Dynamic Updating Procedures in the ASM for the RCA III

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This paper documents the dynamic updating procedures used to forecast agricultural production and demand growth for use in the Agricultural Sector Model (ASM). The purpose of this procedure is to forecast demand and production in the future as part of the RCA III project. These parameters were estimated econometrically for domestic demand, import demand, export demand, and yield. Also procedures were used to identify rates of change in agricultural input usage within crop and livestock production processes as yield increased. The following explains the estimations performed and presents the results.

The estimation of domestic demand was accomplished as follows. Four equations were originally estimated. They are as follows:

$$DDEMAND_{ti} = INT_i + \beta_{1i} DDEMAND_{t-1,i} + \varepsilon_{ti} \quad (1)$$

$$DDEMAND_{ti} = INT_i + \beta_{1i} GNP_t + \varepsilon_{ti} \quad (2)$$

$$DDEMAND_{ti} = INT_i + \beta_{1i} DDEMAND_{t-1,i} + \beta_{2i} GNP_t + \varepsilon_{ti} \quad (3)$$

$$DDEMAND_{ti} = INT + \beta_{1i} DDEMAND_{t-1,i} + \beta_{3i} (GNP_t / GNP_{t-1}) + \varepsilon_{ti} \quad (4)$$

where:

$DDEMAND_{ti}$ = Domestic Demand in year t for commodity i

GNP_{ti} = Gross National Product in year t

INT_i = intercept

α_{1i}, α_{2i} = coefficient

ε_{ti} = error term for commodity i in year t

t = time year 1,2,3...T

i = commodity estimated

Because of decreasing demands in some commodities over time, forecasts would potentially provide negative consumer demand. Therefore a fifth equation was estimated that was of exponential form to eliminate the possibility of negative demand. Equation (5) is presented below.

$$LOG(DDEMAND_{ti}) = INT_i + \alpha_{2i} GNP_t + \varepsilon_{ti} \quad (5)$$

The data used was a time series of domestic demand and GNP from 1950 to 1992. After performing the above estimates two equations provided the highest adjusted R^2 for all commodities. These were equations (2) and (3). Equation (3) dominates in providing the highest R^2 for the majority of commodities; however, at times equation (2) provides the best fit. Originally, population was added as one of the parameters in the forecasting equation. However, due to the collinearity between GNP and population, this term was removed. Again equation (5) was used for commodities with negative demand.

Export demands were estimated using the above equations. However, the equations giving the best fit were similar to equations (2), (3) and (5) are presented below:

$$EXDEMAND_{ti} = INT_{ti} + \alpha_1 EXDEMAND_{t-1,i} + GNP_{ti} + \varepsilon_{ti} \quad (6)$$

$$EXDEMAND_{,i} = INT_{ti} + \alpha_{2i} GNP_t + \varepsilon, \quad (7)$$

where: $$LOG(EXDEMAND_{ti}) = INT_{ti} + \beta_{2i} GNP_t + \varepsilon_{ti} \quad (8)$$

$EXDEMAND_{ti}$ = Export Demand in year t for commodity i

Import demands were also estimated using the form of the original five equations, again, three equations exhibited the best fit. These are:

$$IMDEMAND_{ti} = INT_{ti} + \beta_{1i} IMDEMAND_{t-1,i} + \beta_{2i} GNP_{ti} + \varepsilon_{ti} \quad (9)$$

$$IMDEMAND_{ti} = INT_{ti} + \beta_{2i} GNP_t + \varepsilon_t \quad (10)$$

$$LOG(IMDEMAND_{ti}) = INT_{ti} + \beta_{2i} GNP_t + \varepsilon_{ti} \quad (11)$$

where:

$IMDEMAND_{ti}$ = Import demand in year t for commodity i

The SAM is comprised of many secondary commodities that are processed forms of primary commodities. Also the primary commodities are processed into feeds. Therefore to capture the primary demand for a commodity the secondary demands must be established correctly as well as any residual demand not accounted for. The majority of this residual demand is in the demand for food products and must be estimated separately. An example is provided below.

Corn is a complex primary commodity in the model and will be used for the following example. First off corn has primary demand in livestock in the form of feeds. Therefore livestock demands will input the use of primary corn demand. Corn can also be wetmilled into starch, ethanol, corn oil, and corn syrup. The demands of these commodities must also be forecast to properly estimate corn. Cornstarch can also be converted to fructose corn syrup (HFCS). HFCS is an input into confectionary

goods, baked goods, beverages, and canned fruits and vegetables. Again these secondary commodity demands need to be estimated to impact primary corn demand. A residual amount of domestic corn demand will still be missed by the calculation. This residual would be from demand for corn meal, corn flakes, corn chips, and other industrial uses not accounted for in the models secondary commodities. Therefore, the demand for food usage of the commodities is used to estimate the demand for the residual amount.

