{t-1,Q1} * [\text{Other poultry cash receipts}]_{t-1,Q1}$$

$$[\text{Other poultry cash receipts}]_{Q2} = [\text{Other poultry production}]_{t,Q2}/[\text{Other poultry production}]_{t-1,Q2} * [\text{Other poultry farm price}]_{t,Q2}/[\text{Other poultry farm price}]_{t-1,Q2} * [\text{Other poultry cash receipts}]_{t-1,Q2}$$

$$[\text{Other poultry cash receipts}]_{Q3} = [\text{Other poultry production}]_{t,Q3}/[\text{Other poultry production}]_{t-1,Q3} * [\text{Other poultry farm price}]_{t,Q3}/[\text{Other poultry farm price}]_{t-1,Q3} * [\text{Other poultry cash receipts}]_{t-1,Q3}$$

$$[\text{Other poultry cash receipts}]_{Q4} = [\text{Other poultry production}]_{t,Q4}/[\text{Other poultry production}]_{t-1,Q4} * [\text{Other poultry farm price}]_{t,Q4}/[\text{Other poultry farm price}]_{t-1,Q4} * [\text{Other poultry cash receipts}]_{t-1,Q4}$$

$$[\text{Other poultry cash receipts}]_{t} = [\text{Other poultry cash receipts}]_{Q1} + [\text{Other poultry cash receipts}]_{Q2} + [\text{Other poultry cash receipts}]_{Q3} + [\text{Other poultry cash receipts}]_{Q4}$$

$$[\text{Poultry and egg cash receipts}]_{t} = [\text{Broiler cash receipts}]_{t} + [\text{Turkey cash receipts}]_{t} + [\text{Egg cash receipts}]_{t} + [\text{Other poultry cash receipts}]_{t}$$

$$[\text{Milk cash receipts}]_{Q1} = [\text{Milk production}]_{t,Q1}/[\text{Milk production}]_{t-1,Q1} * [\text{Milk farm price}]_{t,Q1}/[\text{Milk farm price}]_{t-1,Q1} * [\text{Milk cash receipts}]_{t-1,Q1}$$

$$[\text{Milk cash receipts}]_{Q2} = [\text{Milk production}]_{t,Q2}/[\text{Milk production}]_{t-1,Q2} * [\text{Milk farm price}]_{t,Q2}/[\text{Milk farm price}]_{t-1,Q2} * [\text{Milk cash receipts}]_{t-1,Q2}$$

$$[\text{Milk cash receipts}]_{Q3} = [\text{Milk production}]_{t,Q3}/[\text{Milk production}]_{t-1,Q3} * [\text{Milk farm price}]_{t,Q3}/[\text{Milk farm price}]_{t-1,Q3} * [\text{Milk cash receipts}]_{t-1,Q3}$$

$$[\text{Milk cash receipts}]_{Q4} = [\text{Milk production}]_{t,Q4}/[\text{Milk production}]_{t-1,Q4} * [\text{Milk farm price}]_{t,Q4}/[\text{Milk farm price}]_{t-1,Q4} * [\text{Milk cash receipts}]_{t-1,Q4}$$

$$[\text{Milk cash receipts}]_{t} = [\text{Milk cash receipts}]_{Q1} + [\text{Milk cash receipts}]_{Q2} + [\text{Milk cash receipts}]_{Q3} + [\text{Milk cash receipts}]_{Q4}$$

$$[\text{Other dairy products cash receipts}]_{Q1} = [\text{Other dairy products production}]_{t,Q1}/[\text{Other dairy products production}]_{t-1,Q1} * [\text{Other dairy products farm price}]_{t,Q1}/[\text{Other dairy products farm price}]_{t-1,Q1} * [\text{Other dairy products cash receipts}]_{t-1,Q1}$$

$$[\text{Other dairy products cash receipts}]_{Q2} = [\text{Other dairy products production}]_{t,Q2}/[\text{Other dairy products production}]_{t-1,Q2} * [\text{Other dairy products farm price}]_{t,Q2}/[\text{Other dairy products farm price}]_{t-1,Q2} * [\text{Other dairy products cash receipts}]_{t-1,Q2}$$

$$[\text{Other dairy products cash receipts}]_{Q3} = [\text{Other dairy products production}]_{t,Q3}/[\text{Other dairy products production}]_{t-1,Q3} * [\text{Other dairy products farm price}]_{t,Q3}/[\text{Other dairy products farm price}]_{t-1,Q3} * [\text{Other dairy products cash receipts}]_{t-1,Q3}$$

$$[\text{Other dairy products cash receipts}]_{Q4} = [\text{Other dairy products production}]_{t,Q4}/[\text{Other dairy products production}]_{t-1,Q4} * [\text{Other dairy products farm price}]_{t,Q4}/[\text{Other dairy products farm price}]_{t-1,Q4} * [\text{Other dairy products cash receipts}]_{t-1,Q4}$$

$$[\text{Other dairy products cash receipts}]_t = [\text{Other dairy products cash receipts}]_{Q1} + [\text{Other dairy products cash receipts}]_{Q2} + [\text{Other dairy products cash receipts}]_{Q3} + [\text{Other dairy products cash receipts}]_{Q4}$$

$$[\text{Dairy cash receipts}]_t = [\text{Other dairy products cash receipts}]_t + [\text{Milk cash receipts}]_t$$

$$[\text{Other livestock \& products cash receipts}]_{Q1} = [\text{Other livestock \& products production}]_{t,Q1}/[\text{Other livestock \& products production}]_{t-1,Q1} * [\text{Other livestock \& products farm price}]_{t,Q1}/[\text{Other livestock \& products farm price}]_{t-1,Q1} * [\text{Other livestock \& products cash receipts}]_{t-1,Q1}$$

$$[\text{Other livestock \& products cash receipts}]_{Q2} = [\text{Other livestock \& products production}]_{t,Q2}/[\text{Other livestock \& products production}]_{t-1,Q2} * [\text{Other livestock \& products farm price}]_{t,Q2}/[\text{Other livestock \& products farm price}]_{t-1,Q2} * [\text{Other livestock \& products cash receipts}]_{t-1,Q2}$$

$$[\text{Other livestock \& products cash receipts}]_{Q3} = [\text{Other livestock \& products production}]_{t,Q3}/[\text{Other livestock \& products production}]_{t-1,Q3} * [\text{Other livestock \& products farm price}]_{t,Q3}/[\text{Other livestock \& products farm price}]_{t-1,Q3} * [\text{Other livestock \& products cash receipts}]_{t-1,Q3}$$

$$[\text{Other livestock \& products cash receipts}]_{Q4} = [\text{Other livestock \& products production}]_{t,Q4}/[\text{Other livestock \& products production}]_{t-1,Q4} * [\text{Other livestock \& products farm price}]_{t,Q4}/[\text{Other livestock \& products farm price}]_{t-1,Q4} * [\text{Other livestock \& products cash receipts}]_{t-1,Q4}$$

$$[\text{Other livestock \& products cash receipts}]_t = [\text{Other livestock \& products cash receipts}]_{Q1} + [\text{Other livestock \& products cash receipts}]_{Q2} + [\text{Other livestock \& products cash receipts}]_{Q3} + [\text{Other livestock \& products cash receipts}]_{Q4}$$

$$[\text{All livestock cash receipts}]_{Q1} = [\text{Cattle cash receipts}]_{Q1} + [\text{Calves cash receipts}]_{Q1} + [\text{Hog cash receipts}]_{Q1} + [\text{Sheep \& lamb cash receipts}]_{Q1} + [\text{Broiler cash receipts}]_{Q1} + [\text{Turkey cash receipts}]_{Q1} + [\text{Egg cash receipts}]_{Q1} + [\text{Other poultry cash receipts}]_{Q1} + [\text{Milk cash receipts}]_{Q1} + [\text{Other dairy products cash receipts}]_{Q1} + [\text{Other livestock \& products cash receipts}]_{Q1}$$

$$[\text{All livestock cash receipts}]_{Q2} = [\text{Cattle cash receipts}]_{Q2} + [\text{Calves cash receipts}]_{Q2} + [\text{Hog cash receipts}]_{Q2} + [\text{Sheep \& lamb cash receipts}]_{Q2} + [\text{Broiler cash receipts}]_{Q2} + [\text{Turkey cash receipts}]_{Q2} + [\text{Egg cash receipts}]_{Q2} + [\text{Other poultry cash receipts}]_{Q2} + [\text{Milk cash receipts}]_{Q2} + [\text{Other dairy products cash receipts}]_{Q2} + [\text{Other livestock \& products cash receipts}]_{Q2}$$

$$[\text{All livestock cash receipts}]_{Q3} = [\text{Cattle cash receipts}]_{Q3} + [\text{Calves cash receipts}]_{Q3} + [\text{Hog cash receipts}]_{Q3} + [\text{Sheep \& lamb cash receipts}]_{Q3} + [\text{Broiler cash receipts}]_{Q3} + [\text{Turkey cash receipts}]_{Q3} + [\text{Egg cash receipts}]_{Q3} + [\text{Other poultry cash receipts}]_{Q3} + [\text{Milk cash receipts}]_{Q3} + [\text{Other dairy products cash receipts}]_{Q3} + [\text{Other livestock \& products cash receipts}]_{Q3}$$

$$[\text{All livestock cash receipts}]_{Q4} = [\text{Cattle cash receipts}]_{Q4} + [\text{Calves cash receipts}]_{Q4} + [\text{Hog cash receipts}]_{Q4} + [\text{Sheep \& lamb cash receipts}]_{Q4} + [\text{Broiler cash receipts}]_{Q4} + [\text{Turkey cash receipts}]_{Q4} + [\text{Egg cash receipts}]_{Q4} + [\text{Other poultry cash receipts}]_{Q4} + [\text{Milk cash receipts}]_{Q4} + [\text{Other dairy products cash receipts}]_{Q4} + [\text{Other livestock \& products cash receipts}]_{Q4}$$

$$[\text{All livestock cash receipts}]_t = [\text{Cattle cash receipts}]_t + [\text{Calves cash receipts}]_t + [\text{Hog cash receipts}]_t + [\text{Sheep \& lamb cash receipts}]_t + [\text{Broiler cash receipts}]_t + [\text{Turkey cash receipts}]_t + [\text{Egg cash receipts}]_t + [\text{Other poultry cash receipts}]_t + [\text{Milk cash receipts}]_t + [\text{Other dairy products cash receipts}]_t + [\text{Other livestock \& products cash receipts}]_t$$

$$[\text{Cash receipts}]_{Q1} = [\text{All crops cash receipts}]_{Q1} + [\text{All livestock cash receipts}]_{Q1}$$

$$[\text{Cash receipts}]_{Q2} = [\text{All crops cash receipts}]_{Q2} + [\text{All livestock cash receipts}]_{Q2}$$

$$[\text{Cash receipts}]_{Q3} = [\text{All crops cash receipts}]_{Q3} + [\text{All livestock cash receipts}]_{Q3}$$

$$[\text{Cash receipts}]_{Q4} = [\text{All crops cash receipts}]_{Q4} + [\text{All livestock cash receipts}]_{Q4}$$

$$[\text{Cash receipts}]_t = [\text{All crops cash receipts}]_t + [\text{All livestock cash receipts}]_t$$

Deficiency Payments

Wheat Deficiency Payments

$$[\text{Wheat program production}]_t = [\text{Wheat program base acres}]_t * [\text{Wheat participation rate}]_y * (1 - [\text{Wheat ARP/BASE acres ratio}]) * [\text{Wheat program yield}]_t * 0.85$$

$$[\text{Wheat basic loan rate}]_y = [\text{Wheat Findley loan rate}]_y * 1.25$$

Projected advance rates:

$$[\text{Wheat projected basic advance rate}]_y = \text{MIN}([\text{Wheat projected total advance rate}]_y, ([\text{Wheat target price}]_y - [\text{Wheat basic loan rate}]) * [\text{Wheat advance/total payment ratio}]_y)$$

$$[\text{Wheat projected Findley advance rate}]_y = \text{MAX}([\text{Wheat projected total advance rate}]_y - [\text{Wheat projected basic advance rate}]_y, 0)$$

Total rates:

$$[\text{Wheat basic total rate}]_y = \text{MAX}(\text{Wheat target price}]_y - \text{MAX}([\text{Wheat basic loan rate}]_y, [\text{Wheat 5-month price}]_y), 0)$$

$$[\text{Wheat Findley total rate}]_y = \text{MAX}(\text{Wheat Basic loan rate}]_y - \text{MAX}([\text{Wheat season average price}]_y, [\text{Wheat Findley loan rate}]_y), 0)$$

$$[\text{Wheat total rate}]_y = [\text{Wheat basic total rate}]_y + [\text{Wheat Findley total rate}]_y$$

Advance payments:

$$[\text{Wheat basic advance payment}]_y = [\text{Wheat projected basic advance rate}]_y * [\text{Wheat program production}]_t * 0.986$$

$$[\text{Wheat Findley advance payment}]_y = [\text{Wheat projected Findley advance rate}]_y * [\text{Wheat program production}]_t * 0.986$$

$$[\text{Wheat total advance payment}]_y = [\text{Wheat basic advance payment}]_y + [\text{Wheat Findley advance payment}]_y$$

Total payments:

$$[\text{Wheat total 5-month payment}]_y = [\text{Wheat advance/total payment}]_y * [\text{Wheat basic total rate}]_y - [\text{Wheat basic advance payment}]_y$$

$$[\text{Wheat total Findley payment}]_y = [\text{Wheat advance/total payment}]_y * [\text{Wheat Findley total rate}]_y - [\text{Wheat Findley advance payment}]_y$$

$$[\text{Wheat total payment}]_y = [\text{Wheat total advance payment}]_y + [\text{Wheat total 5-month payment}]_y + [\text{Wheat total Findley payment}]_y$$

Disbursed in t:

$$[\text{Wheat cash payments}]_{y,t} = [\text{Wheat cash/certificate advance ratio}]_y * [\text{Wheat total advance payment}]_y + [\text{Wheat cash/certificate 5-month ratio}]_y * [\text{Wheat total 5-month payment}]_y$$

$$[\text{Wheat certificate payments}]_{y,t} = (1 - [\text{Wheat cash/certificate advance ratio}]_y) * [\text{Wheat total advance payment}]_y + (1 - [\text{Wheat cash/certificate 5-month ratio}]_y) * [\text{Wheat total 5-month payment}]_y$$

$$[\text{Wheat payments}]_{y,t} = [\text{Wheat cash payments}]_{y,t} + [\text{Wheat certificate payments}]_{y,t}$$

Disbursed in t+1:

$$[\text{Wheat cash payments}]_{y,t+1} = [\text{Wheat cash/certificate Findley ratio}]_y * [\text{Wheat total Findley payment}]_y$$

$$[\text{Wheat certificate payments}]_{y,t+1} = (1 - [\text{Wheat cash/certificate Findley ratio}]_y) * [\text{Wheat total Findley payment}]_y$$

$$[\text{Wheat payments}]_{y,t+1} = [\text{Wheat cash payments}]_{y,t+1} + [\text{Wheat certificate payments}]_{y,t+1}$$

Quarterly outlays:

$$[\text{Wheat cash payments}]_{Q1} = [\text{Wheat total advance payment}]_y * [\text{Wheat cash/certificate advance ratio}]_y$$

$$[\text{Wheat certificate payments}]_{Q1} = \$0$$

$$[\text{Wheat cash payments}]_{Q2} = [\text{Wheat total advance payment}]_y * [\text{Wheat cash/certificate advance ratio}]_y / 2$$

$[\text{Wheat certificate payments}]_{Q2} = [\text{Wheat total advance payment}]_y * (1 - [\text{Wheat cash/certificate advance ratio}]_y)/2$

$[\text{Wheat cash payments}]_{Q3} = [\text{Wheat total Findley payment}]_y$

$[\text{Wheat certificate payments}]_{Q3} = \$0$

$[\text{Wheat cash payments}]_{Q3} = [\text{Wheat total 5-month payment}]_y$

$[\text{Wheat certificate payments}]_{Q4} = \$0$

$[\text{Wheat deficiency payments}]_t = [\text{Wheat cash payments}]_{Q1} + [\text{Wheat certificate payments}]_{Q1} + [\text{Wheat cash payments}]_{Q2} + [\text{Wheat certificate payments}]_{Q2} + [\text{Wheat cash payments}]_{Q3} + [\text{Wheat certificate payments}]_{Q3} + [\text{Wheat cash payments}]_{Q4} + [\text{Wheat certificate payments}]_{Q4}$

Rice Deficiency Payments

$[\text{Rice program production}]_t = [\text{Rice program base acres}]_t * [\text{Rice participation rate}]_y * (1 - [\text{Rice ARP/BASE acres ratio}]) * [\text{Rice program yield}]_t * 0.85$

Projected advance rate:

$[\text{Rice projected basic advance rate}]_y = \text{MIN}([\text{Rice projected total advance rate}]_y, ([\text{Rice target price}]_y - [\text{Rice basic loan rate}]) * [\text{Rice advance/total payment ratio}]_y)$

Total rate:

$[\text{Rice total rate}]_y = \text{MAX}(\text{Rice target price}]_y - \text{MAX}([\text{Rice basic loan rate}]_y, [\text{Rice 5-month price}]_y), 0)$

Advance payments:

$[\text{Rice total advance payment}]_y = [\text{Rice projected basic advance rate}]_y * [\text{Rice program production}]_t * 0.986$

Total payments:

$[\text{Rice total 5-month payment}]_y = [\text{Rice advance/total payment}]_y * [\text{Rice basic total rate}]_y - [\text{Rice basic advance payment}]_y$

$[\text{Rice total payment}]_y = [\text{Rice total advance payment}]_y + [\text{Rice total 5-month payment}]_y + [\text{Rice total Findley payment}]_y$

Disbursed in t:

$[\text{Rice cash payments}]_{y,t} = [\text{Rice cash/certificate advance ratio}]_y * [\text{Rice total advance payment}]_y$

$[\text{Rice certificate payments}]_{y,t} = (1 - [\text{Rice cash/certificate advance ratio}]_y) * [\text{Rice total advance payment}]_y$

