Staff Paper

Impacts of the Federal Energy Acts
and Other Influences
on Prices of Agricultural Commodities and Food

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Abstract

Most of the increase in ethanol production in the 2008-2012 period can be attributed to the Energy Independence and Security Act of 2007 (EISA) and earlier federal energy legislation. The expansion in U.S. biofuel production, particularly ethanol, was the predominant cause of the elevated commodity prices. Other influences documented were a weak dollar, speculation and an increasingly inelastic commodity demand function. The supply function displayed more elasticity as crop farmers responded to rising profits. Upward pressures on commodity prices from EISA will ease as grain ethanol production will level off but will continue to support the market. The biodiesel industry, as well as dry mill ethanol plants, will benefit from the expansion in the extraction of corn oil from distillers' dried grain.

A major offset to the amount of corn diverted from livestock to ethanol was the increased availability of distillers' dried grain (DDG), a mid-protein feed. As a percent of total protein feed, utilization of DDG increased from 8% in crop years 2001-2005 to 18% in 2007-2011.

While retail food prices increased by 20% between 2002-2006 and 2008-2012, higher agricultural commodity prices accounted for only a 3.80% increase. Over a percentage point of this increase was due to higher energy prices which raised the cost of production on crops, reducing the agricultural commodity price contribution to 2.77%. The net effect was further adjusted downward to 2.38% to account for savings in federal farm subsidies; then adjusted upward to 2.50-2.57% to factor in the costs of the blenders' tax credit in EISA in 2007-2011 and projected to 2021. The conclusion is that EISA and earlier energy legislation has had and will continue to have a minor impact on U.S. retail food prices, less than 2.5%.

Acknowledgments

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34 pages

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Federal government programs to encourage biofuel production began as early as 1978 when ethanol began to be viewed as a replacement for lead additives in gasoline. Also, with gasoline shortages in the 1970s, due to interruptions in petroleum imports from the Middle East, interest grew for energy independence. As an additive, ethanol's high octane and oxygen content facilitates cleaner burning gasoline. For this reason, the Clean Air Act Amendments of 1990, which mandated oxygenated gasoline fuels in certain cities with unhealthy levels of air pollution, was a boost for ethanol. The competing oxygenate, methyl tertiary butyl ether (MTBE), was found to have contaminated water supplies in California and several other states; and ethanol became the oxygenate of choice by 2006. The major early federal legislation for biodiesel was known as the "Jobs Bill," enacted in October 2004, which provided a blenders' tax credit of $1.00 per gallon for 2005 to 2006.

The major instruments of federal energy policy affecting both ethanol and biodiesel were the Energy Policy Act of 2005 (EPACT) and the Energy Independence and Security Act of 2007 (EISA). EPACT established mandates (called Renewable Fuels Standards or RFS1) for the combination of ethanol and biodiesel to 2015. EISA extended the mandates (RFS2) to 2022 and established separate mandates for ethanol and biodiesel.

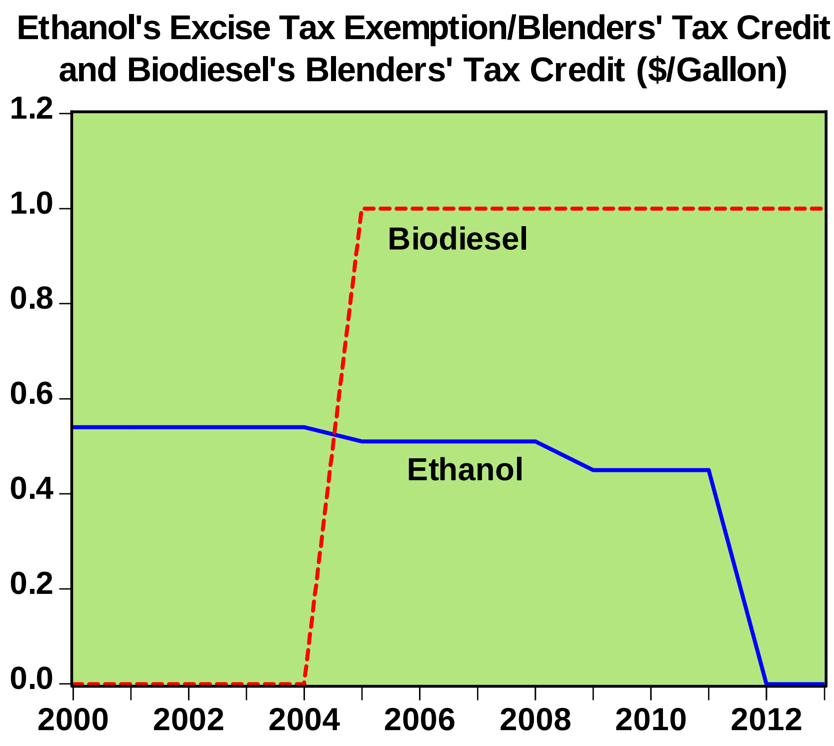
The rationale for these major energy programs was expressed in a March 2006 speech by Senator Richard Lugar of Indiana, then Chair of the U.S. Senate Foreign Relations Committee (Lugar, 2006), as follows: "(1) Oil supplies are vulnerable to natural disasters, wars, and terrorist attacks; (2) Worldwide reserves of crude oil are diminishing within the context of explosive economic growth in China, India, Brazil, and many other nations; (3) Oil producing nations use energy as an overt weapon against import dependent nations; (4) Regimes in countries that are rich in energy are avoiding democratic reforms and are able to insulate themselves from international pressure and the aspirations of their own people; (5) Inefficient and unclean use of nonrenewable energy threatens climate change and (6) High energy costs counter efforts to stem terrorist activities in the developing world as such costs are more burdensome than in the developed world." His views were shared across the aisle, prompting then Senator Barack Obama to join him in introducing several bills to enhance biofuels. Other common arguments for public support of biofuels included: (1) Increase farm income and reduce government subsidies, (2) Improve rural economies and (3) Clean up air pollution.

The purposes of this paper are to establish (1) that the federal energy legislation culminating in EISA was the major reason for the expansion in U.S. biofuel production in 2008-2012, (2) that this expansion was the driving force in the sharp increase in commodity prices related to food, (3) that the ultimate impact on retail food prices was relatively minor and (4) that credit should be given to energy legislation for reducing the costs of the farm program. This paper addresses and evaluates the various factors enumerated by others as the cause of higher food commodity prices. Since the focus of these studies was on the early period of the inflation, their assessment may have been correct but not necessarily for the entire 2008 to 2012 period, the time frame of this analysis. Finally, none of the studies looked at retail food prices – a major shortcoming this paper purports to overcome.

Impacts on Ethanol and Biodiesel Production

The major subsidy for ethanol was an excise tax exemption going back to 1978, ranging between \$.40 and \$.54 per gallon. At \$.54 when the "Jobs Bill" was enacted in 2004, it was reduced to \$.51 per gallon and changed to a blenders' tax credit (Figure 1). After being reduced to \$.45 per gallon in 2009, it was eliminated in 2012.

Figure 1.

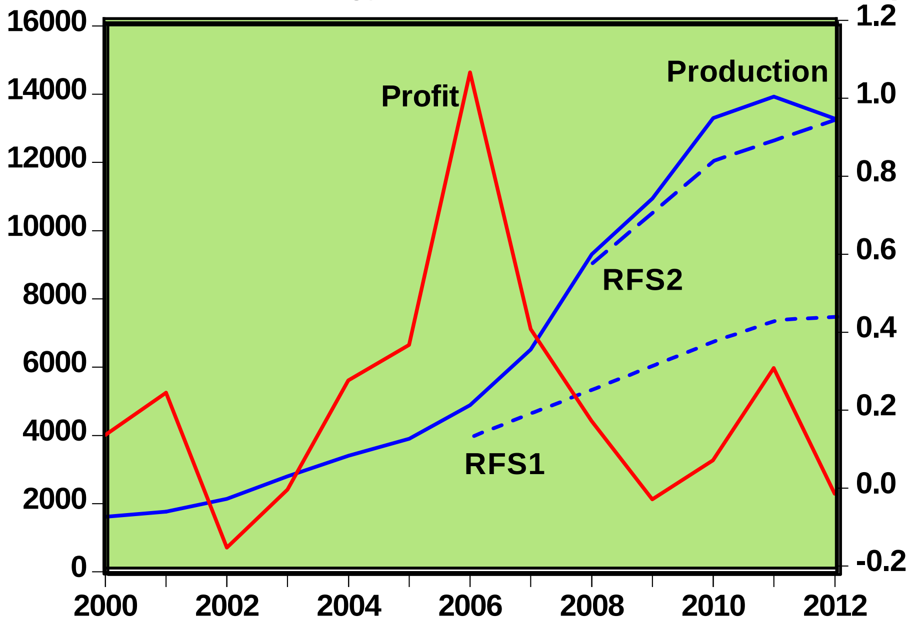


The \$1.00 blenders' tax credit established in the "Jobs Bill" for biodiesel was extended, haltingly, to 2013. It had been eliminated for 2010, but at the end of the year reestablished retroactively to the first of the year and extended through 2011. The same thing happened again in 2012 – not the best way to encourage an industry to expand.

The combination of the blenders' tax credit and the succeeding mandates did effectively encourage the rapid expansion in ethanol production, practically all in dry mill plants processing corn grain. This is illustrated in Figure 2. The peak in profits in 2006 triggered by the switch in oxygenates from MTBE to ethanol resulted in a boom in new plant construction. (Refer to Appendix A for the calculations of profits for dry mill ethanol plants and biodiesel operations.) Data from the Renewable Fuels Association (RFA) indicated that in January 2007, the capacity under construction or expansion was 5635 million gallons per year, about equal to the existing capacity (Cooper, 2013). In January 2008, a month after the enactment of EISA, the ethanol industry had another 5536 million gallons under construction or expansion. By 2008, the industry had reached the 9 billion gallon mandate and exceeded rising RFS2s until 2012.

Figure 2.

Ethanol Production Responding to $ Profits per Gallon (Right Scale) and Mandates under the Energy Acts of 2005 and 2007 in Mil. Gal. (Left Scale)



Without the blenders' tax credit, however, 2006 would have been the only year with a profit in the 2000 to 2006 period, and without the assurance of the RFS1 in January 2007 and RFS2 in January 2008, the incentive for expansion would have been substantially attenuated. Even in 2007 to 2011, taking $.51 to $.45 per gallon off the profit line would severely limit margins, somewhat offset by lower corn prices as ethanol production would have been reduced.

To measure the extent to which the ethanol industry has responded to profits and the mandates, a regression equation was estimated based on the RFA's data base for capacity under construction or expansion from 1990 to 2013 (as of January for each year) as follows:

CAPETHD=266+3783*GMETHD(-1)+.057852*RFSETHEXP
(4.60) (1.51)

CAPETHD is capacity under construction or expansion as of January 1 in million gallons per year.
GMETHD(-1) is the gross margin over variable costs, fixed costs and a nominal profit in the previous year deflated by the Chained Price Indexes for Personal Consumption Expenditures for the Gross Domestic Product of the BEA of the U.S. Dept of Commerce ($/Gal.).
RFSETHEXP is the RFS1 or RFS2 two years in advance of January 1 (Mil. Gal.)
Numbers in parentheses are "t" values.
The "R-squared' value is .589 and the "Adjusted R-squared" value is .548.
The Durban-Watson statistic was 1.21.

