The Effects of Ethanol on Texas Food and Feed









David P. Anderson, Joe L. Outlaw, Henry L. Bryant, James W. Richardson, David P. Ernstes, J. Marc Raulston, J. Mark Welch, George M. Knapek, Brian K. Herbst, and Marc S. Allison

AFPC
Agricultural and Food Policy Center
Texas A&M University

April 10, 2008

AgriLIFE RESEARCH
& EXTENSION
Texas A&M System

Table of Contents

© 2008 by the Agricultural and Food Policy Center

Research Report 08-1

Agricultural and Food Policy Center
Department of Agricultural Economics
2124 TAMU
College Station, TX 77843-2124
Web site: www.afpc.tamu.edu

AFPC

1 Executive Summary

There are many related and difficult questions raised by the fuel vs. food vs. feed debate. Some of those questions may be irrelevant or of less importance when compared to the real issues to be addressed. Clearly, there are winners and losers in Texas and U.S. agriculture. This report addresses a series of the common questions raised in the debate.

The key findings contained in this report are:

- The underlying force driving changes in the agricultural industry, along with the economy as a whole, is overall higher energy costs, evidenced by $100 per barrel oil.
- With rising energy costs, corn and other commodity prices would have to increase. Rising fertilizer costs led to a 3 million acre reduction in planted corn acres in the 2006-07 crop year. Higher production costs will continue to pressure acres.
- This research supports the hypothesis that corn prices have had little to do with rising food costs. Higher corn prices do have a small effect on some food items.
- Important food items like bread, eggs, and milk have high prices that are largely unrelated to ethanol or corn prices, but correspond to fundamental supply/demand relationships in the world.
- Speculative fund activities in futures markets have led to more money in the markets and more volatility. Increased price volatility has encouraged wider trading limits. The end result has been the loss of the ability to use futures markets for price risk management due to the inability to finance margin requirements.
- The potential exists for even higher corn prices based on historical yield variability. Fewer corn acres planted in 2008 leave production susceptible to weather risks. Small yield reductions will result in even higher prices.
- The livestock industry has borne the costs of higher corn prices. The structure of the industry has made it unable to pass costs on, either up or down the supply chain.
- The livestock industry is in the middle of this transition, and prices don't yet reflect the impact of higher costs.
- The net balance to the Texas agricultural economy is negative. While corn and grain sorghum producers benefit from high prices, the livestock industry faces increasing costs. Because the livestock industry is bigger than the crop industry, the net balance is negative.
- Relaxing the RFS does not result in significantly lower corn prices. This is due to the ethanol infrastructure already in place and the generally positive economics for the industry. The ethanol industry has grown in excess of the RFS, indicating that relaxing the standard would not cause a contraction in the industry.

2 Ethanol and By-Products Overview

The boom in corn-based ethanol production in the United States has led to sharply higher corn prices and, by extension, higher soybean and other crop prices as farmers have shifted acres between crops. High prices for some crops like wheat have other causes. The ethanol, or biofuel, revolution has, in turn, been caused by rapidly increasing oil prices, aided by government policies and the desire for cleaner burning fuels to ease global warming fears.

The overall effect on agriculture and the economy, as a whole, is complex. While corn prices have increased, they are offset by higher fertilizer and fuel prices. Higher feed costs have caused large increases in production costs for livestock producers. Rising production costs are being felt by producers and consumers throughout the economy.

This study was prompted by a number of questions asked by livestock and crop producers, elected officials, media, and consumers about the reasons for cost and price changes and what the impact of these changes will be on the agricultural and broader economy. This report is developed to address those questions and is organized as follows:

- An overview of the basics of corn based ethanol, by-product feeds from the ethanol industry, and the energy market.
- The impact of rising costs on crop and livestock production costs.
- The impact of higher corn and energy prices on retail food prices.
- Reasons for higher agricultural commodity prices, including the role of speculative funds in futures markets and the supply and demand situation for various commodities.
- Potential for higher corn prices given weather problems.
- Summary of costs to the livestock industry and benefits to the grain industry.
- Potential impacts of relaxation of the renewable fuel standard on corn prices.

Economic Overview

No discussion or research on any of these issues would be complete without an overview of the overall energy complex. Oil prices have increased over the last 4 years from $35 per barrel in 2005 to over $100 per barrel in early 2008 (DOE-EIA). The impact of sharply higher oil prices continues to ripple through the economy as businesses and consumers deal with higher prices. Oil prices alone are an incomplete look at energy markets and the role of higher prices in the economy. Energy prices from all sources have increased over the same time period. Natural gas prices have increased largely due to the increased demand for it in the production of electricity. Natural gas is also the major input in producing nitrogen fertilizer.

Oil prices reflect not only increased demand in the growing economies of the developing world, including China and India, but political instability in major producing countries, refining infrastructure, shipping, and, for the United States, the effect of the weaker dollar on the cost of imported oil.

Ethanol Industry Overview

Global interest in biofuels production and consumption has surged over the past 5 years. While Brazil (ethanol) and Germany (biodiesel) have relatively more mature biofuels markets, countries such as the United

Table 2.1: Ethanol Production for All Uses for Selected Countries, 2004-2006.

	2004	2005	2006
	Million Gallons		
Brazil	3,989	4,227	4,491
U.S.	3,535	4.264	4,855
China	964	1,004	1,017
India	462	449	502
France	219	240	251
Russia	198	198	171
South Africa	110	103	102
U.K.	106	92	74
Saudi Arabia	79	32	52
Spain	79	93	122
Thailand	74	79	93
Germany	71	114	202
Ukraine	66	65	71
Canada	61	61	153
Poland	53	58	66
Indonesia	44	45	45
Argentina	42	44	45
Italy	40	40	43
Australia	33	33	39
Japan	31	30	30
Pakistan	26	24	24
Sweden	26	29	30
Philippines	22	22	22
South Korea	22	17	16
Guatemala	17	17	21
Cuba	16	12	12
Ecuador	12	14	12
Mexico	9	12	13
Others	364	732	297
Total	**10,770**	**12,150**	**13,489**

Source: Renewable Fuels Association (http://www.ethanolrfa.org).

Table 2.2: Net Returns for a Typical 100 Million Gallon per Year Ethanol Plant at Various Ethanol and Corn Prices.							
	Corn Price ($/bu, FOB)						
Ethanol Price ($/gal)	3.00	3.50	4.00	4.50	5.00	5.50	6.00
1.50	(0.17)	(0.30)	(0.43)	(0.55)	(0.68)	(0.81)	(0.94)
1.75	0.08	(0.05)	(0.18)	(0.30)	(0.43)	(0.56)	(0.69)
2.00	0.33	0.20	0.07	(0.05)	(0.18)	(0.31)	(0.44)
2.25	0.58	0.45	0.32	0.20	0.07	(0.06)	(0.19)
2.50	0.83	0.70	0.57	0.45	0.32	0.19	0.06
2.75	1.08	0.95	0.82	0.70	0.57	0.44	0.31
3.00	1.33	1.20	1.07	0.95	0.82	0.69	0.56

States, Canada, China, and India have recently elevated bioenergy production and consumption in terms of national importance. For example, in the United States, ethanol has gone from initially drawing support from a small number of commodity groups and some environmentalists to being counted on to:

- help lessen reliance on foreign oil imports,
- increase farm commodity prices thereby reducing commodity program expenditures,
- enhance the perception of being more environmentally conscious with fuels that are generally considered more environmentally friendly, and
- enhance rural development through a dispersed ethanol industry.

Table 2.1 contains the 2004 to 2006 annual ethanol production (for all uses not necessarily transportation fuel) of the major producers in the world. Brazil and the United States are by far the largest producers in the world. The U.S. ethanol industry initially began to take shape in the late 1970s, producing what was then called "gasohol" in response to a doubling of oil prices (nearly $30 per barrel). As a result of crude oil prices rising to nearly $40 per barrel in the early 1980s, the industry expanded rapidly and by the middle 1980s, an estimated 170 plants were producing approximately 400 million gallons per year (Vander Griend). However, by July 1986, the price of oil retreated back to $10 per barrel and the gasohol industry collapsed as costs per gallon were not competitive with gasoline at lower oil prices. Few stayed in the industry, but those that did began focusing on decreasing production costs. By the late 1990s, the costs of production (primarily due to larger plants realizing scale economies, reduced enzyme costs, and higher corn to ethanol conversions) for ethanol were competitive with gasoline. It should be noted that the blenders tax credit remained in place throughout the period described here providing incentive to blenders for using ethanol.

There are 147 ethanol plants in operation in the United States with around 55 more under construction (Renewable Fuels Association). Over the past few years, the U.S. ethanol industry has been expanding as fast as plants could feasibly be built. Currently, as corn prices have increased, some of the proposed ethanol plants have dropped their plans and/or put them on hold. Most industry observers realize the Renewable Fuels Standard (RFS) contained in the Energy Policy Act of 2005 was never binding. However, this may not be the case with the RFS of 15 billion gallons of grain based ethanol mandated in the Energy Independence and Security Act of 2007. The higher mandate will likely encourage the build out of ethanol capacity to at least the 15 billion gallon per year level.

Governments around the world have enacted policies designed to encourage biofuels production, encourage biofuels use, and protect biofuel producers from international competition. Some countries, such as the United States, have policies in place to do all three for the ethanol industry. The U.S. has encouraged ethanol use by providing a motor fuel tax exemption and/or credit for more than 20 years. The U.S. also has a secondary tariff on imported ethanol from outside the Caribbean Basin which serves to protect the ethanol industry from imports. In the author's opinion, the two most significant policy/regulatory changes that have resulted in the growth of the ethanol industry are: the decision not to provide oil companies protection from litigation for using MTBE as an oxygenate (MTBE had been found to be a carcinogen in drinking water in California) and the enactment of the 2005 energy bill (discussed later) that required a specific amount of renewable fuels (ethanol and biodiesel) be blended into fuel supplies each year from 2006 through 2012.

In the short-run, it can be argued that some encouragement is needed to develop a new industry through government policies as well as policies that are designed to protect a new industry from international competition. However, in the long run, the cost of production will determine whether or not biofuels can be viewed as viable energy alternatives. Ethanol production is generally perceived in a positive light by the public. However, many industry observers wonder whether the industry will crumble when, and if, the price of oil declines or the government reduces or eliminates the blender's tax credits. The answer is – it depends. The price of oil only gives you part of the information needed to address this question, the other part being the ethanol costs of production. The most important factor in the cost of production is feedstock costs, because they make up over two-thirds of production costs. While it doesn't seem likely today, last year at this time the price of corn in the U.S. was slightly more than one-half where it is today – over $5 per bushel. With or without government support, there will likely be combinations of low and high oil prices and feedstock costs that result in profits or losses for the ethanol sector.

Table 2.2 illustrates that the net income for a typical ethanol plant varies substan-

tially depending on feedstock (corn) costs and the ethanol price. Currently, the corn price in the U.S. is near $5.50 per bushel, and the ethanol price is just over $2.50 per gallon. With this combination, a typical ethanol plant would be expected to realize $0.19 per gallon in net income. While positive, these profit levels are not as likely to spur additional investment. Clearly, this is the reason why some proposed ethanol plants have put their plans on hold. However, for those plants already built, it is in their best interest to continue to produce as long as they can cover their variable costs increasing the amount a plant could pay for corn roughly $0.10 per bushel over the break-even level – roughly $6.15 per bushel of corn at $2.50 per gallon of ethanol. As indicated in Table 2.2, a large number of ethanol and corn price combinations result in negative net cash income for the typical plant. While these numbers are typical of a 100 million gallon per year plant, each potential plant location has attributes or drawbacks that could tilt (both positively and negatively) the economic picture for that plant location. For example, ethanol plants in Texas are expected to reap benefits from their proximity to cattle feeding that offset, to a degree, the drawback of being in a corn deficit state.

By-products of Ethanol Production

The major by-product feeds from current corn based ethanol production are corn gluten feed from wet-mill ethanol plants and distiller's grains from dry grind ethanol plants. Distiller's grains may be wet or dry and may be combined with solubles to yield the more commonly discussed distiller's grains with solubles. As most of the increase in ethanol production is from the dry grind process, the remainder of the discussion will focus on distiller's grains.

The dry grind ethanol process yields about 2.75 gallons of ethanol and 17-18 pounds of distiller's grains per bushel of corn. The removal of starch for ethanol concentrates the remaining nutrients in the distiller's grains. The distiller's grains contain a higher level of protein, energy (from the fat), phosphorus, and sulfur than are found in corn grain.

Disadvantages

Several disadvantages can be associated with distiller's grains:

- It is a highly variable product that may require testing for nutritional content to maintain ration balance. The product varies by batch and by plant. Efforts are underway to create a national standard. Private companies are marketing their own distiller's grains and, in some cases, are trying to keep a standard for those products.
- It is costly to dry given natural gas prices, but in its wet form it is costly to ship due to the water content.
- Flowability, the ability of the product to flow out of the shipping container, has been a problem when shipping distiller's grains in rail cars and trucks long distances due to particle size and the product compacting during travel.
- Wet distiller's spoils in a short period (3-5 days) and so must be fed quickly. When feeding wet distiller's grains, very little inventory is kept on hand as the product is fed almost as delivered. Interruptions in delivery are critical in this situation, whether the interruption is due to the plant production schedule or weather problems.
- Phosphorus and/or sulfur content can be a problem when feeding distiller's grains for confined livestock feeding and for supplemental feeding to beef cows.
- The ethanol production process does not destroy mycotoxins, like aflatoxin. The production process actually results in a 3x concentration of aflatoxin in the distiller's grains, relative to the amount in the corn.

