Agricultural Market Outlook and Sensitivity to Macroeconomic, Productivity, and Policy Changes

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Abstract

The outlook for international agricultural commodity markets is very sensitive to changes in macroeconomic conditions, rates of productivity growth, and government policies. Baseline projections prepared by the Food and Agricultural Policy Research Institute in March 1988 assume moderate rates of economic and productivity growth, and a continuation of current policies. Under these conditions, world production, use, and trade of grains and oilseeds increase at a modest pace, while real prices change little.

More rapid world economic growth and lower rates of inflation result in significantly higher real prices for wheat, feed grains, and soybeans. World trade expands as demand grows more rapidly than supply in importing countries. Increased rates of productivity growth result in lower commodity prices and a contraction of world trade as importing countries become more self-sufficient. Removing trade barriers causes significant shifts in world production and consumption of agricultural commodities, but only modest changes occur in world prices.

Introduction

The Food and Agricultural Policy Research Institute (FAPRI) evaluated the outlook for feed grains, wheat, and soybeans through crop year 1995/96 using the FAPRI global commodity modeling system. The evaluation consists of five scenarios, each related to a baseline conducted in March 1988 and presented in the "FAPRI Ten-Year International Agricultural Outlook" (FAPRI Staff Report 1-88).

The purpose of the exercise was to compare estimated FAPRI results with those from other global models that use similar assumptions, and to gain insights that might be useful in focusing a policy agenda for the 1990s. Uncertainty over global economic conditions, development and adoption of new technology, and the GATT trade agreement frame the options being considered.

This paper includes a description and an evaluation of the baseline and the five scenarios. Due to space limitations, the outcomes from the exercise are presented in aggregate terms. A brief description of the FAPRI modeling system is followed by a review of the baseline and evaluation of the sensitivity of the baseline projections to the alternative policy scenarios. General conclusions are provided in the final section.

Model Description

The FAPRI system includes detailed econometric models for U.S. crops, livestock, government costs, and net farm income. The trade

component of the FAPRI system includes nonspatial equilibrium econometric models for coarse grains, wheat, soybeans, soybean meal, and soybean oil. Supply, demand, and price determination relationships are modeled for selected countries and regions in the trade component. The numbers of countries and regions vary by commodity. They include 22 for wheat, 12 for the soybean complex, 9 for sorghum, and 20 for the other coarse grains. Equilibrium world prices are determined by the market clearing condition that net export supply equals net import demand in the world market. Thus, demand, trade, and prices are determined simultaneously (Bahrenian et al. 1986; Devadoss et al. 1986; Meyers et al. 1986). The cross-commodity interaction of the trade models is examined in Meyers et al. 1987.

Scenarios are evaluated by changing selected exogenous assumptions and then determining new equilibrium levels of prices and quantities. For the policy change exercises, policy instruments and price transmission relationships are altered to reflect changes from protected to open markets in selected countries and regions.

FAPRI Baseline Projections

The baseline assumptions for this analysis are those used in FAPRI Staff Report 1-88. Continuation of current agricultural policies in all countries, moderate levels of economic growth, and financial policies similar to those presently employed were assumed. For example, the provisions of the U.S. Food Security Act of 1985 and the program management strategy to date were assumed to continue for another five years beyond the current legislation. Important implications of this

U.S. policy assumption are that the target price support rates continue to decline at 2 percent per year and that the Conservation Reserve Program (CRP) reaches the maximum of 45 million acres (18.2 million hectares) by 1990/91. The CRP is a ten-year land retirement program and prevents cropland from returning to production as commodity prices increase.

The macroeconomic assumptions for the baseline were provided by the WEFA Group ("World Economic Outlook" 1987). They project average real GDP growth rates for the early 1990s of 2.7 percent per annum for developed market economies, 3.0 percent for centrally planned economies, and 3.8 percent for developing countries. Although still sluggish, the recovery of world economies from the performance of the early 1980s has a significant impact on the level of demand and trade in the FAPRI projections. By comparison, the World Bank's real GDP projections are higher for developed and developing countries and lower for the USSR and Eastern Europe.

The baseline projection (Table 1) was prepared before the onset of the 1988 U.S. drought. The drought will reduce 1988 crop production and increase market prices above baseline levels. Stocks will be reduced more quickly and 1989 planted area will be higher in response to higher prices and reduced U.S. government set-aside programs. However, most impacts of the drought will have played themselves out by the early 1990s. This study focuses primarily on the 1990-1995 period. That is, most results of this analysis are not substantially affected by the drought (Westhoff et al. 1988).

Real prices of wheat, maize, and soybeans remain constant or decline over the period 1989/90-1995/96. In particular, the real price of maize remains nearly constant, wheat prices decline by 5 percent, and soybean prices decline by more than 8 percent over the period. Thus, the historical pattern of declining real prices for these commodities continues, but at a somewhat slower rate than during the past decade.