$[\text{Rice payments}]_{y,t} = [\text{Rice cash payments}]_{y,t} + [\text{Rice certificate payments}]_{y,t}$

Disbursed in t+1:

$[\text{Rice cash payments}]_{y,t+1} = [\text{Rice cash/certificate Findley ratio}]_y * [\text{Rice total Findley payment}]_y$

$[\text{Rice certificate payments}]_{y,t+1} = (1 - [\text{Rice cash/certificate Findley ratio}]_y) * [\text{Rice total Findley payment}]_y$

$[\text{Rice payments}]_{y,t+1} = [\text{Rice cash payments}]_{y,t+1} + [\text{Rice certificate payments}]_{y,t+1}$

Quarterly outlays:

$[\text{Rice cash payments}]_{Q1} = [\text{Rice total advance payment}]_y * [\text{Rice cash/certificate advance ratio}]_y/2 + [\text{Rice total 5-month payment}]_y$

$[\text{Rice certificate payments}]_{Q1} = \$0$

$[\text{Rice cash payments}]_{Q2} = [\text{Rice total advance payment}]_y * [\text{Rice cash/certificate advance ratio}]_y/2$

$$[\text{Rice certificate payments}]_{Q2} = [\text{Rice total advance payment}]_y * (1 - [\text{Rice cash/certificate advance ratio}]_{y)}/2$$

$$[\text{Rice cash payments}]_{Q3} = \$0$$

$$[\text{Rice certificate payments}]_{Q3} = \$0$$

$$[\text{Rice cash payments}]_{Q3} = \$0$$

$$[\text{Rice certificate payments}]_{Q4} = \$0$$

$$[\text{Rice deficiency payments}]_t = [\text{Rice cash payments}]_{Q1} + [\text{Rice certificate payments}]_{Q1} + [\text{Rice cash payments}]_{Q2} + [\text{Rice certificate payments}]_{Q2} + [\text{Rice cash payments}]_{Q3} + [\text{Rice certificate payments}]_{Q3} + [\text{Rice cash payments}]_{Q4} + [\text{Rice certificate payments}]_{Q4}$$

Corn Deficiency Payments

$$[\text{Corn program production}]_t = [\text{Corn program base acres}]_t * [\text{Corn participation rate}]_y * (1 - [\text{Corn ARP/BASE acres ratio}]) * [\text{Corn program yield}]_t * 0.85$$

$$[\text{Corn basic loan rate}]_y = [\text{Corn Findley loan rate}]_y * 1.25$$

Projected advance rates:

$$[\text{Corn projected basic advance rate}]_y = \text{MIN}([\text{Corn projected total advance rate}]_y, ([\text{Corn target price}]_y - [\text{Corn basic loan rate}]) * [\text{Corn advance/total payment ratio}]_y)$$

$$[\text{Corn projected Findley advance rate}]_y = \text{MAX}([\text{Corn projected total advance rate}]_y - [\text{Corn projected basic advance rate}]_y, 0)$$

Total rates:

$$[\text{Corn basic total rate}]_y = \text{MAX}(\text{Corn target price}]_y - \text{MAX}([\text{Corn basic loan rate}]_y, [\text{Corn 5-month price}]_y), 0)$$

$$[\text{Corn Findley total rate}]_y = \text{MAX}(\text{Corn Basic loan rate}]_y - \text{MAX}([\text{Corn season average price}]_y, [\text{Corn Findley loan rate}]_y), 0)$$

$$[\text{Corn total rate}]_y = [\text{Corn basic total rate}]_y + [\text{Corn Findley total rate}]_y$$

Advance payments:

$$[\text{Corn basic advance payment}]_y = [\text{Corn projected basic advance rate}]_y * [\text{Corn program production}]_t * 0.986$$

$$[\text{Corn Findley advance payment}]_y = [\text{Corn projected Findley advance rate}]_y * [\text{Corn program production}]_t * 0.986$$

$$[\text{Corn total advance payment}]_y = [\text{Corn basic advance payment}]_y + [\text{Corn Findley advance payment}]_y$$

Total payments:

$$[\text{Corn total 5-month payment}]_y = [\text{Corn advance/total payment}]_y * [\text{Corn basic total rate}]_y - [\text{Corn basic advance payment}]_y$$

$$[\text{Corn total Findley payment}]_y = [\text{Corn advance/total payment}]_y * [\text{Corn Findley total rate}]_y - [\text{Corn Findley advance payment}]_y$$

$$[\text{Corn total payment}]_y = [\text{Corn total advance payment}]_y + [\text{Corn total 5-month payment}]_y + [\text{Corn total Findley payment}]_y$$

Disbursed in t:

$$[\text{Corn cash payments}]_{y,t} = [\text{Corn cash/certificate advance ratio}]_y * [\text{Corn total advance payment}]_y + [\text{Corn cash/certificate 5-month ratio}]_y * [\text{Corn total 5-month payment}]_y$$

$$[\text{Corn certificate payments}]_{y,t} = (1 - [\text{Corn cash/certificate advance ratio}]_y) * [\text{Corn total advance payment}]_y + (1 - [\text{Corn cash/certificate 5-month ratio}]_y) * [\text{Corn total 5-month payment}]_y$$

$$[\text{Corn payments}]_{y,t} = [\text{Corn cash payments}]_{y,t} + [\text{Corn certificate payments}]_{y,t}$$

Disbursed in t+1:

$[\text{Corn cash payments}]_{y,t+1} = [\text{Corn cash/certificate Findley ratio}]_y * [\text{Corn total Findley payment}]_y$

$[\text{Corn certificate payments}]_{y,t+1} = (1 - [\text{Corn cash/certificate Findley ratio}]_y) * [\text{Corn total Findley payment}]_y$

$[\text{Corn payments}]_{y,t+1} = [\text{Corn cash payments}]_{y,t+1} + [\text{Corn certificate payments}]_{y,t+1}$

Quarterly outlays:

$[\text{Corn cash payments}]_{Q1} = [\text{Corn total advance payment}]_y * [\text{Corn cash/certificate advance ratio}]_y/2 + [\text{Corn total 5-month payment}]_y$

$[\text{Corn certificate payments}]_{Q1} = \$0$

$[\text{Corn cash payments}]_{Q2} = [\text{Corn total advance payment}]_y * [\text{Corn cash/certificate advance ratio}]_y/2$

$[\text{Corn certificate payments}]_{Q2} = [\text{Corn total advance payment}]_y * (1 - [\text{Corn cash/certificate advance ratio}]_y)/2$

$[\text{Corn cash payments}]_{Q3} = [\text{Corn total Findley payment}]_y$

$[\text{Corn certificate payments}]_{Q3} = \$0$

$[\text{Corn cash payments}]_{Q3} = \$0$

$[\text{Corn certificate payments}]_{Q4} = \$0$

$$[\text{Corn deficiency payments}]_t = [\text{Corn cash payments}]_{Q1} + [\text{Corn certificate payments}]_{Q1} + [\text{Corn cash payments}]_{Q2} + [\text{Corn certificate payments}]_{Q2} + [\text{Corn cash payments}]_{Q3} + [\text{Corn certificate payments}]_{Q3} + [\text{Corn cash payments}]_{Q4} + [\text{Corn certificate payments}]_{Q4}$$

Sorghum Deficiency Payments

$$[\text{Sorghum program production}]_t = [\text{Sorghum program base acres}]_t * [\text{Sorghum participation rate}]_y * (1 - [\text{Sorghum ARP/BASE acres ratio}]) * [\text{Sorghum program yield}]_t * 0.85$$

$[\text{Sorghum basic loan rate}]_y = [\text{Sorghum Findley loan rate}]_y * 1.25$

Projected advance rates:

$$[\text{Sorghum projected basic advance rate}]_y = \text{MIN}([\text{Sorghum projected total advance rate}]_y, ([\text{Sorghum target price}]_y - [\text{Sorghum basic loan rate}]) * [\text{Sorghum advance/total payment ratio}]_y)$$

$[\text{Sorghum projected Findley advance rate}]_y = \text{MAX}([\text{Sorghum projected total advance rate}]_y - [\text{Sorghum projected basic advance rate}]_y, 0)$

Total rates:

$[\text{Sorghum basic total rate}]_y = \text{MAX}(\text{Sorghum target price}]_y - \text{MAX}([\text{Sorghum basic loan rate}]_y, [\text{Sorghum 5-month price}]_y), 0)$

$[\text{Sorghum Findley total rate}]_y = \text{MAX}(\text{Sorghum Basic loan rate}]_y - \text{MAX}([\text{Sorghum season average price}]_y, [\text{Sorghum Findley loan rate}]_y), 0)$

$[\text{Sorghum total rate}]_y = [\text{Sorghum basic total rate}]_y + [\text{Sorghum Findley total rate}]_y$

Advance payments:

$[\text{Sorghum basic advance payment}]_y = [\text{Sorghum projected basic advance rate}]_y * [\text{Sorghum program production}]_t * 0.986$

$[\text{Sorghum Findley advance payment}]_y = [\text{Sorghum projected Findley advance rate}]_y * [\text{Sorghum program production}]_t * 0.986$

$[\text{Sorghum total advance payment}]_y = [\text{Sorghum basic advance payment}]_y + [\text{Sorghum Findley advance payment}]_y$

Total payments:

$$[\text{Sorghum total 5-month payment}]_y = [\text{Sorghum advance/total payment}]_y * [\text{Sorghum basic total rate}]_y - [\text{Sorghum basic advance payment}]_y$$

$$[\text{Sorghum total Findley payment}]_y = [\text{Sorghum advance/total payment}]_y * [\text{Sorghum Findley total rate}]_y - [\text{Sorghum Findley advance payment}]_y$$

$$[\text{Sorghum total payment}]_y = [\text{Sorghum total advance payment}]_y + [\text{Sorghum total 5-month payment}]_y + [\text{Sorghum total Findley payment}]_y$$

Disbursed in t:

$$[\text{Sorghum cash payments}]_{y,t} = [\text{Sorghum cash/certificate advance ratio}]_y * [\text{Sorghum total advance payment}]_y + [\text{Sorghum cash/certificate 5-month ratio}]_y * [\text{Sorghum total 5-month payment}]_y$$

$$[\text{Sorghum certificate payments}]_{y,t} = (1 - [\text{Sorghum cash/certificate advance ratio}]_y) * [\text{Sorghum total advance payment}]_y + (1 - [\text{Sorghum cash/certificate 5-month ratio}]_y) * [\text{Sorghum total 5-month payment}]_y$$

$$[\text{Sorghum payments}]_{y,t} = [\text{Sorghum cash payments}]_{y,t} + [\text{Sorghum certificate payments}]_{y,t}$$

Disbursed in t+1:

$$[\text{Sorghum cash payments}]_{y,t+1} = [\text{Sorghum cash/certificate Findley ratio}]_y * [\text{Sorghum total Findley payment}]_y$$

$$[\text{Sorghum certificate payments}]_{y,t+1} = (1 - [\text{Sorghum cash/certificate Findley ratio}]_y) * [\text{Sorghum total Findley payment}]_y$$

$$[\text{Sorghum payments}]_{y,t+1} = [\text{Sorghum cash payments}]_{y,t+1} + [\text{Sorghum certificate payments}]_{y,t+1}$$

Quarterly outlays:

$$[\text{Sorghum cash payments}]_{Q1} = [\text{Sorghum total advance payment}]_y * [\text{Sorghum cash/certificate advance ratio}]_y / 2 + [\text{Sorghum total 5-month payment}]_y$$

$$[\text{Sorghum certificate payments}]_{Q1} = \$0$$

$$[\text{Sorghum cash payments}]_{Q2} = [\text{Sorghum total advance payment}]_y * [\text{Sorghum cash/certificate advance ratio}]_y / 2$$

$$[\text{Sorghum certificate payments}]_{Q2} = [\text{Sorghum total advance payment}]_y * (1 - [\text{Sorghum cash/certificate advance ratio}]_y) / 2$$

$$[\text{Sorghum cash payments}]_{Q3} = [\text{Sorghum total Findley payment}]_y$$

$$[\text{Sorghum certificate payments}]_{Q3} = \$0$$

$$[\text{Sorghum cash payments}]_{Q3} = [\text{Sorghum total 5-month payment}]_y$$

$$[\text{Sorghum certificate payments}]_{Q4} = \$0$$

$$[\text{Sorghum deficiency payments}]_t = [\text{Sorghum cash payments}]_{Q1} + [\text{Sorghum certificate payments}]_{Q1} + [\text{Sorghum cash payments}]_{Q2} + [\text{Sorghum certificate payments}]_{Q2} + [\text{Sorghum cash payments}]_{Q3} + [\text{Sorghum certificate payments}]_{Q3} + [\text{Sorghum cash payments}]_{Q4} + [\text{Sorghum certificate payments}]_{Q4}$$

Barley Deficiency Payments

$$[\text{Barley program production}]_t = [\text{Barley program base acres}]_t * [\text{Barley participation rate}]_y * (1 - [\text{Barley ARP/BASE acres ratio}]) * [\text{Barley program yield}]_t * 0.85$$

$$[\text{Barley basic loan rate}]_y = [\text{Barley Findley loan rate}]_y * 1.25$$

Projected advance rates:

$$[\text{Barley projected basic advance rate}]_y = \text{MIN}([\text{Barley projected total advance rate}]_y, ([\text{Barley target price}]_y - [\text{Barley basic loan rate}]) * [\text{Barley advance/total payment ratio}]_y)$$

$$[\text{Barley projected Findley advance rate}]_y = \text{MAX}([\text{Barley projected total advance rate}]_y - [\text{Barley projected basic advance rate}]_y, 0)$$

Total rates:

$[\text{Barley basic total rate}]_y = \text{MAX}([\text{Barley target price}]_y - \text{MAX}([\text{Barley basic loan rate}]_y, [\text{Barley 5-month price}]_y), 0)$

$[\text{Barley Findley total rate}]_y = \text{MAX}([\text{Barley Basic loan rate}]_y - \text{MAX}([\text{Barley season average price}]_y, [\text{Barley Findley loan rate}]_y), 0)$

$[\text{Barley total rate}]_y = [\text{Barley basic total rate}]_y + [\text{Barley Findley total rate}]_y$

Advance payments:

$[\text{Barley basic advance payment}]_y = [\text{Barley projected basic advance rate}]_y * [\text{Barley program production}]_t * 0.986$

$[\text{Barley Findley advance payment}]_y = [\text{Barley projected Findley advance rate}]_y * [\text{Barley program production}]_t * 0.986$

$[\text{Barley total advance payment}]_y = [\text{Barley basic advance payment}]_y + [\text{Barley Findley advance payment}]_y$

Total payments:

$[\text{Barley total 5-month payment}]_y = [\text{Barley advance/total payment}]_y * [\text{Barley basic total rate}]_y - [\text{Barley basic advance payment}]_y$

$[\text{Barley total Findley payment}]_y = [\text{Barley advance/total payment}]_y * [\text{Barley Findley total rate}]_y - [\text{Barley Findley advance payment}]_y$

$[\text{Barley total payment}]_y = [\text{Barley total advance payment}]_y + [\text{Barley total 5-month payment}]_y + [\text{Barley total Findley payment}]_y$

Disbursed in t:

$[\text{Barley cash payments}]_{y,t} = [\text{Barley cash/certificate advance ratio}]_y * [\text{Barley total advance payment}]_y + [\text{Barley cash/certificate 5-month ratio}]_y * [\text{Barley total 5-month payment}]_y$

$[\text{Barley certificate payments}]_{y,t} = (1 - [\text{Barley cash/certificate advance ratio}]_y) * [\text{Barley total advance payment}]_y + (1 - [\text{Barley cash/certificate 5-month ratio}]_y) * [\text{Barley total 5-month payment}]_y$

$[\text{Barley payments}]_{y,t} = [\text{Barley cash payments}]_{y,t} + [\text{Barley certificate payments}]_{y,t}$

Disbursed in t+1:

$[\text{Barley cash payments}]_{y,t+1} = [\text{Barley cash/certificate Findley ratio}]_y * [\text{Barley total Findley payment}]_y$

$[\text{Barley certificate payments}]_{y,t+1} = (1 - [\text{Barley cash/certificate Findley ratio}]_y) * [\text{Barley total Findley payment}]_y$

$[\text{Barley payments}]_{y,t+1} = [\text{Barley cash payments}]_{y,t+1} + [\text{Barley certificate payments}]_{y,t+1}$

Quarterly outlays:

$[\text{Barley cash payments}]_{Q1} = [\text{Barley total advance payment}]_y * [\text{Barley cash/certificate advance ratio}]_y / 2$

$[\text{Barley certificate payments}]_{Q1} = \$0$

$[\text{Barley cash payments}]_{Q2} = [\text{Barley total advance payment}]_y * [\text{Barley cash/certificate advance ratio}]_y / 2$

$[\text{Barley certificate payments}]_{Q2} = [\text{Barley total advance payment}]_y * (1 - [\text{Barley cash/certificate advance ratio}]_y) / 2$

$[\text{Barley cash payments}]_{Q3} = [\text{Barley total Findley payment}]_y$

$[\text{Barley certificate payments}]_{Q3} = \$0$

$[\text{Barley cash payments}]_{Q3} = [\text{Barley total 5-month payment}]_y$

$[\text{Barley certificate payments}]_{Q4} = \$0$

$[\text{Barley deficiency payments}]_t = [\text{Barley cash payments}]_{Q1} + [\text{Barley certificate payments}]_{Q1} + [\text{Barley cash payments}]_{Q2} + [\text{Barley certificate payments}]_{Q2} + [\text{Barley cash payments}]_{Q3} + [\text{Barley certificate payments}]_{Q3} + [\text{Barley cash payments}]_{Q4} + [\text{Barley certificate payments}]_{Q4}$