Advantages

There are some advantages to distiller's grains, as well:

- Distiller's grains provide an additional feed for livestock producers to help offset higher corn prices and reduced availability as corn is sent to ethanol plants.
- Research indicates that distiller's grains typically have higher protein and energy content than corn.
- Research indicates that inclusion of distiller's grains in feedlot cattle rations can lead to increased gain per day and reduced costs of gain.

There are limits with how much distiller's grains can be fed to different species. Research indicates that they can make up 35-40 percent (dry matter) of feedlot cattle rations. Dairy cow rations can contain 10-20 percent distiller's grains. Hogs, broilers, and turkey rations may contain up to 10 percent. The limiting factor varies by species, but often includes the type and source of the fat in distiller's grains and its interactions with meat quality, fat characteristics, and milk components. Regardless

Table 2.3: Correlation between Corn and Distillers' Dried Grain (DDG) Prices: 1982-2007.

Time Period	*Correlation Coefficient*
1982-2007	0.510
1982-1986	0.483
1987-1991	0.480
1992-1996	0.710
1997-2001	0.794
2002-2006	0.602
2005-2007	0.849

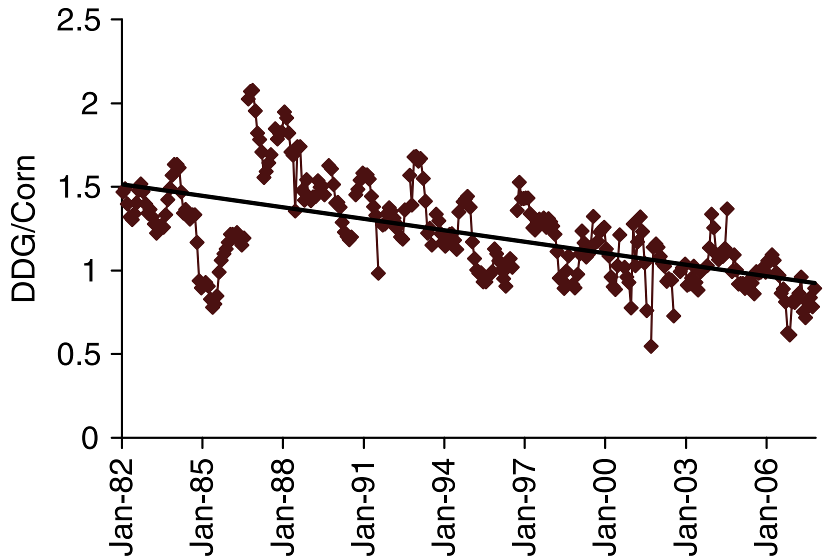


Figure 2.1: Corn and Dried Distiller's Grain (DDG) Price Ratio.

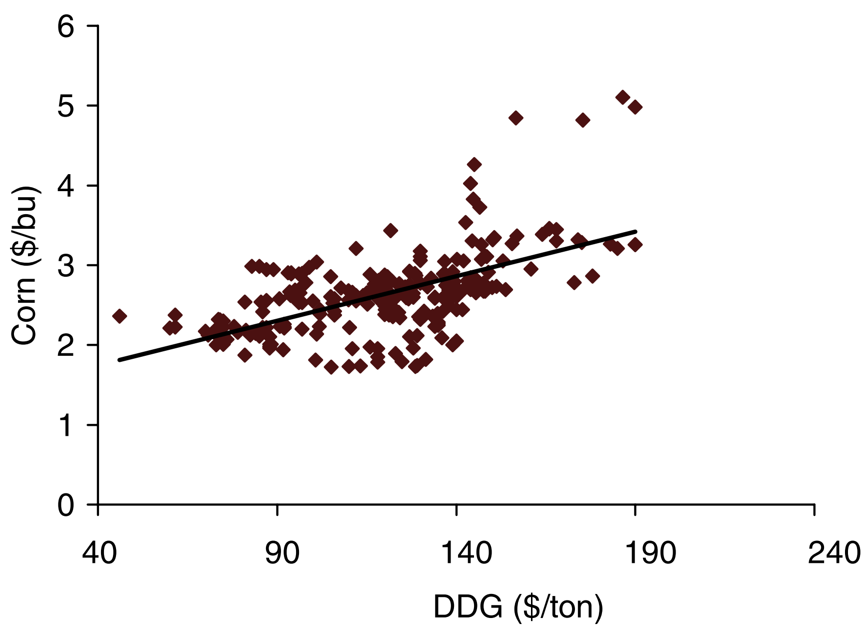


Figure 2.2: Corn and Dried Distiller's Grain (DDG) Price, 1982-2007.

of the issues associated with feeding distiller's grains, these by-products have been fed successfully by many livestock producers for years. Further research is underway to examine ways to successfully include more distiller's grains in rations.

Distiller's Grains Prices

By-products of ethanol production are not new to the feed market. What is new is their perceived importance as an alternative feedstuff in this environment of historically high corn prices. The conventional wisdom has been that the impact of high corn prices on costs of production in livestock operations could be largely offset by the availability of relatively inexpensive by-products – primarily DDG and/or DDGS (dry distiller's grains with solubles). The behavior of DDG prices in relation to corn prices is a simple empirical question.

With respect to the level of DDG prices in comparison to corn prices, Figure 2.1 plots DDG price as a percentage of corn price (with both prices converted to $/lb, as fed) January 1982 through October 2007. DDG prices are wholesale prices for Lawrenceburg, Illinois, and corn prices are Texas Triangle prices received by farmers for corn – both reported by USDA-AMS. Clearly, over time – or at least since about mid-1985 – the price of DDG as a percentage of the corn price for the same period has trended lower. This supports the notion that by-products have become relatively cheaper with increased availability.

Another aspect of the relationship between corn and DDG prices is the responsiveness of DDG prices to corn price changes. If DDG are a good substitute for corn, one would expect their prices to be closely correlated. Figure 2.2 is a scat-

ter diagram of corn and DDG prices from January 1982 through October 2007. These are the same price series as discussed in the previous figure. As the simple linear equation shows, there is a generally positive relationship between corn and DDG prices; however, the association between the two series over the entire time period presented here does not appear to be all that strong. The correlation coefficient between the two series is only about 0.44.

Further investigation of the relationship between corn and DDG prices suggests that the relationship between the two price series has not been all that consistent over time. Table 2.3 shows correlation coefficients for each 5-year period from 1982 through 2006 as well as for the 2005-2007 time period. This data indicates, in general, a closer relationship between corn and DDG prices in about the latter half of the data, with a very close relationship over the last two or three years (Anderson, Anderson, and Sawyer).

The evaluation of DDG and corn prices presented here suggests that DDG prices have become somewhat less expensive relative to corn over time. However, there is some evidence to suggest that DDG and corn prices are more closely related now than in earlier years of DDG production. The significance of this information for livestock producers is twofold. First, DDGs may be an inexpensive feed in a relative sense; however, they will not likely be an inexpensive feed in any absolute sense. Second, DDG prices may become more volatile, with DDG prices more closely following the movement of corn price as more and more producers enter the DDG feed market.

The foregoing evaluation of DDG and corn prices reflects on the national market for corn and DDG. Clearly, some producers are more advantageously situated than others with respect to using DDG as a feed source. Producers who are able to source wet distiller's grain, for example, may in fact find access to a feed that is inexpensive not only relative to corn, but in absolute terms as well. Of course, transporting and handling this type of feed involves special considerations and will only be an option for producers situated very close to a source of supply. A second and related caveat to the preceding analysis is that using DDG wholesale prices reported by USDA masks the significant transportation costs that most producers will incur in obtaining DDG. Corn is widely produced around the country, and a well-developed infrastructure for storing and moving corn efficiently around the country currently exists. The same is not true for DDG. DDG production is still largely concentrated in the Corn Belt. Getting DDG to other parts of the country involves considerable transportation expense that, for producers in many parts of the country, will quickly erode any relative price advantage of DDG compared with corn.

Impact of By-Product Feeding on Livestock Costs of Production

As noted earlier, the availability of by-products from ethanol production has been viewed as an important resource for helping livestock producers deal with the increased competition for grain. Considerable work has been done on the feasibility of feeding the by-products of distillation, and some of this work pre-dates the current surge in ethanol production. For example, Larson et al. were exploring the feeding value of distillery by-products in the early 1990s. Of course, recently, interest in by-product feeds has intensified greatly. This has spurred considerable research into the technical aspects of effectively using these feed sources. (For a fairly current review of this work, see Cole et al.)

Economic evaluation of by-product feeding systems remain, for the most part, very preliminary. Anderson, Daley, and Outlaw develop budgets to compare cattle feeding returns with and without the inclusion of by-products (wet and dry distiller's grains). In their study, they find that including WDGS (wet distiller's grains with solubles) in a ration with dry rolled corn results in the lowest cost of gain. Interestingly, WDGS fed in conjunction with steam flaked corn results in the highest cost of gain of the alternatives considered. They note that their results depend rather critically on assumptions related to feed conversion and average daily gain for each of the rations considered.

To provide further insight into the effect of by-product feeding on producer returns, we simulated feeding returns for a Texas and Nebraska feedlot using DDGS (Texas) and WDGS (Nebraska) in their rations. Rations and associated average feed conversion rates were taken from Anderson, Daley, and Outlaw. Prices for ration components were simulated from a log-normal distribution of prices using parameters (mean and standard deviation) calculated using price data from 2000 to 2007. For each year, May through September average prices were used to be consistent with a Spring placement/Fall slaughter feeding scenario. All prices were correlated using a procedure described by Naylor et al. (See

Table 2.4: Comparison of Cattle Finishing Returns in Texas and Nebraska Feedlots using By-Product Feeds.				
	Return Over Variable Costs (Dollars per Head)			
	Base Ration	*15% DDGS*	*15% WDGS*	*30% WDGS*
Texas				
Average	$87.06	$87.74	10.50	12.96
Std. Dev.	$17.89	$17.30	33.50	48.58
Certainty Equivalent	$84.62	$87.14	0.00	0.00
Nebraska				
Average	$41.10		$65.91	$83.26
Std. Dev.	$34.41		$22.62	$17.15
Certainty Equivalent	$38.86		$64.88	$82.67

Notes: Base ration for Texas includes steam flaked corn as the primary energy feed. Base ration for Nebraska includes dry rolled corn as the primary energy feed. Certainty equivalents are reported for a constant relative risk aversion coefficient of 2 (moderately risk averse) (Hardaker Huirne, and Anderson).

Anderson and Zeuli for a similar application of this procedure.)

Feed conversion rates were simulated from a triangular distribution with the mode taken to be the feed conversion rate associated with each ration in Anderson, Daley, and Outlaw. Minimum and maximum feed conversion rates were taken from Kansas State University feedlot closeout data (Livestock Marketing Information Center). Minimum and maximum feed conversion rates from the past ten years of August through October monthly closeouts were calculated as a percentage of the mean. These percentages were applied to the mode used for each ration to define minimum and maximum values for simulation from the triangular distribution.

Results of this simulation are presented in Table 2.4. The most significant feature of these results is that the availability of wet distiller's grains in Nebraska appears to convey a considerable competitive advantage. This is evidenced by the rather significant improvement in certainty equivalents in moving from the base ration to the 30 percent WDGS ration. WDGS could be fed in Texas, of course; and a preliminary calculation of the effect of a 30 percent WDGS ration on the profitability of the Texas feedlot did show a positive impact on profitability. However, as noted above, WDGS appears to not fit well into rations with steam flaked corn. This is the primary concentrate feed in Texas feedlots, and considerable fixed investment is in place to accommodate steam flaking. Thus, for Texas feedlots, transitioning to WDGS is probably a longer-term proposition than it is in some other regions. The ability to feed DDGS does confer some benefit in terms of profitability, but this benefit appears – at this point – to be marginal in comparison to that which can be obtained from introducing WDGS to a dry rolled corn feeding system.

DDGS Supply and Demand

The supply of distiller's grains is directly related to the amount of ethanol produced because the yield is about 17 pounds per bushel of corn distilled. Current ethanol production projections indicate supplies growing to over 35 million tons by 2012. In the future, the demand for distiller's grains will depend almost entirely on whether there are any cost advantages associated with distiller's grains relative to other feedstocks – primarily corn.

3 Texas Crop Production Costs

Cash receipts have increased over the last two years for the majority of crop producers across the United States; however, the often overlooked reality is farmers are facing unprecedented increases in input prices, leading to declining margins for many. This section will discuss major production cost increases currently faced by producers. Using a crop budget framework, specific expected cost increases will be examined for major crops in key production regions of Texas.

In addition to more heavily publicized increases in fuel and fertilizer prices, today's producers are facing increases in labor costs and replacement costs for machinery. Steel and other raw material prices are on the rise, leading to heftier repair and maintenance bills. Advances in plant breeding and pesticides have enhanced productivity; however, more expensive seed and chemicals have offset much of the potential profitability of higher yields. Figure 3.1 is a graph of monthly indices of prices paid by farmers for inputs over the last decade, reflecting the upward trend in costs faced by producers every day.