The food usage regression equations were estimated using the above five equations. One equation provided the best estimates for all commodities. The equation estimated is presented below.

$$FOODDEMAND_{ti} = INT_{ti} + \beta_{1i} FOODDEMAND_{t-1,i} + \beta_{2i} GNP_t + \varepsilon_{ti}$$

where: $FOODDEMAND_{ti}$ = domestic food usage demand in year t of commodity i.

Table 1 provides a list of what equation and the sample size used for each estimation. Sample sizes vary for many of the secondary commodities due to consistency and date availability.
The results of the demand estimations are provided in Tables 2-6. This table also provides the adjusted R^2 for the estimated equations.

Several estimations are missing for the various commodities. Estimations were not preformed on nine essential commodities. This is due to the fact that their trends were not conducive to estimation. Figures 1 through 9 provide graphs of the data. Several factors contribute to forecast inability. ON the domestic demand estimate changes in tastes and preferences have occurred causing missed signals over time. On the import and export estimate changes in domestic and foreign policy have impacted these variables and therefore are not suitable to estimation through simple linear trends.

The above equations were solved providing the forecast estimate for any projected year.
The three versions of the forecast equation that have been made resident in ASM are reviewed below.

Note for convenience, in exposition, the i subscript (commodity) has been dropped.

$$DEMAND_t = \beta_1 + \beta_2 GNP_t + \beta_3 DEMAND_{t-1}$$

$$YDEMAND_{t+n} = \left[\beta_1 \left(\frac{1-\beta_3^{n+1}}{1-\beta_3}\right) + \beta_2 GNP_t (1+r)^n\right]$$

$$C\left[\frac{1-\left(\frac{1-\beta_3}{1+r}\right)^{n+1}}{1-\frac{\beta_3}{1+r}}\right] + \beta_3^{n+1} DEMAND_{t-1}$$

$$DEMAND_{t+n} = \beta_1 + \beta_2 GNP_t (1+r)^n \quad (2)$$

$$LOG(DEMAND_{t+n}) = \beta_1 + \beta_2 GNP_t (1+r)$$

where:

r = GNP growth rate

n = time period

Therefore, in order to forecast demand in a future time period, the year and assumed GNP growth rate needs to be provided.

Table 7.1 to 7.49 present the forecasted demands yearly from 1990 to 2050 resulting from the above estimated equations. Several items of importance need to be discussed concerning those forecasts. First, this estimation assumes a constant 4% GNP growth rate. The rate of growth in GNP during the 1982-1992 period was 5.38. This decreased slightly between the 1987-91 period to 4.83%, and dropped to 3.96% during the 1989-1992 period. Therefore an arbitrary rate of 4% was

chosen for expository purposes. This rate would have to be accurately calculated to arrive at a rate acceptable for the RCA analysis. Secondly, the forecast demands are estimated from an average base year. This base year is the average demand observed during the three year period of 1990 to 1992. A three year base period was used to avoid changes in demand in any one given year resulting form short supply or price pressures.

Yields were estimated using the following non-linear equation:

$$Yield_t = Yield_o (1+g)^t \quad (10)$$

where:

$Yield_t$ = commodity yield in year t

$Yield_o$ = commodity yield in base year

g = yearly growth rate of yield

The data used to estimate growth was a 1980 to 1992 time series of yields. Experimentation showed that yield projections are highly sensitive based upon the time periods used. Therefore an appropriate time period needs to be selected. The estimates of yields are provided in Table 8. A forecast of yields between 1990 and 2050 is provided in Table 9. Table 9 presents the percentage change in yield from a starting point of 1991 to the years 2010, 2030, and 2050. These are the cumulative rates of change based upon the above estimated yearly growth rates.

Input usages are also expected to change in these future scenarios. Therefore, input elasticities of the various inputs used in the model were calculated on a subregional basis. A short example is provided in Table 10 for Alabama cotton. As the table shows, changes in the fertilizer applications, custom operations, repair costs, etc. are all calculated and used to change input usage. These rates of change were calculated using Feds budgets and calculating an elasticity between the 1976 Fed budgets

and 1980 Fed budgets. Changes in animal input costs are set at a constant rate of 0.5 based on research results obtained from Evenson.

Inputs are believed to change in relation to changing yields. Therefore, the input changes are expressed as the base level of input times one plus the yield change minus one times the input change.

$$INPUT_t = INPUT_{Base} * \text{Elasticity } (1 + (YLDCHNG-1)*INPUTCHNG) \quad (11)$$

where:

$INPUT_{change}$ = elasticity * yield change

$INPUT_t$ = level of inputs used in production in year t

$INPUT_{Base}$ = base level of inputs

YLDCHNG = change in yields between present and future, based upon equation (10)

INPUTCHNG = elasticity of input change calculated using the Fed budgets

Profits are also adjusted and are in formula three:

$$PROFIT_t = PROFIT_{Base} * (1 + (YLDCHNG-1)) \quad (12)$$

where:

$PROFIT_t$ = level of profits in year t

$PROFIT_{Base}$ = base level of profits

Inputs and profits are believed to be a function of yield and marketing costs and other related costs are assumed to change as yields change.