Oats Deficiency Payments

$$[\text{Oats program production}]_t = [\text{Oats program base acres}]_t * [\text{Oats participation rate}]_y * (1 - [\text{Oats ARP/BASE acres ratio}]) * [\text{Oats program yield}]_t * 0.85$$

$$[\text{Oats basic loan rate}]_y = [\text{Oats Findley loan rate}]_y * 1.25$$

Projected advance rates:

$$[\text{Oats projected basic advance rate}]_y = \text{MIN}([\text{Oats projected total advance rate}]_y, ([\text{Oats target price}]_y - [\text{Oats basic loan rate}]) * [\text{Oats advance/total payment ratio}]_y)$$

$$[\text{Oats projected Findley advance rate}]_y = \text{MAX}([\text{Oats projected total advance rate}]_y - [\text{Oats projected basic advance rate}]_y, 0)$$

Total rates:

$$[\text{Oats basic total rate}]_y = \text{MAX}(\text{Oats target price}]_y - \text{MAX}([\text{Oats basic loan rate}]_y, [\text{Oats 5-month price}]_y), 0)$$

$$[\text{Oats Findley total rate}]_y = \text{MAX}(\text{Oats Basic loan rate}]_y - \text{MAX}([\text{Oats season average price}]_y, [\text{Oats Findley loan rate}]_y), 0)$$

$$[\text{Oats total rate}]_y = [\text{Oats basic total rate}]_y + [\text{Oats Findley total rate}]_y$$

Advance payments:

$$[\text{Oats basic advance payment}]_y = [\text{Oats projected basic advance rate}]_y * [\text{Oats program production}]_t * 0.986$$

$$[\text{Oats Findley advance payment}]_y = [\text{Oats projected Findley advance rate}]_y * [\text{Oats program production}]_t * 0.986$$

$$[\text{Oats total advance payment}]_y = [\text{Oats basic advance payment}]_y + [\text{Oats Findley advance payment}]_y$$

Total payments:

$$[\text{Oats total 5-month payment}]_y = [\text{Oats advance/total payment}]_y * [\text{Oats basic total rate}]_y - [\text{Oats basic advance payment}]_y$$

$$[\text{Oats total Findley payment}]_y = [\text{Oats advance/total payment}]_y * [\text{Oats Findley total rate}]_y - [\text{Oats Findley advance payment}]_y$$

$$[\text{Oats total payment}]_y = [\text{Oats total advance payment}]_y + [\text{Oats total 5-month payment}]_y + [\text{Oats total Findley payment}]_y$$

Disbursed in t:

$$[\text{Oats cash payments}]_{y,t} = [\text{Oats cash/certificate advance ratio}]_y * [\text{Oats total advance payment}]_y + [\text{Oats cash/certificate 5-month ratio}]_y * [\text{Oats total 5-month payment}]_y$$

$$[\text{Oats certificate payments}]_{y,t} = (1 - [\text{Oats cash/certificate advance ratio}]_y) * [\text{Oats total advance payment}]_y + (1 - [\text{Oats cash/certificate 5-month ratio}]_y) * [\text{Oats total 5-month payment}]_y$$

$$[\text{Oats payments}]_{y,t} = [\text{Oats cash payments}]_{y,t} + [\text{Oats certificate payments}]_{y,t}$$

Disbursed in t+1:

$$[\text{Oats cash payments}]_{y,t+1} = [\text{Oats cash/certificate Findley ratio}]_y * [\text{Oats total Findley payment}]_y$$

$$[\text{Oats certificate payments}]_{y,t+1} = (1 - [\text{Oats cash/certificate Findley ratio}]_y) * [\text{Oats total Findley payment}]_y$$

$$[\text{Oats payments}]_{y,t+1} = [\text{Oats cash payments}]_{y,t+1} + [\text{Oats certificate payments}]_{y,t+1}$$

Quarterly outlays:

$$[\text{Oats cash payments}]_{Q1} = [\text{Oats total advance payment}]_y * [\text{Oats cash/certificate advance ratio}]_y / 2$$

$$[\text{Oats certificate payments}]_{Q1} = \$0$$

$$[\text{Oats cash payments}]_{Q2} = [\text{Oats total advance payment}]_y * [\text{Oats cash/certificate advance ratio}]_y / 2$$

$$[\text{Oats certificate payments}]_{Q2} = [\text{Oats total advance payment}]_y * (1 - [\text{Oats cash/certificate advance ratio}]_y) / 2$$

$$[\text{Oats cash payments}]_{Q3} = [\text{Oats total Findley payment}]_y$$

$$[\text{Oats certificate payments}]_{Q3} = \$0$$

$$[\text{Oats cash payments}]_{Q3} = [\text{Oats total 5-month payment}]_y$$

$$[\text{Oats certificate payments}]_{Q4} = \$0$$

$$[\text{Oats deficiency payments}]_t = [\text{Oats cash payments}]_{Q1} + [\text{Oats certificate payments}]_{Q1} + [\text{Oats cash payments}]_{Q2} + [\text{Oats certificate payments}]_{Q2} + [\text{Oats cash payments}]_{Q3} + [\text{Oats certificate payments}]_{Q3} + [\text{Oats cash payments}]_{Q4} + [\text{Oats certificate payments}]_{Q4}$$

Cotton Deficiency Payments

$$[\text{Cotton program production}]_t = [\text{Cotton program base acres}]_t * [\text{Cotton participation rate}]_y * (1 - [\text{Cotton ARP/BASE acres ratio}]) * [\text{Cotton program yield}]_t * 0.85$$

Projected advance rate:

$$[\text{Cotton projected basic advance rate}]_y = \text{MIN}([\text{Cotton projected total advance rate}]_y, ([\text{Cotton target price}]_y - [\text{Cotton basic loan rate}]) * [\text{Cotton advance/total payment ratio}]_y)$$

Total rate:

$$[\text{Cotton total rate}]_y = \text{MAX}(\text{Cotton target price}]_y - \text{MAX}([\text{Cotton basic loan rate}]_y, [\text{Cotton 5-month price}]_y), 0)$$

Advance payments:

$$[\text{Cotton total advance payment}]_y = [\text{Cotton projected basic advance rate}]_y * [\text{Cotton program production}]_t * 0.986$$

Total payments:

$$[\text{Cotton total 5-month payment}]_y = [\text{Cotton advance/total payment}]_y * [\text{Cotton basic total rate}]_y - [\text{Cotton basic advance payment}]_y$$

$$[\text{Cotton total payment}]_y = [\text{Cotton total advance payment}]_y + [\text{Cotton total 5-month payment}]_y + [\text{Cotton total Findley payment}]_y$$

Disbursed in t:

$$[\text{Cotton cash payments}]_{y,t} = [\text{Cotton cash/certificate advance ratio}]_y * [\text{Cotton total advance payment}]_y$$

$$[\text{Cotton certificate payments}]_{y,t} = (1 - [\text{Cotton cash/certificate advance ratio}]_y) * [\text{Cotton total advance payment}]_y$$

$$[\text{Cotton payments}]_{y,t} = [\text{Cotton cash payments}]_{y,t} + [\text{Cotton certificate payments}]_{y,t}$$

Disbursed in t+1:

$$[\text{Cotton cash payments}]_{y,t+1} = [\text{Cotton cash/certificate Findley ratio}]_y * [\text{Cotton total Findley payment}]_y$$

$$[\text{Cotton certificate payments}]_{y,t+1} = (1 - [\text{Cotton cash/certificate Findley ratio}]_y) * [\text{Cotton total Findley payment}]_y$$

$$[\text{Cotton payments}]_{y,t+1} = [\text{Cotton cash payments}]_{y,t+1} + [\text{Cotton certificate payments}]_{y,t+1}$$

Quarterly outlays:

$$[\text{Cotton cash payments}]_{Q1} = [\text{Cotton total advance payment}]_y * [\text{Cotton cash/certificate advance ratio}]_y / 2 + [\text{Cotton total 5-month payment}]_y$$

$$[\text{Cotton certificate payments}]_{Q1} = \$0$$

$$[\text{Cotton cash payments}]_{Q2} = [\text{Cotton total advance payment}]_y * [\text{Cotton cash/certificate advance ratio}]_y / 2$$

$$[\text{Cotton certificate payments}]_{Q2} = [\text{Cotton total advance payment}]_y * (1 - [\text{Cotton cash/certificate advance ratio}]_y) / 2$$

$$[\text{Cotton cash payments}]_{Q3} = \$0$$

$$[\text{Cotton certificate payments}]_{Q3} = \$0$$

[Cotton cash payments]$_{Q3}$ = $0

[Cotton certificate payments]$_{Q4}$ = $0

[Cotton deficiency payments]$_t$ = [Cotton cash payments]$_{Q1}$ +[Cotton certificate payments]$_{Q1}$ +[Cotton cash payments]$_{Q2}$ +[Cotton certificate payments]$_{Q2}$ +[Cotton cash payments]$_{Q3}$ +[Cotton certificate payments]$_{Q3}$ +[Cotton cash payments]$_{Q4}$ +[Cotton certificate payments]$_{Q4}$

Nonrecoverable and Recoverable Government Outlays to Farmers

Nonrecoverable outlays:

[Feed grains deficiency payments]$_t$ = [Corn deficiency payments]$_t$ +[Sorghum deficiency payments]$_t$ +[Barley deficiency payments]$_t$ +[Oats deficiency payments]$_t$

[Total program payments]$_t$ = [Wheat deficiency payments]$_t$ +[Rice deficiency payments]$_t$ +[Feed grains deficiency payments]$_t$ +[Cotton deficiency payments]$_t$ +[Dairy payments]$_t$ +[Wool payments]$_t$

[Direct Government payments]$_t$ = [Total program payments]$_t$ +[Reserve storage]$_t$ +[Conservation programs]$_t$ +[Disaster assistance]$_t$ +[Other Government programs]$_t$)

[Cash payments]$_t$ = [Direct Government payments]$_t$ −[Certificate payments]$_t$

[Certificate payments]$_t$ = $500 million

[Direct Government payments 1987$]$_t$ =[Direct Government payments]$_t$ /[GDP deflator 1987=100]*100

Recoverable CCC net loan outlays:

[Total CCC net loans]$_t$ = [Wheat net CCC value]$_t$ +[Rice net CCC value]$_t$ +[Corn net CCC value]$_t$ +[Sorghum net CCC value]$_t$ +[Barley net CCC value]$_t$ +[Oats net CCC value]$_t$ +[Soybeans net CCC value]$_t$ +[Cotton net CCC value]$_t$

[Total outlays]$_t$ = [Total direct payments]$_t$ +[Total CCC net loans]$_t$

Value of Change in Farm Inventories

[Wheat inventory change]$_t$ = ([Wheat production]$_t$ −[Wheat open-market sales]$_{Q1}$/[Wheat price]$_{Q1}$ −[Wheat open-market sales]$_{Q2}$/[Wheat price]$_{Q2}$ −[Wheat open-market sales]$_{Q3}$/[Wheat price]$_{Q3}$ −[Wheat open-market sales]$_{Q4}$/[Wheat price]$_{Q4}$ −[Wheat production]$_{t-1}$*(1 −[Wheat percent sold]$_{t-1}$*0.67 −[Wheat production]$_t$*(1 −[Wheat percent sold]$_t$)*0.33 −[Wheat net CCC quantity]$_{Q1}$ −[Wheat net CCC quantity]$_{Q2}$ −[Wheat net CCC quantity]$_{Q3}$ −[Wheat net CCC quantity]$_{Q4}$)*([Wheat price]$_{Q1}$ +[Wheat price]$_{Q2}$ +[Wheat price]$_{Q3}$ +[Wheat price]$_{Q4}$)/4

[Rice inventory change]$_t$ = ([Rice production]$_t$ −[Rice open-market sales]$_{Q1}$/[Rice price]$_{Q1}$ −[Rice open-market sales]$_{Q2}$/[Rice price]$_{Q2}$ −[Rice open-market sales]$_{Q3}$/[Rice price]$_{Q3}$ −[Rice open-market sales]$_{Q4}$/[Rice price]$_{Q4}$ −[Rice net CCC quantity]$_{Q1}$ −[Rice net CCC quantity]$_{Q2}$ −[Rice net CCC quantity]$_{Q3}$ −[Rice net CCC quantity]$_{Q4}$)*([Rice price]$_{Q1}$ +[Rice price]$_{Q2}$ +[Rice price]$_{Q3}$ +[Rice price]$_{Q4}$)/4

[Rye inventory change]$_t$ = ([Rye production]$_t$ −[Rye open-market sales]$_{Q1}$/[Rye price]$_{Q1}$ −[Rye open-market sales]$_{Q2}$/[Rye price]$_{Q2}$ −[Rye open-market sales]$_{Q3}$/[Rye price]$_{Q3}$ −[Rye open-market sales]$_{Q4}$/[Rye price]$_{Q4}$ −[Rye production]$_{t-1}$*(1 −[Rye percent sold]$_{t-1}$*0.67 −[Rye production]$_t$*(1 −[Rye percent sold]$_t$)*0.33 −[Rye net CCC quantity]$_{Q1}$ −[Rye net CCC quantity]$_{Q2}$ −[Rye net CCC quantity]$_{Q3}$ −[Rye net CCC quantity]$_{Q4}$)*([Rye price]$_{Q1}$ +[Rye price]$_{Q2}$ +[Rye price]$_{Q3}$ +[Rye price]$_{Q4}$)/4

[Corn inventory change]$_t$ = ([Corn production]$_t$ −[Corn open-market sales]$_{Q1}$/[Corn price]$_{Q1}$ −[Corn open-market sales]$_{Q2}$/[Corn price]$_{Q2}$ −[Corn open-market sales]$_{Q3}$/[Corn price]$_{Q3}$ −[Corn open-market sales]$_{Q4}$/[Corn price]$_{Q4}$ −[Corn production]$_{t-1}$*(1 -[Corn percent sold]$_{t-1}$*0.67 −[Corn production]$_t$*(1 −[Corn percent sold]$_t$)*0.33 −[Corn net CCC quantity]$_{Q1}$ −[Corn net CCC quantity]$_{Q2}$ -[Corn net CCC quantity]$_{Q3}$ −[Corn net CCC quantity]$_{Q4}$)*([Corn price]$_{Q1}$ +[Corn price]$_{Q2}$ +[Corn price]$_{Q3}$ +[Corn price]$_{Q4}$)/4

$$[\text{Sorghum inventory change}]_t = ([\text{Sorghum production}]_t - [\text{Sorghum open-market sales}]_{Q1}/[\text{Sorghum price}]_{Q1} - [\text{Sorghum open market sales}]_{Q2}/[\text{Sorghum price}]_{Q2} - [\text{Sorghum open-market sales}]_{Q3}/[\text{Sorghum price}]_{Q3} - [\text{Sorghum open-market sales}]_{Q4}/[\text{Sorghum price}]_{Q4} - [\text{Sorghum production}]_{t-1}*(1 - [\text{Sorghum percent sold}]_{t-1}*0.67 - [\text{Sorghum production}]_t*(1 - [\text{Sorghum percent sold}]_t)*0.33 - [\text{Sorghum net CCC quantity}]_{Q1} - [\text{Sorghum net CCC quantity}]_{Q2} - [\text{Sorghum net CCC quantity}]_{Q3} - [\text{Sorghum net CCC quantity}]_{Q4})*([\text{Sorghum price}]_{Q1} + [\text{Sorghum price}]_{Q2} + [\text{Sorghum price}]_{Q3} + [\text{Sorghum price}]_{Q4})/4$$

$$[\text{Barley inventory change}]_t = ([\text{Barley production}]_t - [\text{Barley open-market sales}]_{Q1}/[\text{Barley price}]_{Q1} - [\text{Barley open market sales}]_{Q2}/[\text{Barley price}]_{Q2} - [\text{Barley open-market sales}]_{Q3}/[\text{Barley price}]_{Q3} - [\text{Barley open-market sales}]_{Q4}/[\text{Barley price}]_{Q4} - [\text{Barley production}]_{t-1}*(1 - [\text{Barley percent sold}]_{t-1}*0.67 - [\text{Barley production}]_t*(1 - [\text{Barley percent sold}]_t)*0.33 - [\text{Barley net CCC quantity}]_{Q1} - [\text{Barley net CCC quantity}]_{Q2} - [\text{Barley net CCC quantity}]_{Q3} - [\text{Barley net CCC quantity}]_{Q4})*([\text{Barley price}]_{Q1} + [\text{Barley price}]_{Q2} + [\text{Barley price}]_{Q3} + [\text{Barley price}]_{Q4})/4$$

$$[\text{Oats inventory change}]_t = ([\text{Oats production}]_t - [\text{Oats open-market sales}]_{Q1}/[\text{Oats price}]_{Q1} - [\text{Oats open-market sales}]_{Q2}/[\text{Oats price}]_{Q2} - [\text{Oats open-market sales}]_{Q3}/[\text{Oats price}]_{Q3} - [\text{Oats open-market sales}]_{Q4}/[\text{Oats price}]_{Q4} - [\text{Oats production}]_{t-1}*(1 - [\text{Oats percent sold}]_{t-1}*0.67 - [\text{Oats production}]_t*(1 - [\text{Oats percent sold}]_t)*0.33 - [\text{Oats net CCC quantity}]_{Q1} - [\text{Oats net CCC quantity}]_{Q2} - [\text{Oats net CCC quantity}]_{Q3} - [\text{Oats net CCC quantity}]_{Q4})*([\text{Oats price}]_{Q1} + [\text{Oats price}]_{Q2} + [\text{Oats price}]_{Q3} + [\text{Oats price}]_{Q4})/4$$

$$[\text{Hay inventory change}]_t = ([\text{Hay production}]_t - [\text{Hay open-market sales}]_{Q1}/[\text{Hay price}]_{Q1} - [\text{Hay open-market sales}]_{Q2}/[\text{Hay price}]_{Q2} - [\text{Hay open-market sales}]_{Q3}/[\text{Hay price}]_{Q3} - [\text{Hay open-market sales}]_{Q4}/[\text{Hay price}]_{Q4} - [\text{Hay production}]_{t-1}*(1 - [\text{Hay percent sold}]_{t-1}*0.67 - [\text{Hay production}]_t*(1 - [\text{Hay percent sold}]_t)*0.33)*([\text{Hay price}]_{Q1} + [\text{Hay price}]_{Q2} + [\text{Hay price}]_{Q3} + [\text{Hay price}]_{Q4})/4$$