Although costs of production have risen across the board, the impacts of increasing fuel and fertilizer prices are the most prevalent. Since February 2006, the average U.S. retail diesel price has climbed from $2.48/gallon to $3.38/gallon in February 2008, a 36.5 percent increase (Figure 3.2). Fuel price increases impact producers directly as they run tillage equipment, harvest and haul crops, and operate irrigation equipment. Indirect effects occur as custom application rates rise and increased trans-

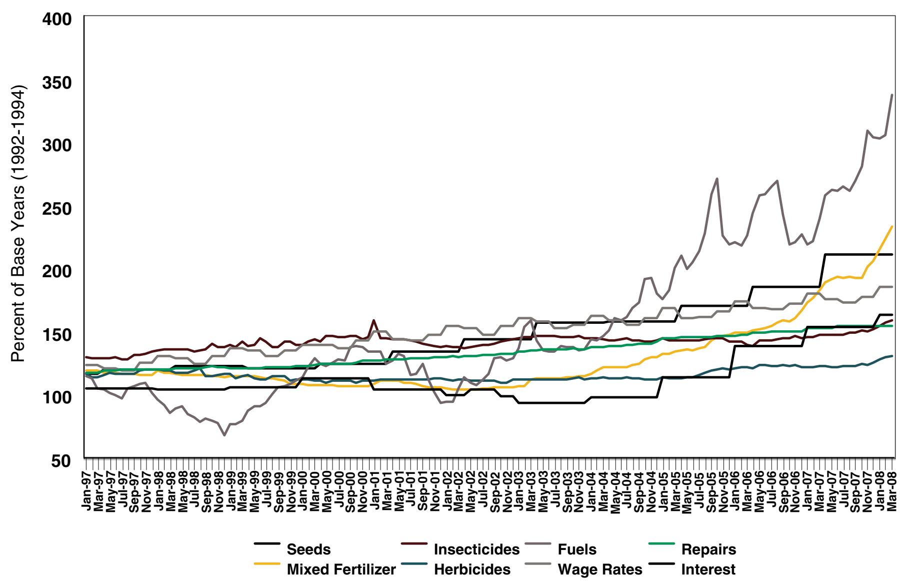


Figure 3.1: Monthly Indices of Farm Prices (Base Year= 1992-1994), January 1997-March 2008.

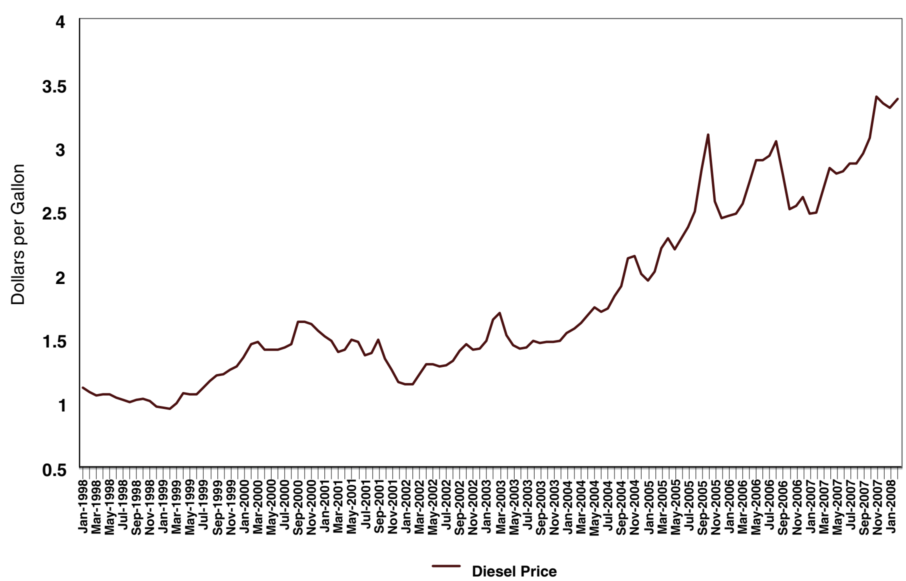


Figure 3.2: Average Monthly U.S. No. 2 Diesel Retail Price for All Sellers, January 1998-February 2008.

portation costs are incurred in delivering inputs and raw materials.

Fertilizer prices have moved in concert with rising energy prices. Figure 3.3 shows the average annual price paid for five selected fertilizer formulations over the past 10 years. The costs per ton of anhydrous ammonia and urea have more than doubled since 1998, and ammonium nitrate is within $4/ton of doubling, as well. Since 1998, the average prices paid for diammonium phosphate and potassium chloride have increased by 67.4 percent and 84.2 percent, respectively. Although the 2006 to 2007 average change in price paid for anhydrous ammonia is minimal, the increase from 2005 to 2007 is just over $100/ton, a 20.5 percent jump. In 2007, the average price paid for diammonium phosphate, another major fertilizer blend, increased $105/ton over the 2006 average price, a 31.2 percent increase. The average price paid for urea increased by $91/ton from 2006 to 2007, a 25.1 percent increase.

An analysis of costs of production for the 2006 growing season and projected 2008 costs was completed to illustrate the increasing expenses farmers face in the rapidly changing business of production agriculture. Crop budgets provided by the Texas AgriLife Extension Service teamed with rates of change for input prices from USDA-NASS were utilized to demonstrate increases in costs of production experienced by producers. Budgets for wheat, corn, cotton, and grain sorghum were obtained for the 2006 growing season for three major production regions in Texas. Rates of change for major inputs were calculated using January 2006 and January 2008 USDA-NASS monthly Index of Prices Paid by farmers (Table 3.1). These inflation rates were used to adjust 2006 direct and fixed expenses found in the extension budgets, estimating the changes in costs of production experienced over the last two years. The following is a more detailed description of the results of this analysis.

Wheat budgets were examined for dryland and irrigated production in the Texas Panhandle along with a dryland sys-

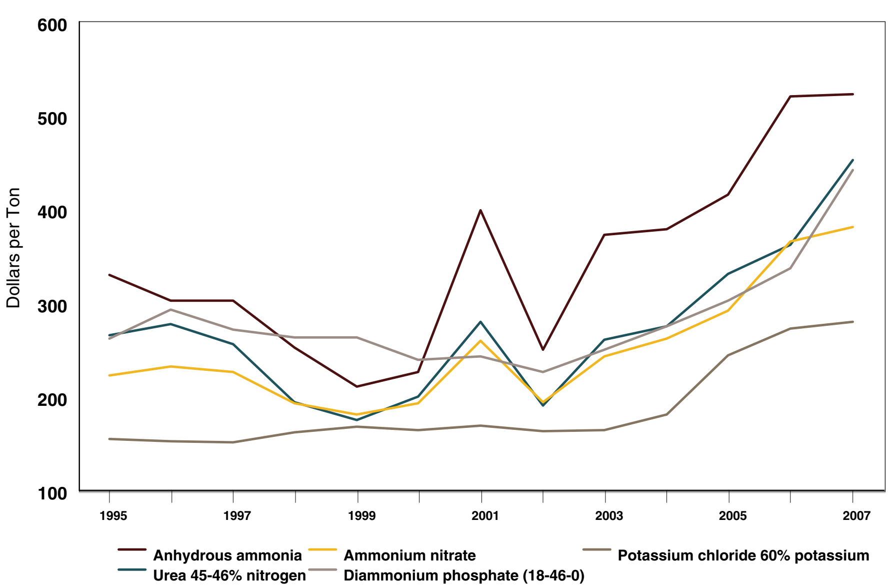


Figure 3.3: Average Annual Prices Paid for Major Fertilizer Formulations, 1998-2007.

Table 3.1: Rates of Change for Prices Paid for Inputs.

Input Category	Change
	Percent
Seeds	23.4
Mixed Fertilizer	45.0
Insecticides	9.2
Herbicides	5.8
Services: Custom Rates	1.6
Fuels	37.1
Wage Rates	6.9
Fuels	37.1
Repairs	5.4
Services: Other Services	8.5
Interest	18.0
Cash Rent	17.5

tem in Central Texas (Table 3.2). The irrigated Panhandle budget experienced the largest increase in production costs per acre. The net increase from 2006 to 2008 is expected to be slightly more than $100/acre, a 26 percent increase in expenses. Natural gas is used to fuel the power units for irrigation, thus the increased cost for irrigation energy alone is in excess of $55/acre. Panhandle dryland wheat experiences the lowest increase in expenses at $11.24/acre, a 13.3 percent jump. Central Texas dryland wheat is expected to cost just under $34/acre more to produce in 2008 as compared to 2006. When taking expected yields into account, the irrigated Texas Panhandle budget yields the highest cost of production of the three examined for 2008 at 8.01/bu. The Central Texas budget estimates 2008 cost of production at $4.65/bu., the lowest of the three evaluated.

Corn production expenses were examined under irrigation in the Texas

Table 3.2: Costs of Production for Wheat in Major Production Regions of Texas, 2006 and 2008.

	Panhandle (Dryland)		Panhandle (Irrigated)		Central Texas	
	2006	*2008*	*2006*	*2008*	*2006*	*2008*
Direct Expenses ($/acre)						
Seed	7.00	8.64	10.50	12.96	13.50	16.66
Fertilizer	0.00	0.00	33.50	48.58	35.30	51.19
Insecticide	0.00	0.00	0.00	0.00	4.50	4.91
Herbicide/Fungicide	0.00	0.00	0.00	0.00	15.60	16.50
Custom	20.62	20.95	42.70	43.38	25.75	26.16
Irrigation Energy	0.00	0.00	150.00	205.65	0.00	0.00
Labor	7.44	7.95	16.39	17.52	8.32	8.89
Fuel	9.21	12.63	40.63	55.70	12.33	16.90
Repairs	8.42	8.87	9.73	10.26	7.10	7.48
Crop Insurance	0.00	0.00	0.00	0.00	5.31	5.76
Operating Interest	2.42	2.72	13.96	18.13	5.87	7.11
Total Direct Expenses	55.11	61.76	317.41	412.17	133.58	161.57
Fixed Expenses ($/acre)						
Implements	6.75	7.32	7.81	8.47	8.57	9.29
Tractors	7.24	8.25	9.13	10.40	8.31	9.47
Self-Propelled Equipment	0.00	0.00	0.00	0.00	0.00	0.00
Pickup	0.28	0.30	0.28	0.27	0.00	0.00
Center Pivot	0.00	0.00	33.60	36.18	0.00	0.00
Total Fixed Expenses	14.27	15.86	50.82	55.32	16.88	18.75
Total Specified Expenses ($/acre)	69.38	77.62	368.23	467.49	150.46	180.33
Allocated Cost Items ($/acre)						
Land Charge	15.00	18.00	45.00	53.00	25.00	29.00
Total Expenses ($/acre)	84.38	95.62	413.23	520.49	175.46	209.33
Expected Yield (bu.)	18.00	18.00	65.00	65.00	45.00	45.00
Cost of Production ($/bu.)	4.69	5.31	6.36	8.01	3.90	4.65

Panhandle and under dryland practices in Central Texas and the Texas Coastal Bend (Table 3.3). The largest increase in production cost is experienced in the Texas Panhandle. Expected costs for producing irrigated corn in this region are expected to climb more than $165/acre, a 23.2 percent increase over 2006. Corn producers in Central Texas and in the Texas Coastal Bend are expected to experience similar increases in expenses at $56.58 and $49.88, respectively. On a per yield unit basis, the 2008 cost of production is highest in the Texas Panhandle ($4.21/bu.) and lowest in the Texas Coastal Bend ($2.89/bu.) for the three regions evaluated.

Cotton production expenses from 2006 to 2008 were evaluated for irrigated and dryland acreages in the Texas Panhandle along with dryland practices in two other regions of the state, Central Texas and the Texas Coastal Bend (Table 3.4).

Table 3.3: Costs of Production for Corn in Major Production Regions of Texas, 2006 and 2008.

	Panhandle (Irrigated)		Central Texas		Coastal Bend	
	2006	*2008*	*2006*	*2008*	*2006*	*2008*
Direct Expenses ($/acre)						
Seed	50.75	62.63	26.50	32.70	19.36	23.89
Fertilizer	91.20	132.24	55.00	79.75	55.50	80.48
Insecticide	23.50	25.66	14.41	15.74	6.26	6.84
Herbicide/Fungicide	36.60	38.72	15.78	16.70	26.72	28.27
Custom	69.60	70.71	4.00	4.06	15.96	16.22
Irrigation Energy	210.00	287.91	0.00	0.00	0.00	0.00
Labor	17.48	18.69	9.38	10.03	6.98	7.46
Fuel	9.14	12.53	20.77	28.48	12.35	16.93
Repairs	53.20	56.07	13.40	14.12	10.16	10.71
Crop Insurance	15.00	16.28	8.77	9.52	6.40	6.94
Operating Interest	14.41	18.04	9.24	11.61	7.35	9.10
Total Direct Expenses	590.88	739.48	177.25	222.70	167.04	206.83
Fixed Expenses ($/acre)						
Implements	9.54	10.34	12.63	13.69	8.50	9.21
Tractors	7.82	8.91	12.16	13.85	11.72	13.35
Self-Propelled Equipment	0.00	0.00	5.87	6.25	11.48	12.23
Pickup	0.28	0.27	0.00	0.00	0.00	0.00
Center Pivot	33.60	36.18	0.00	0.00	0.00	0.00
Total Fixed Expenses	51.24	55.70	30.66	33.79	31.70	34.79
Total Specified Expenses ($/acre)	642.12	795.18	207.91	256.49	198.74	241.62
Allocated Cost Items ($/acre)						
Land Charge	75.00	88.00	45.00	53.00	40.00	47.00
Total Expenses ($/acre)	717.12	883.18	252.91	309.49	238.74	288.62
Expected Yield (bu.)	210.00	210.00	90.00	90.00	100.00	100.00
Cost of Production ($/bu.)	3.41	4.21	2.81	3.44	2.39	2.89

Of the four budgets examined, the greatest increase in production expenses took place on the Texas Panhandle irrigated budget with an increase of $110.81/acre, a 17.2 percent increase. The Texas Panhandle dryland budget increased expenses by only $28.92/acre, the lowest of the four budgets. This system is very low input, spending no money on harvest aids and only allocating the $6/acre boll weevil eradication assessment for insecticide expenses. Although this budget experienced the lowest increase on a per acre basis, it remains the highest on a per yield unit basis due to the relatively low expected yield of 300 lbs./acre. In 2008, the Central Texas and Texas Coastal Bend budgets are expected to increase spending over 2006 estimates by $68.10 and $58.99, respectively.

The final crop budgets evaluated were for grain sorghum under irrigation in the Texas Panhandle and under dryland conditions in Central Texas and the Texas Coastal Bend (Table 3.5). Estimated production cost

Table 3.4: Costs of Production for Cotton in Major Production Regions of Texas, 2006 and 2008.