From 1989 to 1995 world wheat production increases by 12.5 percent, feed grain production by 13.7 percent, and soybean production by 12.5 percent. Consumption is projected to grow at a slightly lower pace except for soybeans, and ending stocks are projected to remain stable or increase. The increase in carryover stocks from 1989 to 1995 leaves inventories still well below the high levels that existed in 1986/87. In fact, the stock-to-use ratios for wheat, coarse grains, and soybeans are projected to be 0.25, 0.24, and 0.15 in 1995/96 compared to 0.34, 0.33, and 0.20 in 1986/87, respectively.

Trade for grains and soybeans increases more rapidly than production and consumption. The patterns of change in net imports and net exports indicate that demand growth continues to outpace supply growth in developing and centrally planned economies and that production growth continues to exceed demand growth in the industrial countries. This pattern has been evident for more than a decade and raises concerns about the foreign exchange costs of the projected developing country imports. Using U.S. Gulf Port prices, the import cost of grains and soybeans to developing countries in 1988 dollars is projected to increase from $9 billion in 1986/87 to $15 billion in 1995/96. The

picture for soymeal trade is different. Argentina and Brazil are projected to export more soybean meal to the industrial and centrally planned economies.

The supply, demand, and prices in the evaluation period indicate a return to more stable commodity market conditions after the extraordinary market boom that occurred in the mid-1970s and the equally traumatic decline of the first half of the 1980s. Much of the explanation for this boom and bust cycle lies in the macroeconomic factors external to agriculture. However, the explanation also rests with agricultural policies and productivity changes.

It is instructive to evaluate these projections for their sensitivity to alternatives for the macroeconomy, productivity growth, and potential policy changes that may occur. The comparison of these evaluations to results from two other modeling systems will highlight similarities and differences, and focus attention on the major policy implications.

Sensitivity Analysis

Macroeconomic Scenario

The sensitivities of the baseline projections have been evaluated relative to the FAPRI baseline under the following macroeconomic conditions:

- HIGRO--high economic growth path, with real GDP growth exceeding the baseline assumption by 0.5 percent per year in industrial countries, by 1.0 percent per year in developing countries, and

by 1.0 percent in centrally planned economies. Inflation rates are two percentage points lower than those used for the baseline.

- LOGRO--low economic growth path, with real GDP growth below the baseline by 0.5 percent per year in industrial countries, by 1.0 in developing countries, and by 0.5 percent in centrally planned economies. Inflation rates are two percentage points above those used for the baseline.

Lower and higher economic growth generates changes in real U.S. Gulf Port prices from -31 to +41 percent for wheat, -30 to +45 for maize, and -31 to +52 percent for soybeans (Table 2 and Figure 1). The inelastic nature of short-run demand and supply in the grains/oilseeds markets results in pronounced lagged responses to changing macroeconomic conditions. Boom periods are characterized by accelerated rates of price increase, with world demand providing strong signals for increased production. Shorter run domestic supply response elasticities ranging between 0.2 to 0.3 imply gradual production increases compared to the demand incentives.

A reverse situation develops with the general economic downturn. As world economies experience demand reductions, world supplies tend to overshoot. Correspondingly, prices drop sharply, adjusting to lower market clearing levels. Soybeans and soymeal are not as regulated as wheat and coarse grains in the major producing and consuming countries. A result is that there are lower stock levels to buffer the changes induced by macroeconomic performance.

Problems for agriculture due to changing economic growth patterns are related to overshooting tendencies. The strong economic growth of the 1970s generated price increases even larger than those projected in this analysis for the high growth option. Lagging production worldwide contributed to this sustained period of higher prices. The world recession of the early 1980s found production capacity in agriculture out of step. Prices fell and stocks accumulated, especially in nations regulating agriculture. Moreover, the regulations in some cases aggravated the situation. For example, the U.S. programs in the early 1980s resulted in rigid support prices and stock accumulation, while policy changes in 1985 led to falling support prices and stock releases. Protected markets such as those of the European Community and Japan caused greater world price variability by insulating domestic markets.

An interesting consequence of recent policy actions led by the United States is a likely tighter supply situation by the mid-1990s as longer term supply control measures take effect. For this reason, the price changes are stronger for the high-growth scenario than for the low-growth path. Lower world demand can be offset by tightening annual supply control measures and increasing government stock holdings. On the other hand, low baseline levels of government stocks and the tighter supply situation of the mid-1990s make it more difficult for governments to deal with higher world demand.

Estimated production and consumption changes are relatively low, ranging from 1-2 percent in the grains to slightly higher levels for soybeans at around 3 percent (Table 2 and Figures 3 and 4). These

moderate changes, however, imply about 28 million metric tons of production above the baseline for these commodities under high growth and 22 million less under low growth.

Strengthening demand increases net exports. Impacts are greater for developing countries in wheat and coarse grain trade (Figures 5 and 6). Longer run estimates are for a 7 percent increase for net wheat exports and a 20 percent increase for coarse grain trade in the high-growth scenario. Low-growth impacts are similar but in the opposite direction. Centrally planned economies are projected to trade actively in coarse grains, increasing imports by 25 percent under the high-growth scenario and reducing imports by 13 percent under low growth. Stocks of all three commodities are lower under HIGRO, but they increase moderately under LOGRO (Figure 2).