$$[\text{Soybean inventory change}]_t = ([\text{Soybean production}]_t - [\text{Soybean open-market sales}]_{Q1}/[\text{Soybean price}]_{Q1} - [\text{Soybean open-market sales}]_{Q2}/[\text{Soybean price}]_{Q2} - [\text{Soybean open-market sales}]_{Q3}/[\text{Soybean price}]_{Q3} - [\text{Soybean open-market sales}]_{Q1}/[\text{Soybean price}]_{Q4} - [\text{Soybean production}]_{t-1}*(1 - [\text{Soybean percent sold}]_{t-1}*0.67 - [\text{Soybean production}]_t*(1 - [\text{Soybean percent sold}]_t)*0.33 - [\text{Soybean net CCC quantity}]_{Q4} - [\text{Soybean net CCC quantity}]_{Q2} - [\text{Soybean net CCC quantity}]_{Q3} - [\text{Soybean net CCC quantity}]_{Q4})*([\text{Soybean price}]_{Q1} + [\text{Soybean price}]_{Q2} + [\text{Soybean price}]_{Q3} + [\text{Soybean price}]_{Q4})/4$$

$$[\text{Peanut inventory change}]_t = ([\text{Peanut production}]_t - [\text{Peanut open-market sales}]_{Q1}/[\text{Peanut price}]_{Q1} - [\text{Peanut open market sales}]_{Q2}/[\text{Peanut price}]_{Q2} - [\text{Peanut open-market sales}]_{Q3}/[\text{Peanut price}]_{Q3} - [\text{Peanut open-market sales}]_{Q4}/[\text{Peanut price}]_{Q4})*([\text{Peanut price}]_{Q1} + [\text{Peanut price}]_{Q2} + [\text{Peanut price}]_{Q3} + [\text{Peanut price}]_{Q4})/4$$

$$[\text{Sunflowerseed inventory change}]_t = ([\text{Sunflowerseed production}]_t*.022 - [\text{Sunflowerseed open-market sales}]_{Q1}/[\text{Sunflowerseed price}]_{Q1} - [\text{Sunflowerseed open-market sales}]_{Q2}/[\text{Sunflowerseed price}]_{Q2} - [\text{Sunflowerseed open-market sales}]_{Q3}/[\text{Sunflowerseed price}]_{Q3} - [\text{Sunflowerseed open-market sales}]_{Q4}/[\text{Sunflowerseed price}]_{Q4})*([\text{Sunflowerseed price}]_{Q1} + [\text{Sunflowerseed price}]_{Q2} + [\text{Sunflowerseed price}]_{Q3} + [\text{Sunflowerseed price}]_{Q4})/4$$

$$[\text{Flaxseed inventory change}]_t = ([\text{Flaxseed production}]_t - [\text{Flaxseed open-market sales}]_{Q1}/[\text{Flaxseed price}]_{Q1} - [\text{Flaxseed open-market sales}]_{Q2}/[\text{Flaxseed price}]_{Q2} - [\text{Flaxseed open-market sales}]_{Q3}/[\text{Flaxseed price}]_{Q3} - [\text{Flaxseed open-market sales}]_{Q4}/[\text{Flaxseed price}]_{Q4})*([\text{Flaxseed price}]_{Q1} + [\text{Flaxseed price}]_{Q2} + [\text{Flaxseed price}]_{Q3} + [\text{Flaxseed price}]_{Q4})/4$$

$$[\text{Cotton lint inventory change}]_t = ([\text{Cotton lint production}]_t*0.48 - [\text{Cotton lint open-market sales}]_{Q1}/[\text{Cotton lint price}]_{Q1} - [\text{Cotton lint open-market sales}]_{Q2}/[\text{Cotton lint price}]_{Q2} - [\text{Cotton lint open-market sales}]_{Q3}/[\text{Cotton lint price}]_{Q3} - [\text{Cotton lint open-market sales}]_{Q4}/[\text{Cotton lint price}]_{Q4} - [\text{Cotton lint net CCC quantity}]_{Q1} - [\text{Cotton lint net CCC quantity}]_{Q2} - [\text{Cotton lint net CCC quantity}]_{Q3} - [\text{Cotton lint net CCC quantity}]_{Q4}) *([\text{Cotton lint price}]_{Q1} + [\text{Cotton lint price}]_{Q2} + [\text{Cotton lint price}]_{Q3} + [\text{Cotton lint price}]_{Q4})/4$$

$$[\text{Cottonseed inventory change}]_t = ([\text{Cottonseed production}]_t - [\text{Cottonseed open-market sales}]_{Q1}/[\text{Cottonseed price}]_{Q1} - [\text{Cottonseed open-market sales}]_{Q2}/[\text{Cottonseed price}]_{Q2} - [\text{Cottonseed open-market sales}]_{Q3}/[\text{Cottonseed price}]_{Q3} - [\text{Cottonseed open-market sales}]_{Q4}/[\text{Cottonseed price}]_{Q4} - [\text{Cottonseed production}]_{t-1}*(1 - [\text{Cottonseed percent sold}]_{t-1}*0.67 - [\text{Cottonseed production}]_t*(1 - [\text{Cottonseed percent sold}]_t)*0.33)*([\text{Cottonseed price}]_{Q1} + [\text{Cottonseed price}]_{Q2} + [\text{Cottonseed price}]_{Q3} + [\text{Cottonseed price}]_{Q4})/4$$

$$[\text{Tobacco inventory change}]_t = ([\text{Tobacco production}]_t - [\text{Tobacco open-market sales}]_{Q1}/[\text{Tobacco price}]_{Q1} - [\text{Tobacco open market sales}]_{Q2}/[\text{Tobacco price}]_{Q2} - [\text{Tobacco open-market sales}]_{Q3}/[\text{Tobacco price}]_{Q3} - [\text{Tobacco open-market sales}]_{Q4}/[\text{Tobacco price}]_{Q4})*([\text{Tobacco price}]_{Q1} + [\text{Tobacco price}]_{Q2} + [\text{Tobacco price}]_{Q3} + [\text{Tobacco price}]_{Q4})/4$$

$$[\text{Potato inventory change}]_t = ([\text{Potato production}]_t - [\text{Potato open-market sales}]_{Q1}/[\text{Potato price}]_{Q1} - [\text{Potato open-market sales}]_{Q2}/[\text{Potato price}]_{Q2} - [\text{Potato open-market sales}]_{Q3}/[\text{Potato price}]_{Q3} - [\text{Potato open-market sales}]_{Q4}/[\text{Potato price}]_{Q4} - [\text{Potato production}]_{t-1}*(1 - [\text{Potato percent sold}]_{t-1}*0.67 - [\text{Potato production}]_t*(1 - [\text{Potato percent sold}]_t)*0.33)*([\text{Potato price}]_{Q1} + [\text{Potato price}]_{Q2} + [\text{Potato price}]_{Q3} + [\text{Potato price}]_{Q4})/4$$

$$[\text{Dry beans inventory change}]_t = ([\text{Dry beans production}]_t - [\text{Dry beans open-market sales}]_{Q1}/[\text{Dry beans price}]_{Q1} - [\text{Dry beans open-market sales}]_{Q2}/[\text{Dry beans price}]_{Q2} - [\text{Dry beans open-market sales}]_{Q3}/[\text{Dry beans price}]_{Q3} - [\text{Dry beans open-market sales}]_{Q4}/[\text{Dry beans price}]_{Q4})*([\text{Dry beans price}]_{Q1} + [\text{Dry beans price}]_{Q2} + [\text{Dry beans price}]_{Q3} + [\text{Dry beans price}]_{Q4})/4$$

$$[\text{All crops inventory change}]_t = [\text{Wheat inventory change}]_t + [\text{Rice inventory change}]_t + [\text{Rye inventory change}]_t + [\text{Oats inventory change}]_t + [\text{Hay inventory change}]_t + [\text{Soybean inventory change}]_t + [\text{Peanut inventory change}]_t + [\text{Sunflowerseed inventory change}]_t + [\text{Flaxseed inventory change}]_t + [\text{Cotton lint inventory change}]_t + [\text{Cottonseed inventory change}]_t + [\text{Tobacco inventory change}]_t + [\text{Potato inventory change}]_t + [\text{Dry beans inventory change}]_t +$$

$$[\text{Cattle and calves inventory change}]_t = ([\text{Cattle and calves on farm}]_t - [\text{Cattle and calves on farm}]_{t-1})*[\text{Cattle mid-year price/head}]_t/1000$$

$$[\text{Hog inventory change}]_t = ([\text{Hog inventory, Dec 1}]_t - [\text{Hog inventory, Dec 1}]_{t-1}) * [\text{Hog mid-year price/head}]_t / 1000$$

$$[\text{Sheep \& lamb inventory change}]_t = ([\text{Sheep \& lamb inventory, Jan 1}]_t - [\text{Sheep \& lamb inventory, Jan 1}]_{t-1}) * [\text{Sheep \& lamb mid-year price/head}]_t / 1000$$

$$[\text{Chicken inventory change}]_t = ([\text{Chicken inventory, Dec 1}]_t - [\text{Chicken inventory, Dec 1}]_{t-1}) * [\text{Chicken mid-year price/head}]_t / 1000$$

$$[\text{All livestock inventory change}]_t = [\text{Cattle and calves inventory change}]_t + [\text{Hog inventory change}]_t + [\text{Sheep \& lamb inventory change}]_t + [\text{Broiler inventory change}]_t$$

$$[\text{Value of inventory change}]_t = [\text{All livestock inventory change}]_t + [\text{All crops inventory change}]_t$$

Indexes of Prices Received by Farmers, 1977=100

$$[\text{Food grains prices received index}]_t = [\text{Food grains prices received index}]_{t-1} * (([\text{Wheat price}]_{Q1} + [\text{Wheat price}]_{Q2} + [\text{Wheat price}]_{Q3} + [\text{Wheat price}]_{Q4})/4 * 36.382617284 + ([\text{Rice price}]_{Q1} + [\text{Rice price}]_{Q2} + [\text{Rice price}]_{Q3} + [\text{Rice price}]_{Q4})/4 * 2.0652838854) / (([\text{Wheat price}]_{Q1,t-1} + [\text{Wheat price}]_{Q2,t-1} + [\text{Wheat price}]_{Q3,t-1} + [\text{Wheat price}]_{Q4,t-1})/4 * 36.382617284 + ([\text{Rice price}]_{Q1,t-1} + [\text{Rice price}]_{Q2,t-1} + [\text{Rice price}]_{Q3,t-1} + [\text{Rice price}]_{Q4,t-1})/4 * 2.0652838854)$$

$$[\text{Feed grains prices received index}]_t = [\text{Feed grains prices received index}]_{t-1} * ([\text{Corn price}]_{Q1} + [\text{Corn price}]_{Q2} + [\text{Corn price}]_{Q3} + [\text{Corn price}]_{Q4})/4 * 36778 + ([\text{Sorghum price}]_{Q1} + [\text{Sorghum price}]_{Q2} + [\text{Sorghum price}]_{Q3} + [\text{Sorghum price}]_{Q4})/4 * 3625 + ([\text{Oats price}]_{Q1} + [\text{Oats price}]_{Q2} + [\text{Oats price}]_{Q3} + [\text{Oats price}]_{Q4})/4 * 4318 + ([\text{Barley price}]_{Q1} + [\text{Barley price}]_{Q2} + [\text{Barley price}]_{Q3} + [\text{Barley price}]_{Q4})/4 * 3819) / ([\text{Corn price}]_{Q1,t-1} + [\text{Corn price}]_{Q2,t-1} + [\text{Corn price}]_{Q3,t-1} + [\text{Corn price}]_{Q4,t-1})/4 * 36778 + ([\text{Sorghum price}]_{Q1,t-1} + [\text{Sorghum price}]_{Q2,t-1} + [\text{Sorghum price}]_{Q3,t-1} + [\text{Sorghum price}]_{Q4,t-1})/4 * 3625 + ([\text{Oats price}]_{Q1,t-1} + [\text{Oats price}]_{Q2,t-1} + [\text{Oats price}]_{Q3,t-1} + [\text{Oats price}]_{Q4,t-1})/4 * 4318 + ([\text{Barley price}]_{Q1,t-1} + [\text{Barley price}]_{Q2,t-1} + [\text{Barley price}]_{Q3,t-1} + [\text{Barley price}]_{Q4,t-1})/4 * 3819)$$

$$[\text{Feed grains and hay prices received index}]_t = [\text{Feed grains and hay prices received index}]_{t-1} * (([\text{Hay price}]_{Q1} + [\text{Hay price}]_{Q2} + [\text{Hay price}]_{Q3} + [\text{Hay price}]_{Q4})/4 * 0.2815462702 + [\text{Feed grains prices received index}]_t * 0.8903452696) / (([\text{Hay price}]_{Q1,t-1} + [\text{Hay price}]_{Q2,t-1} + [\text{Hay price}]_{Q3,t-1} + [\text{Hay price}]_{Q4,t-1})/4 * 0.2815462702 + [\text{Feed grains prices received index}]_{t-1} * 0.8903452696)$$

$$[\text{Cotton prices received index}]_t = [\text{Cotton prices received index}]_{t-1} * ([\text{Cotton lint price}]_{Q1} + [\text{Cotton lint price}]_{Q2} + [\text{Cotton lint price}]_{Q3} + [\text{Cotton lint price}]_{Q4}) / ([\text{Cotton lint price}]_{Q1,t-1} + [\text{Cotton lint price}]_{Q2,t-1} + [\text{Cotton lint price}]_{Q3,t-1} + [\text{Cotton lint price}]_{Q4,t-1})$$

$$[\text{Tobacco prices received index}]_t = [\text{Tobacco prices received index}]_{t-1} * ([\text{Tobacco price}]_{Q1} + [\text{Tobacco price}]_{Q2} + [\text{Tobacco price}]_{Q3} + [\text{Tobacco price}]_{Q4}) / ([\text{Tobacco price}]_{Q1,t-1} + [\text{Tobacco price}]_{Q2,t-1} + [\text{Tobacco price}]_{Q3,t-1} + [\text{Tobacco price}]_{Q4,t-1})$$

$$[\text{Oil crops prices received index}]_t = ([\text{Cottonseed price}]_{Q1} + [\text{Cottonseed price}]_{Q2} + [\text{Cottonseed price}]_{Q3} + [\text{Cottonseed price}]_{Q4})/4 * 5 + ([\text{Peanut price}]_{Q1} + [\text{Peanut price}]_{Q3} + [\text{Peanut price}]_{Q4})/4 * 3235 + ([\text{Flaxseed price}]_{Q1} + [\text{Flaxseed price}]_{Q2} + [\text{Flaxseed price}]_{Q3} + [\text{Flaxseed price}]_{Q4})/4 * 17 + ([\text{Soybean price}]_{Q1} + [\text{Soybean price}]_{Q2} + [\text{Soybean price}]_{Q3} + [\text{Soybean price}]_{Q4}) * 1179) * 0.0117288569$$

$$[\text{Fruit prices received index}]_t = [\text{Fruit prices received index}]_{t-1} * ([\text{Fruit price index 1910-14=100}]_{Q1} + [\text{Fruit price index 1910-14=100}]_{Q2} + [\text{Fruit price index 1910-14=100}]_{Q3} + [\text{Fruit price index 1910-14=100}]_{Q4}) / ([\text{Fruit price index 1910-14=100}]_{Q1,t-1} + [\text{Fruit price index 1910-14=100}]_{Q2,t-1} + [\text{Fruit price index 1910-14=100}]_{Q3,t-1} + [\text{Fruit price index 1910-14=100}]_{Q4,t-1})$$

$$[\text{Potatoes and beans prices received index}]_t = 1300 + ([\text{Potato price}]_{Q1} + [\text{Potato price}]_{Q2} + [\text{Potato price}]_{Q3} + [\text{Potato price}]_{Q4})/4 * 2750 + ([\text{Dry beans price}]_{Q1} + [\text{Dry beans price}]_{Q2} + [\text{Dry beans price}]_{Q3} + [\text{Dry beans price}]_{Q4})/4 * 180) / 143.64284459$$

$$[\text{Vegetable prices received index}]_t = ([\text{Vegetable price index 1910-12=100}]_{Q1} + [\text{Vegetable price index 1910-12=100}]_{Q2} + [\text{Vegetable price index 1910-12=100}]_{Q3} + [\text{Vegetable price index 1910-12=100}]_{Q4})/4 * 0.2011173184$$

$$[\text{All crops prices received index}]_t = ([\text{Food grains prices received index}]_t * 12553 + [\text{Feed grains and hay prices received index}]_t * 26078 + [\text{Cotton prices received index}]_t * 9470 + [\text{Tobacco prices received index}]_t * 5036 + [\text{Oil crops prices received index}]_t * 21019 + [\text{Fruit prices received index}]_t * 9582 + [\text{Potatoes and beans prices received index}]_t * 3702 + [\text{Vegetable prices received index}]_t * 9133) / 100000$$

$$[\text{Meat animals prices received index}]_t = [\text{Meat animals prices received index}]_{t-1} * (([\text{Cattle farm price}]_{Q1} + [\text{Cattle farm price}]_{Q2} + [\text{Cattle farm price}]_{Q3} + [\text{Cattle farm price}]_{Q4})/4 * 480 + ([\text{Calves farm price}]_{Q1} + [\text{Calves farm price}]_{Q2} + [\text{Calves farm price}]_{Q3} + [\text{Calves farm price}]_{Q4})/4 * 37 + ([\text{Hog farm price}]_{Q1} + [\text{Hog farm price}]_{Q2} + [\text{Hog farm price}]_{Q3} + [\text{Hog farm price}]_{Q4})/4 * 212)) / (([\text{Cattle farm price}]_{Q1,t-1} + [\text{Cattle farm price}]_{Q2,t-1} + [\text{Cattle farm price}]_{Q3,t-1} + [\text{Cattle farm price}]_{Q4,t-1})/4 * 480 + ([\text{Calves farm price}]_{Q1,t-1} + [\text{Calves farm price}]_{Q2,t-1} + [\text{Calves farm price}]_{Q3,t-1} + [\text{Calves farm price}]_{Q4,t-1})/4 * 37 + ([\text{Hog farm price}]_{Q1,t-1} + [\text{Hog farm price}]_{Q2,t-1} + [\text{Hog farm price}]_{Q3,t-1} + [\text{Hog farm price}]_{Q4,t-1})/4 * 212))$$

$$[\text{Poultry and eggs prices received index}]_t = [\text{Poultry and eggs prices received index}]_{t-1} * (([\text{Egg farm price}]_{Q1} + [\text{Egg farm price}]_{Q2} + [\text{Egg farm price}]_{Q3} + [\text{Egg farm price}]_{Q4})/4 * 5669 + ([\text{Turkey farm price}]_{Q1} + [\text{Turkey farm price}]_{Q2} + [\text{Turkey farm price}]_{Q3} + [\text{Turkey farm price}]_{Q4})/4 * 2382 + ([\text{Broiler farm price}]_{Q1} + [\text{Broiler farm price}]_{Q2} + [\text{Broiler farm price}]_{Q3} + [\text{Broiler farm price}]_{Q4})/4 * 11111) / (([\text{Egg farm price}]_{Q1,t-1} + [\text{Egg farm price}]_{Q2,t-1} + [\text{Egg farm price}]_{Q3,t-1} + [\text{Egg farm price}]_{Q4,t-1})/4 * 5669 + ([\text{Turkey farm price}]_{Q1,t-1} + [\text{Turkey farm price}]_{Q2,t-1} + [\text{Turkey farm price}]_{Q3,t-1} + [\text{Turkey farm price}]_{Q4,t-1})/4 * 2382 + ([\text{Broiler farm price}]_{Q1,t-1} + [\text{Broiler farm price}]_{Q2,t-1} + [\text{Broiler farm price}]_{Q3,t-1} + [\text{Broiler farm price}]_{Q4,t-1})/4 * 11111))$$