	Panhandle (Dryland)		Panhandle (Irrigated)		Central Texas		Coastal Bend	
	2006	*2008*	*2006*	*2008*	*2006*	*2008*	*2006*	*2008*
Direct Expenses ($/acre)								
Seed	7.20	8.88	48.00	59.23	69.00	85.15	61.56	75.97
Fertilizer	17.90	25.96	46.75	67.79	50.00	72.50	48.26	69.98
Insecticide	6.00	6.00	12.00	12.00	33.75	35.64	33.62	34.85
Herbicide/Fungicide	0.00	0.00	18.50	19.57	42.48	44.94	37.46	39.63
Custom	96.47	98.01	155.56	158.05	114.00	115.82	149.50	151.89
Irrigation Energy	0.00	0.00	120.00	164.52	0.00	0.00	0.00	0.00
Labor	20.01	21.39	24.80	26.51	11.04	11.80	6.71	7.17
Fuel	15.49	21.24	18.21	24.97	22.34	30.63	9.44	12.94
Repairs	26.35	27.77	48.86	51.50	11.69	12.32	5.10	5.38
Crop Insurance	12.25	13.29	17.25	18.72	10.00	10.85	13.00	14.11
Operating Interest	7.18	7.92	16.60	19.62	10.74	12.37	16.56	18.70
Total Direct Expenses	208.85	230.47	526.53	622.48	375.04	432.03	381.21	430.61
Fixed Expenses ($/acre)								
Implements	22.85	24.77	20.92	22.68	12.93	14.02	8.44	9.15
Tractors	19.11	21.77	18.24	20.78	14.54	16.56	9.56	10.89
Self-Propelled Equipment	0.28	0.00	0.00	0.00	0.01	0.01	8.40	8.95
Pickup	0.00	0.00	0.49	0.48	0.00	0.00	0.00	0.00
Center Pivot	0.00	0.00	33.60	36.18	0.00	0.00	0.00	0.00
Total Fixed Expenses	42.24	46.54	73.25	80.11	27.48	30.59	26.40	28.98
Total Specified Expenses ($/acre)	251.09	277.00	599.78	702.59	402.52	462.62	407.61	459.60
Allocated Cost Items ($/acre)								
Land Charge	15.00	18.00	45.00	53.00	45.00	53.00	40.00	47.00
Total Expenses ($/acre)	266.09	295.00	644.78	755.59	447.52	515.62	447.61	506.60
Expected Yield (lbs.)	300.00	300.00	850.00	850.00	600.00	600.00	750.00	750.00
Cost of Production ($/lb.)	0.89	0.98	0.76	0.89	0.75	0.86	0.60	0.68

increases are over $100/acre for the irrigated Panhandle budget in 2008, representing a 21.9 percent increase in expenditures over 2006 numbers. The next highest increase in expenditures is expected in the Texas Coastal Bend with an expected increase of $44.68/acre. The lowest expected increase is on the Central Texas budget, where an expected increase of almost $35/acre represents a 17.7 percent increase over 2006 expenditures. The Texas Coastal Bend budget slightly edges out the Central Texas budget for lowest cost of production on a per hundredweight basis at $4.87/cwt.

Producers growing irrigated crops and those employing more intensive production practices are more exposed to the increases in input prices; however, in an environment of rising prices of all inputs, no producers are completely insulated. The degree of impact on individual producers will vary, but all producers face rising costs that threaten bottom lines.

Table 3.5: Costs of Production for Grain Sorghum in Major Production Regions of Texas, 2006 and 2008.

	Panhandle (Irrigated)		Central Texas		Coastal Bend	
	2006	*2008*	*2006*	*2008*	*2006*	*2008*
Direct Expenses ($/acre)						
Seed	6.25	7.71	8.40	10.37	6.58	8.12
Fertilizer	52.50	76.13	30.30	43.94	49.95	72.43
Insecticide	0.00	0.00	23.00	25.12	14.29	15.60
Herbicide/Fungicide	0.00	0.00	9.75	10.32	23.51	24.87
Custom	71.51	72.65	28.25	28.70	19.96	20.28
Irrigation Energy	140.00	191.94	0.00	0.00	0.00	0.00
Labor	17.56	18.77	5.59	5.98	6.98	7.46
Fuel	11.25	15.42	10.69	14.66	12.35	16.93
Repairs	43.67	46.03	8.02	8.45	10.16	10.71
Crop Insurance	0.00	0.00	4.34	4.71	5.70	6.19
Operating Interest	10.73	13.42	5.45	6.47	6.68	8.16
Total Direct Expenses	353.47	442.07	133.79	158.70	156.16	190.75
Fixed Expenses ($/acre)						
Implements	12.58	13.64	10.00	10.84	8.50	9.21
Tractors	12.87	14.66	7.33	8.35	11.72	13.35
Self-Propelled Equipment	0.28	0.30	1.02	1.09	11.48	12.23
Pickup	0.00	0.00	0.00	0.00	0.00	0.00
Center Pivot	33.60	36.18	0.00	0.00	0.00	0.00
Total Fixed Expenses	59.33	64.78	18.35	20.28	31.70	34.79
Total Specified Expenses ($/acre)	412.80	506.85	152.14	178.97	187.86	225.54
Allocated Cost Items ($/acre)						
Land Charge	75.00	88.00	45.00	53.00	40.00	47.00
Total Expenses ($/acre)	487.80	594.85	197.14	231.97	227.86	272.54
Expected Yield (cwt.)	70.00	70.00	45.00	45.00	56.00	56.00
Cost of Production ($/cwt.)	6.97	8.50	4.38	5.15	4.07	4.87

4 Livestock Production Costs

An important measure of the impact of ethanol and other costs on the livestock industry is to examine changes in production costs. Costs include more than feed, although feed is often the largest cost for livestock producers and feeders. This section examines production cost changes for the livestock industry from 2006 to 2008. This time period was chosen to capture the time period of increased corn prices due to expanded demand for corn from ethanol. Several different data sources are used. Those are noted in the text.

Dairy

The analysis of dairy production costs uses the representative Texas dairy farms maintained by the Agricultural and Food Policy Center (AFPC). The four dairies are a 1,300 cow Central Texas dairy, two East Texas dairies with 450 and 1,000 cows, and a 3,000 cow North Texas dairy.

On each dairy, feed is the largest cost, including both purchased and raised on the dairy. Feed costs ranged from 53 percent of costs on the 450 cow East Texas dairy to 62 percent of costs on the North Texas dairy. Over the 2006 to 2008 period, feed costs increased by 17 percent (450 cow East Texas dairy) to 22 percent (3,000 cow North Texas dairy) across these dairies (Figure 4.1). Only fuel and utilities costs increased at a faster rate (23 percent). The increase in feed costs result in the dairies being even more subject to feed cost changes by 2008, in that feed makes up an even larger share of total costs.

Of more importance is the change in total production costs over this period. The 450 cow East Texas dairy's production costs per cwt of milk increase from $15.18 to $16.84 per cwt. Of that $1.66

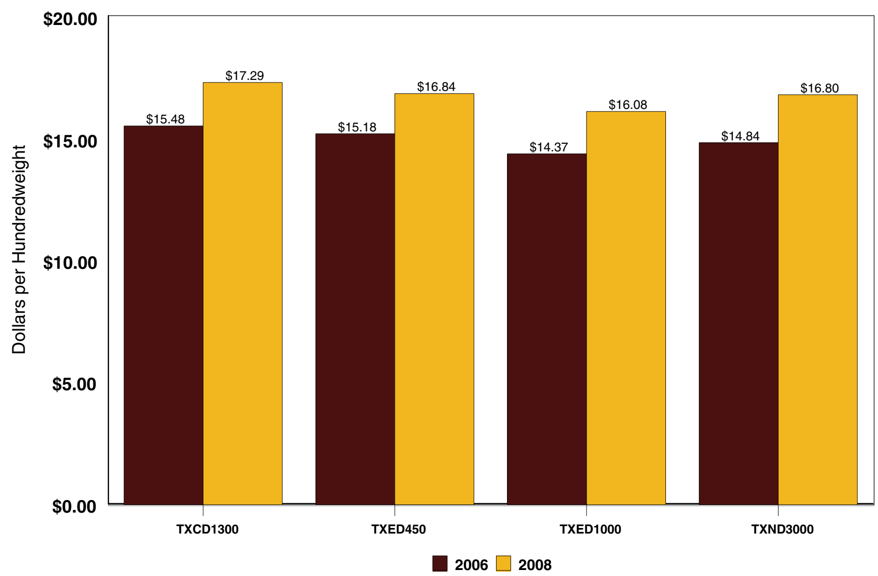


Figure 4.1: Dairy Production Costs.

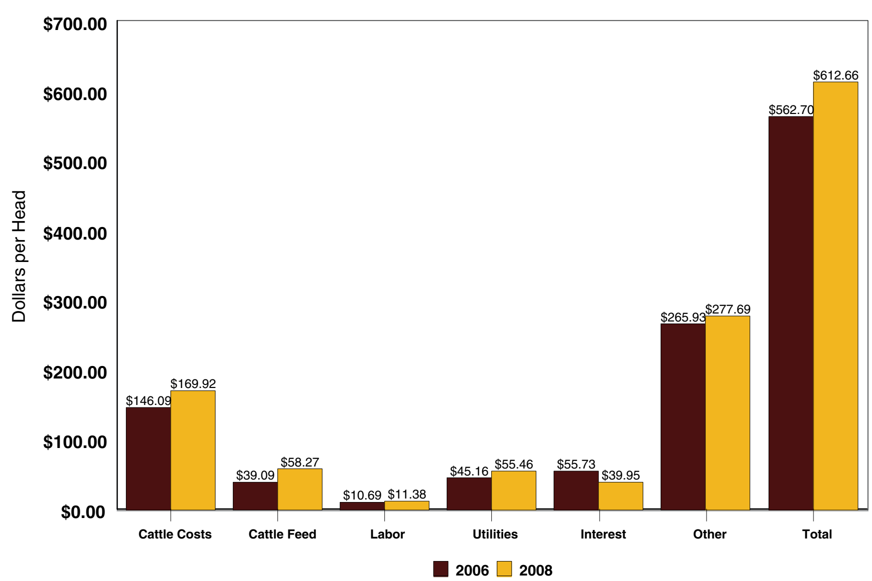


Figure 4.2: Texas Representative Ranch Cow-Calf Production Costs.

per cwt increase, $1.19 is due to feed costs, and the remainder is due to other dairy costs, labor, utilities, and interest. The 1,000 cow East Texas dairy experiences production costs increasing from $14.37 to $16.08 per cwt. Costs increase from $15.48 to $17.29 per cwt on the Central Texas dairy, with feed costs increasing $1.26 per cwt. Total costs on the North Texas dairy increase $2.06 per cwt to $16.90. It is important to note that higher costs can be mitigated by increases in productivity. Production per cow increased at slightly less than 2 percent per year which is consistent with historical increases in productivity.

Cost increases on these representative dairies range from about $1.50 to $2.00 per cwt. While milk prices have remained high due to export demand, increased milk production is expected to lower milk prices later in 2008. In practical terms, these results indicate that milk prices do not have to decline historical levels to create financial hardship on dairies which would jeopardize economic growth in the Texas Panhandle and further accelerate the exit of dairies in other areas of the state.

Cattle

For the purposes of this study, the cattle sector is divided into two parts, the cow-calf sector and the feedlot sector.

Cow-Calf

Texas is the largest cow-calf producing state in the United States. It is common for ranchers to feed hay over the winter and supplemental feed at times throughout the year. Their total costs are less dependent on purchased feed costs than other production costs. However, feed production for the ranch may include costs of cutting and baling hay and fertilizing pastures. Production costs are analyzed using one representative ranch developed by the AFPC; a 500 cow ranch in the Rolling Plains.

From 2006 to 2008 the ranch experienced a significant increase in costs. Total expenses on the Rolling Plains ranch increased by about $100 per cow from 2006 to 2008 (Figure 4.2). Feed costs increased by about $20 per cow and cattle costs increased by about $23 per cow. Cattle costs include production costs such as fuel, fertilizer, transportation, marketing costs, and labor. Feed costs increased from about 7 percent of cash costs to 9.5 percent of cash costs in 2008.

Cattle Feeding

Texas is also the largest cattle feeding state in the United States. Most of the cattle feeding industry is located in the Panhandle, but feedlots are also located in South Texas. Several sources of data are used to examine the impact of corn costs on the cattle feeding industry, including feed cost data published by the Agricultural Marketing Service (AMS), cattle feeding cost closeout data gathered and reported by Kansas State University, and cattle feeding returns estimated by the Livestock Marketing Information Center. The time period 2006 through 2008 is used in this analysis to capture the effects of higher corn prices.