The livestock yield and inputs change in a similar fashion, to crops; however, the feed usage is affected as described below:

$$FEED_t = FEED_{Base} *(1 + INPUTELAS*(YLDCHANGE - 1)) \quad (13)$$

where:

$FEED_t$ = level of feed used in production in year t

$FEED_{Base}$ = base level of feed used

INPUTELAS = the elasticity of input use of livestock feeds

The above relationship is used because it is felt as the yield of livestock changes it has a relationship to changes in feeding which has been expressed as a multiple of the feed input elasticity. This input elasticity may be changed based upon futuristic assumptions, but for now is assumed to be 1.0 based upon an assumption of constant feed efficiency.

This paper identifies parameters which need to be changed to accommodate the upcoming RCA analysis for the ASM. All of these parameters have been forecasted either econometrically or through estimated growth rates. These rates of change have been provided in the various tables. Currently work continues on demand for the livestock commodities contained in the ASM.

References

Evenson, R.E. “Adjusting Partial Factor Productivity Measures to Reflect Total Factor Productivity in U.S. Agriculture.” Staff Paper. Yale University, 1995.

Table 1. Estimated Commodity Equations and the Sample Size Used

Primary Commodities			
Item		Sample	Equation *
Egg	Domestic	1951-1992	I
	Export	1952-1992	I
	Import	1951-1992	I
Cotton	Domestic	1952-1992	I
	Export	1952-1992	I
	Import	1951-1988	III
	Yield per acre	1980-1992	IV
Oats	Domestic	1950-1992	III
	Export	1950-1992	III
	Import	1952-1992	I
	Yield per acre	1980-1992	IV
	Domestic use	1952-1992	III
	Food use	1950-1992	I

* Equation I : $Y_t = a + b*Y_{t-1} + c*GNP_t$

Equation II : $Y_t = a + c*GNP_t$

Equation III : $Log(Y_t) = a + c*GNP_t$

Equation IV : $Y^t = Y^0 * (1+r)_t$

Corn	Domestic	1952-1992	I
	Export	1952-1992	I
	Import	1950-1992	II
	Yield per acre	1980-1992	IV
	Domestic use	1952-1992	I
	Food use	1952-1992	I
Barley	Domestic	1952-1992	I
	Export	1952-1992	I
	Import	1950-1992	III
	Yield per acre	1980-1992	IV
	Domestic use	1952-1992	I
	Food use	1952-1992	I
Sorghum	Domestic	1952-1992	I
	Export	1952-1992	I
	Import	1952-1992	I
	Yield per acre	1980-1992	IV
	Domestic use	1952-1992	I
	Food use	1952-1992	I
Wheat	Domestic	1952-1992	I
	Export	1952-1992	I
	Import	1952-1992	I
	Yield per acre	1980-1992	IV
	Domestic use	1952-1992	I
	Food use	1952-1992	I

Rice	Domestic	1952-1992	I
	Export	1952-1992	I
	Import	1952-1992	I
	Yield per acre	1980-1992	IV
Soybean	Domestic	1952-1992	I
	Export	1952-1992	I
	Import	1952-1992	I
	Yield per acre	1980-1992	IV
Hay	Domestic	1952-1992	I
	Yield per acre	1980-1992	IV
Sugarbeet	Domestic	1952-1992	I
	Yield per acre	1980-1992	IV
Sugarcane	Domestic	1952-1992	I
	Yield per acre	1980-1992	IV
Tomato (Fresh)	Domestic	1951-1992	I
	Export	1951-1992	I
	Import	1951-1992	I
	Total	1951-1992	I
Tomato (Processed)	Domestic	1951-1992	I
	Export	1951-1992	I
	Import	1951-1992	I
	Total	1951-1992	I
Orange (Fresh)	Domestic	1950-1992	II
	Export	1951-1992	I
	Total	1962-1992	I
Orange (Processed)	Domestic	1951-1992	I

Grapefruit (Fresh)	Total	1951-1992	I
	Import	1951-1992	I
	Export	1951-1992	I
	Domestic	1951-1992	I
Grapefruit (Processed)	Domestic	1951-1992	I

Secondary Commodities			
Corn by-products			
Cornoil	Domestic	1971-1992	I
	Export	1970-1990	II
Corn Starch	Domestic	1981-1992	I
	Export	1976-1992	I
Ethanol	Domestic	1981-1992	I
Meats			
Chicken (retail cut)	Domestic	1952-1992	I
	Export	1952-1992	I
Turkey (retail cut)	Domestic	1952-1992	I
	Export	1959-1991	I
Beef (retail cut)	Domestic	1951-1992	I
	Export	1951-1992	I
	Import	1951-1992	I
Lamb (retail cut)	Domestic	1972-1992	I
	Export	1951-1992	I
	Import	1973-1992	I
Veal (retail cut)	Domestic	1958-1992	III
Pork (retail cut)	Domestic	1951-1992	I
	Export	1951-1992	I
	Import	1958-1992	I
Dairy Products			