[Dairy products prices received index]$_t$ = [Dairy products prices received index]$_{t-1}$ *([Milk farm price]$_{Q1}$ +[Milk farm price]$_{Q2}$ +[Milk farm price]$_{Q3}$ +[Milk farm price]$_{Q4}$)/([Milk farm price]$_{Q1,t-1}$ +[Milk farm price]$_{Q2,t-1}$ +[Milk farm price]$_{Q3,t-1}$ +[Milk farm price]$_{Q4,t-1}$)

[All livestock prices received index]$_t$ = (5965*[Meat animals prices received index]$_t$ +1529*[Poultry and eggs prices received index]$_t$ +2506*[Dairy products prices received index]$_t$)/10000

[All farm products prices received index]$_t$ = ([All crops prices received index]$_t$*489 +[All livestock prices received index]$_t$*511)/1000

Indexes of Prices Paid by Farmers, 1977=100

Miscellaneous Variables for Prices-Paid Indexes

[Total acres planted (12-crops)]$_t$ = [Wheat acres planted]$_t$ +[Rice acres planted]$_t$ +[Corn acres planted]$_t$ +[Sorghum acres planted]$_t$ +[Barley acres planted]$_t$ +[Oats acres planted]$_t$ +[Soybeans acres planted]$_t$ +[Peanuts acres planted]$_t$ +[Sunflowerseed acres planted]$_t$ +[Flaxseed acres planted]$_t$ +[Cotton acres planted]$_t$ +[Potato acres planted]$_t$

[Wholesale Price index]$_t$ = (EXP((-513 +762*LN([Natural gas price]$_{t-1}$/[GDP Deflator 1987=100]$_t$*100) +257*LN((189 +904*LN([World oil price]$_t$/[GDP Deflator 1987=100]$_t$*100))/1000))/1000)*[GDP Deflator 1987=100]$_t$)/(EXP((-513 +762*LN([Natural gas price]$_{t-2}$/[GDP Deflator 1987=100]$_{t-1}$*100) +257*LN((189 +904*LN([World oil price]$_{t-1}$ /[GDP Deflator 1987=100]$_{t-1}$*100))/1000))/1000)*[GDP Deflator 1987=100]$_{t-1}$)*[WP index]$_{t-1}$

[Family living CPI]$_t$ = 1.041*([GDP deflator, 1987=100]$_t$ -[GDP deflator, 1987=100]$_{t-1}$) +[Family living CPI]$_{t-1}$

Prices-paid indexes

[Feed prices paid index]$_t$ = 11.17*([Corn price]$_{y-1}$ -[Corn price]$_{y-2}$)+7.92*([Corn price]$_y$ -[Corn price]$_{y-1}$) +0.1645*([Soybean meal price]$_{y-1}$ -[Soybean meal price]$_{y-2}$) +[Feed prices paid index]$_{t-1}$

[Feeder livestock prices paid index]$_t$ = 1.283*(1.772784*([Cattle average annual farm price]$_t$ -[Cattle average annual farm price]$_{t-1}$) -12.14366*([Corn price]$_y$ -[Corn price]$_{y-1}$) -0.201474*([Hay price]$_y$ -[Hay price]$_{y-1}$)) +0.186*(2.335*([Hog feeder price]$_t$ -[Hog feeder price]$_{t-1}$) -8.245*([Corn price]$_y$ -[Corn price]$_{y-1}$)) +2.34*(0.25*([Broiler annual price wholesale]$_t$ -[Broiler annual price wholesale]$_{t-1}$) +0.724*([Corn price]$_y$ -[Corn price]$_{y-1}$)) +0.032*(119.43*([Milk average annual price]$_t$ -[Milk average annual price]$_{t-1}$) -142.738*([Corn price]$_y$ -[Corn price]$_{y-1}$)) +[Feeder livestock prices paid index]$_{t-1}$

[Seed prices paid index]$_t$ = (EXP(4.29 +2*[Total acres planted]$_t$)*[GDP Deflator 1987=100]$_t$/100) -(EXP(4.29 +2*[Total acres planted]$_{t-1}$)*[GDP Deflator 1987=100]$_{t-1}$/100) +[Seed prices paid index]$_{t-1}$

[Farm origin inputs prices paid index]$_t$ = 0.5202*[Feed prices paid index]$_t$ +0.4107*[Feeder livestock prices paid index]$_t$ +0.0691*[Seed prices paid index]$_t$

[Fertilizer prices paid index]$_t$ = (1.1+.58*([WP index]$_t$ -[WP index]$_{t-1}$)+.0012*([Corn acres planted]$_t$ -[Corn acres planted]$_{t-1}$)) +[Fertilizer prices paid index]$_{t-1}$

[Agricultural chemicals prices paid index]$_t$ = 0.354*([Fertilizer prices paid index]$_t$ -[Fertilizer prices paid index]$_{t-1}$) +1.88 +[Agricultural chemicals prices paid index]$_{t-1}$

[Fuels and energy prices paid index]$_t$ = (EXP(3.9861+0.379*(0.189+0.904*LN([World oil price]$_t$/[GDP Deflator 1987=100]$_t$*100)))*[GDP Deflator 1987=100]$_t$/100) -(EXP(3.9861+0.379*(0.189+0.904*LN([World oil price]$_t$/[GDP Deflator 1987=100]$_t$*100)))*[GDP Deflator 1987=100]$_t$/100) +[Fuels and energy prices paid index]$_{t-1}$

[Farm and motor supplies prices paid index]$_t$ = EXP(1.966+0.454*LN([land value/acre]$_t$/[GDP Deflator 1987=100]$_t$ *100))*[GDP Deflator 1987=100]$_t$/100 -EXP(1.966+0.454*LN([land value/acre]$_{t-1}$/[GDP Deflator 1987=100]$_{t-1}$ *100))*[GDP Deflator 1987=100]$_{t-1}$/100 +[Farm and motor supplies prices paid index]$_{t-1}$

[Autos and trucks prices paid index]$_t$ = 268.65*LN([CPI 1982-84=100]$_t$/[CPI 1982-84=100]$_{t-1}$) +[Autos and trucks prices paid index]$_{t-1}$

[Tractors & self-propelled machinery prices paid index]$_t$ = 2.9597*([CPI 1982-84=100]$_t$^(0.87)-[CPI 1982-84=100]$_{t-1}$^(0.87)) +[Tractors & spec. machinery prices paid index]$_{t-1}$

[Other farm machinery prices paid index]$_t$ = 0.96079*([CPI 1982-84=100]$_t$^(1.12)-[CPI 1982-84=100]$_{t-1}$^(1.12)) +[Other farm machinery prices paid index]$_{t-1}$

[Building and fencing prices paid index]$_t$ = 0.1204*([GDP deflator 1987=100]$_t$*([Land value/acre]$_t$/[GDP deflator 1987=100]$_t$* 100)^(0.36) -[GDP deflator 1987=100]$_{t-1}$*([Land value/acre]$_{t-1}$/[GDP deflator 1987=100]$_{t-1}$ *100)^(0.36)) +[Building and fencing prices paid index]$_{t-1}$

[Services and cash rent prices paid index]$_t$ = 0.0382*([GDP deflator 1987=100]$_t$*([Land value/acre]$_t$/[GDP deflator 1987=100]$_t$*100)^(0.556) −[GDP deflator 1987=100]$_{t-1}$*([Land value/acre]$_{t-1}$/[GDP deflator 1987=100]$_{t-1}$ *100)^(0.556)) +[Services and cash rent prices paid index]$_{t-1}$

[Non-farm origin inputs prices paid index]$_t$ = (1615*[Fertilizer prices paid index]$_t$ +609*[Agricultural chemicals prices paid index]$_t$ +1167*[Fuels and energy prices paid index]$_t$ +704*[Farm and motor supplies prices paid index]$_t$ +668*[Autos and trucks prices paid index]$_t$ +1280*[Tractors & spec. machinery prices paid index]$_t$ +762*[Other farm machinery prices paid index]$_t$ +996*[Building and fencing prices paid index]$_t$ +2196*[Services and cash rent prices paid index]$_t$)/10000

[Production items prices paid index]$_t$ = 0.44*[Farm origin inputs prices paid index]$_t$ +0.56*[Non-farm origin inputs prices paid index]$_t$

[Interest prices paid index]$_t$ = 18.67*([Moody's AAA bond rate]$_{t-2}$ +[Moody's AAA bond rate]$_{t-1}$ +[Moody's AAA bond rate]$_t$)/3 −([Moody's AAA bond rate]$_{t-3}$ +[Moody's AAA bond rate]$_{t-2}$ +[Moody's AAA bond rate]$_{t-1}$)/3 +0.000243*([Real estate debt]$_t$ −[Real estate debt]$_{t-1}$) +[Interest prices paid index]$_{t-1}$

[Farmland taxes prices paid index]$_t$ = 0.83*([CPI 1982-84=100]$_t$ −[CPI 1982-84=100]$_{t-1}$) +[Farmland taxes prices paid index]$_{t-1}$

[Farm wage rates prices paid index]$_t$ = [Wage rate of hired labor]$_t$/[Wage rate of hired labor]$_{t-1}$*[Farm wage rates prices paid index]$_{t-1}$

[Prod. items, interest, taxes, & wages prices paid index]$_t$ = 0.867*[Production items prices paid index]$_t$ +0.058*[Interest prices paid index]$_t$ +0.020*[Farmland taxes prices paid index]$_t$ +0.055*[Farm wage rates prices paid index]$_t$

[Ratio of price indices]$_t$ = [All farm products prices received index]$_t$/[Prod. items, interest, taxes, & wages prices paid index]$_t$*100

Farm Capital Expenditures

Machinery:

[Tractor purchases]$_t$ = (−13392 +2209*[Number of farms]$_t$ +0.026954*[Total acres planted]$_t$ +0.0033197*[All crops cash receipts]$_t$ +0.06031*[All livestock cash receipts]$_t$ −166.89*[Prime rate]$_t$)/(−13392 +2209*[Number of farms]$_{t-1}$ +0.026954*[Total acres planted]$_{t-1}$ +0.0033197*[All crops cash receipts]$_{t-1}$ +0.06031*[All livestock cash receipts]$_{t-1}$ −166.89*[Prime rate]$_{t-1}$)*[Tractor purchases]$_{t-1}$

[Truck purchases]$_t$ = (−1269−0.01962665*[Total acres planted]$_t$ +4.9633*[All crops cash receipts]$_t$ −0.00808*[All livestock cash receipts]$_t$ +0.0358*([Farm debt including households]$_t$))/(−1296−0.01962665*[Total acres planted]$_{t-1}$ +4.9633*[All crops cash receipts]$_{t-1}$ −0.00808*[All livestock cash receipts]$_{t-1}$ +0.0358*([Farm debt including households]$_{t-1}$))*[Truck purchases]$_{t-1}$

[Auto purchases]$_t$ = (−255 +2.788*[Number of farms]$_t$ −0.007*[Total acres planted]$_t$ +0.0042323*[All crops cash receipts]$_t$ +0.0000664*[All livestock cash receipts]$_t$ −18.307*[Prime rate]$_t$)/(−255 +2.788*[Number of farms]$_{t-1}$ −0.007*[Total acres planted]$_{t-1}$ +0.0042323*[All crops cash receipts]$_{t-1}$ +0.0000664*[All livestock cash receipts]$_{t-1}$ −18.307*[Prime rate]$_{t-1}$)*[Auto purchases]$_{t-1}$

[Other machinery purchases]$_t$ = (−31119.7 +5241*[Number of farms]$_t$ +0.062*[Total acres planted]$_t$ −0.0308*[All crops cash receipts]$_t$ +0.16378*[All livestock cash receipts]$_t$ −430.11*[Prime rate]$_t$)/(−31119.7 +5241*[Number of farms]$_{t-1}$ +0.062*[Total acres planted]$_{t-1}$ −0.0308*[All crops cash receipts]$_{t-1}$ +0.16378*[All livestock cash receipts]$_{t-1}$ −403.11*[Prime rate]$_{t-1}$)*[Other machinery purchases]$_{t-1}$

Buildings:

[Farm service building purchases]$_t$ =(−12800.51 +0.0613696*[Total acres planted]$_t$ −0.034009*[All crops cash receipts]$_t$ +0.05495*[All livestock cash receipts]$_t$ −0.012363*([Farm debt including households]$_t$))/(−12800.51 +0.0613696*[Total acres planted]$_{t-1}$ −0.034009*[All crops cash receipts]$_{t-1}$ +0.05495*[All livestock cash receipts]$_{t-1}$ −0.012363*([Farm debt including households]$_{t-1}$))*[Farm service building purchases]$_{t-1}$

[Operator dwelling purchases]$_t$ = (−1571.5 +8.5/1000*[Total acres planted]$_t$ +0.00874*[All crops cash receipts]$_t$ +0.0009116 *[All livestock cash receipts]$_t$ −0.000969*([Farm debt including households]$_t$))/ (−1571.5 +8.5/1000*[Total acres planted]$_t$ +0.00874*[All crops cash receipts]$_{t-1}$ +0.0009116*[All livestock cash receipts]$_{t-1}$ −0.000969*([Farm debt including households]$_{t-1}$))*[Operator dwelling purchases]$_{t-1}$

[Capital expenditures]$_t$ = [tractor purchases]$_t$ +[truck purchases]$_t$ +[Auto purchases]$_t$ +[Other machinery purchases]$_t$ +[Farm service building purchases]$_t$ +[Operator dwelling purchases]$_t$

Operator Dwelling Expense Components

[Operator dwelling interest]$_t$ = [Short-term interest expenses]$_t$/[Short-term interest expenses]$_{t-1}$*[Operator dwelling interest]$_{t-1}$

[Operator dwelling taxes]$_t$ = [Farmland tax prices paid index]$_t$/[Farmland tax prices paid index]$_t$*[Operator dwelling taxes]$_{t-1}$

[Operator dwelling repairs]$_t$ = ([Prod. items, interest, taxes, & wages prices paid index]$_t$/[Prod. items, interest, taxes, & wages prices paid index]$_{t-1}$ +([Tractors & self-propelled machinery prices paid index]$_t$ +[Other farm machinery prices paid index]$_t$ +[Building and fencing prices paid index]$_t$ +[Services and cash rent prices paid index]$_t$)/[Tractors & spec. machinery prices paid index]$_{t-1}$ +[Other farm machinery prices paid index]$_{t-1}$ +[Building and fencing prices paid index]$_{t-1}$ +[Services and cash rent prices paid index]$_{t-1}$) −1)*[Operator dwelling repairs]$_t$

$$[\text{Operator dwelling insurance}]_t = [\text{parity index}]_t/[\text{parity index}]_{t-1}*[\text{Operator dwelling insurance}]_t$$

$$[\text{Operator dwelling expenses}]_t = [\text{Operator dwelling interest}]_t + [\text{Operator dwelling taxes}]_t + [\text{Operator dwelling repairs}]_t + [\text{Operator dwelling insurance}]_t$$