The Texas Triangle is a common reference point for corn prices reported by AMS daily and weekly. The area includes the Plainview to Canyon area of the state. Texas Triangle corn prices averaged $2.32 per bushel in January 2006 (Figure 4.3). In January 2008, corn prices averaged $4.95 per bushel, an increase of $2.63 per bushel, or 113 percent. Even though Texas is a corn deficit state and sources a significant amount of grain out of state,

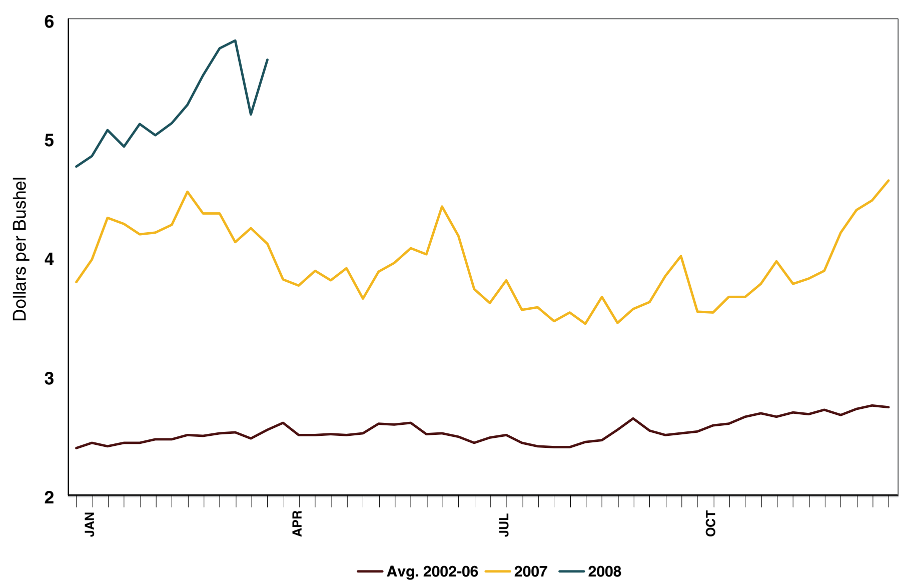
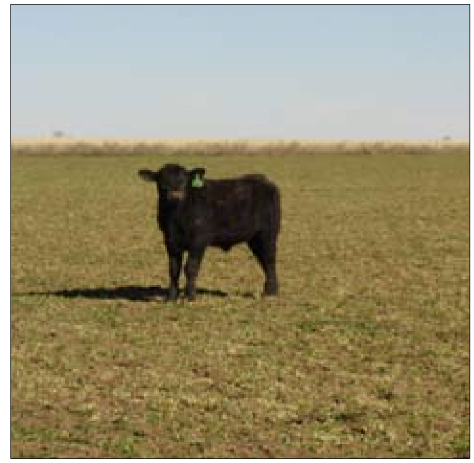


Figure 4.3: Texas Triangle Corn Prices, 2006-2008.



this market is a good reference point for corn prices paid by feedlots.

Feed cost is the largest cost in the cattle feeding process (after the feeder steer or heifer purchase), accounting for approximately 78 percent of non-feeder costs. The remaining costs reflect interest, death loss, other operating costs, and labor (LMIC). The LMIC cattle feeding returns data series is calculated using feed, feeder steer, and fed steer prices to estimate returns to cattle feeding in Western Kansas. In this series, feed costs increased from $119.58 per head in January 2006 to $216.46 per head in January 2008, or $96.88 per head (Figure 4.4). It is important to note that this series calculates feed costs by multiplying the average price for each month by the amount fed for each month in the feeding process. Because of this, during recent weeks of rapidly increasing corn prices, the higher prices are not immediately priced into total feed costs. Updating these feed costs to reflect Texas Triangle corn prices and finished weights estimates feed costs at $284.48 per head in January 2008, a $129.81 per head increase since January 2006.

However, in this fast moving corn market, prices have further increased. Texas Triangle corn prices were reported to be $5.96 per bushel for the week ending April 3, 2008. That is $1.02 per bushel higher than the average in January. Using the same cattle feeding returns estimate yields a projected feed cost of $357.34 per head for April 2008.

Kansas State University has published a feedlot closeout series for many years called "Focus on Feedlots" (Kuhl). This data is based on a monthly survey of 6-10 feedlots. The reported January 2008 average steer cost of gain per cwt was $74.11. January, 2006 average cost of gain was $52.88.

Costs of gain in feeding cattle have increased significantly due to the increase in feed costs. Breakeven fed cattle prices have increased from $94.22 to $106.74 per cwt as feed costs have increased. Normally, feeder cattle prices decline as feed costs increase. However, in this market, due to tighter supplies of cattle and the competitive structure of the market, feeder cattle prices have declined, but so have fed cattle prices. Texas combined auction feeder steer prices have declined from $110 to $98 per cwt from January, 2006 to January, 2008. Fed steer prices declined from $94 to $92 per cwt over the same reference period. The result is higher production costs, and the inability to pass on those costs, resulting in higher losses in the industry.

Hogs

The hog industry has had a long run of profitable feed costs and prices. However, recent market conditions and rising feed costs have changed the profit picture dramatically. This analysis uses Iowa State University Extension Service's Estimated Returns for Farrowing and Finishing Hogs in Iowa for the same reference period, January 2006 and January 2008 that

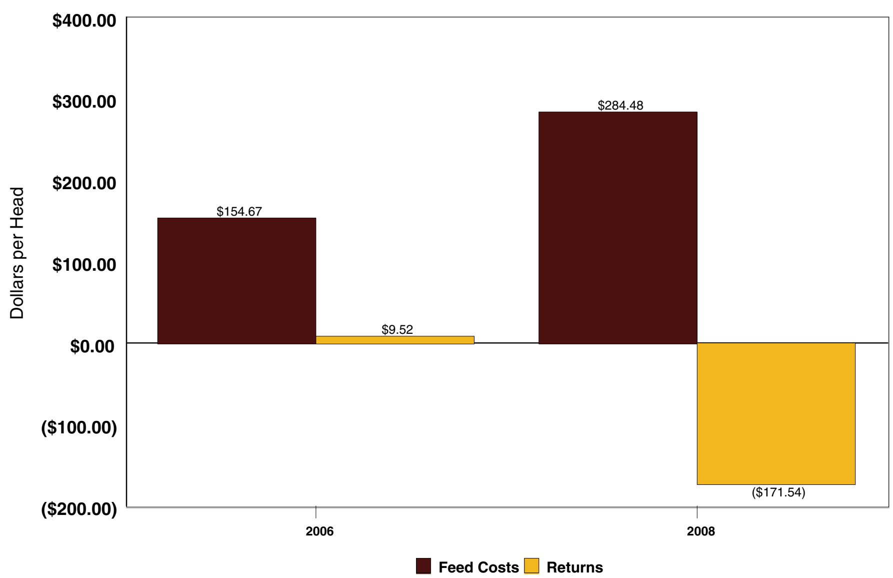


Figure 4.4: Cattle Feeding Costs and Returns, January 2006 and 2008.

was used in the cattle feeding returns analysis.

The ISU data indicates corn costs to finish a 260 pound hog at $17.77 per head for pigs finished in January 2006. Feed and supplements other than corn accounted for $21.87 per finished pig. Feed made up 66 percent of the total finishing costs per head. By November, corn costs had surpassed the cost of the other feeds and supplements in the total cost of finishing. Corn costs in January 2008 totaled $35.60 per head, more than double the corn costs of January 2006. The breakeven price increased from $38.41 to $51.04 per cwt. The estimated profit per head decreased from $4.27 to -$33.38 in January 2008 (Figure 4.5).

While this analysis uses Iowa production costs and returns, the estimates should make a good comparison for Texas production. Corn is priced at a premium to move it to Texas as it is a corn deficit state. Higher corn prices have resulted in major financial losses to hog producers while the hog market has not yet begun the adjustment to higher costs.

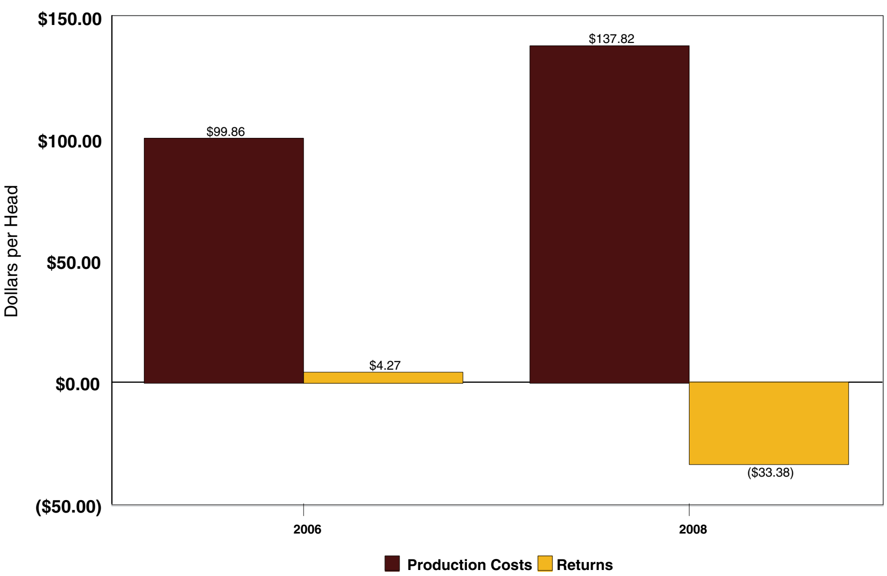


Figure 4.5: Hog Finishing Production Costs and Returns.

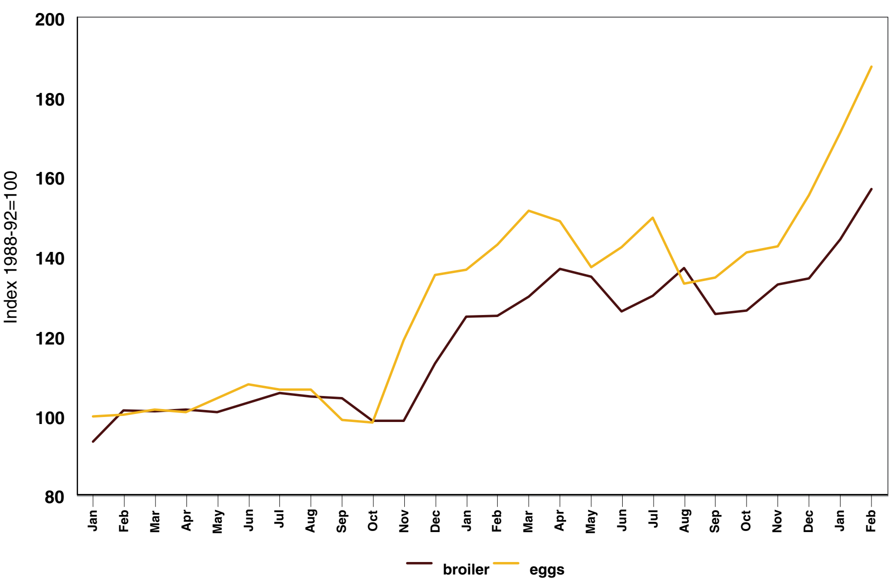


Figure 4.6: Broiler and Egg Ration Cost Index, 2006-2008.

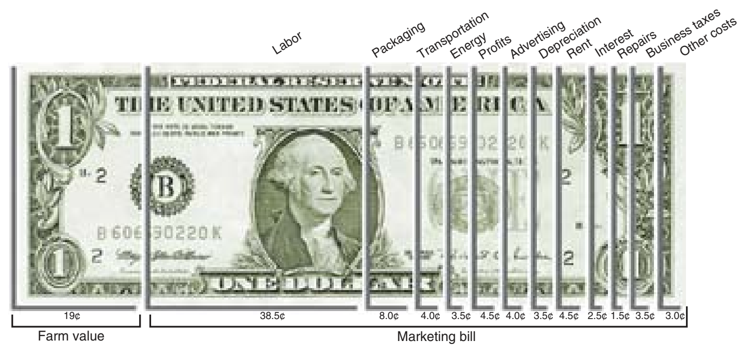
Poultry

Broiler, turkey, and egg producers have all been affected by higher feed costs. USDA publishes an index of feed costs for producing broilers and eggs (Figure 4.6). Broiler feed costs have increased from an index value of 93.5 in January 2006 to an index value of 144.3 in January 2008. The feed cost index for egg production has increased even more dramatically, from 99.7 in January 2006 to 171.0 in January 2008.

5 Impact on Retail Prices – Farm Share of Retail Prices

As media outlets across the country have reported, retail food prices have increased, in some cases rapidly, over past few years. Table 5.1 contains the annual change in retail food prices for various products in the United States. Across all products, retail food price inflation has risen from 2.4 percent in 2005 and 2006 to 4 percent in 2007 with the same increase expected for 2008. Other than eggs, there does not appear to be large deviations from price changes experienced in previous years. In 2008, the fats and oils and cereals categories are expected to see much higher than normal increases in costs.

The farm level value of the raw commodity that is contained in retail food products is generally referred to as the farm share of retail food prices. While the latest data does not cover the current period of rapidly rising farm level prices, a few observations can be made with regard to the likely impact on retail food prices. Table 5.2 illustrates that, on average, the farmer's share of retail food prices has declined from 32 percent in 1970 to 19 percent in 2002. Also evident from the data is that, in general, the farm share of retail food prices tends to decline as agricultural commodities are further processed into food products. For example, the farm share of retail food prices for fresh vegetables in 2002 was 20 percent while the farm share of retail food prices for bakery and cereal products was 5 percent. While not definitive, the USDA data would provide some support to the notion that the in-



Source: ERS.

Figure 5.1: Illustration of the Farm Share and Components of the Marketing Bill for U. S. Retail Food Products.

Table 5.1: Annual Change in Consumer Price Index for Selected Food Categories, 2004 to 2008.