Productivity Scenario

The second set of scenarios is for differing rates of technical change. The assumptions for this scenario were:

- HIYLD--high rate of technological change in all regions, with yields projected to increase at a rate of 150 percent of the rates used for the baseline.
- LOYLD--low rate of technological change in all regions, with yields projected to increase at 50 percent of the rates used for the baseline.

Trend rates of technical change were used in projecting yields for the baseline. For example, in the United States the annual rate of yield

increase in the FAPRI baseline is 1.2 percent per year for maize, 0.9 percent for wheat, and 1.0 percent for soybeans.

The general impact of the productivity change assumptions for prices is as expected (Table 2 and Figure 1). Qualitatively, accelerated productivity change results in reduced prices, while slowed productivity change causes prices to rise. Impacts of the high-yield scenario are for 1995/96 price reductions of 33 percent for wheat, 28 percent for maize, and 21 percent for soybeans. In contrast, for the low-yield scenario, 1995/96 prices increase by 48 percent for wheat, 41 percent for maize, and 40 percent for soybeans. The price impacts are generally asymmetric due to the more limited options for government program adjustment in tight markets.

Under the high-yield scenario, 1995/96 world wheat production is 3.2 percent higher than in the baseline, while coarse grain and soybean production increase by 3.4 and 1.8 percent, respectively. Production declines are of comparable magnitudes in the low-yield scenario. Yields change proportionally more than does production, as price changes induce offsetting shifts in area planted and harvested. Stock levels adjust as anticipated on the basis of the consumption and production changes.

Relatively large price changes are required to induce modest changes in utilization. In part, this is due to the inelastic demand characteristic of world agricultural markets. In large part, however, it is also due to pricing policies in many important trading countries that insulate domestic producers and consumers from changes in world market conditions. In the absence of trade barriers, the price changes

that would result from the assumed changes in productivity would be smaller and the changes in consumption would be larger.

In general, changes in 1995/96 trade patterns (Figures 5-8) resulting from the productivity scenarios show that higher rates of technical change favor developing countries. Such change reduces net exports from the industrial countries to the developing countries and the centrally planned economies. The opposite occurs in the low-yield scenario. The United States adjusts more than other countries to changes in technical growth. In the high-yield scenario, most importing countries become more self-sufficient, and other exporting countries dispose of most of their increased production on the world market. Demand for U.S. exports falls sharply as a result, and the United States is forced to reduce area planted and increase domestic consumption and carryover stocks.

The productivity scenarios assume that rates of technical change adjust in a similar fashion in all countries. In reality, new technological breakthroughs will not affect all producers in all countries in the same way. Producers are more likely to gain from new technologies if they adopt early and if their governments protect them from the price-depressing effects of increased supplies. Consumers generally gain from the lower prices that result from higher yields, but again, government policies may limit these gains.

Free Trade Scenario

The free trade, or full liberalization, scenario is the most difficult to incorporate into the FAPRI system. It is also likely that

the scenario, when implemented in the three models involved in the Outlook exercise, will produce the results most specialized to the model structures and implementation procedures. The specific assumption for the free trade scenario is of

- free, full liberalization of agricultural protection by the United States, the European Community, Japan, Brazil, Argentina, and most importing countries.

Target prices, loan rates, annual acreage reduction programs, government stocks programs, dairy price supports, import restrictions on sugar and livestock products, and ethanol subsidies were all assumed to be phased out in the United States over the period 1989-1992. The Conservation Reserve Program is interpreted as primarily for natural resources and is retained at the same level as in the baseline. Grain export subsidies such as the EEP had already been eliminated in the baseline by 1989.

For the other countries--not modeled in the same detail as the United States--protectionist policies were eliminated over the same phase-in period. Prices in these countries were linked to border prices, and world market price fluctuations were directly transmitted into the domestic markets.

Prices for wheat and maize increase under the free trade assumption. Nominal price increases are on the order of $20 per metric ton, or 13 percent and 18 percent for wheat and maize, respectively. Prices for soybeans decline by about $20 per metric ton, or 10 percent. These results are driven primarily by the effects of trade liberalization on the United States and the European Community.

In the United States, eliminating both target prices and acreage reduction programs has little net effect on production of wheat and coarse grains. Removing maize and wheat price supports, however, makes soybean production relatively more attractive. Everything else being equal, U.S. soybean production would increase and soybean prices would fall relative to wheat and coarse grain prices (Table 2).

In the European Community, eliminating the Common Agricultural Policy would bring domestic wheat and coarse grain prices down sharply. Since soybean trade is not currently limited, internal soybean prices would not be significantly affected. As wheat and coarse grain prices in the EC fall relative to soybean prices, important changes occur in the net trade position of the EC--wheat exports fall, coarse grain imports increase (so that the EC again becomes a net importer of coarse grains), and soybean and soybean product imports fall.

The combined effect of changes in the United States and the European Community is an increase in world wheat and coarse grain prices, and a reduction in world soybean prices (Figure 1). Trade liberalization in other countries has less effect on world markets for the commodities considered here. Soybean production and exports increase in both Argentina and Brazil as export taxes are eliminated. Japanese rice production falls and imports increase, with important consequences for world rice and wheat markets.