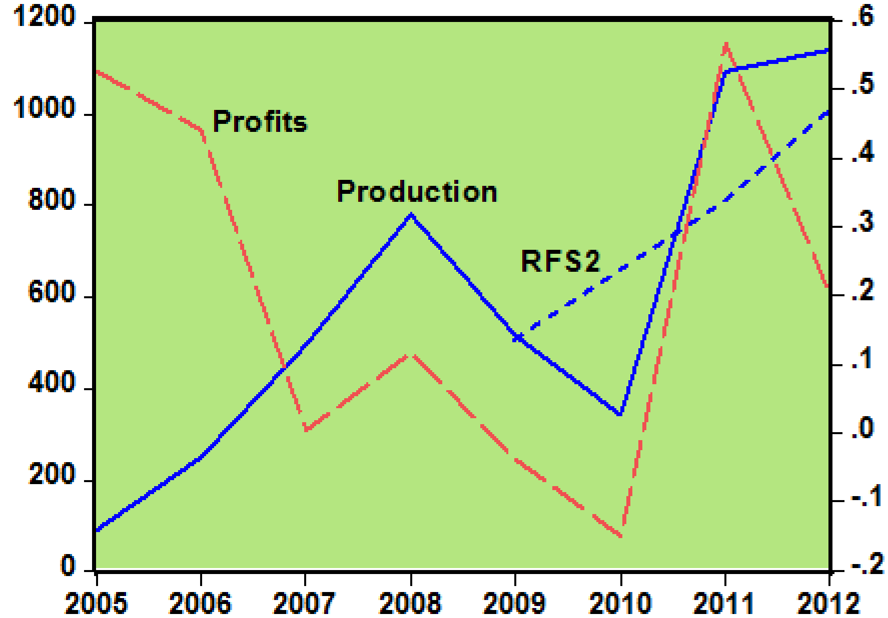
This is not the strongest equation in terms of being able to capture the changes in the intended expansion in the capacity of the ethanol industry over the 23 years, but the contribution of the two independent variables appeared to be in line with expectations. To speculate on what might have been in the years of 2007 to 2012, the blenders' tax credit was deducted from GMETHD and the RFSETHEXP was removed. The results for 2007 were of most interest since the impact on corn prices was not affected. The equation forecast CAPETHD at 2315 million gallons, half of the actual intentions. From there on, however, no expansion was projected.

Unfortunately, for biodiesel, the boom in expanding ethanol plants in January 2007 was a setback as farmers shifted in a major way in the spring to corn and away from soybeans. The result was a disruption in the balance between the two major Midwestern crops, and high soybean oil prices curtailed the budding expansion in biodiesel (Figure 3). Even so, production rebounded in 2011 and 2012 exceeding the RFS2. Without the $1.00 blenders' tax credit in 2005-2009, profits would have been negative. The RFS2 was binding in 2010 and 2011, providing support to biodiesel prices through the RIN system. RINs (Renewable Identification Numbers) are serial numbers assigned to a batch of biofuel in order to track a gallon's production, use and trading implemented by the U.S. Environmental Protection Agency (EPA). Obligated firms not able to meet their blending quota must purchase RINs in a market supplied by firms exceeding their quota.

The conclusion is that the combination of the Jobs Bill of 2004, EPACT of 2005 and EISA of 2007 had a major impact on production of ethanol and biodiesel in the five year period from 2008 to 2012. How much was due to the federal programs versus rising energy prices cannot be determined precisely. However, the equation on ethanol capacity under construction or expansion would indicate that about 80 percent of the expansion could be attributed to the energy legislation.

Figure 3.

Biodiesel Production Responding to $ Profits per Gallon (Right Scale) and RFS2 under the Energy Act of 2007 in Mil. Gal. (Left Scale)



Impact of Expanding Biofuel Production on Food Commodity Prices

A question separate from the effect of energy legislation on biofuel production is how much has the expansion in biofuel production impacted agricultural commodity prices. The presumption is that biofuels have had a major impact on prices on commodities tied to food, but measurement is difficult because of the other factors involved.

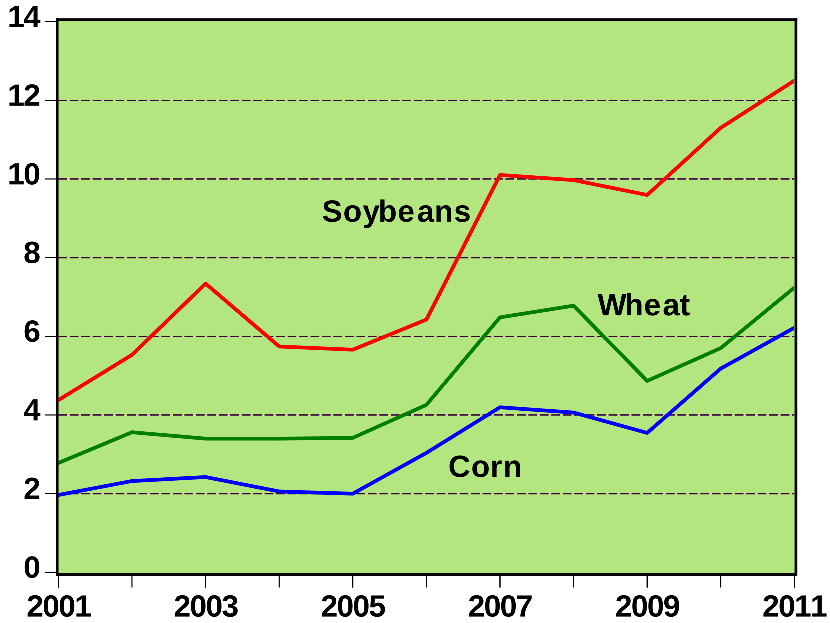
In the fall of 2006, the world awakened to the realization that agriculture was undergoing a major structural change. The U.S. farm price of corn, having averaged $2.00 per bushel in the 2005-06 crop year, soared in the middle of harvest from $2.09 in August to $3.00 in December and to a peak of $3.50 in June 2007. The crop was about 4% smaller than the USDA had forecast in August, but the main reason was a frenetic effort to expand ethanol plants around the nation (Ferris, 2009) (Cooper, 2013). Plotted in Figure 4 are the crop year average prices for corn, soybeans and wheat for 2001 to 2011.

<u>Literature Review</u>

A comprehensive analysis of factors contributing to rising commodity prices related to food as viewed in mid 2008 was a report from the Economic Research Service of the U.S. Department of Agriculture (Trostle, 2008). Cited in addition to biofuels was the slower growth in global agricultural production combined with a more rapid growth in demand which tightened balances of grains and oilseeds. Also mentioned were adverse weather

Figure 4.

Crop Year Average Farm Prices on Corn, Soybeans and Wheat ($/Bu.)



conditions in 2006 and 2007, the declining value of the U.S. dollar, rising energy prices and increased cost of production on farms. Other factors mentioned included growing foreign exchange holdings by major food-importing nations and policies adopted by exporting and importing nations to mitigate their own food price inflation.

Von Braun and Torero of the International Food Policy Research Institute (IFPRI) agreed that trade policies of individual nations exacerbated the problems attendant to rising commodity prices (Von Braun and Torero, 2009). As of April 2008, 15 countries imposed export restrictions on agricultural commodities. Some net-food importing developing countries reduced import barriers. They claimed that this action could explain as much as 30 percent of the increase in prices in the first six months of 2008. Their analysis also concluded that speculation contributed significantly to the global rise in commodity prices and proposed a "virtual" agricultural commodity reserve.

In a paper by Purdue agricultural economists for the Farm Foundation entitled, "What's Driving Food Prices in 2011," they identified biofuels and Chinese soybean imports as "*Two big, persistent demand shocks*" affecting food prices (Abbott, Hurt, and Tyner, 2011.) Also cited were greater market inelasticity, weather, a weak dollar exchange rate and world wide economic growth.

Zilberman, et. al. in a survey of the impact of biofuels on "commodity" food prices concluded that "changes in biofuel prices have little impact on food prices" (Zilberman, Hochman, Rajagopal, Sexton and Timilsina, 2013). A caveat was that this "result does not imply that the introduction of biofuels has minimal impact on the price of food but that the analysis of the relationship between food and fuel prices cannot fully capture the impact of biofuel on food prices." Not clear is the purpose of some of these studies which concentrated on establishing correlations between corn, ethanol, gasoline and crude oil prices. Of course, how fuel prices affect the cost of production for major crops is of particular interest.

One publication cited by these authors did try to measure the impact of biofuel production on food commodity prices (Mitchell, 2008). As stated, higher energy prices in combination with the weak dollar caused food commodity prices to rise by about 35-40 percentage points from January, 2002 to June, 2008, which explains 25-30% of the total price increase. The remainder of 70-75% was due to biofuels and the consequences of low grain stocks, large land-use shifts, speculative activity and export bans.

Analysis of Contributing Factors, 2008-2012

Prices, Acreages and Yields in 2001-2005 and 2007-2011

December 2012 marked the fifth anniversary of the passage of EISA. With the data available for five calendar years as well as for crop years 2007 to 2011, some assessment can be made of the impact of the program on farm prices. As bases for comparison, the five calendar year period from 2002 to 2006 and crop years 2001 to 2005 were selected since production of ethanol was just starting to accelerate, production of biodiesel was very low and the farm price of corn had been stable at around $2 per bushel (Figure 4).

In Table 1, the prices of the commodities most closely related to food prices – the farm prices of corn, soybeans and wheat and the wholesale prices of soybean meal and soybean oil – were averaged for the two periods. As can be noted, the farm price of corn more than doubled with prices on the other commodities up 79 to 91%.

Table 1.

Key Agricultural Commodity Prices, Average for Crop Years 2001-2005 and 2007-2011

Item	Unit	2001-2005	2007-2011	% Change
Corn, farm price	$/Bu.	2.15	4.64	116
Soybeans, farm price	$/Bu.	5.73	10.69	87
Soybean Meal, 48%, Decatur, IL	$/S.T.	192	344	79
Soybean Oil, crude, Decatur, IL	Cents/Lb.	23.5	45.0	91
Wheat, farm price	$/Bu.	3.31	6.21	88

The higher prices encouraged an expansion in corn acreage mostly at the expense of other coarse grains, hay, corn silage and pasture (Table 2). Soybeans and wheat maintained the acreage harvested in 2001-2005, and the total for the four crop classifications increased 8.2 million acres or 4%. By the 2011-12 crop year, the total harvested acreage of these crops reached 221.7 million acres, 7.2% more than in 2001-2005. The point is that U.S. farmers do respond to price and profits and did adjust quickly to the new structural

Table 2.