	2004	*2005*	*2006*	*2007*	*2008 (forecast)*
Consumer price indexes	*Percent Change*				
All food	3.4	2.4	2.4	4.0	3.0 to 4.0
Food at home	3.8	1.9	1.7	4.2	3.5 to 4.5
Meats, poultry, and fish	7.4	2.4	0.8	3.8	2.0 to 3.0
Meats	8.4	2.3	0.7	3.3	1.5 to 2.5
Beef and Veal	11.6	2.6	0.8	4.4	2.0 to 3.0
Pork	5.6	2.0	-0.2	2.0	1.5 to 2.5
Other meats	4.5	2.4	1.8	2.3	0.0 to 1.0
Poultry	7.5	2.0	-1.8	5.2	1.5 to 2.5
Fish and seafood	2.3	3.0	4.7	4.6	3.0 to 4.0
Eggs	6.2	-13.7	4.9	29.2	0.0 to 1.0
Dairy products	7.3	1.2	-0.6	7.4	2.0 to 3.0
Fats and oils	6.6	-0.1	0.2	2.9	6.5 to 7.5
Fruits and vegetables	3.0	3.7	4.8	3.8	3.0 to 4.0
Fresh fruits & vegetables	3.5	3.9	5.3	3.9	3.0 to 4.0
Fresh fruits	2.8	3.7	6.0	4.5	3.5 to 4.5
Fresh vegetables	4.3	4.0	4.6	3.2	2.5 to 3.5
Processed fruits & vegetables	1.3	3.3	2.9	3.6	3.0 to 4.0
Sugar and sweets	0.7	1.2	3.8	3.1	2.0 to 3.0
Cereals and bakery products	1.6	1.5	1.8	4.4	5.5 to 6.5
Nonalcoholic beverages	0.4	2.9	2.0	4.1	3.5 to 4.5
Other foods	0.5	1.6	1.4	1.8	2.5 to 3.5

Source of historical data: Bureau of Labor Statistics; forecasts by Economic Research Service.

crease in farm level corn prices should be impacting retail food prices very little – primarily because corn is generally consumed as an ingredient in highly processed foods such as HFCS in soft drinks, cereals, sauces, and hundreds of other products. The same type of generalization is expected to hold for the impact of rising wheat prices on the price of bread, cereal, and other bakery products.

A number of news stories have been written that cite recent increases in the farm level prices of corn, grain sorghum, wheat, soybeans, and rice as causing significant increases in retail food prices. Based on the examples provided earlier, it is clear that while some of the increase in retail food prices is due to farm level price increases, there are likely a number of causes for higher retail food prices. Figure 5.1 displays the components of the marketing margin for retail food products. Again, based off of 2002 data, the portion of a dollar spent on retail food products averages $0.19 while labor accounts for $0.38. One element to rising food prices that tends to be overlooked is the impact of higher fuel prices (oil and natural gas) have on retail food prices. The impacts of higher energy prices would be felt throughout several categories in the marketing bill but would be primarily in the packag-

Table 5.2: Farm Share of the Retail Value of Selected Categories of Agricultural Products, 1970 to 2002.

Year	*Fresh Vegetables*	*Processed Fruit and Vegetables*	*Bakery and Cereal Products*	*Average for All Farm Products*
		Percent		
1970	32	19	16	32
1971	33	18	16	32
1972	32	19	17	33
1973	35	19	22	37
1974	34	22	25	36
1975	35	21	18	33
1976	33	20	15	32
1977	33	18	12	30
1978	30	25	13	32
1979	28	24	14	32
1980	27	23	14	31
1981	32	23	13	28
1982	34	24	12	27
1983	34	23	12	27
1984	34	24	12	27
1985	31	26	11	25
1986	28	23	8	25
1987	31	24	8	24
1988	28	28	9	24
1989	29	25	9	25
1990	28	26	8	24
1991	24	22	7	22
1992	26	23	8	22
1993	26	19	7	22
1994	23	20	8	21
1995	23	21	8	21
1996	20	20	9	22
1997	21	19	7	22
1998	20	18	6	20
1999	19	17	6	20
2000	19	17	5	19
2001	19	16	5	19
2002	20	16	5	19

Source: Calculated by ERS based on data from government and private sources.

ing ($0.08), transportation ($0.04), and energy ($0.04) categories.

Ag Value of Commodities

The frequency of the questions regarding the agriculture value of popular products led us to develop the table below of our estimates of the farm value of a few commodities. Table 5.3 provides the farm level prices for selected agricultural commodities for 2004 and 2007; a typical retail food product that is made from each commodity; and the farmer's share of the value of the selected retail product in 2004 and 2007. For example, a typical 12-pack of soda contains roughly $0.11 worth of corn when the price is $2.06 per bushel and $0.22 worth of corn at $4.00 per bushel. As the table indicates, the farmer's share of these selected retail products is very small compared to the overall retail cost. The examples for beef and pork are slightly different because of the nature of how beef and pork are priced. Each carcass is valued at the live animal price paid to feeders. That also ends up being the farmer's (or feeders in this case) share per pound of the retail products including from low priced hamburger to much higher priced steaks.

Table 5.3: Farm Commodity Prices and Farm Value in Typical Retail Food Products.

Farm Commodity	2004 Farm Price	2007 Farm Price	Retail Product	Farm Cost of Retail Product in 2004	Farm Cost of Retail Product in 2007
Corn	$2.06/bu	$4.00/bu	HFCS in Soda	$0.115/12-pack	$0.222/12-pack
Cotton	$0.416/lb	$0.535/lb	Dress Shirt	$0.26/shirt	$0.33/shirt
Wheat	$3.40/bu	$6.65/bu	Loaf of Bread	$0.05/loaf	$0.09/loaf
Wheat	$3.40/bu	$6.65/bu	Donuts	$0.056/dozen	$0.109/dozen
Milk	$16.13/cwt	$19.15/cwt	Gallon of Milk	$1.38/gallon	$1.65/gallon
Steer	$0.8451/lb	$0.9296/lb	Pound of Beef*	$0.8451/lb	$0.9296/lb
Hog	$0.51/lb	$0.48/lb	Pound of Pork*	$0.51/lb	$0.48/lb

*Reflects that the purchase price of a steer or hog is for the entire animal. The retail price is for a specific cut of meat that has a wide range of prices. For example, steaks at $6.99/lb and hamburger at (1.99/lb) each are obtained from the carcass but are sold at different prices while the live animal is sold at a constant price per pound.

6 Effects on Equilibrium Food Market Prices and Livestock Margins

Economists have scarcely begun to analyze the effects of recent, dramatic increases in the prices of agricultural inputs used in producing biofuels. Many organizations have recently examined the possible effects of these price increases on the costs of producing food (Informa, 2007; Urbanchuck, 2007; Henderson, 2008). These studies have generally conducted such inference using historical cost shares and the assumption of no substitution in production as the market prices of inputs change. For a practical example, it is well known that portion size changes and the mix of ingredients, like the amount of cheese on a pizza, changes in response to prices. This fixed proportions assumption is, or course, inappropriate in the long run. Furthermore, no consideration is given to the changes in the extent of production that would be compelled by evolving production profitability. Given these issues, the analyses cited above provide only rough evidence, even on the supply side.[1] Of course, those studies only provide limited information regarding possible effects on equilibrium prices, as the effects on market demands are not considered.

An analysis of the effects of crude oil price increases on biofuel production and agricultural market equilibria (including retail food prices), was undertaken by Tokgoz, et al. (2007). Specifically, they used a large-scale, partial equilibrium econometric model to examine the effects of a permanent increase in the crude oil price of $10 per barrel, starting from a base price of approximately $65 per barrel. Based on their particular specification for the biofuels sector, this resulted in an increase of about 40 percent in the long-run equilibrium price of corn. This, in turn, resulted in varying increases in the equilibrium retail prices of food items, with larger increases (though small in absolute terms) being realized in meat and dairy products.[2]

This section of this report takes a small step in understanding the effects of increasing biofuels production on equilibrium retail market prices for food and on meat production margins. We measure the effects of three putative causes of changes in equilibrium retail food prices that have been of particular concern in recent years – the prices of energy, labor, and agricultural biofuels inputs. In addition, we measure the effects of these same price changes on equilibrium margins at different stages of beef and pork production. For both retail food prices and meat production margins, we provide estimates of the specific effects of unexpected changes in energy, labor, and biofuels feedstock prices that have been realized since 2005, as biofuels production has increased.

We employ relatively simple time-series methods for this analysis. This provides a counter-point to the structural analysis of Tokgoz, et al. Also, our measurements of historical realized effects of energy, labor, and biofuels feedstock price changes provides a basis of comparison for the expected future effects that they estimate. Taking a relatively simple time-series approach is both a strength and a weakness of this analysis. Measurements of historical, realized average effects of increased commodity prices reflect market peculiarities that may not be fully reflected in large-scale structural models, such as shifting consumer preferences and the net effects of market power at various stages of production. We also enjoy a reduced risk of mis-specifying structural relationships, as we require only very minimal assumptions in that regard. A weakness of our approach is that the historical data are just that, and as such our measurements do not fully reflect the structural change that has been taking place in recent years. More specifically, the indirect effects of increases in crude oil prices, mediated by corn prices, are likely under-represented in the models.

Methodology

We employ standard vector autoregression (VAR) and innovation accounting techniques. We describe these techniques very tersely; for an accessible treatment of these methods, see Enders (1995). For each margin or retail price that we consider, we specify a VAR model consisting of four variables, the price of crude oil, the price of labor, the price of corn, and the retail price or margin under consideration. Innovations, or changes, to the price of corn in these systems not only reflects the direct influence of increasing biofuels production, but, in the absence of other agricultural prices in these systems, serves as a proxy for the indirect effects being transmitted through the agricultural economy.

For each margin or retail price, we estimate a VAR in standard form

$$y_t = A_0 + \sum_{n=1}^{N} A_1 y_{t-n} + e_t$$

where y_t is a 4x1 vector of variables observed in period t, the A_i are conformable parameter matrices, and e_t is a vector of correlated, zero-mean innovations for period t with $E(u_t u_t') = \sum$. Systems other than those containing the overall food at and away from home CPIs also contain seasonal harmonic variables. The standard VAR is an over-pa-

[1] A more careful analysis of the effects of input price changes (including agricultural inputs) on food processing costs is provided by Paul and MacDonald (2003).

[2] All effects of energy price increases on retail food prices were indirect, being mediated by increases in the prices of agricultural commodities used in biofuels production.

rameterized, reduced-form representation of a dynamic structural model:

$$By_t = \Gamma_0 + \sum_{n=1}^{N} \Gamma_n y_{t-n} + \varepsilon_t$$

where ε_t is a 4x1 vector of uncorrelated disturbances. The standard from VAR can be written in a vector moving average representation, where the value of the endogenous variables are written strictly as functions of the history of the underlying, orthogonal structural disturbances:

$$y_t = \mu + \sum_{i=0}^{\infty} \phi_i \varepsilon_{t-i}$$

where ϕ_i the parameter matrices reflect various elements of the B and A_i matrices from above. The sum over i of specific elements from the ϕ_i matrices provide an estimates of the long-run multipliers – the long-run effects on one variable of a shock to another. For example, the impact on egg prices of a shock to corn prices or, in other words, how egg prices are affected, in the long run, by a change in corn prices. In this application, we recover the ε_t series and estimates of the ϕ_i matrices from the underidentified standard VAR system using the Choleski decomposition of $\sum$. This implicitly assumes that the underlying structural model is recursive, as discussed further below. The vector moving average expression above can be partitioned to separate the effects of shocks occurring before and after a particular point in time:

$$y_t = \sum_{i=0}^{s} \phi_i \varepsilon_{t-i} + \quad \mu + \sum_{j=s+1}^{\infty} \phi_j \varepsilon_{t-j}$$

where the term in parentheses represents the effects of shocks occurring before period t–s, and the term before the parentheses represents the effects of shocks occurring after.

For the present application, a natural ordering of the variables and associated set of just-identifying restrictions suggests itself. We assume that the price of crude oil in one period is not affected by contemporaneous shocks in any of the other variables, the U.S. labor price is affected by contemporaneous crude oil shocks, the corn price could be affected by contemporaneous shocks from either oil or labor prices, and retail food prices are last. This ordering reflects the relative sizes of these markets, and lags in food production. The crude oil price is placed first, as the crude oil market is a very large, international market. The labor price, obviously, has great importance across many industries within the U.S., but will likely affect international energy prices only with delays. The corn price should naturally be ahead of retail food prices, given it is an input into production of livestock and consumer food products.

All VAR systems are estimated using OLS, with optimal lag lengths being determined by the Akaike information criterion. We heed the recommendations of Nerlove et al (1979), Sims (1980), and Doan (2004), and do not difference the data, even though non-stationarity could be present, so as not to lose information. However we do take care to ensure that the non-stationarity in the explanatory variables explains any the non-stationarity in the dependent variable, as Nerlove et al. suggest. Specifically, we check the recovered VAR residual series for non-stationarity using augmented Dickey-Fuller tests, finding they are stationary in all cases (results not shown). For each system, a block exogeneity test is conducted for each of our three putative determinants of meat production margins and retail food prices. Restricted systems in which coefficients on all lags of the variable being tested are zero are estimated, and a likelihood ratio test statistic is calculated:

$$LR = (T - c)(\log|\Sigma_r| - \log|\Sigma_u|)$$

where T is the number of observations, c is the total number of individual parameters being restricted, and $\sum_r$ and $\sum_u$ are the restricted and unrestricted error covariance matrices, respectively. This test statistic is distributed as χ^2 with c degrees of freedom.

Data

We employ monthly observations of all variables. All systems include crude oil, labor, and corn prices. The crude oil price series we use is the spot price of West Texas Intermediate crude at Cushing, Oklahoma, collected from the Department of Energy. The labor price we employ is the Average Weekly Earnings of Production Workers (total private) as reported but the Current Employments Statistics (CES) survey conducted by the Bureau of Labor Statistics. The corn price is the spot price of number 2 yellow corn in central Illinois, collected from Primark Datastream.