Total world production and consumption change relatively little under free trade, even though outcomes vary significantly in some countries (Figures 3 and 4). Stocks decline for wheat and coarse grains

(Figure 2). Net exports of wheat, coarse grains, and soybeans by industrial countries fall, due primarily to the effects on the European Community. Net imports of wheat and coarse grains by developing countries fall, primarily due to the effects of higher prices. Increased soybean exports by Argentina and Brazil reduce the net imports of developing countries as a group. Trade by centrally planned economies is essentially unaffected (Figures 5-8).

Implications

A number of general conclusions are supported by the exercise conducted with the FAPRI modeling system. These general observations are perhaps of more value than the particular results for individual countries, specific commodities, and year-to-year changes. The FAPRI modeling system, like others, is an approximation of the world production and distribution systems. Government policies in the system are modeled for the major trading countries. But in many cases, these government polices are reflected in terms of reduced-form price linkage equations. Thus, the methods of adjusting the policies--say, for the free trade scenario, which could have major distributional effects--are not explicitly incorporated in the analysis.

Similar qualifications are appropriate for the macroeconomic and the technology or productivity sensitivity exercises. The growth and inflation rates given for the macroeconomic scenario result from sets of presumed macroeconomic, financial, investment, and even perhaps development assistance policies. Alternative policy packages for generating these results could again have major distributional effects, distorting

the approximations of the agricultural markets that have been developed for the FAPRI model. For yield or productivity increases, the income feedback effects are not modeled; that is, increased rates of yield growth would increase incomes and, especially in developing countries, would have consumption effects. Such a feedback would reduce the price effects and increase the consumption effects of these scenarios.

With these qualifications, the general implications from the FAPRI results can be summarized. First, for the macroeconomic scenario, the major observations involve the apparent swings in prices of agricultural commodities as macroeconomic conditions change. The supply of agricultural products is generally inelastic as modeled in the FAPRI system. This is particularly true in the short run. Thus, the demand-induced changes result in significant price swings. These price swings are perhaps accelerated by government programs that adjust slowly to altered economic and market conditions. The projected price increases are of significant magnitude but, for example, do not return real prices for the three agricultural commodities studied to more than half the levels that were experienced in the early 1970s.

Second, altering productivity growth rates produced perhaps the most predictable adjustments in the system. One reason is the way in which the yield changes were introduced, building up or increasing over time by modifying the rates of yield change assumed in the FAPRI system. Lower yields result in higher commodity prices. Higher yields result in lower commodity prices. A concern that is raised by the low-yield or productivity scenario involves agricultural capacity. With the

45-million-acre conservation reserve in the United States, supplies become very tight under the high economic growth and the low yield growth scenarios. Placing 45 million acres (18.2 million hectares) of land in a long-term reserve limits the ability of policymakers and producers to respond to unexpected increases in demand or shortfalls in supply. The drought of 1988 is taking place when world grain stocks are still high. Therefore, the effects are modest relative to the likely consequences of a similar drought in the 1990s.

Third, the free trade scenario emphasizes that the anticipated impacts from this policy change are largely distributional. Projected aggregate production and consumption levels and world trade levels are similar to those from the baseline. This is not to say that distributional effects are unimportant--impacts on individual countries could be very significant. Also, prices of wheat and coarse grains increase. These commodities have been more controlled by domestic policies, resulting in incentives for overproduction and a depression of international prices. The close relationship between soybeans, which have been less controlled, and the grains is highlighted by the free trade scenario. The implications of the existing domestic wheat and coarse grain programs have been very important for the soybean market. Programs in the United States have indirectly reduced land in soybean production, while programs in the European Community have induced the substitution of soybean meal for more costly grains. The removal of these programs causes market prices for soybeans to fall substantially.

In general, the macroeconomic and productivity scenarios showed larger impacts on price, production, and consumption than did the trade

liberalization scenario. This emphasizes that decisions by governments on macroeconomic and technology policy are likely to be at least as important for agriculture as decisions about agricultural policy. Thus, coordination of technology and macroeconomic policies may make agricultural policy reform more feasible.

Table 1. Baseline Projections of Grains and Soybean Supply, Use, Trade and Prices