Acreage Harvested on Selected Crops, Average for Crop Years 2001-2005 and 2007-2011, Millions

Crop	2001-2005	2007-2011	Absolute Change	% Change
Corn	71.5	82.0	10.5	14.7
Soybeans	72.7	73.1	0.4	0.6
Wheat	49.5	50.0	0.5	1.0
Other Coarse Grain	13.2	10.0	-3.2	-24.2
Total	206.9	215.1	8.2	4.0
CRP for above crops	21.3	21.2	-0.1	-0.5
Hay	62.9	59.3	-3.6	-5.7
Corn Silage	6.4	5.8	-0.6	-9.4
Pasture [1]	57.1	55.4	-1.7	-3.0
Total for above four land uses	147.7	141.7	-6.0	-4.1

[1] Estimated from livestock numbers and crop yields.

change in demands. To provide a perspective, harvested acreage of these crops plus the set-aside programs in effect in 1982, 30 years earlier, totaled 260.0 million acres. Flexibility remains in farmland utilization.

Global Crop Yields

As ventured by Trostle, world agricultural productivity is slowing. Referring to the combination of grain and oilseeds, he states that "Global aggregate yield growth averaged 2.0 percent per year between 1970 and1990, but declined to 1.1 percent between 1990 and 2007. Yield growth is projected to continue declining over the next 10 years to less than 1.0 percent" (Trostle, 2008). Typically, crop yields tend to increase linearly which means that the percentage increase would naturally decline over time. Recall the Malthusian dilemma that food production increases linearly while population increases exponentially.

A visual perspective on world yields of coarse grains, wheat and oilseed from 1990 to 2011 is presented in Figure 5. By inspection, one would not conclude that most yields have leveled off significantly from linear upward trends, with coarse grain, wheat and oilseeds in the important region of the Rest of the World actually demonstrating some acceleration. Applying double exponential smoothing to each yield, the only persistent leveling off was established on coarse grain and wheat beginning in the mid1990s in the EU-15 where yields are among the highest in the world and on soybeans in Argentina and Brazil as yields have approached 3.0 MT per hectare.

While weather problems may have had adverse effects on yields in some areas of the world in 2006 and 2007, yields were generally in line with trends for crop years 2007 to 2011 (Table 3). In every commodity classification, yields increased between 2001-2005

Figure 5.

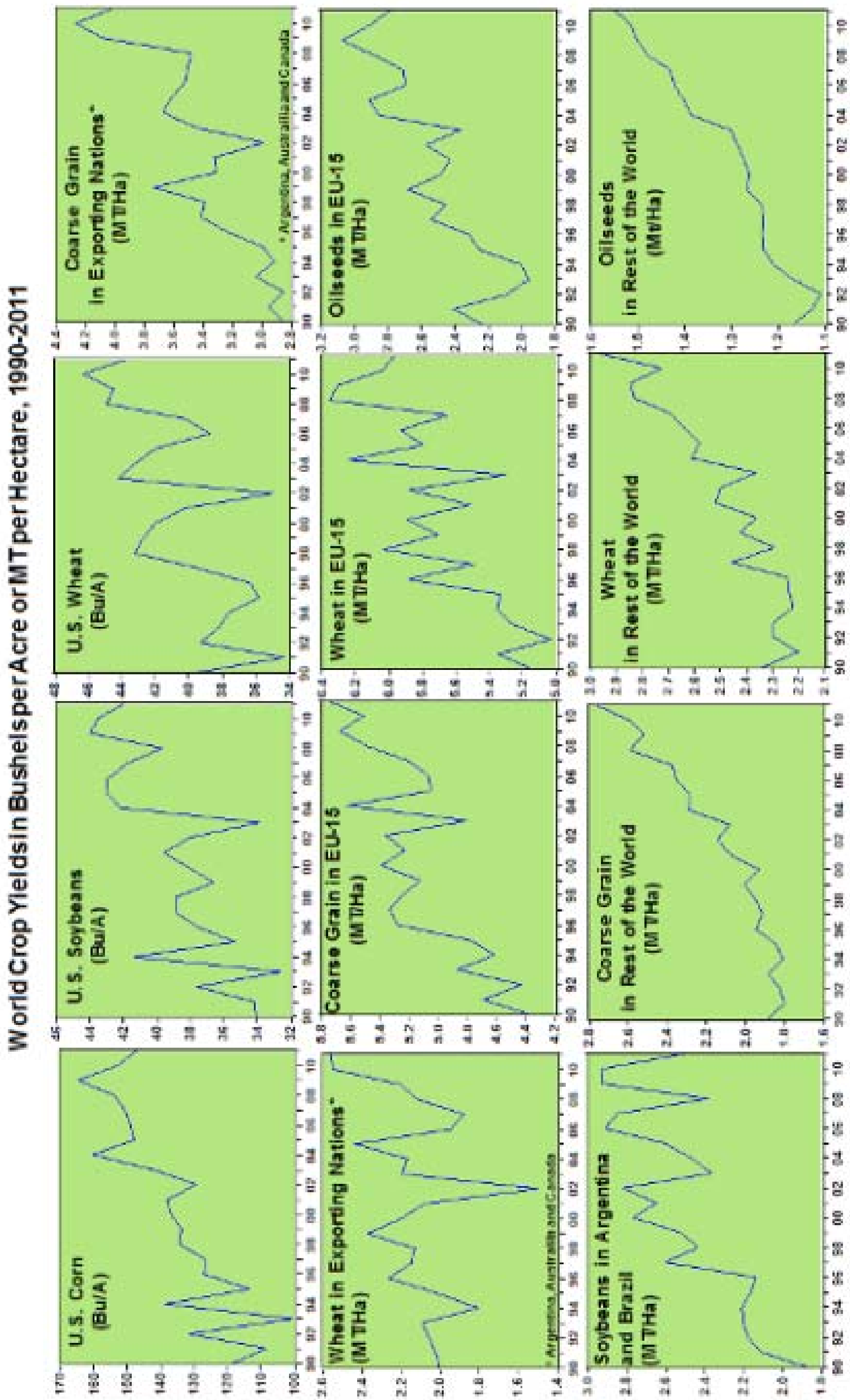

World Crop Yields in Bushels per Acre or MT per Hectare, 1990-2011
U.S. Corn (Bu/A)
U.S. Soybeans (Bu/A)
U.S. Wheat (Bu/A)
Coarse Grain in Exporting Nations* (MT/Ha)
* Argentina, Australia and Canada
Wheat in Exporting Nations* (MT/Ha)
* Argentina, Australia and Canada
Coarse Grain in EU-15 (MT/Ha)
Wheat in EU-15 (MT/Ha)
Oilseeds in EU-15 (MT/Ha)
Soybeans in Argentina and Brazil (MT/Ha)
Coarse Grain in Rest of the World (MT/Ha)
Wheat in Rest of the World (MT/Ha)
Oilseeds in Rest of the World (Mt/Ha)

Table 3.

World Crop Yields Compared to Trends, Average for 2001-2005 and 2007-2011

Area and Crop	Unit	2001-2005			2007-2011		
		Yield	Trend	Difference	Yield	Trend	Difference
United States							
Corn	Bu./Acre	143.6	144.5	-0.9	153.9	156.1	-2.2
Soybeans	"	39.3	39.1	0.2	42.2	42.2	0.0
Wheat	"	40.9	41.9	-1.0	43.9	43.4	0.5
Other Coarse Grain	MT/Ha.	3.48	3.68	-0.20	3.77	3.82	-0.05
Major Exporting Nations [1]							
Coarse Grain	"	3.41	3.52	-0.11	3.86	3.83	0.03
Wheat	"	2.08	2.19	-0.11	2.26	2.33	-0.07
European Union (15 Nations)							
Coarse Grain	"	5.21	5.44	-0.23	5.52	5.50	0.02
Wheat	"	5.75	6.00	-0.25	6.06	6.12	-0.06
Oilseeds	"	2.63	2.63	0.00	2.87	2.92	-0.05
Brazil and Argentina							
Soybeans	"	2.58	2.57	0.01	2.72	2.80	-0.08
Rest of the World							
Coarse Grain	"	2.18	2.07	0.11	2.57	2.20	0.37
Wheat	"	2.51	2.48	0.03	2.81	2.64	0.17
Oilseeds	"	1.33	1.36	-0.03	1.49	1.46	0.03

[1] Argentina, Australia and Canada

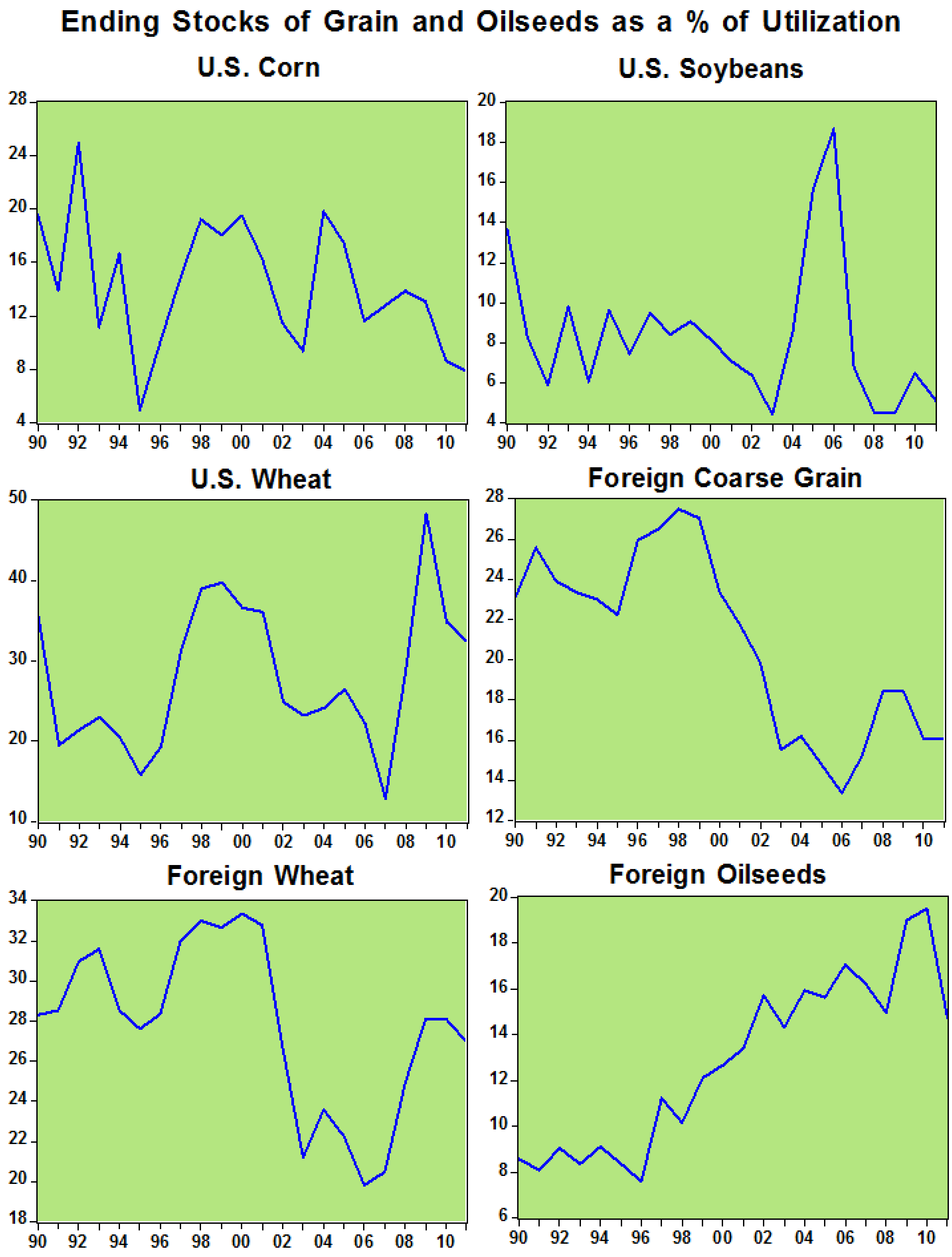
and 2007-2011. Notably, U.S. yields of corn and other coarse grain were below trend along with oilseeds in the European Union (15) and soybeans in Brazil and Argentina. However, in regions where yields were above average, coarse grain production swamped the reduction in the U.S.; and oilseed production in the Rest of the World offset production in nations where yields were below trend. The conclusion is that neither a leveling off of global crop yields nor unfavorable weather in the five crop years of 2007 to 2011 contributed to the much higher level of agricultural commodity prices.