In addition to those three variables, each system contains one meat processing or retailing margin series, a livestock price series, or a retail price series. Retail prices for eggs, bread, milk, tomatoes, and lettuce are the U.S. City Average Prices reported in the Bureau of Labor Statistics Average Price Data. Beef, pork, and broiler retail prices are reported by USDA. The Food at Home and Food Away From Home CPIs are the U.S. City Averages (Not seasonally adjusted; base period = 1982-84) as reported by the Bureau of Labor Statistics in the Consumer Price

Table 6.1: Block Exogeneity Tests for Retail Food Price Systems.										
	Egg price	Bread price	Milk Price	Beef price	Pork price	Chicken price	Lettuce price	Tomato price	Food-at-home CPI	Food-away-from-home CPI
Crude oil price	0.239	0.590	0.643	0.457	0.381	0.170	0.613	0.264	0.650	**0.036**
Labor price	**0.005**	**0.040**	**0.002**	0.293	**0.039**	**0.014**	**0.000**	**0.000**	**0.064**	**0.000**
Corn price	**0.005**	**0.005**	**0.102**	0.508	0.375	0.197	0.657	0.816	**0.046**	0.816

Table 6.2: Long-run Effects of Crude Oil, Labor, and Corn Price Shocks on Retail Food Prices.										
	Egg price	Bread price	Milk Price	Beef price	Pork price	Chicken price	Lettuce price	Tomato price	Food-at-home CPI	Food-away-from-home CPI
Crude oil price	–	–	–	–	–	–	–	–	–	0.007
Labor price	0.355	0.364	0.373	–	0.140	0.154	0.339	0.399	0.146	0.000
Corn price	0.250	0.066	0.100	–	–	–	–	–	0.038	–

Index – All Urban Consumers (Current Series).

The feeder cattle price is the Amarillo monthly average 700-800 pound steer price reported by AMS. Fed cattle prices are the Texas-Oklahoma average fed steer price. The feeder-fed price margin is calculated as the value of a fed steer minus the value of the feeder steer. Live-to-cutout and cutout-to-retail beef and pork data series are provided by the Livestock Marketing Information Center.

Effects on Equilibrium Retail Food Prices

P-values for block exogeneity tests are reported in Table 6.1. For all retail food prices considered, we cannot find a statistically significant effect of crude oil prices. We cannot find a significant effect of the labor price on equilibrium retail beef prices, but it is significant for all other commodities. We find a significant effect of the price of corn on egg, bread, and milk prices only. The food-at-home CPI is influenced significantly by the labor and corn prices, while the food-away-from home CPI is influenced significantly by the crude oil and labor prices. For each retail price considered, the corresponding final VARs from which long-run multipliers and historical decompositions are calculated exclude the series that we find are block exogenous.

Long-run multipliers are calculated at the 24-month horizon. The 24 month horizon indicates the cumulative effect of a change in oil prices, for example, on egg prices 24 months later. This lag allows for economic adjustments to occur to estimate the long term changes in prices. In Table 6.2, we report the effect on each equilibrium retail food price of a one percent shock in the crude oil, labor, or corn price. Effects are less than one percent in all cases. The results indicate that a one percent increase in corn price leads to a 0.25 percent change in retail egg price at the end of 24 months. Or that a 10 percent increase in corn prices leads to a 2.5 percent change in retail egg prices after 24 months.

While bread is not made with corn, it was modeled this way to capture the effect of higher corn prices – the primary feedstock for ethanol. The model indicates a relationship between corn and bread prices. The reason for this relationship is the indirect effects of tradeoffs between corn and wheat. Higher corn prices



change production and use of other crops. That feedback is captured here.

Also of interest is the effect of labor prices on food. Labor price can also be thought of as wages. As labor prices increase, production costs increase. But, also, higher labor costs imply higher wages or incomes. Higher incomes affect the demand for food. It is interesting that shocks to labor costs did not significantly affect beef prices.

Decompositions of unexpected changes in retail food prices since January 2005 are presented in Table 6.3. The decomposition breaks up the total effect into its parts. For example, since 2005 unexpected egg price changes have amounted to a 27.6 percent change. Corn prices caused 6.4 percentage points, unexpected labor price increases caused 1.7 percentage points of increase, and other causes accounted for the remaining 19.5 percentage point change. In each food price, other factors accounted for the largest share of the percentage change in prices.

So, what constitutes other causes? It includes costs other than oil, labor, and

Table 6.3: Decompositions of Unexpected Changes in Retail Prices since January 2005.

	Egg price	Bread price	Milk Price	Beef price	Pork price	Chicken price	Lettuce price	Tomato price	Food-at-home CPI	Food-away-from-home CPI
Due to crude oil price shocks	–	–	–	–	–	–	–	–	–	0.1%
Due to labor price shocks	1.7%	1.9%	1.2%	–	0.6%	0.7%	1.2%	1.3%	0.4%	0.0%
Due to corn price shocks	6.4%	4.6%	4.0%	–	–	–	–	–	0.4%	–
Due to other causes	19.5%	5.2%	6.6%	-4.7%	-2.3%	1.4%	-4.9%	-11.4%	0.5%	0.2%
Total	27.6%	11.7%	11.9%	-4.7%	-4.7%	2.1%	-3.7%	-10.1%	1.3%	0.4%





corn. Interest cost is one example. But, perhaps most important, are issues of industry structure and production cycles. For example, milk prices have increased due to export demand. But, competitive pressures and market environment dictate the ability to change prices. High prices do reduce quantity demanded and result in lower prices. Egg prices have increased sharply, but are the result of low prices and reduced supplies early in the period. All of the change in retail beef prices is due to other causes which could be changes in marketing margins.

Effects on Equilibrium Beef and Pork Margins

The small effects of corn and oil prices on retail food prices led us to investigate effects on price spreads in livestock. Costs have already clearly increased to some sectors of the livestock industry, affecting profitability. A natural question is to what extent these price changes have affected margins in the livestock industry. P-values for block exogeneity tests for systems including livestock prices and meat production or marketing margins are reported in Table 6.4.

The labor price was found to be significant for each livestock price and price spread analyzed. That makes some sense given the large labor costs in the packing industry, represented by the live-to-cutout price spread. Oil prices had a significant effect on hog and feeder prices and the pork live-to-cutout spread. Corn only

Table 6.4: Block Exogeneity Tests for Livestock Prices and Meat Production or Marketing Margin Systems.

	Hog price	Pork live-to-cutout spread	Pork cutout-to-retail spread	Texas-Oklahoma feeder steer price	Fed cattle – feeder steer price spread	Beef live-to-cutout spread	Beef cutout-to-retail spread
Crude oil price	**0.022**	**0.028**	0.738	**0.098**	0.241	0.354	0.461
Labor price	**0.020**	**0.000**	**0.010**	**0.041**	**0.135**	**0.001**	**0.043**
Corn price	0.544	0.920	0.804	0.154	**0.035**	0.745	0.751

Table 6.5: Long-Run Effects of Crude Oil, Labor, and Corn Price Shocks on Livestock Prices and Meat Production and Retailing Margins.

	Hog price	Pork live-to-cutout spread	Pork cutout-to-retail spread	Texas-Oklahoma feeder steer price	Fed cattle – feeder steer price spread	Beef live-to-cutout spread	Beef cutout-to-retail spread
Crude oil price	0.296	-0.432	–	0.179	–	–	–
Labor price	0.081	0.408	0.319	0.164	0.304	0.605	0.452
Corn price	–	–	–	–	0.173	–	–



had a significant effect on the fed cattle-feeder cattle price spread.

Table 6.5 contains the long-run effect of changes in corn, oil, and labor prices on the livestock and meat price spreads. A one percent change in the corn price is estimated to lead to a 0.173 percent change in the fed-to-feeder price spread. That spread increased partially to offset the price of feed.

Decomposing the long run effects into their various parts yields the data contained in Table 6.6. The long run effects reveal, in some cases, offsetting effects on prices and price spreads. For example, hog prices have declined, but oil and labor comprise a 10 percentage point increase partially offsetting the 13.3 percentage point decline from other causes. The same holds for Amarillo feeder steer prices.

This analysis indicates that high corn prices have had very little impact on retail food prices. Oil prices have also had very little effect on food prices. But, labor costs do significantly affect prices. Increased labor costs have two effects. They increase production costs and increase consumers' incomes.

The lack of evidence of the impact of corn price changes on livestock prices and margins is critical in understanding the transition period underway. The analysis looks at a long run, 24 month adjustment period. In the case of cattle, corn price changes are thought to translate quickly to feeder cattle prices which would make the difference at 24 months insignificant. In fact, examining the shorter length effects indicate that there is a larger effect of corn prices early that declines to almost nothing by 24 months. It would appear that this research supports the hypothesis that the transition in livestock prices and margins has yet to move through the system.

Table 6.6: Long-Run Effects of Crude Oil, Labor, and Corn Price Shocks on Livestock Prices and Meat Production and Retailing Margins.

	Hog price	Pork live-to-cutout spread	Pork cutout-to-retail spread	Texas-Oklahoma feeder steer price	Fed cattle – feeder steer price spread	Beef live-to-cutout spread	Beef cutout-to-retail spread
Due to crude oil price shocks	9.0%	-16.8%	–	2.9%	–	–	–
Due to Labor price shocks	1.0%	1.2%	1.1%	0.7%	2.3%	1.6%	2.2%
Due to corn price shocks	–	–	–	–	11.0%	–	–
Due to other causes	-13.3%	1.2%	-3.1%	-10.1%	2.0%	-7.8%	1.5%
Total	-3.3%	-14.4%	-2.0%	-6.4%	15.3%	-6.2%	3.7%

7 Supply and Demand: Some Reasons for High Prices

Fundamentally, the prices of agricultural commodities depend on the relative supply and demand for those commodities. Supply and demand depend on many factors. Prices exhibit cyclical and seasonal patterns based on longer term characteristics (cycles) and normal supply and demand patterns during the year (seasonal).

All of Texas' agricultural commodities have been affected to some degree by higher fuel costs and increased demand, and the resulting higher prices, for corn. But, each commodity has some underlying reasons for why prices are where they are today. Different fundamental causes by commodity affect the timing and severity of market corrections. The biological nature of production of each of the commodities affects the speed of adjustment. The structure of each of these sectors and the competitive market environment of each also affects the ability of industry segments to pass on cost increases. The following is a brief overview of major commodity markets. This overview is included in this report to aid readers who may not be involved in day to day agricultural markets.

Wheat

Wheat is most importantly a food grain, as opposed to a feed or fuel grain. Some wheat is fed to livestock when price relationships to corn allow it, but feed use is not typically large in any year.

Recent record high wheat prices have been predominantly caused by supply problems in the United States and the world. In the U.S., fewer acres and a rain damaged harvest in the Southern Plains limiting supplies. A record drought in Australia sharply cut supplies from that major world supplier of wheat. Tighter supplies in other major producing regions of the world have been the major cause of record prices.

Given that ethanol (demand) has not been the major cause of higher prices for wheat, this is one market that could experience a major downward correction in prices due to increased planted acres, worldwide. Price declines would be limited, however, by increased production costs and relative corn prices.

Corn

Historically, livestock have been the largest user of corn and feedgrains in the United States, followed by exports. Food, seed, and industrial corn use, the category that includes ethanol and high fructose corn syrup, has been the third largest user of corn. As ethanol production has increased, it has exceeded exports in use and is projected to exceed livestock feeding in the next decade to become the largest user of corn.

While the increased demand for corn to make fuel is the largest reason for high corn prices, it is important to put the market situation in context. Some other market forces are at work in pushing prices higher.

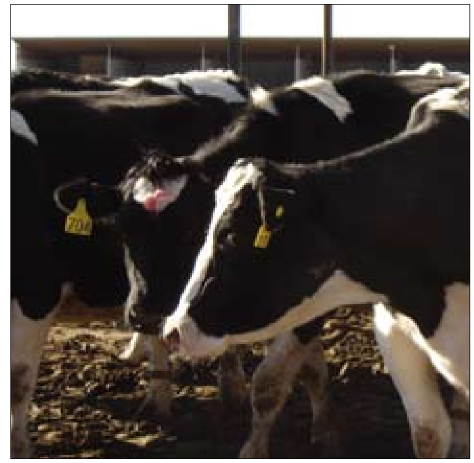
Planted corn acres declined for the 2006-2007 marketing year to 78.8 million acres, largely due to higher fertilizer and fuel costs. That was a 3 million acre decline from the prior year. Corn prices made their first large increase in the fall of 2006 due to the realization of fewer acres planted and harvested and the rapid increase in demand from ethanol plants.

Planted acres surged to 93.6 million in 2007, to the largest number since World War II. Combined with today's high yields, the harvested corn crop in 2007 was the largest U.S. crop in history. Increased use has kept stocks historically tight and prices high.

Increased corn acres came, largely, out of soybean acres. The resulting reduced soybean production led to sharp price increases for soybeans and a bidding war for acres to be planted in 2008, for the 2008-09 marketing year. USDA's prospective plantings report issued March 31, 2008 indicated that only 86 million acres of corn would be planted in 2008, an 8 percent reduction from 2007.

With record high corn prices why would planted acres decline? The first reason is relative prices to soybeans. Compared to corn prices, soybean prices have been even higher, the market's signal to farmers was to plant more soybeans relative to corn. Corn is often grown in the Corn Belt in a crop rotation with soybeans. Some producers may have had to switch some acres back to soybeans to maintain the benefits of their rotation patterns. Soybeans are a less expensive crop to grow than corn, which pulls more acres to soybeans.

The last market factor to consider is exports. Exports are normally thought of



as the most responsive to price. But, corn prices are high worldwide, limiting the ability of high prices in the U.S. to ration exports. The falling value of the dollar makes U.S. corn, relatively, less expensive to foreign buyers.

Soybeans

Much of the increase in corn acres planted in 2007 came at the expense of soybean acres. The resulting high soybean, meal, and oil prices have encouraged more soybean acres in 2008. Some of the price increases in corn and soybeans are due to the market signals to bid acres into one crop or the other. These signals are felt more keenly in corn and soybeans due to the large majority of U.S. production of these crops being in the Midwest or Corn Belt. Those two crops probably more directly compete for acres than any other two crops in the country.