	Actual	Projected						
	1986/87	1989/90	90/91	91/92	92/93	93/94	94/95	95/96
Nominal Prices ($/mt)								
Wheat[1]	109	134	137	138	138	139	144	150
Maize[2]	74	90	91	94	99	98	100	105
Soybeans[3]	193	211	204	233	215	232	224	228
Real Prices (1988 $/mt)								
Wheat[1]	117	131	129	128	124	122	123	124
Maize[2]	79	87	87	87	89	86	85	87
Soybeans[3]	207	205	194	215	194	204	191	188
Wheat (mil. mt.)								
Production	529	535	548	560	572	583	591	602
Consumption	521	536	549	561	572	582	592	602
Ending Stocks	176	150	149	149	149	149	149	149
Net Exports								
Industrial	72	79	81	83	85	86	87	89
Developing	-45	-51	-52	-54	-56	-57	-59	-60
CPE (incl. China)	-26	-28	-29	-29	-29	-29	-28	-28
Coarse Grains (mil. mt.)[4]								
Production	752	748	767	792	805	825	838	851
Consumption	724	764	776	791	802	817	831	845
Ending Stocks	236	182	173	174	177	186	193	199
Net Exports								
Industrial	41	46	48	51	53	56	59	62
Developing	-28	-32	-34	-36	-39	-41	-44	-46
CPE (incl. China)	-13	-14	-14	-15	-15	-15	-16	-16
Soybeans (mil. mt.)								
Production	98	112	113	114	119	120	124	126
Consumption	101	110	112	115	118	120	123	126
Ending Stocks	20	18	19	18	19	19	19	19
Net Exports								
Industrial	1.6	2.6	2.9	3.4	3.6	4.1	4.5	5.0
Developing	-1.4	-0.8	-1.1	-1.4	-1.6	-2.0	-2.3	-2.8
CPE (Incl. China)	-0.2	-1.8	-1.9	-2.0	-2.0	-2.1	-2.2	-2.3
Soymeal Net Exports (mil. mt.)								
Industrial	-2.1	-3.4	-3.6	-3.7	-3.7	-3.8	-3.9	-3.9
Developing	7.4	9.7	10.1	10.4	10.7	11.1	11.4	11.7
CPE (Incl. China)	-5.3	-6.2	-6.5	-6.7	-7.0	-7.3	-7.5	-7.8

[1] Wheat - FOB Gulf #2 H.W. 13%.
[2] Corn - FOB Gulf #3 Yellow.
[3] Soybeans - FOB Gulf #2 Yellow.
[4] Maize, Sorghum, Barley and Oats.

Table 2. Sensitivity Analysis of Commodity Market Outlook, Comparison of 1995 Projections

	Base	HIGRO	LOGRO	HIYLD	LOYLD	FREE
Nominal Prices ($/mt)						
Wheat[1]	150	182	121	101	222	169
Maize[2]	105	131	86	76	148	124
Soybeans[3]	228	298	181	181	319	206
Real Prices (1988 $/mt)						
Wheat[1]	124	175	86	84	184	140
Maize[2]	87	126	61	63	123	103
Soybeans[3]	188	286	129	150	264	170
Wheat (mil. mt.)						
Production	602	611	595	621	583	602
Consumption	602	612	594	618	584	602
Ending Stocks	149	144	153	167	133	138
Net Exports						
Industrial	89	95	83	83	92	84
Developing	-60	-66	-55	-57	-62	-57
CPE (incl. China)	-28	-29	-28	-26	-30	-28
Coarse Grains (mil. mt.)[4]						
Production	851	866	840	880	817	845
Consumption	845	860	832	871	815	838
Ending Stocks	199	192	204	211	178	182
Net Exports						
Industrial	62	74	53	56	68	60
Developing	-46	-55	-39	-43	-50	-44
CPE (incl. China)	-16	-20	-14	-13	-19	-16
Soybeans (mil. mt.)						
Production	126	130	122	128	123	126
Consumption	126	130	122	128	123	126
Ending Stocks	19	18	20	20	18	19
Net Exports						
Industrial	5.0	5.5	4.6	4.8	5.0	3.8
Developing	-2.8	-2.5	-3.0	-2.7	-2.7	-1.6
CPE (Incl. China)	-2.3	-3.0	-1.7	-2.1	-2.3	-2.2
Soymeal Net Exports (mil. mt.)						
Industrial	-3.9	-3.1	-4.3	-4.0	-4.0	-3.9
Developing	11.7	12.0	11.6	11.7	11.8	11.6
CPE (Incl. China)	-7.8	-8.9	-7.3	-7.7	-7.8	-7.8

[1] Wheat - FOB Gulf #2 H.W. 13%.
[2] Corn - FOB Gulf #3 Yellow.
[3] Soybeans - FOB Gulf #2 Yellow.
[4] Maize, Sorghum, Barley and Oats.