Impact of Tight Supply-Demand Balances

Indeed, the reason for elevated corn and soybean prices in crop years 2007-2011 is the lower ending stocks in the U.S. triggered by the rapid expansion in U.S. ethanol production (Figure 6). Analysts correctly called the importance of declining foreign stocks of coarse grain and wheat in 2006 and 2007 although foreign oilseed stocks were at a comfortable level. The major reason coarse grain and wheat stocks declined dramatically between 2001 and 2005 was a policy decision in China to cut stocks.

As the saying goes, “The solution to high prices is high prices.” The response in area and yields in Tables 2 and 3 and Figure 5 attests to the saying and mutes the early assessment on what is driving food commodity prices. In the perspective of crop years 2007-2011, low foreign grain and oilseed carryover stocks were not responsible for high food commodity prices.

Figure 6.


Ending Stocks of Grain and Oilseeds as a % of Utilization
U.S. Corn
U.S. Soybeans
U.S. Wheat
Foreign Coarse Grain
Foreign Wheat
Foreign Oilseeds
90 92 94 96 98 00 02 04 06 08 10

Impact of Expansion in Foreign Production of Biofuels

The USDA's Economic Research Service's article referenced earlier had an excellent tabulation entitled "Update on Global Land Use in Biofuel Feedstock Production" with reference to major producing countries in 2006-2007 (Trostle, 2008). Of particular interest was the extent to which expansion of foreign biofuel production would require more land. For Argentina and Brazil (sugarcane for ethanol and soybean oil for biodiesel), the area required in the 2006-2007 crop year was 4.77% of the arable land. For Canada and China (corn and wheat for ethanol), the area required was only 0.66% of the arable land. For the EU-27 (mostly rape and soybean oil for biodiesel, secondly wheat and sugarbeets for ethanol), the area required was 4.44% of the arable land. The implication is that substantial opportunities existed to shift more land into biofuel crops in 2007-2011.

In their annual issues on the Agricultural Outlook, OECD/FAO estimates and projects ethanol and biodiesel production for the world and major nations and also utilization of coarse grain, wheat and sugar crops for ethanol and vegetable oils for biodiesel (OECD/FAO, 2012). Trends from 2008 to the 2011 crop year and projections for the 2012 to 2021 crop years are plotted in Figure 7 for coarse grain and wheat utilized for ethanol in nations outside of the U.S. Somewhat surprising is the extent to which wheat is processed into ethanol and the expectation for its expansion.

Dividing the OECD/FAO data on the foreign utilization of coarse grain and wheat for ethanol by their respective trends and projections for production generates the relative importance of the two grains as plotted in Figure 8. The essence of the trends and projections is that, starting from about 1.5% of production in the 2008 crop year, utilization of coarse grains for ethanol will not likely exceed 3.0% of production even by 2021; starting from about 0.8% of production in 2008, utilization of wheat for ethanol will not likely exceed 2.0% of production by 2021. These percentages may be even less considering that there is some evidence that the OECD/FAO estimates may be high. This is not trivial because the OECD/FAO estimates for global ethanol production in recent years have been running about 25% above those of F.O. Licht's (Baker, 2012).

A similar look at trends and projections from OECD/FAO for foreign utilization of vegetable oils for biodiesel is presented in Figure 9. Clearly, biodiesel is a much more important biofuel abroad than in the U.S. Starting at about 9.5% of foreign production of vegetable oils in the 2008 crop year, OECD/FAO expects the percentage to reach about 16% by 2021. Use of vegetable oils for biodiesel outside the U.S. has been a significant factor but accommodated quite well as evident in the increase in ending stocks of oilseeds as a percent of utilization as portrayed in Figure 6.

Figure 7.

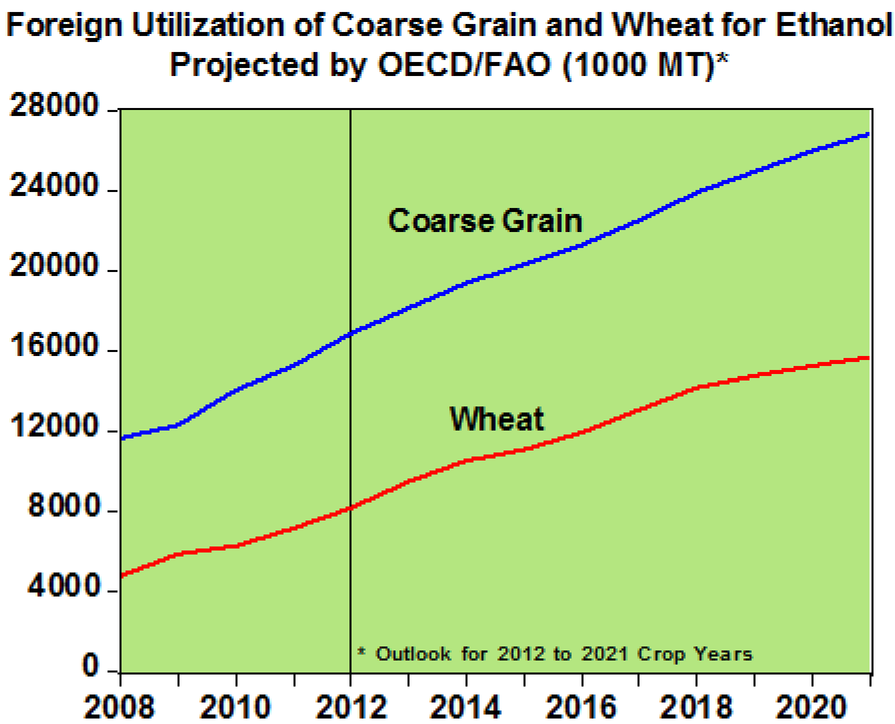


Figure 8.

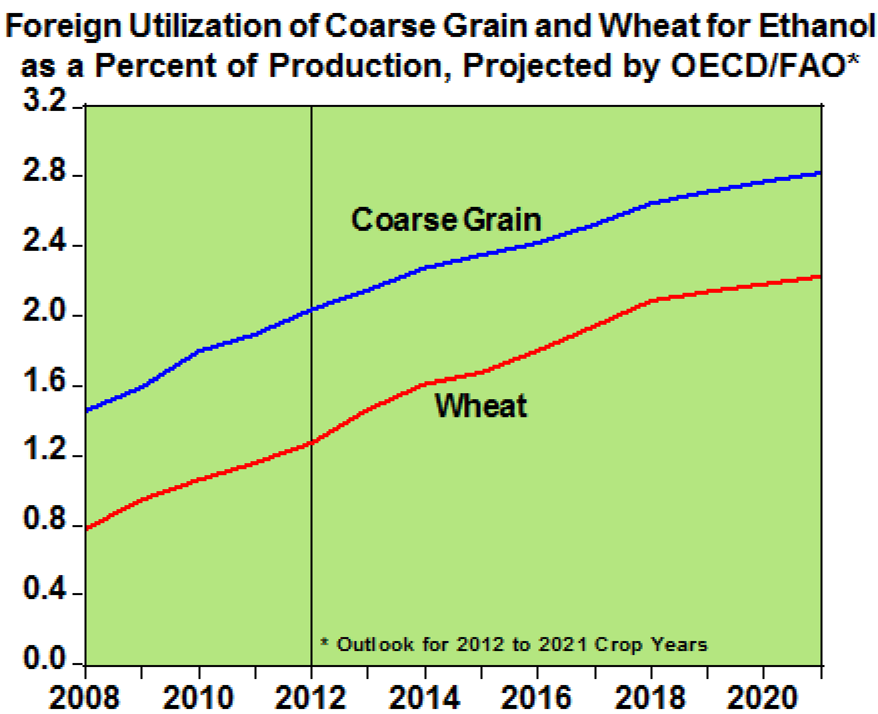
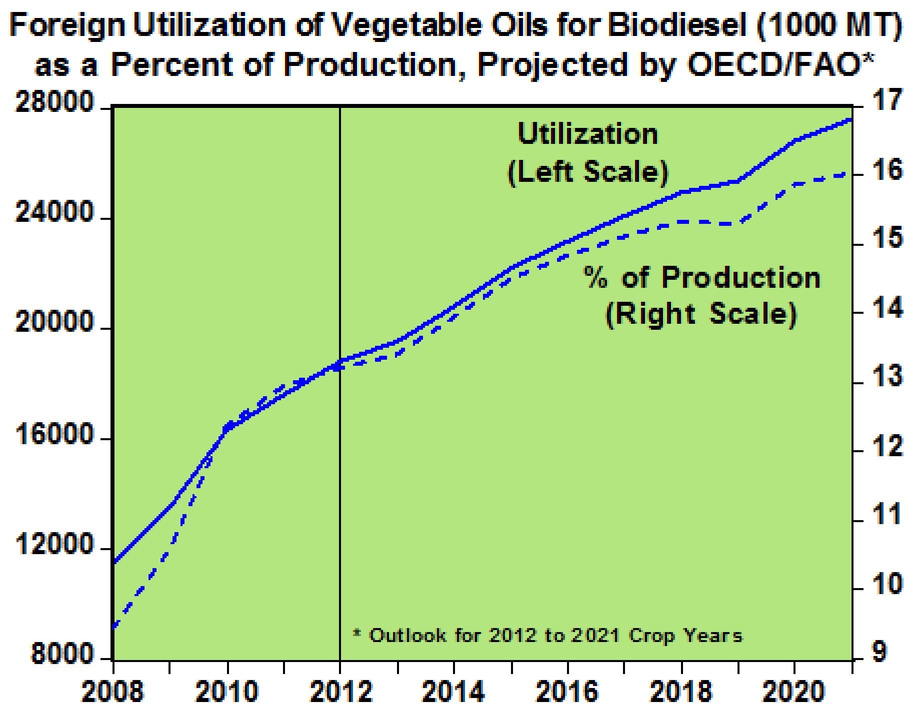


Figure 9.