Fluid Milk Cream	Domestic	1951-1992	I
Nonfat Dry Milk	Domistic	1965-1992	III
Cottage Cheese	Domestic	1970-1992	III
Evaporated Condensed Milk	Domestic	1970-1992	III
	Export	1965-1992	III
Ice Cream	Domestic	1965-1992	I
American Cheese	Domestic	1965-1992	II
	Export	1965-1992	I
Other cheeses	Domestic	1966-1992	I
	Export	1965-1992	II
	Import	1966-1992	I
Potato products			
Frozen Potato	Domestic	1971-1992	I
	Export	1979-1992	I
	Import	1979-1992	I
Dried Potatoes	Domestic	1971-1992	I
	Export	1980-1992	I
	Import	1971-1989	I
Chip Potatoes	Export	1971-1989	I
Sugars			
Glucose Syrup	Domestic	1975-1992	I
	Export	1975-1992	I
	Total	1971-1992	I
Dextrose	Domestic	1975-1992	I
	Import	1975-1992	I
	Export	1975-1992	I

	Total	1971-1992	I
Confection	Domestic	1974-1992	I
Refined	Domestic	1974-1992	I
Canned Goods	Domestic	1973-1992	III
Beverage	Domestic	1973-1992	III
Soybean by-products			
Soybean meal	Domestic	1951-1992	I
	Export	1951-1992	I
Soybean Oil	Domestic	1951-1992	I
	Export	1951-1992	I
Juices			
Orange juice	Domestic	1983-1992	I
	Export	1980-1992	I
Grapefruit juice	Export	1980-1992	I

Table 10. Yearly Rates of Change for Inputs (Alabama Cotton Example).	
Input	**Change**
Nitrogen	-0.115
Phosphorous	-0.115
Potassium	-0.115
Lime	1.080
Custom Operations	-1.589
Chemical Costs	1.250
Seed Cost	0.889
Capital	0.396
Repair Costs	0.823
Fuel and Other	1.312

Figure 1.

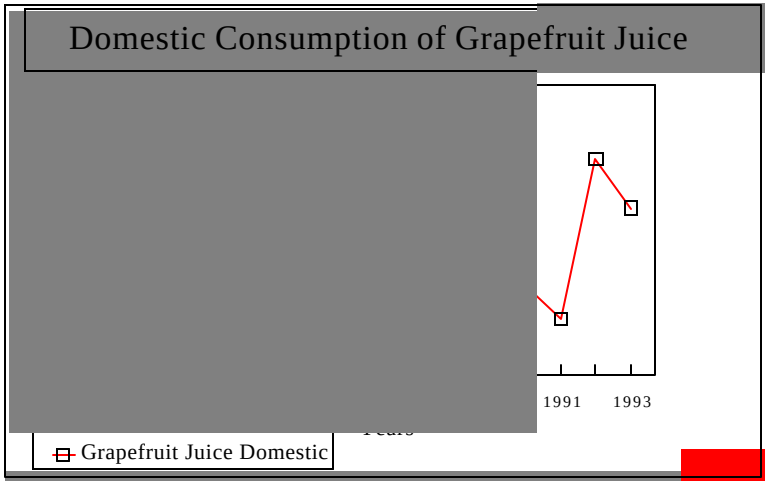


Figure 2.

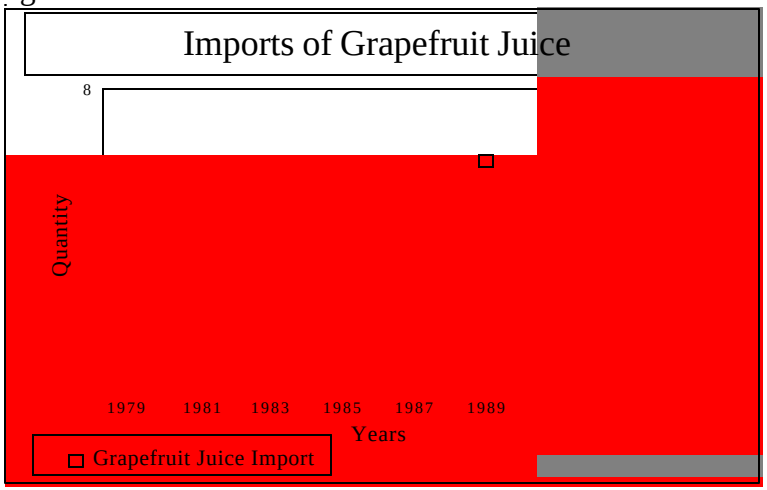


Figure 3.