Farm Production Expenses

$$[\text{Seed expenses}]_t = ([\text{Sunflower acres planted}]_t*[\text{Sunflowers seed price (\$/cwt)}]_t*1.4667 + [\text{Flaxseed acres planted}]_t*[\text{Flax seed price (\$/bu)}]_t*0.8160 + [\text{Potato acres planted}]_t*[\text{Potato seed price (\$/cwt)}]_t*19.9 + [\text{Corn acres planted}]_t*[\text{Corn seed cost/acre}]_t + [\text{Sorghum acres planted}]_t*[\text{Sorghum seed cost/acre}]_t + [\text{Barley acres planted}]_t*[\text{Barley seed cost/acre}]_t + [\text{Oats acres planted}]_t*[\text{Oats seed cost/acre}]_t + [\text{Soybeans acres planted}]_t*[\text{Soybeans seed cost/acre}]_t + [\text{Cotton acres planted}]_t*[\text{Cotton seed cost/acre}]_t + [\text{Wheat acres planted}]_t*[\text{Wheat seed cost/acre}]_t + [\text{Peanut acres planted}]_t*[\text{Peanut seed cost/acre}]_t) / ([\text{Sunflower acres planted}]_{t-1}*[\text{Sunflowers seed price (\$/cwt)}]_{t-1}*1.4667 + [\text{Flaxseed acres planted}]_{t-1}*[\text{Flaxseed price (\$/bu)}]_{t-1}*0.8160 + [\text{Potato acres planted}]_{t-1}*[\text{Potato seed price (\$/cwt)}]_{t-1}*19.9 + [\text{Corn acres planted}]_{t-1}*[\text{Corn seed cost/acre}]_{t-1} + [\text{Sorghum acres planted}]_{t-1}*[\text{Sorghum seed cost/acre}]_{t-1} + [\text{Barley acres planted}]_{t-1}*[\text{Barley seed cost/acre}]_{t-1} + [\text{Oats acres planted}]_{t-1}*[\text{Oats seed cost/acre}]_{t-1} + [\text{Soybeans acres planted}]_{t-1}*[\text{Soybeans seed cost/acre}]_{t-1} + [\text{Cotton acres planted}]_{t-1}*[\text{Cotton seed cost/acre}]_{t-1} + [\text{Wheat acres planted}]_{t-1}*[\text{Wheat seed cost/acre}]_{t-1} + [\text{Peanut acres planted}]_{t-1}*[\text{Peanut seed cost/acre}]_{t-1})*[\text{Seed expenses}]_{t-1}$$

$$[\text{Feed expenses}]_t = (([\text{Corn price}]_{Q1} + [\text{Corn price}]_{Q2} + [\text{Corn price}]_{Q3} + [\text{Corn price}]_{Q4})/([\text{Corn price}]_{Q1,t-1} + [\text{Corn price}]_{Q2,t-1} + [\text{Corn price}]_{Q3,t-1} + [\text{Corn price}]_{Q4,t-1})*200 + ([\text{Hay price}]_{Q1} + [\text{Hay price}]_{Q2} + [\text{Hay price}]_{Q3} + [\text{Hay price}]_{Q4})/([\text{Hay price}]_{Q1,t-1} + [\text{Hay price}]_{Q2,t-1} + [\text{Hay price}]_{Q3,t-1} + [\text{Hay price}]_{Q4,t-1})*70 + [\text{Feed prices paid index}]_t/[\text{Feed prices paid index}]_{t-1}*670 + [\text{Cattle and calves total supply}]_t/[\text{Cattle and calves total supply}]_{t-1}*177 + [\text{Dairy cattle number}]_t/[\text{Dairy cattle number}]_{t-1}*188 + [\text{Hog inventory, Dec 1}]_t/[\text{Hog inventory, Dec 1}]_{t-1}*247 + [\text{Broiler annual production}]_t/[\text{Broiler annual production}]_{t-1}*151 + [\text{Turkey annual production}]_t/[\text{Turkey annual production}]_{t-1}*50 + [\text{Egg annual production}]_t/[\text{Egg annual production}]_{t-1}*63 - 816)*[\text{Feed expenses}]_{t-1}/1000$$

$$[\text{Feeder livestock expenses}]_t = (([\text{Cattle Oklahoma feeder price}]_t/[\text{Cattle Oklahoma feeder price}]_{t-1} + [\text{Cattle and calves on feed, net placements}]_t/[\text{Cattle and calves on feed, net placements}]_{t-1})*835 + ([\text{Hog feeder price}]_t/[\text{Hog feeder price}]_{t-1} + [\text{Hog inventory, Dec 1}]_t/[\text{Hog inventory, Dec 1}]_t)*19 + ([\text{Broiler annual wholesale price}]_t/[\text{Broiler annual wholesale price}]_{t-1} + [\text{Broiler annual production}]_t/[\text{Broiler annual production}]_{t-1})*111 + ([\text{Turkey annual price, 8-16 lbs.}]_t/[\text{Turkey annual price, 8-16 lbs.}]_{t-1} + [\text{Turkey annual production}]_t/[\text{Turkey annual production}]_{t-1})*27-992*2 + 1000)*[\text{Feeder livestock expenses}]_{t-1}/1000$$

$$[\text{Farm origin input expenses}]_t = [\text{Seed expenses}]_t + [\text{Feed expenses}]_t + [\text{Feeder livestock expenses}]_t$$

$$[\text{Fertilizer expenses}]_t = ([\text{Fertilizer prices paid index}]_t/[\text{Fertilizer prices paid index}]_{t-1} + [\text{Total acres planted}]_t/[\text{Total acres planted}]_{t-1} - 1)*[\text{Fertilizer expenses}]_{t-1}$$

$$[\text{Fuels and oils expenses}]_t = ([\text{Fuels and energy prices paid index}]_t/[\text{Fuels and energy prices paid index}]_{t-1} + [\text{Total acres planted}]_t/[\text{Total acres planted}]_{t-1} - 1)*[\text{Fuels and oils expenses}]_{t-1}$$

$$[\text{Electricity expenses}]_t = ([\text{Fuels and energy prices paid index}]_t/[\text{Fuels and energy prices paid index}]_{t-1} + [\text{Electricity use}]_t/[\text{Electricity use}]_{t-1} - 1)*[\text{Electricity expenses}]_{t-1}$$

$$[\text{Pesticides expenses}]_t = ([\text{Agricultural chemicals prices paid index}]_t/[\text{Agricultural chemicals prices paid index}]_{t-1} + [\text{Total acres planted}]_t/[\text{Total acres planted}]_{t-1} - 1)*[\text{Pesticides expenses}]_{t-1}$$

$$[\text{Manufactured inputs expenses}]_t = [\text{Fertilizer expenses}]_t + [\text{Fuels and oils expenses}]_t + [\text{Electricity expenses}]_t + [\text{Pesticides expenses}]_t$$

$$[\text{Short-term interest expenses}]_t = (([\text{Debt, commercial bank nonreal estate}]_t + [\text{Debt, commercial bank nonreal estate}]_{t-1})*[\text{Interest rate, commercial banks nonreal estate}]_t + ([\text{Debt, PCA nonreal estate}]_t + [\text{Debt, PCA nonreal estate}]_{t-1})*[\text{Interest rate, PCA nonreal estate}]_t + ([\text{Debt, Federal inter. credit bank nonreal estate}]_t + [\text{Debt, Federal inter. credit bank nonreal estate}]_{t-1})*[\text{Interest rate, Federal inter. credit nonreal estate}]_t + ([\text{Debt, FmHA nonreal estate}]_t + [\text{Debt, FmHA nonreal estate}]_{t-1})*[\text{Interest rate, FmHA nonreal estate}]_t + ([\text{Debt, individual \& other nonreal estate}]_t + [\text{Debt, individual \& other nonreal estate}]_{t-1})*[\text{Interest rate, individual \& other nonreal estate}]_t + ([\text{Debt, CCC nonreal estate}]_t + [\text{Debt, CCC nonreal estate}]_{t-1})*[\text{Interest rate, CCC nonreal estate}]_t)/200000$$

$$[\text{Real estate interest expenses}]_t = (([\text{Debt, Federal land banks}]_t + [\text{Debt, Federal land bank}]_{t-1})*[\text{Interest rate, commercial banks real estate}]_t + ([\text{Debt, life insurance co. real estate}]_t + [\text{Debt, life insurance co. real estate}]_{t-1})*[\text{Interest rate, life insurance co. real estate}]_t + ([\text{Debt, commercial bank real estate}]_t + [\text{Debt, commercial bank real estate}]_{t-1})*[\text{Interest rate, commercial bank real estate}]_t + ([\text{Debt, FmHA real estate}]_t + [\text{Debt, FmHA real estate}]_{t-1})*[\text{Interest rate, FmHA real estate}]_t + ([\text{Debt, individual \& other real estate}]_t + [\text{Debt, individual \& other real estate}]_{t-1})*[\text{Interest rate, individual \& other real estate}]_t)/200000$$

$$[\text{Interest expenses}]_t = [\text{Short-term interest expenses}]_t + [\text{Real estate interest expenses}]_t$$

$$[\text{Marketing, storage, \& transportation expenses}]_t = ([\text{Parity index}]_t/[\text{Parity index}]_{t-1} + [\text{All crops output index}]_t/[\text{All crops output index}]_{t-1} - 1)*[\text{Marketing, storage, \& transportation expenses}]_{t-1}$$

$$[\text{Animal health expenses}]_t = ([\text{Parity index}]_t/[\text{Parity index}]_{t-1} + [\text{Cattle and calves on farms}]_t/[\text{Cattle and calves on farms}]_{t-1}*0.3 + [\text{Dairy cattle number}]_t/[\text{Dairy cattle number}]_t*0.5 + [\text{Hog inventory, Dec 1}]_t/[\text{Hog inventory, Dec 1}]_{t-1}/*0.2 - 1)*[\text{Animal health expenses}]_{t-1}$$

$$[\text{Hired labor expenses}]_t = ([\text{Wage rates for hired labor}]_t/[\text{Wage rates for hired labor}]_{t-1} + [\text{Hired farm workers number}]_t/[\text{Hired farm workers number}]_{t-1} - 1)*[\text{Hired labor expenses}]_{t-1}$$

$$[\text{Repair and maintenance expenses}]_t = ([\text{Prod. items, interest, taxes, \& wages prices paid index}]_t/[\text{Prod. items, interest, taxes, \& wages prices paid index}]_{t-1} + ([\text{Farm and motor supplies prices paid index}]_t + [\text{Autos and trucks prices paid index}]_t + [\text{Tractors \& spec. machinery prices paid index}]_t + [\text{Other farm machinery prices paid index}]_t + [\text{Building and fencing prices paid index}]_t)/([\text{Farm and motor supplies prices paid index}]_{t-1} + [\text{Autos and trucks prices paid index}]_{t-1} + [\text{Tractors \& spec. machinery prices paid index}]_{t-1} + [\text{Other farm machinery prices paid index}]_{t-1} + [\text{Building and fencing prices paid index}]_{t-1}) - 1)*[\text{Repair and maintenance expenses}]_{t-1}$$

$$[\text{Machine hire \& custom work}]_t = ([\text{Prod. items, interest, taxes, \& wages prices paid index}]_t/[\text{Prod. items, interest, taxes, \& wages prices paid index}]_{t-1} + [\text{Total acres planted}]_t/[\text{Total acres planted}]_{t-1} - 1)*[\text{Machine hire \& custom work}]_{t-1}$$

$$[\text{Miscellaneous operating expenses}]_t = ([\text{Production items, interest, taxes, \& wages prices paid index}]_t/[\text{Prod. items, interest, taxes, \& wages prices paid index}]_{t-1} + [\text{Cattle and calves on farms, Jan 1}]_t/[\text{Cattle and calves on farms, Jan 1}]_{t-1} - 1)*([\text{Misc. operating expenses}]_{t-1} - [\text{Dairy assessments}]_{t-1}/1000) + [\text{Dairy assessments}]_t/1000$$

$$[\text{Other operating expenses}]_t = [\text{Marketing, storage, \& transportation expenses}]_t + [\text{Animal health expenses}]_t + [\text{Hired labor expenses}]_t + [\text{Repair and maintenance expenses}]_t + [\text{Machine hire \& custom work}]_t + [\text{Miscellaneous operating expenses}]_t$$

$$[\text{Net rent to non-operator landlords}]_t = ([\text{Land value/acre}]_t/[\text{Land value/acre}]_{t-1}*0.4 + [\text{All crops cash receipts}]_t/[\text{All crops cash receipts}]_{t-1}*0.6)*[\text{Net rent to non-operator landlords}]_{t-1}$$

$$[\text{Capital consumption}]_t = (([\text{Assets, real estate}]_{t-1}*0.2465 + ([\text{Farm service building purchases}]_t + [\text{Operator dwelling purchases}]_t)/3000)*0.04 + ([\text{Assets, machinery and vehicles}]_{t-1} + ([\text{Tractor purchases}]_t + [\text{Truck purchases}]_t + [\text{Auto purchases}]_t + [\text{Other machinery purchases}]_t)/3000)*0.12)/(([\text{Assets, real estate}]_{t-2}*0.2465 + ([\text{Farm service building purchases}]_{t-1} + [\text{Operator dwelling purchases}]_{t-1})/3000)*0.04 + ([\text{Assets, machinery and vehicles}]_{t-2} + ([\text{Tractor purchases}]_{t-1} + [\text{Truck purchases}]_{t-1} + [\text{Auto purchases}]_{t-1} + [\text{Other machinery purchases}]_{t-1})/3000)*0.12)$$

$$[\text{Business taxes}]_t = [\text{Farmland taxes prices paid index}]_t/[\text{Farmland taxes prices paid index}]_{t-1}*[\text{Business taxes}]_{t-1}$$

$$[\text{Overhead expenses}]_t = [\text{Net rent to non-operator landlords}]_t + [\text{Capital consumption}]_t + [\text{Business taxes}]_t$$

$$[\text{Non-farm origin inputs}]_t = [\text{Total production expenses}]_t - [\text{Farm origin input expenses}]_t$$

$$[\text{Total production expenses}]_t = [\text{Farm origin input expenses}]_t + [\text{Manufactured inputs expenses}]_t + [\text{Interest expenses}]_t + [\text{Other operating expenses}]_t + [\text{Overhead expenses}]_t$$

$$[\text{Labor perquisites}]_t = ([\text{Farm wage rates prices paid index}]_t/[\text{Farm wage rates prices paid index}]_{t-1} + [\text{Hired farm workers number}]_t/[\text{Hired farm workers number}]_{t-1} - 1)*[\text{Labor perquisites}]_{t-1}$$

$$[\text{Cash expenses}]_t = [\text{Total production expenses}]_t - [\text{Capital consumption}]_t - [\text{Labor perquisites}]_t - [\text{Operator dwelling expenses}]_t$$

Nonmoney Income and Farm-Related Income

$$[\text{Gross rental value of operator housing}]_t = 8.9875*[\text{Real estate assets}]_t$$

$$[\text{Home consumption}]_t = (2*[\text{Crop cash receipts}]_t + 8*[\text{Livestock cash receipts}]_t)/(2*[\text{Crop cash receipts}]_{t-1} + 8*[\text{Livestock cash receipts}]_{t-1})*[\text{Home consumption}]_{t-1}$$

$$[\text{Nonmoney income}]_t = [\text{Gross rental value of operator housing}]_t + [\text{Home consumption}]_t$$

$$[\text{Machine hire and custom work}]_t = ([\text{All crops output index}]_t/[\text{All crops output index}]_{t-1} + [\text{Parity index}]_t/[\text{Parity index}]_{t-1} - 1)*[\text{Machine hire and custom work}]_t$$

$$[\text{Forest products}]_t = ([\text{Greenhouse cash receipts}]_t/[\text{Greenhouse cash receipts}]_{t-1} + [\text{Building and fencing prices paid index}]_t/[\text{Building and fencing prices paid index}]_{t-1} - 1)*[\text{Forest products}]_{t-1}$$

$$[\text{Miscellaneous farm related income}]_t = ([\text{Cattle \& calves total supply}]_t/[\text{Cattle \& calves total supply}]_{t-1} + [\text{GDP deflator 1987=100}]_t/[\text{GDP deflator 1987=100}]_t - 1)*[\text{Miscellaneous farm related income}]_{t-1}$$

$$[\text{Farm related income}]_t = [\text{Machine hire and custom work}]_t + [\text{Forest products}]_t + [\text{Miscellaneous farm related income}]_t$$

Net Income Statements

$[\text{Gross cash income}]_t = [\text{Cash receipts}]_t + [\text{Direct Government payments}]_t + [\text{Farm-related income}]_t$

$[\text{Net cash income}]_t = [\text{Gross cash income}]_t - [\text{Cash expenses}]_t$

$[\text{Net cash income \$1987}]_t = [\text{Net cash income}]_t / [\text{GDP deflator}]_t * 100$

$[\text{Total gross income}]_t = [\text{Gross cash income}]_t + [\text{Nonmoney income}]_t + [\text{Value of change of inventory}]_t$

$[\text{Net farm income}]_t = [\text{Total gross income}]_t - [\text{Total expenses}]_t$

$[\text{Net farm income \$1987}]_t = [\text{Net farm income}]_t / [\text{GDP deflator}]_t * 100$

Farm Output Indexes, 1977=100

$[\text{Food grains output index}]_t = ([\text{Wheat production}]_t * 2670 + [\text{Rice production}]_t * 8160 + [\text{Rye production}]_t * 2160) / 63069$

$[\text{Feed grains output index}]_t = [\text{Feed grains output index}]_{t-1} * ([\text{Corn production}]_t * 214 + [\text{Sorghum production}]_t * 194 + [\text{Oat production}]_t * 125 + [\text{Barley production}]_t * 196) / ([\text{Corn production}]_{t-1} * 214 + [\text{Sorghum production}]_{t-1} * 194 + [\text{Oat production}]_{t-1} * 125 + [\text{Barley production}]_{t-1} * 196)$

$[\text{Hay and forage output index}]_t = [\text{Hay production}]_t / [\text{Hay production}]_{t-1} * [\text{Hay and forage output index}]_{t-1}$

$[\text{Oil crops output index}]_t = ([\text{Soybean production}]_t * 6420 + [\text{Peanut production}]_t * 207 + [\text{Flaxseed production}]_t * 5510 + [\text{Cottonseed production}]_t * 93.37 + [\text{Sunflowerseed production}]_t * 106) / 130017$

$[\text{Cotton output index}]_t = [\text{Cotton production}]_t / [\text{Cotton production}]_{t-1} * [\text{Cotton output index}]_{t-1}$

$[\text{Tobacco output index}]_t = [\text{Tobacco production}]_t * 0.0522429947$

$[\text{Vegetables output index}]_t = [\text{Vegetables output index}]_{t-1} * [\text{Other vegetables production index}]_t / [\text{Other vegetables production index}]_{t-1}$

$[\text{Sugar crops output index}]_t = ([\text{Sugarcane production}]_t + [\text{Sugarbeet production}]_t) / 518.37$