Economic Growth and Exchange Rates

A rapid economic growth, particularly in the developing nations such as China and India, has been cited as another reason for the acceleration in commodity prices attendant to the expansion in biofuel production. This was the case in 2002 to 2007 but to a lesser degree in the five year span from 2008 to 2012 (Table 4). In all the selected regions, the annual percent change in real gross domestic product was attenuated in 2008-2012 relative to 2002-2006. Even so, the real economic growth rate continued at a relatively high level for China and India.

Table 4.

Annual Percent Changes in Real Gross Domestic Products in Selected Regions
Average for Calendar Years 2002-2006 and 2008-2012 [1]

Region	2002-2006	2008-2012	Difference
United States	2.7100	0.5900	-2.1200
China	10.6400	9.1700	-1.4700
India	7.7900	7.4000	-0.3900
Former Soviet Union	7.2500	2.3500	-4.9000
Rest of the World	2.7900	1.0600	-1.7300

[1] International Macroeconomic Data Set, Economic Research Service, U.S. Department of Agriculture, Contact: Matthew Shane

Frequently mentioned as a force behind the rise in commodity prices was the weak dollar. This has validity as measured by the indexes of real commodity trade weighted exchange rates for the products most closely linked to food prices (Table 5). Comparing 2007-2011 crop years with 2001-2005, the indexes dropped in a range from 11.5 percentage points on corn to18.1 percentage points on wheat.

Table 5.

Indexes of Real Commodity Trade Weighted Exchange Rates for Key Agricultural Products
Average for Crop Years 2001-2005 and 2007-2011 (2005=100) [1]

Commodity	2001-2005	2007-2011	Difference
Corn	102.8	91.2	-11.5
Soybeans	102.0	88.0	-14.1
Soybean Meal	105.6	88.1	-17.5
Soybean Oil	104.3	90.9	-13.4
Wheat	104.3	86.1	-18.1

[1] Agricultural Exchange Rate Data Set, Economic Research Service,
U.S. Department of Agriculture, Contact: Matthew Shane

In the analysis which follows, structural equations from an econometric/simulation model of U.S. agriculture called AGMOD were employed (Ferris, 1998, 2005 and Appendix B). Based on regression equations estimated from annual data from 1970 to 2011, exchange rates were statistically significant variables in explaining exports on corn, soybeans and wheat. With other independent variables held constant, the weak dollar would account for an increase of about 10% (200 million bushels) in corn exports in 2007-2011, 3% (39 million bushels) in soybean exports and 8% (92 million bushels) in wheat exports. However, a 200 million bushel increase in corn exports would equal only 6.4% of the increase in corn processed into ethanol between 2001-2005 and 2007-2011.

<u>Trade Policies of Food Commodity Exporting and Importing Nations</u>

Tracing the effect of trade policies in food commodity exporting and importing nations as enumerated by Trostle (Trostle, 2008) is somewhat difficult because of other influences on trade. Indeed China (exporter) did cut exports of coarse grain and wheat more than in half in the crop years 2007 to 2011, based on data from the Foreign Agricultural Service of the U.S. Department of Agriculture. Argentina (exporter) reduced wheat and soybean oil exports but increased exports of corn and soybean meal. Russia and the Ukraine (exporters) increased wheat exports presumably because of larger crops. In total for China, Argentina, Russia and the Ukraine, exports of coarse grain declined by 10%; wheat actually increased by 32%, and the combination increased by 13%. The reduction in exports of coarse grain represented only 0.2% of world domestic consumption.

Countries which reduced import restrictions included: India which dramatically increased imports of wheat flour; Indonesia which increased imports of soybeans and wheat; and the EU-27 which increased coarse grain imports. The imports of wheat into the EU-27 actually declined. In total, coarse grain imports increased 67% and wheat imports increased 10% in these nations. Compared to world domestic consumption, these increases represented only 0.3% on coarse grain and 0.2% on wheat.

Other Influences on the Rise in Food Commodity Prices

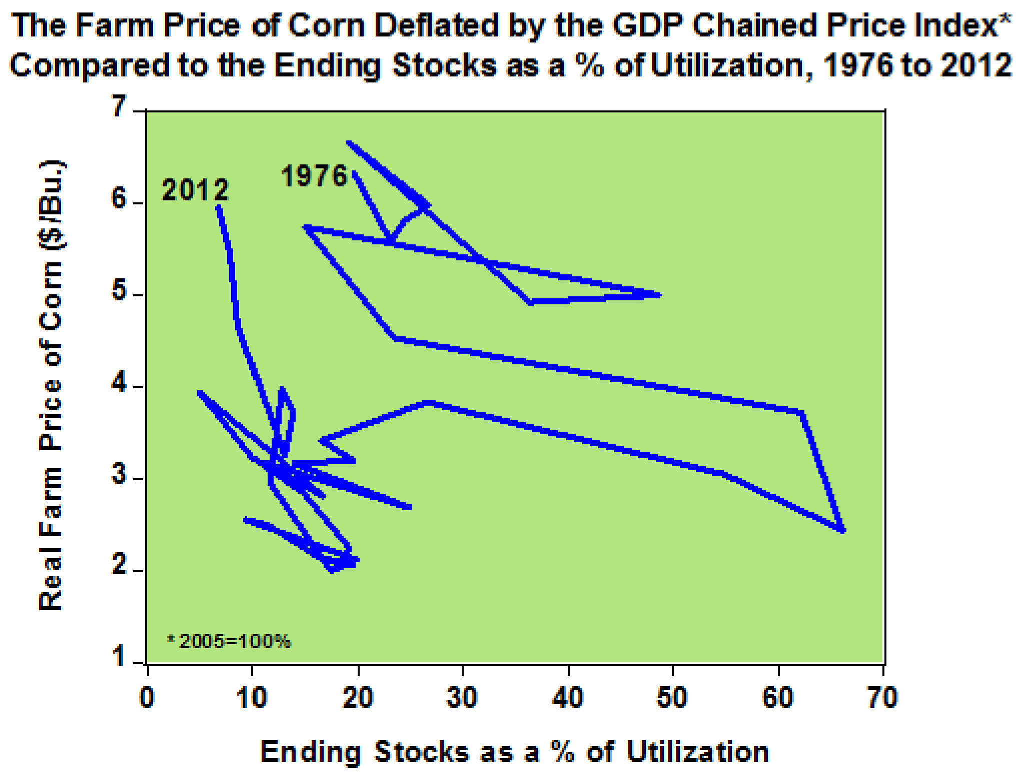
Like other references in this paper, the impact over time of forces identified as contributing to higher commodity prices has been muted by the ability of U.S. farmers and others around the world to respond. This may be the case with the accelerated imports of soybeans in China as documented in the Purdue paper (Abbott, Hurt and Tyner, 2011). Indeed, China more than doubled their imports of soybeans between 2001-2005 and 2007-2011. Total exports of U.S. soybeans did increase 35% between the two periods contributing to the sharp reduction in soybean carryover. However, soybean prices are primarily driven by the linkage of soybean meal prices to corn prices and secondarily by the ending stocks of oilseed outside of the U.S. The balance sheet for oilseeds outside of the U.S. generated ending oilseed stocks at about 17 percent of annual utilization for 2007-2011 compared to 15 percent for 2001-2005. Also, lower soybean stocks carryover had a positive impact on soybean oil prices which, in turn, raised prices on soybeans.

Two of the references cited mentioned speculation as a reason for the "spike" in commodity prices – a spike which has a much higher level at the end than at the beginning. There is some validity to this claim although one must be careful in that speculation is an element in fundamental analysis of commodity prices. In AGMOD, the farm price of corn is a function of (1) the ending stocks versus total utilization and (2) the breakeven price in dry mill ethanol production. The weighting between (1) and (2) is based on the importance of ethanol utilization relative to the total. As a judgment, perhaps as much a $.25 per bushel in the average of $4.64 of the farm price of corn for 2007-2011 could be attributed to speculation.

However, as emphasized in the Purdue publication, commodity markets have become more inelastic. In recent years, carryovers in the major grains and oilseeds sectors have approached what is termed "pipeline" levels – just enough to keep the flows to food and livestock demands between crop years adequate. In those years, commodity prices became very sensitive not only to estimates of current supplies but also prospects for the next crop year. Portrayed in Figure 10 is a visual representation of how the demand for corn has become much more inelastic in the last 4 or 5 years. This compounds the problem of measuring speculation.

In this plot, the first crop year is labeled 1976 and the last year 2012, the latter based on the May World Agricultural Supply and Demand Estimates of the USDA (USDA, May, 2013). The flattening out in the interim years reflects the federal farm program, which employed a non-recourse loan scheme which held prices from tanking when ending stocks were very large.

Figure 10.



Importance of Ethanol's Distillers' Dried Grains

Ethanol

To provide a perspective on the importance of the demand for corn from the ethanol industry, the balance sheet for the two periods using the USDA's format is displayed in Table 6. Increased corn production accommodated the expansion in the utilization for ethanol although the ending stocks as a percent of utilization approached a "pipeline" level at around 11 percent. As can be noted, the USDA has added "& By-products" to the ethanol classification pointing out that such corn also is the source of distillers' dried grain (DDG) from dry mill plants and corn gluten feed, corn gluten meal and corn oil from wet mill plants. As a percent of utilization, corn used for ethanol and by-products increased from 11.3 in crop years 2001-2005 to 33.7 in 2007-2011. By 2010, this classification had exceeded the amount fed to livestock which declined by 13.4% between the two periods.

Notwithstanding the major impact that expanding ethanol production has had on increasing corn prices, the increased feeding and availability of DDG, which more than tripled between the two periods, has helped to offset the diversion of corn from livestock feed and exports to ethanol (Table 6). Relative to all protein feeds utilized for domestic livestock, on a protein equivalent basis, DDG increased from about 8% to 18%. The

Table 6.

USDA Balance Sheets on Corn and Soybean Meal and AGMOD's Estimates on Distillers' Dried Grain
Average for Crop Years 2001-2005 and 2007-2011

Crop or Product	Unit	2001-2005	2007-2011	Absolute Change	% Change
Corn					
Production	Mil. Bu.	10296	12606	2310	22.4
Utilization					
Feed and Residual	"	5894	5102	-792	-13.4
Ethanol & By-products	"	1159	4276	3117	268.9
As a % of Utilization	%	11.3	33.7	22.4	198.2
Other Domestic	Mil. Bu.	1379	1382	3	0.2
Exports	"	1869	1939	70	3.7
Total	"	10293	12688	2395	23.3
Ending Stocks	"	1544	1424	-120	-7.8
As a % of Utilization	%	15.0	11.2	-3.8	-25.3
Soybean Meal					
Production	Mil. M.T.	35.7	36.9	1.2	3.4
Utilization					
Feed	"	29.7	28.4	-1.3	-4.4
Exports	"	6.3	8.7	2.4	38.1
Distillers' Dried Grain					
Production	Mil. M. T.	7.1	32.0	24.9	350.7
As a % of Soybean Meal	%	19.9	86.7	66.8	335.7
Utilization					
Feed	Mil. M.T.	6.3	25.5	19.2	304.8
As a % of all Protein Feed [1]	%	8.1	26.2	18.1	223.5
Exports	Mil. M.T.	0.9	6.9	6.0	666.7

[1] Calculated on a protein equivalent basis

increased feeding of DDG replaced about 80% of the reduction in feeding corn in energy equivalents and added to the protein supplies in countering the small reduction in feeding soybean meal (Table 6).