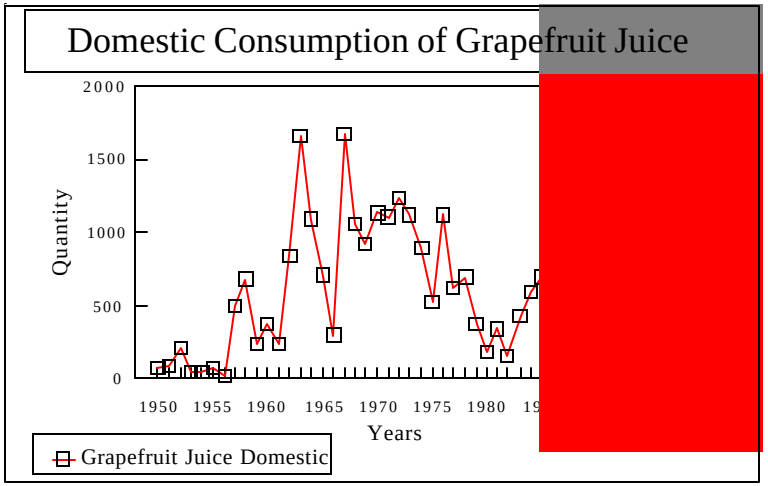


Figure 4.

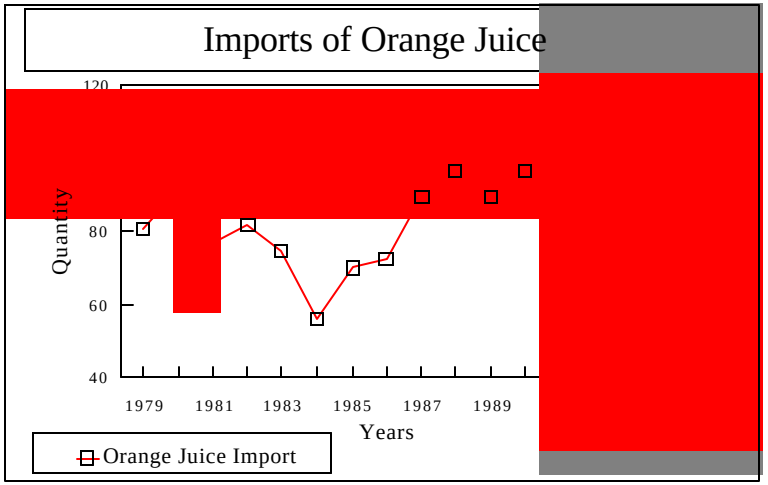
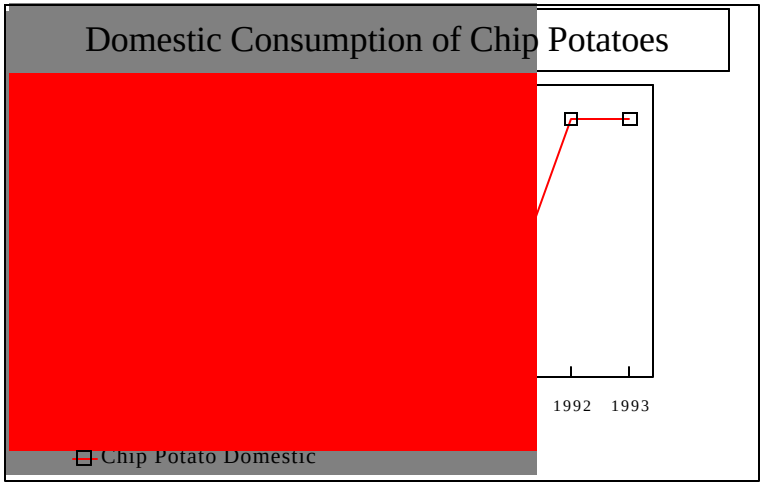


Figure 5.



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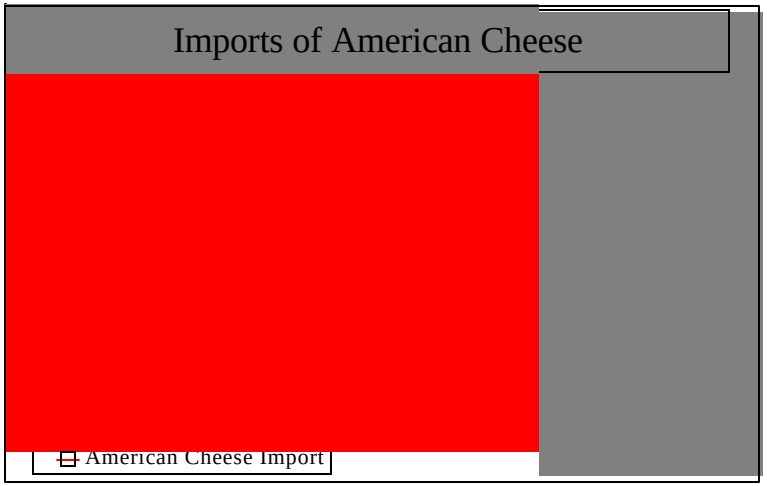

Figure 7.