$[\text{All crops output index}]_t = [\text{Feed grains output index}]_t * 0.289 + [\text{Hay \& forage output index}]_t * 0.119 + [\text{Food grains output index}]_t * 0.11 + [\text{Vegetable output index}]_t * 0.071 + [\text{Fruits and nuts output index}]_t * 0.074 + [\text{Sugar crops output index}]_t * 0.017 + [\text{Cotton output index}]_t * 0.064 + [\text{Tobacco output index}]_t * 0.037 + [\text{Oil crops output index}]_t * 0.219$

$[\text{Meat animals output index}]_t = ([\text{Beef production}]_t + [\text{Veal production}]_t + [\text{Pork production}]_t * 2 + [\text{Sheep and lamb production}]_t) / ([\text{Beef production}]_{t-1} + [\text{Veal production}]_{t-1} + [\text{Pork production}]_{t-1} * 2 + [\text{Sheep and lamb production}]_{t-1}) * [\text{Meat animals output index}]_{t-1}$

$[\text{Poultry and eggs output index}]_t = (([\text{Broiler production}]_t + [\text{Other chicken production}]_t + [\text{Turkey production}]_t + [\text{Egg production}]_t * 1.57) / ([\text{Broiler production}]_{t-1} + [\text{Other chicken production}]_{t-1} + [\text{Turkey production}]_{t-1} + [\text{Egg production}]_{t-1} * 1.57)) * [\text{Poultry and eggs output index}]_{t-1}$

$[\text{Dairy products output index}]_t = ([\text{Milk production}]_t / [\text{Milk production}]_{t-1}) * [\text{dairy products output index}]_{t-1}$

$[\text{All livestock output index}]_t = [\text{Meat animals output index}]_t * 0.562 + [\text{Poultry and eggs output index}]_t * 0.168 + [\text{Dairy products output index}]_t * 0.264$

$[\text{Total farm output index}]_t = [\text{All crops output index}]_t * 0.5 + [\text{All livestock output index}]_t * 0.5$

Select Balance Sheet and Farm Income Ratios

$[\text{Debt/cash income ratio}]_t = [\text{Farm debt excluding households}]_t / [\text{Net cash income}]_{t-1}$

$[\text{Times interest earned}]_t = [\text{Net cash income}]_t / [\text{Total interest expenses}]_t$

$[\text{Assets/cash receipts ratio}]_t = [\text{Farm assets excluding households}]_t / [\text{Cash receipts}]_t$

$[\text{Debt/cash receipts ratio}]_t = [\text{Farm debt excluding households}]_t / [\text{Cash receipts}]_t$

Cash Receipts at Seasonally Adjusted Annual Rates

$$[\text{Crop open mkt sales, SAAR}]_{Q1,t} = [\text{Crop open mkt sales}]_t + ([\text{Crop open mkt sales}]_{t-3}/[\text{Crop open mkt sales}]_{Q1,t-3} + [\text{Crop open mkt sales}]_{t-2}/[\text{Crop open mkt sales}]_{Q1,t-2} + [\text{Crop open mkt sales}]_{t-1}/[\text{Crop open mkt sales}]_{Q1,t-1})/4 * [\text{Crop open mkt sales}]_{Q1,t} - ([\text{Crop open mkt sales}]_{t-3}/[\text{Crop open mkt sales}]_{Q2,t-3} + [\text{Crop open mkt sales}]_{t-2}/[\text{Crop open mkt sales}]_{Q2,t-2} + [\text{Crop open mkt sales}]_{t-1}/[\text{Crop open mkt sales}]_{Q2,t-1})/12 * [\text{Crop open mkt sales}]_{Q2,t} - ([\text{Crop open mkt sales}]_{t-3}/[\text{Crop open mkt sales}]_{Q3,t-3} + [\text{Crop open mkt sales}]_{t-2}/[\text{Crop open mkt sales}]_{Q3,t-2} + [\text{Crop open mkt sales}]_{t-1}/[\text{Crop open mkt sales}]_{Q3,t-1})/12 * [\text{Crop open mkt sales}]_{Q3,t} - ([\text{Crop open mkt sales}]_{t-3}/[\text{Crop open mkt sales}]_{Q4,t-3} + [\text{Crop open mkt sales}]_{t-2}/[\text{Crop open mkt sales}]_{Q4,t-2} + [\text{Crop open mkt sales}]_{t-1}/[\text{Crop open mkt sales}]_{Q4,t-1})/12 * [\text{Crop open mkt sales}]_{Q4,t}$$

$$[\text{Crop open mkt sales, SAAR}]_{Q2,t} = [\text{Crop open mkt sales}]_t - ([\text{Crop open mkt sales}]_{t-3}/[\text{Crop open mkt sales}]_{Q1,t-3} + [\text{Crop open mkt sales}]_{t-2}/[\text{Crop open mkt sales}]_{Q2,t-2} + [\text{Crop open mkt sales}]_{t-1}/[\text{Crop open mkt sales}]_{Q1,t-1})/12 * [\text{Crop open mkt sales}]_{Q1,t} + ([\text{Crop open mkt sales}]_{t-3}/[\text{Crop open mkt sales}]_{Q2,t-3} + [\text{Crop open mkt sales}]_{t-2}/[\text{Crop open mkt sales}]_{Q2,t-2} + [\text{Crop open mkt sales}]_{t-1}/[\text{Crop open mkt sales}]_{Q2,t-1})/4 * [\text{Crop open mkt sales}]_{Q2,t} - ([\text{Crop open mkt sales}]_{t-3}/[\text{Crop open mkt sales}]_{Q3,t-3} + [\text{Crop open mkt sales}]_{t-2}/[\text{Crop open mkt sales}]_{Q3,t-2} + [\text{Crop open mkt sales}]_{t-1}/[\text{Crop open mkt sales}]_{Q3,t-1})/12 * [\text{Crop open mkt sales}]_{Q3,t} - ([\text{Crop open mkt sales}]_{t-3}/[\text{Crop open mkt sales}]_{Q4,t-3} + [\text{Crop open mkt sales}]_{t-2}/[\text{Crop open mkt sales}]_{Q4,t-2} + [\text{Crop open mkt sales}]_{t-1}/[\text{Crop open mkt sales}]_{Q4,t-1})/12 * [\text{Crop open mkt sales}]_{Q4,t}$$

$$[\text{Crop open mkt sales, SAAR}]_{Q3,t} = [\text{Crop open mkt sales}]_t - ([\text{Crop open mkt sales}]_{t-3}/[\text{Crop open mkt sales}]_{Q1,t-3} + [\text{Crop open mkt sales}]_{t-2}/[\text{Crop open mkt sales}]_{Q2,t-2} + [\text{Crop open mkt sales}]_{t-1}/[\text{Crop open mkt sales}]_{Q1,t-1})/12 * [\text{Crop open mkt sales}]_{Q1,t} - ([\text{Crop open mkt sales}]_{t-3}/[\text{Crop open mkt sales}]_{Q2,t-3} + [\text{Crop open mkt sales}]_{t-2}/[\text{Crop open mkt sales}]_{Q2,t-2} + [\text{Crop open mkt sales}]_{t-1}/[\text{Crop open mkt sales}]_{Q2,t-1})/12 * [\text{Crop open mkt sales}]_{Q2,t} + ([\text{Crop open mkt sales}]_{t-3}/[\text{Crop open mkt sales}]_{Q3,t-3} + [\text{Crop open mkt sales}]_{t-2}/[\text{Crop open mkt sales}]_{Q3,t-2} + [\text{Crop open mkt sales}]_{t-1}/[\text{Crop open mkt sales}]_{Q3,t-1})/4 * [\text{Crop open mkt sales}]_{Q3,t} - ([\text{Crop open mkt sales}]_{t-3}/[\text{Crop open mkt sales}]_{Q4,t-3} + [\text{Crop open mkt sales}]_{t-2}/[\text{Crop open mkt sales}]_{Q4,t-2} + [\text{Crop open mkt sales}]_{t-1}/[\text{Crop open mkt sales}]_{Q4,t-1})/12 * [\text{Crop open mkt sales}]_{Q4,t}$$

$$[\text{Crop open mkt sales, SAAR}]_{Q4,t} = [\text{Crop open mkt sales}]_t - ([\text{Crop open mkt sales}]_{t-3}/[\text{Crop open mkt sales}]_{Q1,t-3} + [\text{Crop open mkt sales}]_{t-2}/[\text{Crop open mkt sales}]_{Q2,t-2} + [\text{Crop open mkt sales}]_{t-1}/[\text{Crop open mkt sales}]_{Q1,t-1})/12 * [\text{Crop open mkt sales}]_{Q1,t} - ([\text{Crop open mkt sales}]_{t-3}/[\text{Crop open mkt sales}]_{Q2,t-3} + [\text{Crop open mkt sales}]_{t-2}/[\text{Crop open mkt sales}]_{Q2,t-2} + [\text{Crop open mkt sales}]_{t-1}/[\text{Crop open mkt sales}]_{Q2,t-1})/12 * [\text{Crop open mkt sales}]_{Q2,t} - ([\text{Crop open mkt sales}]_{t-3}/[\text{Crop open mkt sales}]_{Q3,t-3} + [\text{Crop open mkt sales}]_{t-2}/[\text{Crop open mkt sales}]_{Q3,t-2} + [\text{Crop open mkt sales}]_{t-1}/[\text{Crop open mkt sales}]_{Q3,t-1})/12 * [\text{Crop open mkt sales}]_{Q3,t} + ([\text{Crop open mkt sales}]_{t-3}/[\text{Crop open mkt sales}]_{Q4,t-3} + [\text{Crop open mkt sales}]_{t-2}/[\text{Crop open mkt sales}]_{Q4,t-2} + [\text{Crop open mkt sales}]_{t-1}/[\text{Crop open mkt sales}]_{Q4,t-1})/4 * [\text{Crop open mkt sales}]_{Q4,t}$$

$$[\text{Net CCC payments, SAAR}]_{Q1} = [\text{Net CCC payments}]_{Q1,t} + [\text{Net CCC payments}]_t * 3/4 + ([\text{Net CCC payments}]_{t-3} + [\text{Net CCC payments}]_{t-2} + [\text{Net CCC payments}]_{t-1}) - ([\text{Net CCC payments}]_{Q1,t-3} + [\text{Net CCC payments}]_{Q1,t-2} + [\text{Net CCC payments}]_{Q1,t-1}) * 4)/3$$

$$[\text{Net CCC payments, SAAR}]_{Q2} = [\text{Net CCC payments}]_{Q2,t} + [\text{Net CCC payments}]_t * 3/4 + ([\text{Net CCC payments}]_{t-3} + [\text{Net CCC payments}]_{t-2} + [\text{Net CCC payments}]_{t-1}) - ([\text{Net CCC payments}]_{Q2,t-3} + [\text{Net CCC payments}]_{Q2,t-2} + [\text{Net CCC payments}]_{Q2,t-1}) * 4)/3$$

$$[\text{Net CCC payments, SAAR}]_{Q3} = [\text{Net CCC payments}]_{Q3,t} + [\text{Net CCC payments}]_t * 3/4 + ([\text{Net CCC payments}]_{t-3} + [\text{Net CCC payments}]_{t-2} + [\text{Net CCC payments}]_{t-1}) - ([\text{Net CCC payments}]_{Q3,t-3} + [\text{Net CCC payments}]_{Q3,t-2} + [\text{Net CCC payments}]_{Q3,t-1}) * 4)/3$$

$$[\text{Net CCC payments, SAAR}]_{Q4} = [\text{Net CCC payments}]_{Q4,t} + [\text{Net CCC payments}]_t * 3/4 + ([\text{Net CCC payments}]_{t-3} + [\text{Net CCC payments}]_{t-2} + [\text{Net CCC payments}]_{t-1}) - ([\text{Net CCC payments}]_{Q4,t-3} + [\text{Net CCC payments}]_{Q4,t-2} + [\text{Net CCC payments}]_{Q4,t-1}) * 4)/3$$

$$[\text{Crop cash receipts, SAAR}]_{Q1} = [\text{Crop open mkt sales, SAAR}]_{Q1} + [\text{Net CCC payments, SAAR}]_{Q1}$$

$$[\text{Crop cash receipts, SAAR}]_{Q2} = [\text{Crop open mkt sales, SAAR}]_{Q2} + [\text{Net CCC payments, SAAR}]_{Q2}$$

$$[\text{Crop cash receipts, SAAR}]_{Q3} = [\text{Crop open mkt sales, SAAR}]_{Q3} + [\text{Net CCC payments, SAAR}]_{Q3}$$

$$[\text{Crop cash receipts, SAAR}]_{Q4} = [\text{Crop open mkt sales, SAAR}]_{Q4} + [\text{Net CCC payments, SAAR}]_{Q4}$$

$$[\text{Livestock receipts, SAAR}]_{Q1,t} = [\text{Livestock receipts}]_t + ([\text{Livestock receipts}]_{t-3}/[\text{Livestock receipts}]_{Q1,t-3} + [\text{Livestock receipts}]_{t-2}/[\text{Livestock receipts}]_{Q1,t-2} + [\text{Livestock receipts}]_{t-1}/[\text{Livestock receipts}]_{Q1,t-1})/4 * [\text{Livestock receipts}]_{Q1,t} - ([\text{Livestock receipts}]_{t-3}/[\text{Livestock receipts}]_{Q2,t-3} + [\text{Livestock receipts}]_{t-2}/[\text{Livestock receipts}]_{Q2,t-2} + [\text{Livestock receipts}]_{t-1}/[\text{Livestock receipts}]_{Q2,t-1})/12 * [\text{Livestock receipts}]_{Q2,t} - ([\text{Livestock receipts}]_{t-3}/[\text{Livestock receipts}]_{Q3,t-3} + [\text{Livestock receipts}]_{t-2}/[\text{Livestock receipts}]_{Q3,t-2} + [\text{Livestock receipts}]_{t-1}/[\text{Livestock receipts}]_{Q3,t-1})/12 * [\text{Livestock receipts}]_{Q3,t} - ([\text{Livestock receipts}]_{t-3}/[\text{Livestock receipts}]_{Q4,t-3} + [\text{Livestock receipts}]_{t-2}/[\text{Livestock receipts}]_{Q4,t-2} + [\text{Livestock receipts}]_{t-1}/[\text{Livestock receipts}]_{Q4,t-1})/12 * [\text{Livestock receipts}]_{Q4,t}$$

$$[\text{Livestock receipts, SAAR}]_{Q2,t} = [\text{Livestock receipts}]_t - ([\text{Livestock receipts}]_{t-3}/[\text{Livestock receipts}]_{Q1,t-3} + [\text{Livestock receipts}]_{t-2}/[\text{Livestock receipts}]_{Q2,t-2} + [\text{Livestock receipts}]_{t-1}/[\text{Livestock receipts}]_{Q1,t-1})/12 * [\text{Livestock receipts}]_{Q1,t} + ([\text{Livestock receipts}]_{t-3}/[\text{Livestock receipts}]_{Q2,t-3} + [\text{Livestock receipts}]_{t-2}/[\text{Livestock receipts}]_{Q2,t-2} + [\text{Livestock receipts}]_{t-1}/[\text{Livestock receipts}]_{Q2,t-1})/4 * [\text{Livestock receipts}]_{Q2,t} - ([\text{Livestock receipts}]_{t-3}/[\text{Livestock receipts}]_{Q3,t-3} + [\text{Livestock receipts}]_{t-2}/[\text{Livestock receipts}]_{Q3,t-2} + [\text{Livestock receipts}]_{t-1}/[\text{Livestock receipts}]_{Q3,t-1})/12 * [\text{Livestock receipts}]_{Q3,t} - ([\text{Livestock receipts}]_{t-3}/[\text{Livestock receipts}]_{Q4,t-3} + [\text{Livestock receipts}]_{t-2}/[\text{Livestock receipts}]_{Q4,t-2} + [\text{Livestock receipts}]_{t-1}/[\text{Livestock receipts}]_{Q4,t-1})/12 * [\text{Livestock receipts}]_{Q4,t}$$

$$[\text{Livestock receipts, SAAR}]_{Q3,t} = [\text{Livestock receipts}]_t - ([\text{Livestock receipts}]_{t-3}/[\text{Livestock receipts}]_{Q1,t-3} + [\text{Livestock receipts}]_{t-2}/[\text{Livestock receipts}]_{Q2,t-2} + [\text{Livestock receipts}]_{t-1}/[\text{Livestock receipts}]_{Q1,t-1})/12 * [\text{Livestock receipts}]_{Q1,t} - ([\text{Livestock receipts}]_{t-3}/[\text{Livestock receipts}]_{Q2,t-3} + [\text{Livestock receipts}]_{t-2}/[\text{Livestock receipts}]_{Q2,t-2} + [\text{Livestock receipts}]_{t-1}/[\text{Livestock receipts}]_{Q2,t-1})/12 * [\text{Livestock receipts}]_{Q2,t} + ([\text{Livestock receipts}]_{t-3}/[\text{Livestock receipts}]_{Q3,t-3} + [\text{Livestock receipts}]_{t-2}/[\text{Livestock receipts}]_{Q3,t-2} + [\text{Livestock receipts}]_{t-1}/[\text{Livestock receipts}]_{Q3,t-1})/4 * [\text{Livestock receipts}]_{Q3,t} - ([\text{Livestock receipts}]_{t-3}/[\text{Livestock receipts}]_{Q4,t-3} + [\text{Livestock receipts}]_{t-2}/[\text{Livestock receipts}]_{Q4,t-2} + [\text{Livestock receipts}]_{t-1}/[\text{Livestock receipts}]_{Q4,t-1})/12 * [\text{Livestock receipts}]_{Q4,t}$$

$$[\text{Livestock receipts, SAAR}]_{Q4,t} = [\text{Livestock receipts}]_t - ([\text{Livestock receipts}]_{t-3}/[\text{Livestock receipts}]_{Q1,t-3} + [\text{Livestock receipts}]_{t-2}/[\text{Livestock receipts}]_{Q2,t-2} + [\text{Livestock receipts}]_{t-1}/[\text{Livestock receipts}]_{Q1,t-1})/12 * [\text{Livestock receipts}]_{Q1,t} - ([\text{Livestock receipts}]_{t-3}/[\text{Livestock receipts}]_{Q2,t-3} + [\text{Livestock receipts}]_{t-2}/[\text{Livestock receipts}]_{Q2,t-2} + [\text{Livestock receipts}]_{t-1}/[\text{Livestock receipts}]_{Q2,t-1})/12 * [\text{Livestock receipts}]_{Q2,t} - ([\text{Livestock receipts}]_{t-3}/[\text{Livestock receipts}]_{Q3,t-3} + [\text{Livestock receipts}]_{t-2}/[\text{Livestock receipts}]_{Q3,t-2} + [\text{Livestock receipts}]_{t-1}/[\text{Livestock receipts}]_{Q3,t-1})/12 * [\text{Livestock receipts}]_{Q3,t} + ([\text{Livestock receipts}]_{t-3}/[\text{Livestock receipts}]_{Q4,t-3} + [\text{Livestock receipts}]_{t-2}/[\text{Livestock receipts}]_{Q4,t-2} + [\text{Livestock receipts}]_{t-1}/[\text{Livestock receipts}]_{Q4,t-1})/4 * [\text{Livestock receipts}]_{Q4,t}$$

$$[\text{Total cash receipts, SAAR}]_{Q1} = [\text{Crop cash receipts, SAAR}]_{Q1} + [\text{Livestock receipts, SAAR}]_{Q1}$$

$$[\text{Total cash receipts, SAAR}]_{Q2} = [\text{Crop cash receipts, SAAR}]_{Q2} + [\text{Livestock receipts, SAAR}]_{Q2}$$

$$[\text{Total cash receipts, SAAR}]_{Q3} = [\text{Crop cash receipts, SAAR}]_{Q3} + [\text{Livestock receipts, SAAR}]_{Q3}$$

$$[\text{Total cash receipts, SAAR}]_{Q4} = [\text{Crop cash receipts, SAAR}]_{Q4} + [\text{Livestock receipts, SAAR}]_{Q4}$$