The expansion in the availability of DDG for the domestic livestock operations would be expected to affect both corn and soybean meal prices. In AGMOD, all feeds utilized are converted into energy and protein equivalents. The equation for the feeding of coarse grain includes a ratio of the utilization of all feeds except coarse grain in energy equivalents to the utilization of all feeds in energy equivalents. Practically all of the increase in this ratio between 2001-2005 and 2007-2011 was due to the feeding of DDG. Similarly, the equation for the feeding of soybean meal includes a ratio of the utilization of all feeds except soybean meal in protein equivalents to the utilization of all feeds in protein equivalents. Nearly all of the increase in this ratio was attributed to DDG. The higher the ratios, the less the feeding of coarse grain and soybean meal leading to higher ending stocks.

In AGMOD, the price of corn is the major determinant of the price of soybean meal. Also in AGMOD, prices on DDG, corn gluten feed and corn gluten meal, along with the other meals are based on (1) values derived from "synthetic" energy and protein prices derived from corn and soybean meal and (2) ratios of their use in protein equivalents relative to the total protein feeds in protein equivalents (Ferris, 2006).

Biodiesel

The role of soybean oil in furnishing feedstock for biodiesel production between the two periods is presented in Table 7. Production increased nominally, and easily accommodated the expansion in the utilization of soybean oil, the preferred feedstock in biodiesel production, going from 2.3% of total utilization to 14.4%. In essence, this was brought about by a substitution of other vegetable oils for soybean oil in food consumption. Much of this was due to the importation of palm oil plus the expansion in the production of canola oil. Notably, exports of soybean oil also increased by about 60% in this period.

Because of the substitution of other vegetable oils for food relative to soybean oil, the pressure from the expanded use of soybean oil for biodiesel production did not, by itself, appear to have measurable impact on soybean oil prices considering the increase in ending stocks as a percent of utilization. In addition, utilization of feedstock other than soybean oil has edged up approaching half of the total feedstock. However, U.S. soybean stocks, a significant variable in explaining soybean oil prices, did drop from 8.4% of utilization in 2001-2005 to 5.5% in 2007-2011.

Data on biodiesel feedstock other than soybean oil has been somewhat sketchy. In mid 2010, the Energy Administration (EIA) of the U.S. Department of Energy started publishing monthly usage of the various feedstock. A breakdown for crop years 2010 and 2011 as an average is shown in Table 7 for (1) vegetable oils other than soybean oil and DDG corn oil, (2) animal fats, (3) recycled vegetable oils and animal fats and (4) DDG corn oil. The extraction of corn oil from DDG is becoming an increasingly important profit center for dry mill ethanol plants because of the elevated prices in the vegetable oil/animal fat sector (Ferris, 2011).

Table 7.

USDA Balance Sheet on Soybean Oil, Average for Crop Years 2001-2005 and 2007-2011 (Million Pounds) and Data for the 2010-2011 Crop Years on the Utilization of Other Feedstocks for Biodiesel from the EIA

Item	2001-2005	2007-2011	Absolute Change	% Change
Production	18716	19514	798	4.3
Utilization				
Biodiesel	438	2897	2459	561.4
As a % of Utilization	2.3	14.4	12.1	526.1
Food, Feed and other Industrial	16799	14193	-2606	-15.5
Exports	1638	2632	994	60.7
Total	18876	20120	1244	6.6
Ending Stocks	1927	2743	816	42.3
As a % of Utilization	10.1	13.7	3.6	35.6
		2010-2011		
Biodiesel Feedstocks [1]				
Soybean Oil		3804		
Other than Soybean Oil				
Other Vegetable Oils [2]		920		
Animal Fats		1121		
Recycled Veg. Oils and Animal Fats		720		
DDG Corn Oil		381		
Total		3143		
As a % of Total Feedstock		45.2		

[1] Source: The Energy Information Administration of the U.S. Department of Energy (EIA)

[2] Other than DDG Corn Oil

Impact of Rising Commodity Prices on Retail Food Prices

In the research cited in the literature review section, the focus was on commodity prices related to food. Following is an attempt to measure the link between commodity prices and retail food prices. (For literary convenience, EISA will be substituted frequently for "rising agricultural commodity prices," recognizing that more than EISA was involved.)

The analytical procedure used was to compare five year average food prices in calendar 2008-2012, as measured by the Consumer Price Index (CPI) of the U.S. Department of Labor, with the five year average for 2002-2006 and determine the extent to which agricultural prices contributed to the increase. The instrument was AGMOD as previously described. In the food price sector, statistical regression equations generated forecasts of 17 major CPI classifications of food consumed at home, which are translated to food consumed away from home and the combined index of all food. Each equation includes the price of the relevant agricultural commodity and an indicator of general inflation to measure the marketing spread between the farm or wholesale agricultural commodity price and the retail price. The estimates are based on annual data, typically going back to the 1970s.

As an example, the equation for pork includes (1) the price of barrows and gilts and (2) the Chained Price Index for the Gross Domestic Product's Personal Consumption

Expenditures (GDPPIPCE) of the U.S. Department of Commerce, an indicator of inflation which accounts for the marketing spread between wholesale hog prices and the retail price of pork. The equation for cereals and bakery products includes the farm price of wheat and the GDPPIPCE. The equation for salad dressing includes the wholesale price of soybean oil and the GDPPIPCE.

The agricultural commodities include prices on steers (5-Area, Direct, Total all grades), barrows and gilts (National Base, live equivalent, 51-52% lean), broilers (Wholesale, 12-city average), turkeys (8-16 lbs, hens National), eggs (Grade A large, New York, volume buyers), soybean oil (crude, Decatur, IL), soybean meal (48 percent, Decatur, IL) and prices received by farmers for milk, corn, soybeans and wheat (as carried in the USDA's World Board reports). The CPI commodities in the analysis were a subset of the 17 in AGMOD including beef and veal, pork, chicken, other poultry including turkey, eggs, dairy and related products, butter, margarine, salad dressing and other fats and oils.

The CPIs for fresh fruits and vegetables were linked to general inflation while the CPI for processed fruits and vegetables was a function of the price of corn and general inflation. The rationale was that, at the margin, higher prices on field crops do affect acreages planted to specialty crops.

The implementation of EISA and earlier energy legislation impacted the grain and oilseed sectors as represented by prices on corn, soybean meal and soybean oil. Wheat is also affected in competition for land with corn, other coarse grain and soybeans. Also, some wheat is fed to livestock. AGMOD generates feed costs for livestock derived mostly from prices on corn and soybean meal. Of interest was the extent to which the higher feed costs were reflected in livestock prices, the key independent variables in forecasting retail prices on meat, dairy and eggs. There was almost a one-to-one relationship between the increase in feed costs and the increase in all the livestock prices in comparing 2008-2012 with 2002-2006.

The price changes for each agricultural commodity in combination with the change in the GDPPIPCE were multiplied by their respective coefficients to derive their separate impacts on the CPI for a particular food. The impacts for each food were added using the weights assigned to each food based on their importance in urban consumption. The total affect is registered in the Food At Home Index, which helps to determine the Food Away from Home and Total Food Indices. Of note is that the GDPPIPCE increased by about 15% between 2002-2006 and 2008-2012. The results are shown in the top section of Table 8.

Between 2002-2006 and 2008-2012, the CPI on Food, whether at home or away from home increased about 20%. Higher prices on corn, soybean meal, soybean oil and wheat accounted for an increase of 4.42% for food prices at home, 2.98% away from home and 3.80% for the combination. As a share of the approximate 20% increase in food prices, the higher prices on the agricultural commodities were estimated at 22.8% for food at home, 14.9% for food away from home and 19.1% for the combination of total food.

Table 8.

Percent Changes in the Consumer Price Index (CPI) on Food between 2002-06 and 2008-12 and a Measure of the Contribution from Higher Prices on Corn, Soybean Meal, Soybean Oil and Wheat

Item	At Home	Away from Home	Total
CPI on Food [1]	19.35	20.06	19.90
Impact of Higher Ag Prices	4.42	2.98	3.80
Higher Ag Prices as a % of Higher CPI on Food	22.8	14.9	19.1
Adjustment fo Account for Higher Variable Costs of Production for Corn, Soybeans and Wheat			
Impact of Higher Ag Prices	3.22	2.17	2.77
Higher Ag Prices as a % of Higher CPI on Food	16.6	10.8	13.9

[1] Bureau of Labor Statistics, U.S. Department of Labor

Effect of Higher Production Costs

As indicated earlier, the federal energy legislation was not the only influence on commodity prices. For one, farmers faced higher production costs due in a major way to higher energy prices. The Composite Refiner Acquisition Cost of crude oil tabulated by the U.S. Department of Energy increased from an average of $40 per barrel in 2002-2006 to $80 per barrel in 2008-2012, a doubling. To what extent farmers adjusted to higher production costs is difficult to determine. Over 25% of the increase in feed costs can be attributed to increases in variable costs of production on corn and soybeans. This is mostly due to increased costs for fertilizer, fuels and chemicals traced to higher energy prices. Similar adjustments can be directed to soybean oil prices. On wheat, about 30% of the higher prices can be attributed to higher variable costs, mostly involving energy components.