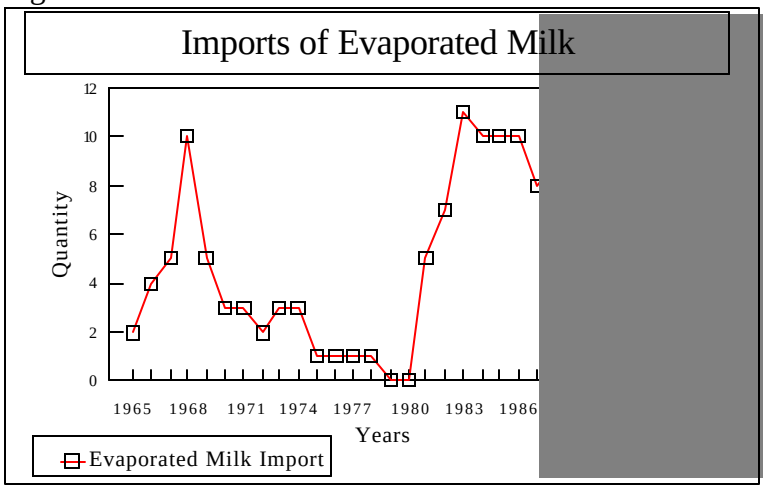

Figure 8.

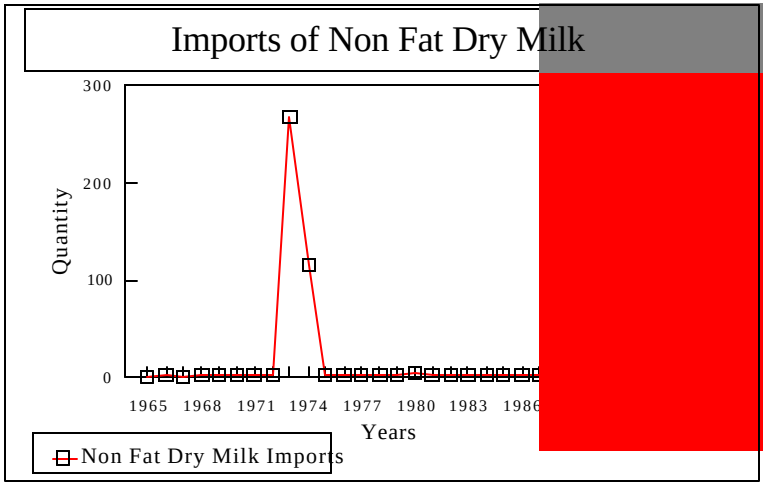

Figure 9.

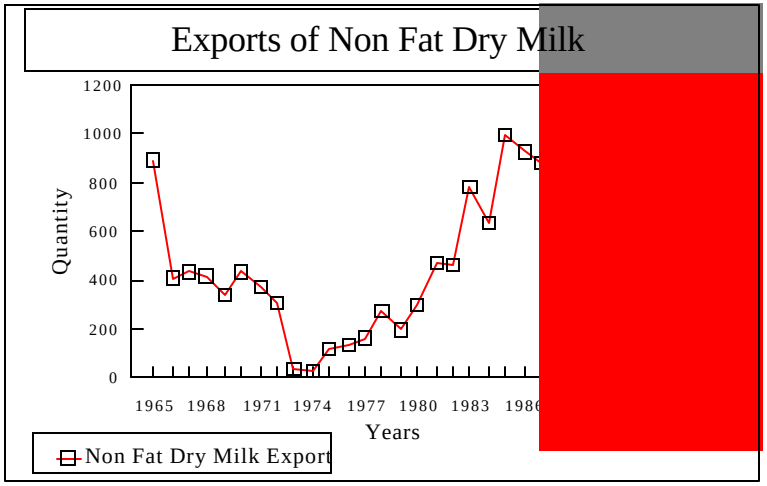

Table 2. Regression coefficient estimates for domestic demand.