Regional Income Estimates

R = Northeast, Midwest, Southeast, Southcentral, or West

$$[\text{Crop cash receipts}]_{R,t} = [\text{Food grains cash receipts}]_t * [\%\text{ of U.S. Food grains cash receipts}]_{R,t} + [\text{Feed crops cash receipts}]_t * [\%\text{ of U.S. Feed crops cash receipts}]_{R,t} + [\text{Oil crops cash receipts}]_t * [\%\text{ of U.S. Oil crops cash receipts}]_{R,t} + [\text{Cotton cash receipts}]_t * [\%\text{ of U.S. Cotton cash receipts}]_{R,t} + [\text{Vegetable cash receipts}]_t * [\%\text{ of U.S. Vegetable crops cash receipts}]_{R,t} + [\text{Tobacco cash receipts}]_t * [\%\text{ of U.S. Tobacco crops cash receipts}]_{R,t} + [\text{Fruits and nuts cash receipts}]_t * [\%\text{ of U.S. Fruits and nuts cash receipts}]_{R,t} + ([\text{Greenhouse cash receipts}]_t + [\text{Other crops cash receipts}]_t) * [\%\text{ of U.S. Other crops cash receipts}]_{R,t}$$

$$[\text{Livestock cash receipts}]_{R,t} = [\text{Meat animals cash receipts}]_t * [\%\text{ of U.S. Meat animals cash receipts}]_{R,t} + [\text{Poultry and eggs cash receipts}]_t * [\%\text{ of U.S. Poultry and eggs cash receipts}]_{R,t} + [\text{Dairy cash receipts}]_t * [\%\text{ of U.S. Dairy cash receipts}]_{R,t} + [\text{Other livestock cash receipts}]_t * [\%\text{ of U.S. Other livestock cash receipts}]_{R,t}$$

$$[\text{Government payments}]_{R,t} = [\text{Feed grains payments}]_t * [\%\text{ of U.S. Feed grains payments}]_{R,t} + [\text{Wheat payments}]_t * [\%\text{ of U.S. Wheat payments}]_{R,t} + [\text{Rice payments}]_t * [\%\text{ of U.S. Rice payments}]_{R,t} + [\text{Cotton payments}]_t * [\%\text{ of U.S. Cotton payments}]_{R,t} + [\text{Wool payments}]_t * [\%\text{ of U.S. Wool payments}]_{R,t} + [\text{Conservation payments}]_t * [\%\text{ of U.S. Conservation payments}]_{R,t} + [\text{Dairy payments}]_t * [\%\text{ of U.S. Dairy cash receipts}]_{R,t} + ([\text{Reserve storage}]_t + [\text{Disaster assistance}]_t + [\text{Other programs}]_t) * [\%\text{ of U.S. Other payments}]_{R,t}$$

$$[\text{Farm related income}]_{R,t} = [\text{Machine hire \& custom work}]_t*[\%\text{ of U.S. Machine Hire \& custom work}]_{R,t} + [\text{Forest products}]_t*[\%\text{ of U.S. Forest products}]_{R,t} + [\text{Misc. farm related income}]_t*[\%\text{ of U.S. Other farm income}]_{R,t}$$

$$[\text{Gross cash income}]_{R,t} = [\text{Crop cash receipts}]_{R,t} + [\text{Livestock cash receipts}]_{R,t} + [\text{Government payments}]_{R,t} + [\text{Farm related income}]_{R,t}$$

$$[\text{Cash expenses}]_{R,t} = [\text{Feed expenses}]_t*[\%\text{ of U.S. Feed expenses}]_{R,t} + [\text{Feeder livestock expenses}]_t*[\%\text{ of U.S. Feeder livestock expenses}]_{R,t} + [\text{Seed expenses}]_t*[\%\text{ of U.S. Seed expenses}]_{R,t} + [\text{Fertilizer expenses}]_t*[\%\text{ of U.S. Fertilizer expenses}]_{R,t} + [\text{Fuel and oils expenses}]_t*[\%\text{ of U.S. Fuels and oils expenses}]_{R,t} + [\text{Electricity expenses}]_t*[\%\text{ of U.S. Electricity expenses}]_{R,t} + [\text{Agricultural chemicals expenses}]_t*[\%\text{ of U.S. Agricultural chemicals expenses}]_{R,t} + [\text{Short-term interest expenses}]_t*[\%\text{ of U.S. Short-term interest expenses}]_{R,t} + [\text{Real estate interest expenses}]_t*[\%\text{ of U.S. Real estate interest expenses}]_{R,t} + [\text{Repair and maintenance expenses}]_t*[\%\text{ of U.S. Repair and maintenance expenses}]_{R,t} + [\text{Hired labor expenses}]_t*[\%\text{ of U.S. Hired labor expenses}]_{R,t} + [\text{Machine hire \& custom work expenses}]_t*[\%\text{ of U.S. Machine hire \& custom work expenses}]_{R,t} + [\text{Business taxes expenses}]_t*[\%\text{ of U.S. Business taxes expenses}]_{R,t} + [\text{Net rent to non-operator landlords}]_t*[\%\text{ of U.S. Net rent to non-operator landlords}]_{R,t} + ([\text{Misc. operating expenses}]_t + [\text{Marketing, storage, \& transportation expenses}]_t + [\text{Animal health expenses}]_t)*[\%\text{ of U.S. Other expenses}]_{R,t}$$

$$[\text{Net cash income}]_{R,t} = [\text{Gross cash income}]_{R,t} - [\text{Cash expenses}]_{R,t}$$

Farm-Type Income Estimates

F = Cash grains, Cotton, Tobacco, Fruits and vegetables, Greenhouse and nursery, Red meats, Poultry and eggs, Dairy, Other farms, All crop farms, or All livestock farms

$$[\text{Crop cash receipts}]_{F,t} = [\text{Food grains cash receipts}]_t*[\%\text{ of U.S. Food grains cash receipts}]_{F,t} + [\text{Feed crops cash receipts}]_t*[\%\text{ of U.S. Feed crops cash receipts}]_{F,t} + [\text{Oil crops cash receipts}]_t*[\%\text{ of U.S. Oil crops cash receipts}]_{F,t} + [\text{Cotton cash receipts}]_t*[\%\text{ of U.S. Cotton cash receipts}]_{F,t} + [\text{Vegetable cash receipts}]_t*[\%\text{ of U.S. Vegetable crops cash receipts}]_{F,t} + [\text{Tobacco cash receipts}]_t*[\%\text{ of U.S. Tobacco crops cash receipts}]_{F,t} + [\text{Fruits and nuts cash receipts}]_t*[\%\text{ of U.S. Fruits and nuts cash receipts}]_{F,t} + ([\text{Greenhouse cash receipts}]_t + [\text{Other crops cash receipts}]_t)*[\%\text{ of U.S. Other crops cash receipts}]_{F,t}$$

$$[\text{Livestock cash receipts}]_{F,t} = ([\text{Cattle cash receipts}]_t + [\text{Calves cash receipts}]_t)*[\%\text{ of U.S. Cattle and calves cash receipts}]_{F,t} + [\text{Hog cash receipts}]_t*[\%\text{ of U.S. Hog cash receipts}]_{F,t} + [\text{Sheep cash receipts}]_t*[\%\text{ of U.S. Sheep cash receipts}]_{F,t} + [\text{Dairy cash receipts}]_t*[\%\text{ of U.S. Dairy cash receipts}]_{F,t} + [\text{Poultry and eggs cash receipts}]_t*[\%\text{ of U.S. Poultry and eggs cash receipts}]_{F,t} + [\text{Other livestock cash receipts}]_t*[\%\text{ of U.S. Other livestock cash receipts}]_{F,t}$$

$$[\text{Government payments}]_{F,t} = [\text{Government payments}]_t*[\%\text{ of U.S. Government payments}]_{F,t}$$

$$[\text{Gross cash income}]_{F,t} = [\text{Crop cash receipts}]_{F,t} + [\text{Livestock cash receipts}]_{F,t} + [\text{Government payments}]_{F,t} + [\text{Farm related income}]_t*[\%\text{ of U.S. Farm related income}]_{F,t}$$

$$[\text{Cash expenses}]_{F,t} = [\text{Feed expenses}]_t*[\%\text{ of U.S. Feed expenses}]_{F,t} + [\text{Feeder livestock expenses}]_t*[\%\text{ of U.S. Feeder livestock expenses}]_{F,t} + [\text{Seed expenses}]_t*[\%\text{ of U.S. Seed expenses}]_{F,t} + [\text{Fertilizer expenses}]_t*[\%\text{ of U.S. Fertilizer expenses}]_{F,t} + ([\text{Fuel and oils expenses}]_t + [\text{Electricity expenses}]_t)*[\%\text{ of U.S. Energy expenses}]_{F,t} + [\text{Agricultural chemicals expenses}]_t*[\%\text{ of U.S. Agricultural chemicals expenses}]_{F,t} + [\text{Short-term interest expenses}]_t*[\%\text{ of U.S. Short-term interest expenses}]_{F,t} + [\text{Real estate interest expenses}]_t*[\%\text{ of U.S. Real estate interest expenses}]_{F,t} + [\text{Repair and maintenance expenses}]_t*[\%\text{ of U.S. Repair and maintenance expenses}]_{F,t} + ([\text{Hired labor expenses}]_t - [\text{Labor perquisites}]_t)*[\%\text{ of U.S. Hired labor expenses}]_{F,t} + [\text{Machine hire \& custom work expenses}]_t*[\%\text{ of U.S. Machine hire \& custom work expenses}]_{F,t} + [\text{Business taxes expenses}]_t*[\%\text{ of U.S. Business taxes expenses}]_{F,t} + ([\text{Net rent to non-operator landlords}]_t*[\%\text{ of U.S. Net rent to non-operator landlords}]_{F,t} + [\text{Misc. operating expenses}]_t + [\text{Marketing, storage, \& transportation expenses}]_t + [\text{Animal health expenses}]_t - [\text{Operator dwelling expenses}]_t)*[\%\text{ of U.S. Other expenses}]_{F,t}$$

$$[\text{Net cash income}]_{F,t} = [\text{Gross cash income}]_{F,t} - [\text{Cash expenses}]_{F,t}$$

$$[\text{Real estate assets}]_{F,t} = [\text{Real estate assets}]_t*[\%\text{ of U.S. Real estate assets}]_{F,t}$$

$$[\text{Nonreal estate assets}]_{F,t} = [\text{Nonreal estate assets}]_t*[\%\text{ of U.S. Nonreal estate assets}]_{F,t}$$

$$[\text{Debt}]_{F,t} = [\text{Debt}]_t*[\%\text{ of U.S. Debt}]_{F,t}$$

$$[\text{Debt-to-asset ratio}]_{F,t} = [\text{Liabilities}]_{F,t}/([\text{Real estate assets}]_{F,t} + [\text{Nonreal estate assets}]_{F,t})$$

$$[\text{Number of farms}]_{F,t} = [\text{Number of farms}]_t*[\%\text{ of U.S. farms}]_{F,t}$$

U.S. Department of Agriculture
Economic Research Service

SUMMARY OF REPORT

Farm Sector Financial Health Improved

Number 24, June 1993

Contact: Ken Erickson, 202-219-0798

The U.S. farm economy was in a much better financial position in 1991 than during the early- to mid-1980's, according to a series of financial ratios compiled by the U.S. Department of Agriculture's Economic Research Service.

The level of farm debt as a percentage of farm equity was down in 1991 compared with the 1980's, rates of return on farm assets were up, the sector was using its resources more efficiently, and farmers could more easily repay their debts out of income without having to dip into savings or go further into debt.

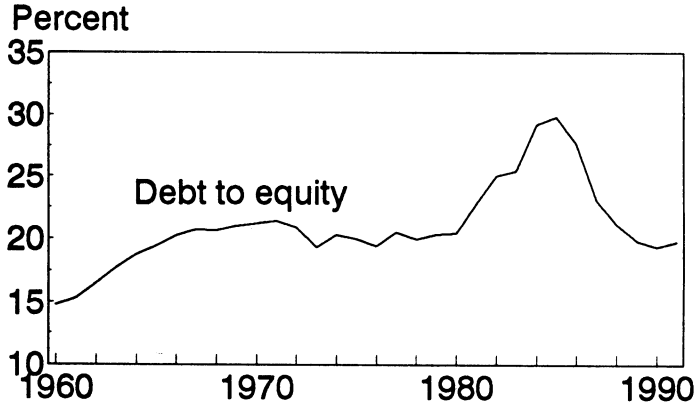
The ratios are presented in the report, *U.S. and State Farm Sector Financial Ratios, 1960-91*, published by USDA's Economic Research Service.

The ratios, compiled for the Nation as a whole as well as for each State, show:

Farm debt declined as a percentage of farm equity from 29.8 percent in 1985 to 19.7 percent in 1991. That shows that farm sector solvency improved as farmers' dependence on debt financing dropped.

U.S. farm debt as percentage of farm equity

Decline in farm debt-equity ratios from levels of early- to mid-1980's indicates improved farm solvency



Rates of return on farm assets have been positive since 1987, in contrast to the negative returns during the first half of the 1980's. Overall, farm sector investments have become profitable again.

The *asset turnover ratio,* which measures income generated per dollar of farm assets, has returned to the 20-percent range since 1986, after having fallen to the midteens in the early 1980's. That means that farmers are more efficiently using their assets.

The *debt-servicing ratio* fell by nearly half, from 0.28 in 1982 and 1983 to 0.16 in 1991. So farmers are better able to repay their debts, both interest and principal, out of current income.

The ratios varied, sometimes significantly, from one State to another. For example, the debt-servicing ratio ranged from a low of 0.09 in Alabama to a high of 0.20 in Montana. Alaska had the lowest debt-equity ratio, just over 0.042, while Mississippi and Delaware had the highest at 0.282. Lower debt-equity ratios generally indicate more favorable conditions.

To Order This Report...

Information presented here is excerpted from *U.S. and State Farm Sector Financial Ratios, 1960-91*, SB-857, by Kenneth Erickson, Janusz Kubica, Duane Hacklander, Charles Barnard, James Ryan, Helen Devlin, and Sean Chance. Cost is $15.00.

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SUMMARY OF REPORT

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Lower Expenses in 1991 Boosted Returns to Cow/Calf Producers

Number 20, June 1993

Contact: Ken Mathews, 202-219-1286

U.S. beef cow/calf producers had lower production costs in 1991 than in 1990, leading to a better bottom line, according to the U.S. Department of Agriculture's Economic Research Service. Producers' variable cash costs were down by about $20 per cow in 1991, while their cash receipts were up by more than $15. Despite those improvements, net cash returns (including capital expenditures) nationwide averaged out to a loss of more than $2 per cow. Both costs and returns varied widely by region and by the size of the operation.

Net cash returns were highest in the North Central region ($33.89 per cow) and the Great Plains ($27.39). Producers in the West and South averaged losses for the year. By size of operation, net cash returns were best ($80.76 per cow) for producers with 500-1,000 head. Producers with fewer than 100 head reported losses on a national average.

Regional differences depended on other agricultural activities in the regions. Feed in the North Central region was largely homegrown (feed costs can run up to half of a producer's total variable cash costs). Land charges were greater in the West and Great Plains because of more acres per cow. Cow herds were larger in the West and Great Plains, too. The South had the lowest cash receipts of all regions, partly because producers there sold fewer pounds of yearling cattle per cow.

Those estimates of costs and returns were recently published in *Cow/Calf Costs of Production, 1990-91* by the Economic Research Service. The data are based on operations with 20 or more cows that were surveyed with the cow/calf version of the 1990 Farm Costs and Returns Survey. Just over 98 percent of all U.S. beef cows were represented in the survey. The report includes national estimates as well as estimates for four regions and four size groups. In addition to reporting variable cash costs and net cash returns, the report also includes other accounting measures (such as cash expenses and capital expenditures, total economic costs, and residual returns) to help show a more complete picture of the overall income statement of cow/calf producers in 1990 and 1991.

To Order This Report...

The information presented here is excerpted from ***Cow/Calf Costs of Production, 1990-91,*** AIB-670, by Hosein Shapouri, Kenneth H. Mathews, Jr., and Pat Bailey. The cost is $9.00.

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