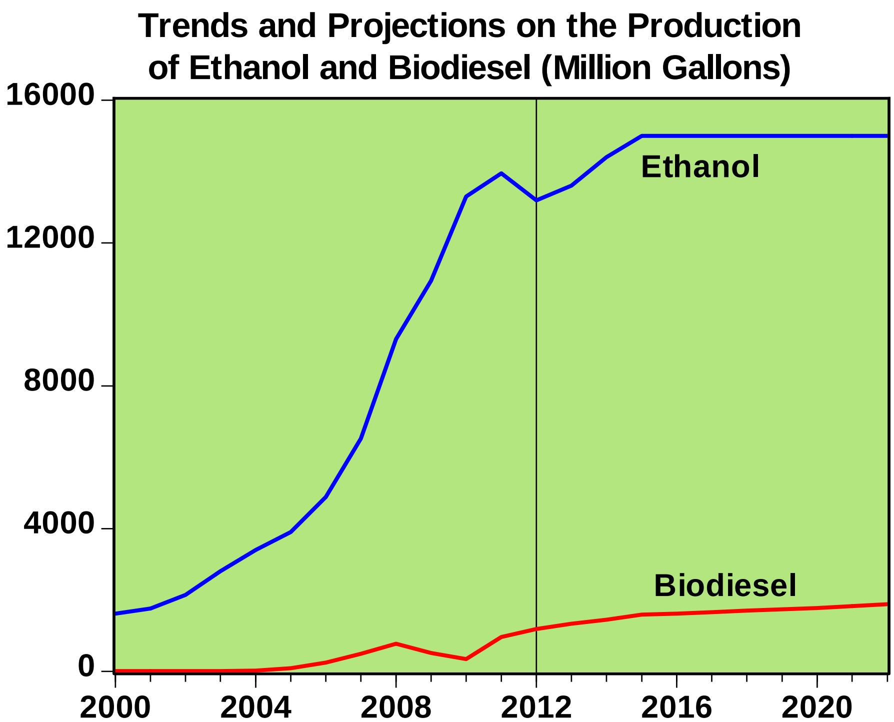
As a result of this adjustment, the impact of higher agricultural prices on total food prices was reduced from 3.80% to 2.77% -- a reduction of 27%. (See lower section of Table 8.) In comparison to the 20% increase in food prices between 2002-2006 and 2008-2012, the share represented by higher agricultural prices was reduced from19.1% to 13.9%.

This comparison of the impact of higher agricultural prices on food prices between 2002-2006 and 2008-2012 is only to establish some parameters of the role of EISA and the earlier federal legislation. In any case, with EISA continuing through 2022, price structure for commodities and food will likely be maintained at the recent levels.

A Look at the Next 10 Years

While comparing five year periods helps to cancel out anomalies such as unusual weather, some patterns remain such as lags in adjustment to changing economic conditions. The long term cattle cycle comes to mind as well as a shorter hog cycle. The point is that the impact of EISA will continue beyond 2008-2012. To gain insights into what might prevail in 2018-2022, ten years after 2008-2012, the projections from AGMOD were employed. Most important are the assumptions about future ethanol and biodiesel production as portrayed in Figure 11.

Figure 11.



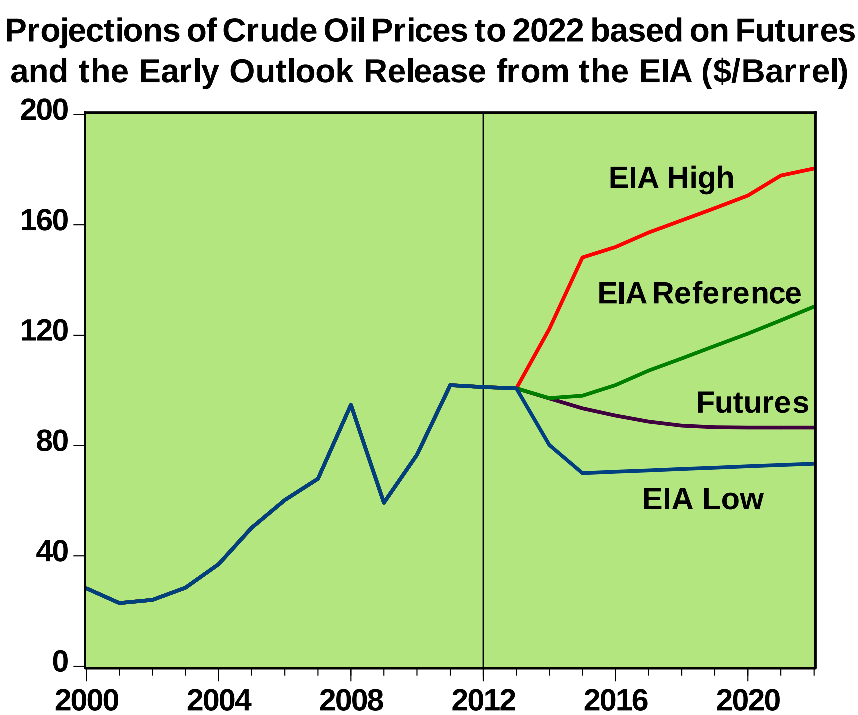
Ethanol production from grain will move up to about the 15 billion gallon RFS2 (mandate) by 2015 and level off. For this reason, the pressure from the dramatic expansion of the past decade will diminish. Assuming that the EPA will raise the RFS2 on biodiesel above and beyond the 1.28 billion gallons set for 2013, production could approach 2.00 billion gallons by 2022. As dry mill ethanol plants expand their extraction of corn oil from distillers' dried grain, feedstock for biodiesel production should be ample along with vegetable oils, animal fats and recycled fats and oils. Soybean oil is projected to continue to represent about half the feedstock for biodiesel.

The key to prospective food prices relates not only to agricultural prices but also the marketing spread. Agricultural prices connect in a major way to energy prices as does the spread between farm and retail prices on food. Figure 12 provides a perspective on alternative projections on energy prices. Shown is the December 2012 preliminary set of projections from the Energy Information Administration (EIA) of the U.S. Department of Energy for crude oil prices. Also shown is an average of the futures quotes for West Texas Intermediate and Brent as traded on the New York Mercantile Exchange through 2020 as of January 7, 2013 and extended to 2022. The AGMOD model uses the latter projection set.

To the extent that higher energy costs contributed to the marketing spread by more than measured by the GDPPIPCE, the impact of energy programs on food prices may be less than indicated in Table 8. Needed is a detailed analysis of the components of the marketing spread.

Considering that ethanol production from grain, estimated at 13.5 billion gallons in 2012, will be leveling off at around 15 billion gallons under the EISA mandates by 2015, and assuming normal weather, further impacts of EISA for the 2013 to 2022 period should be minimal. A projection for the five year period of 2018-2022 relative to 2008-2012 from AGMOD indicates that food prices will increase by about 13 percent with practically all of the increase due to an increase in the marketing spread and not due to higher agricultural or energy prices. Assumed is that crude oil prices will stabilize around $85 to $100 per barrel as indicated by futures prices in Figure 12.

Figure 12.



Impact of Rising Commodity Prices on Government Farm Payments

Since 2001, the major provisions in federal farm legislation affecting feed grains, wheat and soybeans include (1) Production Flexibility Contract/Direct Payments, (2) Counter-cyclical Payments and (3) Marketing Assistance Loans and Loan Deficiency Payments.

The Production Flexibility Contract Payment provision was established in the 1996 farm act to "de-couple" commodity supports from acreage allotments, allowing farmers more flexibility in planting. Soybeans were excluded. This provision was continued in the 2002 and 2008 farm bills with the addition of soybeans and oilseeds, and was labeled "Direct Payments."

Counter-cyclical payments are made on a selected crop whenever the farm price drops below a specified target price by a certain amount. This amount has varied depending on the commodity and has been $.28 per bushel on corn, $.44 on soybeans and $.52 on wheat. Since 2002, the target price on corn ranged from $2.60 to $2.63 per bushel, on soybeans from $5.80 to $6.00 and on wheat from $3.86 to $4.17. Loan Deficiency Payments are made on a specific crop in years in which the farm price drops below a specified loan rate. Since 2002, the loan rate on corn has ranged from $1.95 to $1.98 per bushel; on soybeans the loan rate has held at $5.00 per bushel and on wheat ranged from $2.75 to $2.94. As can be noted in Figure 4, farm prices exceeded even the target prices after 2006. The impact on government farm payments in the five crop years from 2007-11 compared to 2001-05 can be traced in Table 9.

Table 9.

Annual Average Payments under the Federal Farm Bills, Crop Years 2001-05 and 2007-11 (Mil. $) [1]

Item	Crop Years		
	2001-05	2007-11	Change
Feed Grains			
Direct	2123	2137	14
Other	2690	60	-2630
Total	4813	2197	-2616
Soybeans			
Direct	530	546	16
Other	806	0	-806
Total	1336	546	-790
Wheat			
Direct	1011	1024	13
Other	148	124	-24
Total	1159	1148	-11
Total of Above			
Direct	3664	3707	43
Other	3644	184	-3460
Total	7308	3891	-3417

[1] "Direct" includes payments under the Production Flexibility Contract in 2001. "Other" is mostly Counter-cyclical and Loan Deficiency Payments and excludes conservation payments including the Conservation Reserve. Source: Commodity Credit Corporation from the USDA's Farm Service Agency

While Direct Payments registered a small increase in the recent five year period, the "Other" classification, which is almost entirely Counter-cyclical and Loan Deficiency

Payments, dropped sharply. The bulk of the savings was in the feed grain sector with only minor changes for wheat. One can conclude that the savings in government farm payments, largely due to EISA, approached $3.5 billion annually in crop years 2007-2011.

Equally important is that the program will result in a saving of as much as an additional $3.7 billion annually in the 2014 to 2021 crop years as the direct payments are eliminated in new farm legislation. Congress failed to pass a replacement to the 2008 farm bill in 2012. As a result, the 2008 legislation was extended in 2013. However, proposals from both the Senate and the House for the next farm bill eliminate Direct Payments as well as the Counter-cyclical provision. Projections to 2022 from AGMOD indicate that the farm prices for corn, soybeans and wheat will likely maintain the levels reached in the 2007-11 crop years, again enabled by the continuation of EISA. This provides endorsement for the proposed shift in the focus of farm legislation to reducing the inherent risk in agriculture.

Cost of the Blenders' Tax Credit on Ethanol and Biodiesel

While the cost savings EISA generated in farm programs did counter the impact on higher food prices, the analysis would not be complete without accounting for the loss in federal government revenue from the blenders' tax credit on ethanol and biodiesel. Now that the "Fiscal Cliff" legislation has extended the credit for biodiesel to calendar 2013, retroactive to 2012, and did not for ethanol, estimates can be made for calendar 2012 and 2013. The credit had been terminated for both ethanol and biodiesel at the beginning of 2012. Presumed is that the credit will not be reinstated for ethanol.

As was done for food prices and government farm payments, a recent five year period was compared with an earlier five year period to examine the extent of foregone revenue from the two programs to encourage biofuel production. In this case, data for 2008-2012 were compared to 2002-2006 calendar years in Table 10. The bottom line was that the blenders' tax credit for ethanol and biodiesel at a total cost of nearly $5 billion in 2008-2012 represented an increase of just over $3 billion from 2002-2006. In a sense, this about negates the $3.5 billion savings from the federal farm program. However, as long as the ethanol from grain mandate is intact through 2022 without a blenders' tax credit, EISA will continue to have a positive effect.

The question might be whether the extension to 2013 for biodiesel might continue through 2022. Assuming (1) an increase in production from 1.28 billion gallons in 2013 to nearly 2.00 billion gallons by 2022 and (2) a continuation of the $1.00 blenders' tax credit, the annual cost would reach about $1.5 billion annually. If not, the cost would be only for 2013 or $.124 billion on an annual basis for the 2013-22 period.

Table 10.