	TYPE	TIME	INTERCEPT	GNP	LAG	R-SQ
COTTON	1.0	0.000000	-44.671000	0.028167	0.977040	0.82
CORN	1.0	0.000000	1090.242398	0.062101	0.639720	0.92
SOYBEANS	1.0	0.000000	187682.764539	20.301549	0.586441	0.85
WHEAT	1.0	0.000000	392.580066	0.021031	0.298035	0.87
SORGHUM	1.0	0.000000	96.590620	-0.000108	0.808271	0.72
RICE	1.0	0.000000	15.879150	0.002165	0.246441	0.94
BARLEY	1.0	0.000000	78.885728	0.000393	0.780953	0.72
OATS	3.0	0.000000	7.087716	-0.000060	0.000000	0.88
HAY	1.0	0.000000	69668.352349	1.112826	0.394585	0.77
LAMBSLAUGH	3.0	0.000000	6.166284	-0.000013	0.000000	0.00
SUGARCANE	1.0	0.000000	3572.846714	0.083090	0.838511	0.90
SUGARBEET	1.0	0.000000	4449.440944	0.091836	0.780434	0.77
SOYBEANMEA	1.0	0.000000	1877.353000	0.193455	0.773164	0.95
SOYBEANOIL	1.0	0.000000	840.638800	0.112938	0.769354	0.95
FLUIDMILK	1.0	0.000000	11.054380	0.000029	0.800738	0.73
FEDBEEF	2.0	0.000000	18974.160000	0.360143	0.000000	0.00
VEAL	3.0	0.000000	6.869919	-0.000050	0.000000	0.00
NONFEDBEEF	2.0	0.000000	18974.160000	0.360143	0.000000	0.00
PORK	1.0	0.000000	3444.134000	0.087042	0.702522	0.00
AMCHEESE	2.0	0.000000	1109.981000	0.093543	0.000000	0.00
OTCHEESE	1.0	0.000000	33.620020	0.013365	0.960147	0.99
EVAPCONDM	3.0	0.000000	7.432235	-0.000040	0.000000	0.71
ICECREAM	1.0	0.000000	527.446700	0.003259	0.861611	0.00
NONFATDRYM	3.0	0.000000	7.016343	-0.000035	0.000000	0.58
COTTAGECHE	3.0	0.000000	7.042058	-0.000013	0.000000	0.81
SKIMMILK	1.0	0.000000	-277.263300	0.030392	1.021072	0.96
BEVERAGES	3.0	0.000000	10.006110	-0.000189	0.000000	0.89
CONFECTION	1.0	0.000000	1027.166000	0.036362	0.265356	0.82
CANNING	3.0	0.000000	7.797351	-0.000064	0.000000	0.92
REFSUGAR	1.0	0.000000	889.000300	0.025236	0.568966	0.83
STARCH	1.0	0.000000	22.844150	0.002945	0.657031	0.94
CORNOIL	1.0	0.000000	179.959600	0.036024	0.178421	0.92
ETHANOL	1.0	0.000000	-114.366300	0.024791	0.601927	0.97
COSYRUP	1.0	0.000000	2073.665000	0.041560	0.371103	0.00
DEXTROSE	1.0	0.000000	143.691800	0.005901	0.771215	0.79
FROZENPOT	1.0	0.000000	770844.400000	108.804200	0.532180	0.99
DRIEDPOT	1.0	0.000000	8064.757000	0.080684	0.677378	0.43
TOMATOFRSH	1.0	0.000000	17999.740000	1.064934	0.710998	0.00
TOMATOPROC	1.0	0.000000	2344401.000000	155.022900	0.399501	0.00
ORANGEFRSH	2.0	0.000000	41787.290000	-0.103939	0.000000	0.00
ORANGEPROC	1.0	0.000000	20592.940000	0.854294	0.798311	0.00
GRPFRTFRSH	1.0	0.000000	15200.820000	-0.048404	0.292153	0.13
GRPFRTPROC	1.0	0.000000	4996.643000	0.106516	0.804693	0.70
ORANGEJUIC	1.0	0.000000	-14.635570	0.038847	0.059027	0.50
CHICKEN	1.0	0.000000	244.335000	0.058809	0.963072	0.99
EGGS	1.0	0.000000	1610.240000	-0.001264	0.683603	0.51
TURKEY	1.0	0.000000	112.184200	0.030037	0.863570	0.99

Table 3. Regression coefficient estimates for import demand.

	TYPE	TIME	INTERCEPT	GNP	LAG	R-SQ
COTTON	3.0	0.000000	5.181047	-0.000219	0.000000	0.82
CORN	2.0	0.000000	0.130341	0.000253	0.000000	0.92
WHEAT	1.0	0.000000	-0.865664	0.000054	1.334899	0.87
BARLEY	3.0	0.000000	2.672016	-0.000024	0.000000	0.72
OATS	1.0	0.000000	-4.169152	0.000981	0.728837	0.88
LAMBSLAUGH	1.0	0.000000	12.366140	0.000991	0.245519	0.00
NONFEDBEEF	1.0	0.000000	164.545700	0.009507	0.869759	0.00
PORK	2.0	0.000000	213.836900	0.037107	0.000000	0.00
OTCHEESE	1.0	0.000000	48.476140	0.002085	0.680333	0.99
DEXTROSE	1.0	0.000000	-0.894997	0.000259	0.682885	0.79
FROZENPOT	1.0	0.000000	-33112.580000	3.277102	0.886188	0.99
DRIEDPOT	1.0	0.000000	-11.820350	0.002594	0.203170	0.43
TOMATOFRSH	1.0	0.000000	4359.126000	0.432536	0.631699	0.00
TOMATOPROC	1.0	0.000000	22521.540000	1.207333	0.658728	0.00
GRPFRTFRSH	1.0	0.000000	4.846965	0.002650	0.757524	0.13
EGGS	1.0	0.000000	3.633975	0.000264	0.258434	0.51

Table 4. Regression coefficient estimates for export demand.