Figure 1 REAL PRICES

$/mt Absolute and Percent Change from Baseline 1995

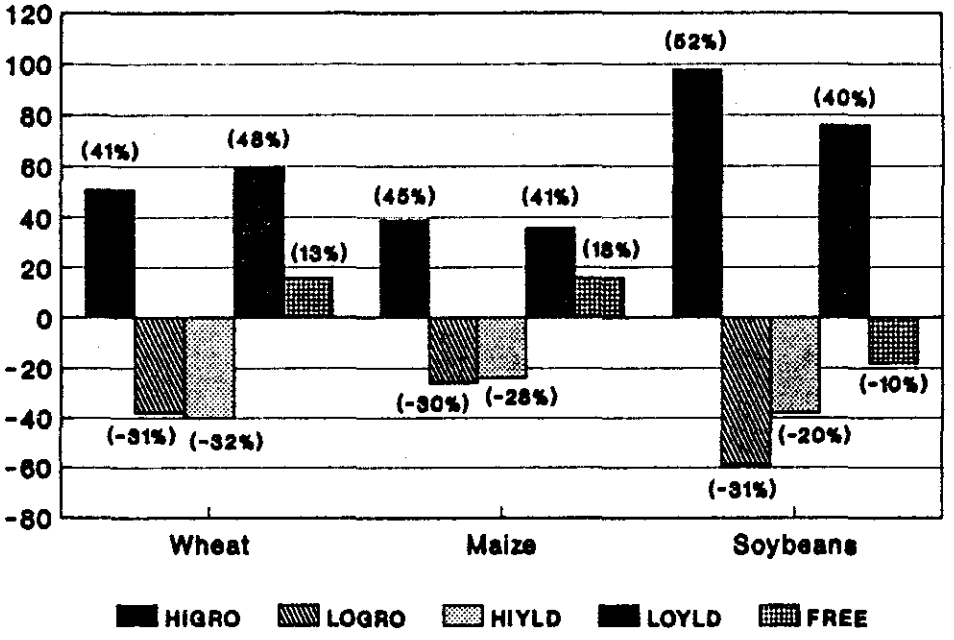


Figure 2 ENDING STOCKS

mil mt Absolute and Percent Change from Baseline 1995

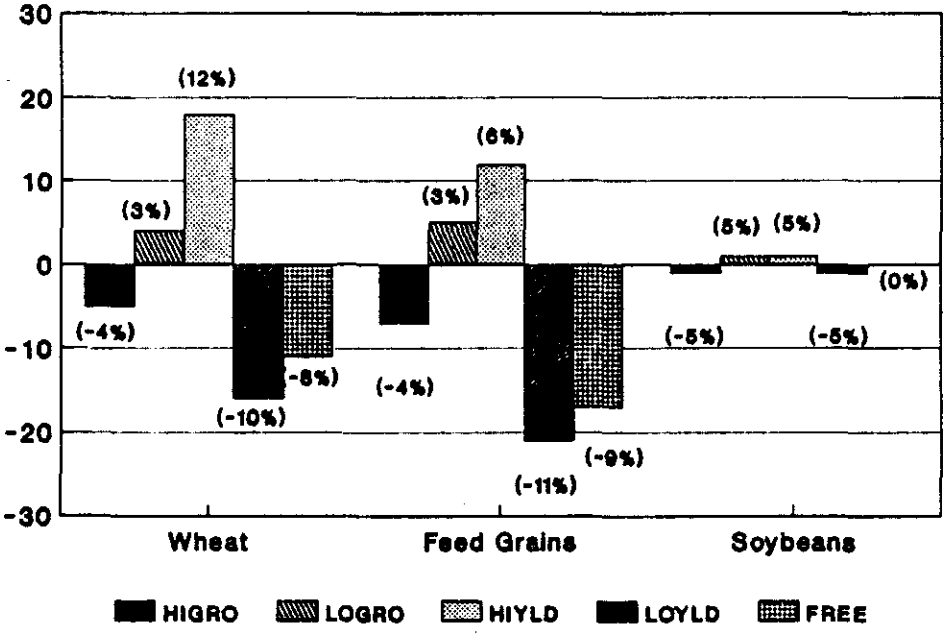


Figure 3 PRODUCTION

mil mt Absolute and Percent Change from Baseline 1995

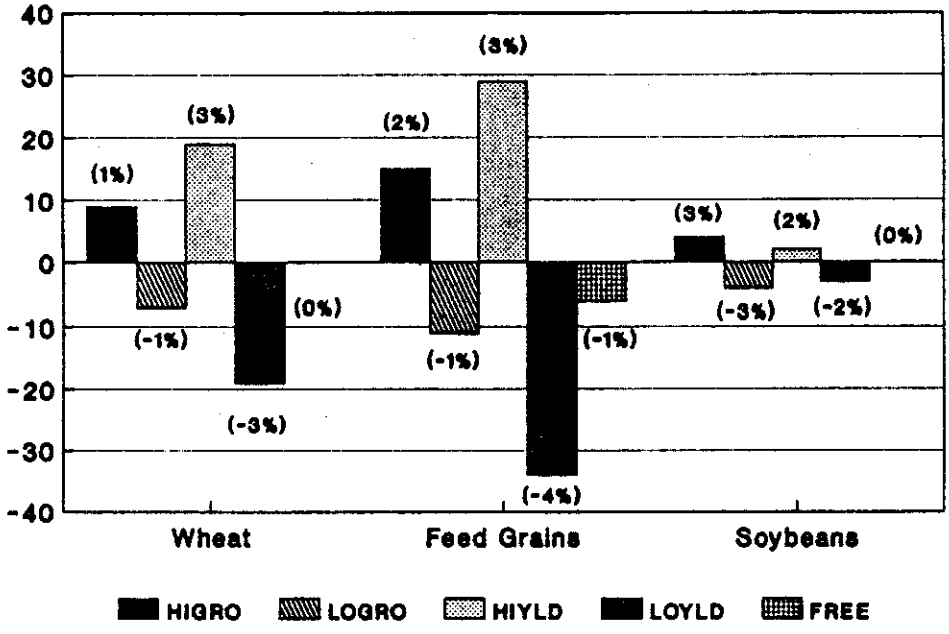