Estimates of the Annual Average Costs of the Blenders' Tax Credit for Ethanol and Biodiesel

Item	Unit	Calendar Years		
		2002-2006	2008-2012	Change
Ethanol				
Credit Rate	Cents/Gal.	51	37.2	
Domestic Use	Mil. Gal.	3598	11942	
Cost	Mil. $	1835	4299	2464
Biodiesel				
Credit Rate	Cents/Gal.	40	100	
Domestic Use	Mil. Gal.	81	655	
Cost	Mil. $	70	655	585
Total Cost	Mil.$	1905	4954	3049

Compilation of the Government Payment Savings versus the Cost of EISA

The annual savings of about $3.5 billion in government farm payments in crop years 2007-2011 are projected to continue at about that rate in 2012 and 2013 as the Counter-cyclical and Loan Deficiency Payments will be nil. The annual savings in Direct Payments will begin at about $3.7 billion in crop year 2014. The cumulated savings over the 2007 to 2021 crop years would be about $52 billion for Counter-cyclical and Loan Deficiency Payments and $30 billion for Direct Payments – a total savings of $82 billion.

To determine the extent to which government payment savings offset higher food prices, total food sales over the calendar years 2008 to 2022 were estimated. Annual sales for 2008 to 2011 were available from the Economic Research Service (ERS) of the U.S. Department of Agriculture. The series, entitled "Food and alcoholic beverages: Total expenditures," includes both sales at home and away from home.

To project total food sales in 2012 to 2022, data from the ERS series for 1970 to 2011 were used in two regression equations: (1) Sales of Food at Home per capita as a function of per capita disposable incomes and the CPI for food at home and (2) Sales of Food away from Home per capita as a function of per capita disposable income and the CPI for food away from home. Both carried strong t-Statistics and R-squared properties. The per capita sales were multiplied by the projected population to generate total food sales. Population and per capita incomes are exogenous in AGMOD and were based on projections in EIA's "AEO2013 Early Release Overview" of December 2012 (USDOE, 2012)

The estimate for aggregate food sales in 2008 to 2022 was $20,852 billion as indicated in Table 11. The 2.77% derived in Table 8 as the adjusted impact (adjusted to reflect higher variable costs on crops) of EISA on higher food prices in 2008 to 2012 was assumed to continue for 2013 to 2022. This provided the estimate of the aggregate effect over the 2008 to 2022 period of $578 billion. With the indicated total savings in the farm program

Table 11.

Estimates of the Impact of EISA on Food Sales in Relation to Savings in Government Costs
Calendar Years from 2008 to 2022 and Crop Years from 2007 to 2021

Item	Unit	Assumes that the Biodiesel $1.00 Blenders' Tax Credit ends in 2013	Assumes that the Biodiesel $1.00 Blenders' Tax Credit ends in 2022
Aggregate Food Sales [1]	Bil. $	20852	20852
Increase due to EISA	"	578	578
As a Percent	%	2.77	2.77
Government Farm Payment Savings	Bil. $	82	82
As a % of Food Sales Increase due to EISA	%	14.19	14.19
Adjustment to the 2.77%	%	2.38	2.38
Cost of Blenders' Tax Credit	Bil. $	26	41
Net Government Cost Savings	Bil. $	56	41
As a % of Food Sales Increase	%	9.69	7.09
Adjustment to the 2.77%	%	2.50	2.57

[1] Food sales at home and away from home for 2008 to 2011 were obtained from the ERS of the USDA. Their data beginning in 1970 were used in an statistical analysis on both food sales at home and away from home with independent variables including projections of disposable income per capita and indices of consumer food prices to derive the aggregate food sales for the period from 2012 to 2002.

of $82 billion over the 2007 to 2021 crop years, this amount was equal to 14.19% of the increase in food sales due to EISA. Reducing the gross impact of 2.77% by 14.19%, the adjusted figure was 2.38%.

However, properly the cost of the blenders' tax credit should be considered in a broader view of the federal government's cost savings. As indicated in Table 11, those costs would reach $26 billion for 2008 to 2022 if the credit for biodiesel is terminated at the end of 2013 and $41 billion if extended to 2022, leaving the net government cost savings at $56 and $41 billion respectively. This adjusts the impact of food prices up to 2.50% and 2.57% respectively. In a sense, EISA is shifting the cost of supporting farm incomes from the taxpayer to the consumer.

The extent to which EISA and the earlier energy legislation contributed to higher retail food prices through higher commodity prices by an adjusted 2.50 to 2.57% remains somewhat a matter of judgment. The conclusion of this analysis is that the impact was predominant.

Summary and Conclusions

The summary and conclusions are organized in line with the purposes of this analysis as stated at the beginning of this paper.

Energy legislation was the major reason for the expansion in biofuels

Most, perhaps as much as 80%, of the increase in ethanol production in the 2008-2012 calendar year period can be attributed to EISA and earlier energy legislation. The rapid expansion in ethanol production held back the biodiesel industry until 2011 and 2012.

Expansion in biofuels was the driving force behind increased commodity prices

The evidence is strong that the increase in biofuel production, particularly ethanol, was the predominant cause of the sharp run up in agricultural commodity prices. Global crop yields continued to increase in the 2007-2011 marketing years and were generally in line with trends. Unfavorable weather was not a significant factor in higher food commodity prices. While U.S. corn and soybean ending stocks were low in 2007-2011 crop years due to the rapid expansion in biofuel production, carryovers of foreign coarse grain and wheat increased from relatively low levels in 2006; and foreign oilseed stocks remained relatively high during the 2007-2011 crop years. Foreign utilization of coarse grain and wheat for ethanol has expanded and OECD/FAO anticipates continued increases but representing a minor proportion of grain production. Foreign utilization of vegetable oil for biodiesel increased from 9.5% to 13% of production in 2007 to 2011 crop years and will continue to expand according to OECD/FAO, having some impact on global supply-demand balances.

The global economy registered much slower growth in 2008-2012 compared to 2002-2006 although the Real Gross Domestic Product of China and India continued at a rapid pace. The weak dollar as a factor in higher food commodity prices can be confirmed, although the role was minor. The trade policies of food commodity exporting and importing nations certainly was important in the early phases of the dramatic price surge but was difficult to measure over the entire five year period. That the commodity market was subject to speculation can be documented in combination with the increased inelasticity of demand as stock levels were reduced to pipeline levels. The elasticity of supply, however, may have been somewhat of a surprise as crop farmers worldwide responded to much improved profits.

Nearly all of the expansion in ethanol production was in dry mills processing corn. A major offset to the diversion of the predominant livestock feed to ethanol was the increased availability of the major by-product, distillers' dried grain (DDG). Compared to all protein feed, utilization of DDG reached 18% in 2007-2011 having been at 8% in 2001-2005. In addition, nearly 20% of the production was exported in the recent period.

With soybean oil as the most important and preferred feedstock for biodiesel, pressure on supplies has been eased by the substitution of other vegetable oils for food use in the

U.S., and with the expansion of the utilization of other feedstock such as animal fat, yellow grease, DDG corn oil and other vegetable oils. The availability of DDG corn oil should increase as the extraction becomes a more important profit center for the dry mill ethanol industry, helping to enable the biodiesel industry to double production in the next decade.

Energy legislation had a minor impact on retail food prices

While retail food prices increased by 20% between 2002-2006 and 2008-2012, higher commodity prices accounted for only a 3.80% increase – that is about 19% of the 20% increase in retail food prices. Because variable production costs on the crops involved increased in this period mostly due to higher energy prices, the increase was adjusted downward to 2.77%. With the leveling off of prices on agricultural commodities and energy along with corn ethanol production in the coming decade, increased food prices will be due primarily to increased marketing spreads, not farm and energy prices. The 2.77% food price increase should roughly hold for the entire 2008 to 2022 period.

Credit should be given to energy legislation for reducing farm program costs

Because of higher grain and oilseed prices mainly due to energy legislation, payments under the federal farm bills were reduced by nearly $3.5 billion annually in the 2007-2011 crop years with a doubling in annual savings in prospect for the 2014-2021 crop years. The total over the 2007 to 2021 crop years could exceed $80 billion. In essence, this taxpayer saving could further reduce the impact of energy legislation on retail food prices from 2.77% to 2.38%, a 14% cut.

However, properly the cost of the blenders' tax credit should be considered in a broader view of the federal government's cost savings. This adjusts the impact of food prices upward from 2.38% to 2.50% and 2.57% respectively, depending on whether the biodiesel blenders' tax credit is extended beyond 2013.

The contribution of EISA and earlier energy legislation to higher food prices through higher commodity prices was something less than 2.50 to 2.57% due to other influences on the commodity market in recent years. However, the conclusion is that the energy program was predominant.

Appendix A.

Ethanol Cost of Production

Estimates of the cost of processing corn grain into ethanol in dry mill plants were based on a survey conducted by the USDA in 2002 (Shapouri and Gallagher, 2005). To estimate subsequent costs, adjustments were based on changes in prices relative to the specific cost or collection of costs. For example, the cost of natural gas for industrial use from the Energy Information Administration of the U.S. Department of Energy provided the base for estimating this cost before and after 2002. The Producer Price Index for Fuels and Related Products and Power from the Bureau of Labor Statistics of the U.S. Department of Labor was applied to energy related costs of electricity and chemicals. Other costs were adjusted by the Chained Price Index for Personal Consumption Expenditures of the Bureau of Economic Analysis of the U.S. Department of Commerce. Capital costs and profits were adjusted by an interest rate series. In addition, to account for increased efficiency, the conversion of bushels of corn to gallons of ethanol were on a scale starting from 2.662 gallons per bushel in 2002 to 3.000 in 2022.

Biodiesel Cost of Production

The procedure for estimating the cost of processing soybean oil into biodiesel was similar to that for ethanol. Costs were based on an analysis in 2004 at the Eastern Regional Research Center of the Agricultural Research Service of the U.S. Department of Agriculture in an article entitled, "A process model to estimate biodiesel production costs" (Haas, M., A. McAloon, W. Yee and T. Foglia). Estimates before and after 2004 were based on price changes relative to the respective costs or collection of costs. A nominal profit was included in the total cost figure.

Appendix B.

Description of AGMOD

AGMOD is an econometric/simulation model of U.S. agriculture with a structure which is primarily recursive containing 1190 equations of which 143 are statistical regressions. The regressions are re-estimated every year from annual data going back as far as 1965. The model has been built using the software program EViews from Quantitative Micro Software, LLC and is solved for a 10 to 15 year projection period by a "Gause –Seidel" algorithm, capable of stochastic runs on crop yields. Exogenous to AGMOD are crude oil prices, exchange rates, population, consumer incomes and interest rates.

Coverage includes the major U.S. crop and livestock enterprises as follows:

Corn	Beef cow-calf	Turkeys
Other feed grain	Cattle feeding	Eggs
Soybean sector	Hogs	Dairy
Wheat	Broilers	

Coarse grain, wheat and oilseeds are included in selected regions in the international sector.

Sectors devoted to ethanol and biodiesel contain, in addition to ethanol and biodiesel production and prices, production and prices on feedstock. Cellulosic feedstock includes corn stover and switchgrass. The retail food sector includes the Consumer Price Index for 17 different items.

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