

POLYSYS is composed of both a supply module and a demand module. The supply module is linear-programming based and operates at the county level. The supply module takes last year's prices, crop budgets, and crop yields, and allocates planting decisions to determine each year's total supply of crops. The demand module is econometrically based and operates at the national level. The demand module takes the year's total crop supply (coming from the supply module) and determines crop prices, food feed and industrial demands, and exports. In the demand module prices and all demand levels are solved simultaneously through the model coming to an equilibrium. At the equilibrium all demand levels are satisfied at the equilibrium price. Both the supply and demand modules operate for all years in all scenarios (including the baseline).

The baseline is extended by expanding one exogenous variable in the supply module (yield); expanding two exogenous variables (imports and industrial demand) in the demand module; and by 'shocking' two endogenous variables (exports and food demand) in the demand module. In the demand module the 'shocks' are used to fix these variables in a first run of the baseline, but then a second run allows these variables to adjust to come to an equilibrium with prices and other endogenous variables. **This can be thought of as a suggested trend and we allow the model to adjust demand levels and prices to equilibrium around the suggestion.** In this 2nd run of the baseline, all endogenous variables are solved via the equations listed in Chapter 7 of the POLYSYS documentation (page 55).

The following exogenous variables were expanded and set beyond the last year of baseline:

$$1) \text{ Yields} = \text{Lagged Yield} * (1 + \text{average annual \% change of last 3 years of baseline} * 0.5)$$

Note: We reduce the rate by 50% based on expert advice on long-term trends showing yield gains tailing off. Slight adjustments are made to yield increases to keep prices from either nose-diving or exploding. The exact rates of yield increases are listed in table 1.

Table 1. Annual Percent Gain in Yields

Crop	Last 3 years of USDA baseline	used in POLYSYS extended baseline	% reduction from baseline trend *
Corn	1.10%	0.65%	59%
Wheat	0.76%	0.40%	53%
Soybeans	0.95%	0.39%	41%

* adjusted slightly from the 50% reduction level
dependent on price trajectory.

2) Imports = lagged imports

3) Industrial demand = lagged demand * (lagged demand/2year lagged demand)

This is used for corn and soybeans.

For the 2015 baseline, the following endogenous variables were 'shocked' in the 1st run of the baseline by:

1) Exports = lagged exports * (1 + average annual % change of last 3 years of baseline)

Note: We reduce the rate by 50% for corn and wheat based on expert advice on long-term historical trends showing that exports are declining for these crops. We did not reduce soybean trend rate. The shock used in the 2015 extended baseline are listed in Table 2.

Table 2. Annual Percent Gain in Exports

Crop	Last 3 years of USDA baseline	Shock used in POLYSYS extended baseline*	% reduction from baseline trend
Corn	2.08%	1.04%	50%
Wheat	0.47%	0.24%	50%
Soybeans	1.11%	1.11%	100%

* Shock applied in first baseline run. In the second baseline run, exports are solved endogenously and allowed to adjust.

2) Food Demand = lagged food demand * (1+population growth rate/100)

We used the 2015 US Census Bureau growth rate estimate (0.82%)

Note: This is only for wheat and rice

Remember that these shocks are only 'fixed' in the first run of the baseline. In the second run exports and food demand are solved endogenously and are allowed to adjust to come to an equilibrium with prices. For this reason the final extended baseline number for exports and food demand may not match the initial 'shocks'.