Figure 4 CONSUMPTION

mil mt Absolute and Percent Change from Baseline 1995

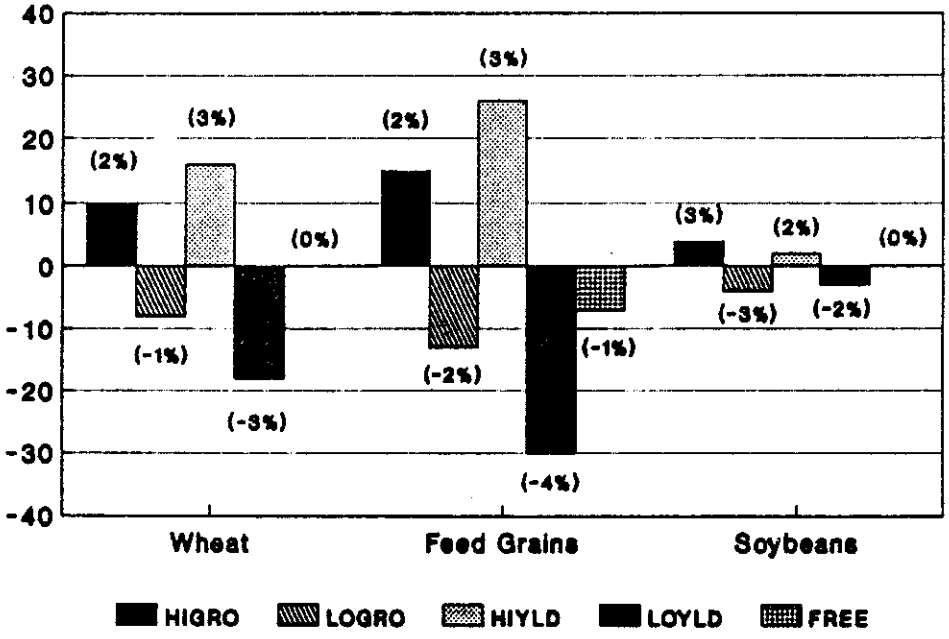


Figure 5 WHEAT NET EXPORTS

mil mt Absolute and Percent Change from Baseline 1995

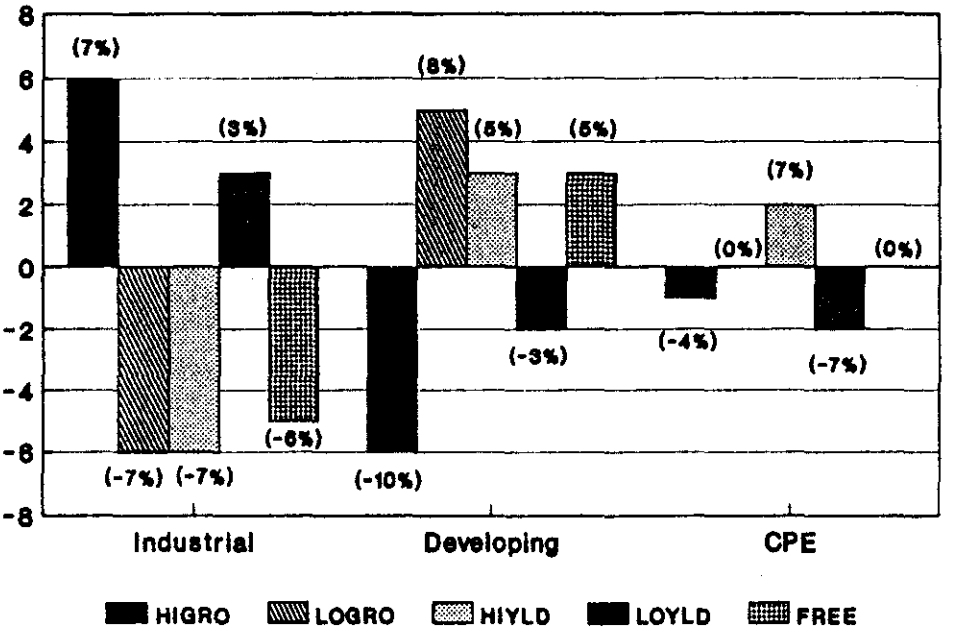


Figure 6 FEED GRAINS NET EXPORTS

mil mt Absolute and Percent Change from Baseline 1995