	TYPE	TIME	INTERCEPT	GNP	LAG	R-SQ
COTTON	1.0	0.000000	3640.080534	0.115321	0.078809	0.82
CORN	1.0	0.000000	99.276040	0.002034	0.928097	0.92
SOYBEANS	1.0	0.000000	43438.256495	3.340831	0.875079	0.85
WHEAT	1.0	0.000000	172.507493	0.011426	0.729960	0.87
SORGHUM	1.0	0.000000	37.795904	0.003140	0.662972	0.72
RICE	1.0	0.000000	8.972611	0.000472	0.781123	0.94
BARLEY	1.0	0.000000	40.357580	0.000832	0.304654	0.72
OATS	3.0	0.000000	2.779317	-0.000121	0.000000	0.88
LAMBSLAUGH	1.0	0.000000	0.415198	0.000035	0.843216	0.00
SOYBEANMEA	1.0	0.000000	328.898600	0.016120	0.913093	0.95
SOYBEANOIL	1.0	0.000000	289.679300	0.008289	0.727266	0.95
FEDBEEF	1.0	0.000000	-21.334460	0.005788	1.024041	0.00
PORK	1.0	0.000000	34.348190	0.001824	0.783285	0.00
AMCHEESE	2.0	0.000000	15.844300	0.001287	0.000000	0.00
OTCHEESE	2.0	0.000000	-7.055416	0.003020	0.000000	0.99
EVAPCONDM	3.0	0.000000	5.138204	-0.000051	0.000000	0.71
STARCH	1.0	0.000000	9.082942	0.002389	0.519015	0.94
CORNOIL	2.0	0.000000	-71.957320	0.023121	0.000000	0.92
COSYRUP	1.0	0.000000	-10.134770	0.001348	0.725143	0.00
DEXTROSE	1.0	0.000000	0.177623	0.000995	0.714561	0.79
FROZENPOT	1.0	0.000000	-79513.750000	9.125112	0.790941	0.99
DRIEDPOT	1.0	0.000000	42.993410	0.002154	0.135905	0.43
CHIPPOT	1.0	0.000000	10.973610	0.001242	0.844062	0.00
TOMATOFRSH	1.0	0.000000	457.672300	0.083411	0.848923	0.00
TOMATOPROC	1.0	0.000000	-5771.374000	1.017267	1.040026	0.00
ORANGEFRSH	1.0	0.000000	3815.975000	0.158142	0.369199	0.00
GRPFRTFRSH	1.0	0.000000	691.760400	0.243500	0.506388	0.13
ORANGEJUIC	1.0	0.000000	5.265637	0.001657	0.630562	0.50
GRPFRTJUIC	1.0	0.000000	7.921052	0.000334	0.235756	0.00
CHICKEN	1.0	0.000000	-18.639710	0.008670	0.951176	0.99
EGGS	1.0	0.000000	21.376060	0.003515	0.318531	0.51
TURKEY	1.0	0.000000	11.804430	0.000548	0.670859	0.99

Table 5. Regression coefficient estimates for food usage demand.

	TYPE	TIME	INTERCEPT	GNP	LAG	R-SQ
CORN	1.0	0.000000	28.132063	0.016239	0.770449	0.92
WHEAT	1.0	0.000000	146.123654	0.005548	0.677466	0.87
SORGHUM	1.0	0.000000	5.504481	0.000137	0.346739	0.72
BARLEY	1.0	0.000000	67.815620	0.002707	0.275264	0.72
OATS	1.0	0.000000	1.966225	0.000580	0.892031	0.88

Table 6. Regression coefficient estimates for yield forecasts.

	TYPE	TIME	INTERCEPT	GNP	LAG	R-SQ
COTTON	4.0	0.010782	0.000000	0.000000	0.000000	0.82
CORN	4.0	0.005033	0.000000	0.000000	0.000000	0.92
SOYBEANS	4.0	0.004819	0.000000	0.000000	0.000000	0.85
WHEAT	4.0	0.002148	0.000000	0.000000	0.000000	0.87
SORGHUM	4.0	0.007584	0.000000	0.000000	0.000000	0.72
RICE	4.0	0.004914	0.000000	0.000000	0.000000	0.94
BARLEY	4.0	0.001400	0.000000	0.000000	0.000000	0.72
OATS	4.0	0.001201	0.000000	0.000000	0.000000	0.88
HAY	4.0	0.001833	0.000000	0.000000	0.000000	0.77
SUGARCANE	4.0	-0.000646	0.000000	0.000000	0.000000	0.90
SUGARBEET	4.0	0.000820	0.000000	0.000000	0.000000	0.77