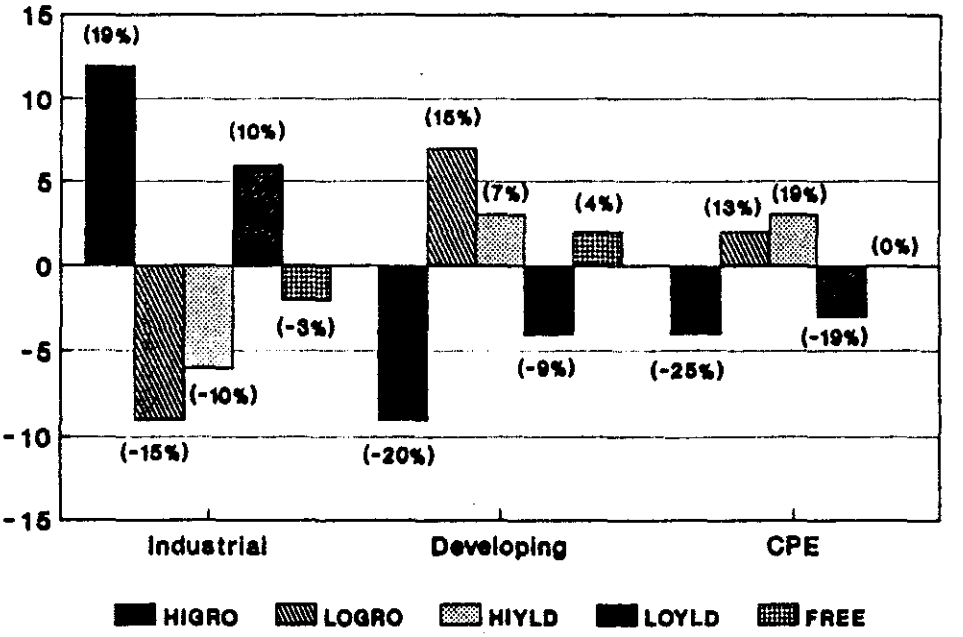


Figure 7 SOYBEANS NET EXPORTS

mil mt Absolute and Percent Change from Baseline 1995

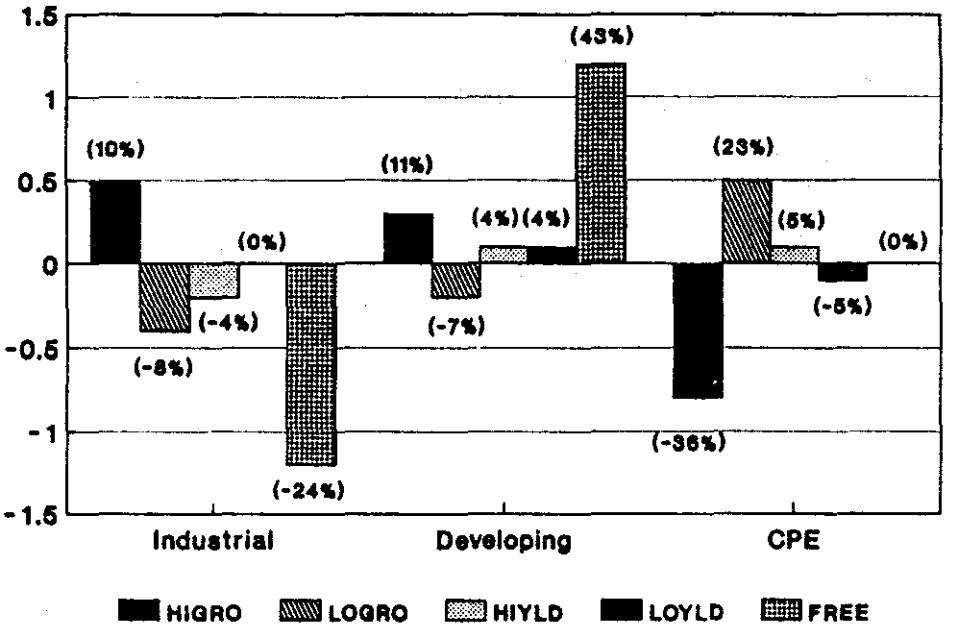
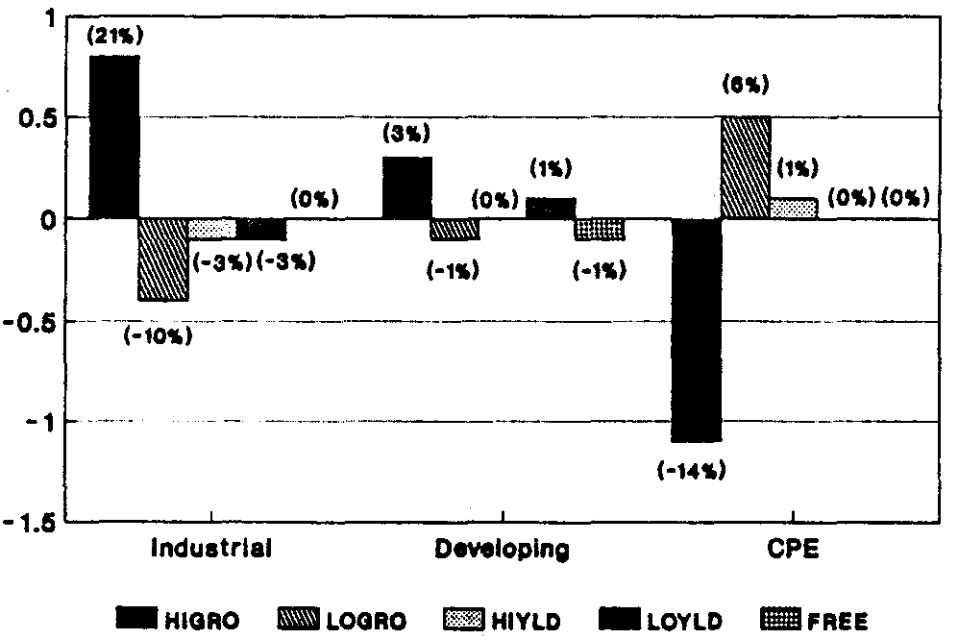


Figure 8 SOYMEAL NET EXPORTS

mil mt Absolute and Percent Change from Baseline 1995



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