Cattle

The cattle industry remains a cyclical industry. Drought in the Southern Plains in 2006 and the Southeast in 2007 forced contraction in the cow inventory. This liquidation phase has been aided by lower calf prices and higher production costs. Tight supplies of calves are acting to support calf prices in the face of higher feed costs.

The Southern Plains of the United States is the predominant wheat pasture area of the country. Wheat is planted in the fall and grazed over the winter. The calves are removed in March if the wheat is to be harvested or May if the wheat is to be grazed out. Record wheat prices, poor wheat stand establishment, and the short supply of wheat seed (critical if a producer had to re-plant) resulted in a sharp reduction in the availability of wheat pasture and the number of calves on wheat pasture. The result was more cattle placed on feed over winter, even though feed costs were increasing.

More cattle imported from Canada have been placed on feed in recent months because their feed costs have increased even more than those in the U.S. Beef exports have increased to Canada in return as they produce less beef and as the weaker U.S. dollar encourages exports.

The cattle and beef market might best be described at this time as a tug-o-war between high feed costs and the economy pushing prices down and tighter supplies of cattle supporting feeder cattle and calf prices.

Dairy

Milk prices hit record high levels in 2007. Prices continued to increase even as production per cow and milk cow inventory increased. In this case, record prices were caused by increasing demand for milk products. Tight supplies in the rest of the world, as Australia contended with a drought and the EU reduced production as subsidies were cut, led to higher world prices and sharply higher U.S. exports.

Milk prices can best be characterized as an export led expansion and not tighter supplies due to higher feed costs. However, moderating export demand and expanded production is reducing milk prices. Higher feed costs are increasing production costs, However, milk prices continue to fuel expansion in the number of milk cows, production per cow and total production.

Hogs

The hog industry has been in the midst of a long expansion due to profitable conditions. Industry consolidation and structural change has led to increased efficiencies supporting expansion. World markets have expanded for U.S. pork increasing exports and providing a market outlet for increased production. It is also generally agreed that more effective vaccines for circovirus have led to reduced mortality, further increasing production.

Record large pork production is occurring simultaneously with sharply higher feed costs, leading to expectations of record financial losses in the production sector in 2008. While sow slaughter has increased over early 2007, productivity gains continue to increase, as well.

Poultry

Broiler production in 2008 has been larger than in 2007 due to more birds slaughtered and heavier weights. In spite of large production, prices only recently have begun to fall befow year ago levels. Combined with higher feed costs, low prices are increasing the losses in the sector. Only leg quarter prices have remained higher, supported by exports.

8 Futures and Funds

The increase in speculative funds in agricultural commodities over the last couple of years is somewhat related to ethanol and oil markets, but is part of a larger change in financial investments.

An influential 2004 working paper by economists at Wharton and Yale (eventually published in Gorton and Rouwenhorst, 2006) demonstrated that investments in commodities could significantly improve the risk-reward profile of portfolios previously comprised of only the traditional class of liquid assets. That article coincided with an increasing belief on the part of large investors that the world economy was headed into a period of rapid growth in the value of commodities, including agricultural commodities. This confluence of events spurred the rapid expansion of investment money in commodities.

Growing demand for ethanol and critical supply shortfalls of wheat, corn, and soybeans have combined to drive grain prices to record high levels. Accentuating this price movement is the impact of speculative investment in commodity markets. Commodities have long been viewed as a defensive asset class, earning favorable returns in times of inflation at a time when stocks and bonds generally decline (Lam, 2004). But the recent flood of speculative money into commodity markets is increasing price volatility and pushing up further the prices of raw commodities and food products.

From 1999 to 2007, the average range of wheat prices in the July Kansas City contract was $1.29 per bushel (life of contract high minus low). Thus far for 2008, that range has increased to $8.61 per bushel (Figure 8.1). According to Brian Grete, Senior market analyst with Pro Farmer, "Inflationary talk has largely been the reason speculative traders have flooded commodity markets with money. While most com-

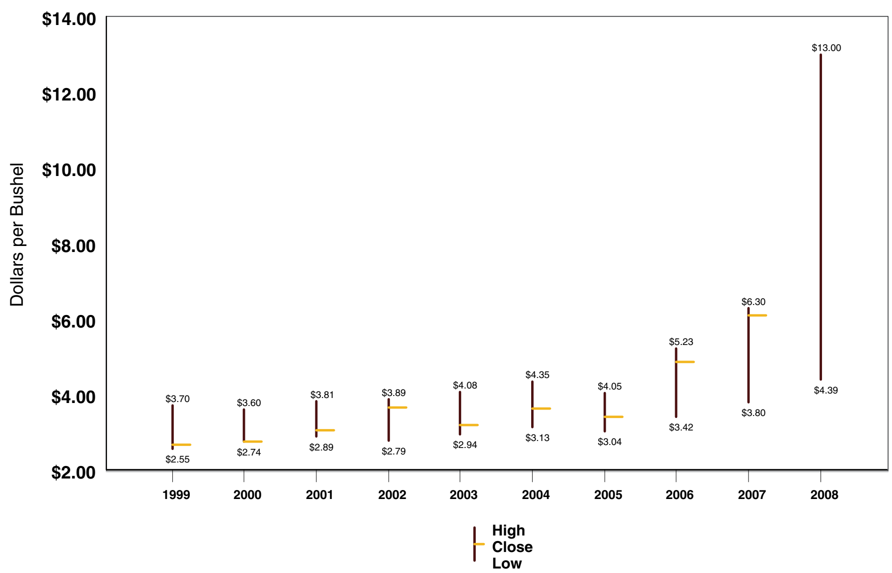


Figure 8.1: High, Low, and Close of July KCBT Wheat Prices.

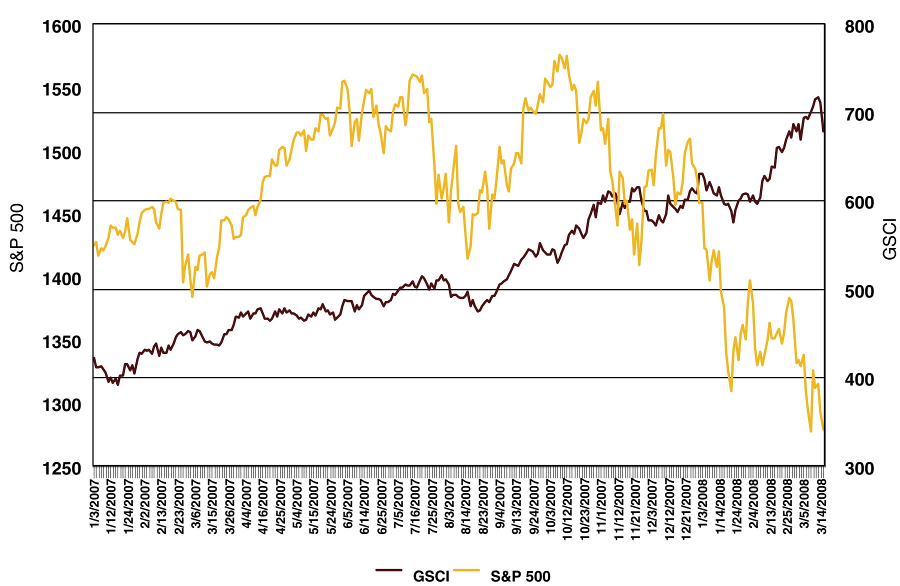


Figure 8.2: Comparison of Returns, GSCI Versus S&P 500 (closing prices).

modities (including grains) have bullish fundamentals, prices wouldn't be at current levels on fundamentals alone" (2008).

Relatively new investment tools allow individuals to join professionals in making investments in commodities. Most prominent are index funds dominated by the Goldman Sachs Commodity Index (GSCI). These funds offer long-only investment in a broadly diverse basket of commodities that includes energy, industrial metals, precious metals, agricultural commodities, and livestock. Annual returns of the Goldman Sachs Commodity Index measured in early March show a return on investment of over 50 percent while the return on the Standard and Poor's 500 stock index was a negative 6 percent (Figure 8.2).

Estimated investment funds in the GSCI have increased from $8 billion in 2000 to over $103 billion today (Cohn and Symonds, 2004, Goldman Sachs, 2007, Brock, 2008) (Figure 8.3). Long only funds such as the GSCI typically hold their positions in the nearby futures contracts. As contract expiration nears, they 'roll' their futures positions into the next nearest contract month. The price exaggeration generated by these investment funds is so pervasive, traders have coined a phrase to explain price activity at these critical junctures: the Goldman Roll (van Essen, 2007).

What About Hedging Opportunities?

The increased activity in futures markets has had the unexpected consequence of reducing producer's ability to manage price risk using futures markets. The large influx of money into the markets, typically long positions, has pushed commodities to extremely high levels. But, these funds also quickly move large amounts of money in and out of positions. This has generated much more price volatility in the futures markets. In response, the exchanges have increased the daily move limits for most of the agricultural commodities over the last 6 months.

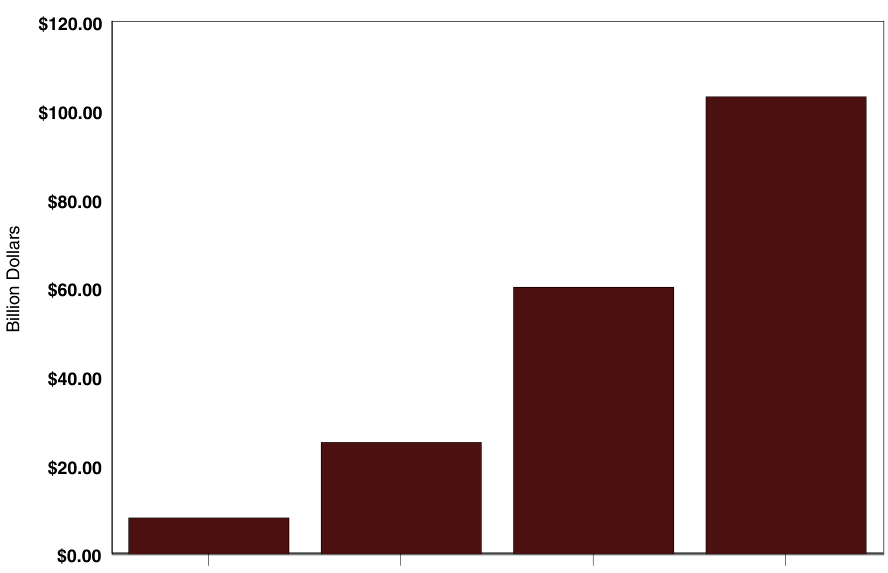


Figure 8.3: Investor Funds in the Goldman Sachs Commodity Index.

The increased volatility has had unintended consequences. Grain elevators, large grain companies like Archer Daniels Midland, Bunge, and Cargill, large cotton merchants, and cooperatives often provide farmers the opportunity to forward contract their crops. At the time the forward contract is accepted the elevator or merchant normally takes an offsetting position in the futures market to protect their offered price and limit their risk. However, the up and down volatility in the market and expanded trading price limits mean that more margin calls occur. Small elevators and even large grain companies and cotton merchants, who are trading even larger volumes, not to mention farmers doing their own price risk management, have been unable to make the margin calls.

Producers, elevators, and companies use bank financing to finance their businesses and the price risk management. As the margin calls have increased they have exhausted their ability to finance their normal hedging activities and have therefore been forced out of the market. The end result is an inability to use the futures market to manage price risk due to the increased price volatility and a lack of financing to bridge the growing season.

It is unclear, at this time, how this situation can be reversed. Futures market price volatility is unlikely to decline unless fund activity is reduced. Even without fund activity in the markets given demand and supply situations for some commodities, a measure of increased price volatility could be expected. There are no regulations anticipated, at this time, to limit participation in the markets.

9 Estimating the Variability in Corn Price

The volatility in corn prices and changing market leads to the natural question, "how high could corn prices go?" Increased demand, tighter stocks, and the normal variation in yields caused by weather increase the stress on the market. This report section addresses potential price volatility.

The past few years' price action in commodities has once again enforced the fact that prices can move very far and very fast. The AFPC used a simulation model to project possible price and yield combinations in 2008 to estimate where corn prices might go if there was a bumper crop or a severe drought in this country. Using a national planting of 86 million acres of corn with a projected national yield of 153.5 bushels per acre as a base point, we accounted for variability in domestic supply by using historical national yields and export numbers. Using this data, along with appropriate price elasticities and harvested acreage, we projected 500 possible outcomes for price and yield in 2008 (Figure 9.1).

The model forecasts a national season average mean price of $4.66 per bushel in 2008, with a possible range of the projected high of $10.05 per bushel to a low of $2.68 per bushel. Possible national yields have a mean of 153.5 bushels per acre and range from a high of 173.7 bushels per acre to a low of 115.8 bushels per acre. The figure below shows a graph of the 500 possible price and yield combinations. Most of the observations are clustered around the mean price and yield. The minimum yield of 115.8 bushels, corresponding to the maximum price, represents approximately a 25 percent reduction from the projected mean yield. It should be noted that a price as high as $10 is very unlikely, as only one of the 500 observation (less than one tenth of one percent) of the projected prices are greater than $10 per bushel. In fact, 82% of the projected prices are less than $6.00 per bushel, with most (53%) of the prices falling between $3.50 and $6.00 per bushel. A 10% reduction from the mean yield (drought) results in a national average corn price of approximately $6.32 per bushel. A 10% increase from the mean yield (bumper crop) results in a price of approximately $3.13 per bushel. Seventy percent of the observations fall in the $3.13 to $6.32 per bushel range.

Increased demand for corn and more corn utilizing infrastructure coupled with the acreage devoted to corn means, in economist's terms, that we have moved to a more inelastic portion of the demand function. The end result is more price variability because small supply changes create larger price changes. This analysis suggests an extremely wide range of possible price outcomes.

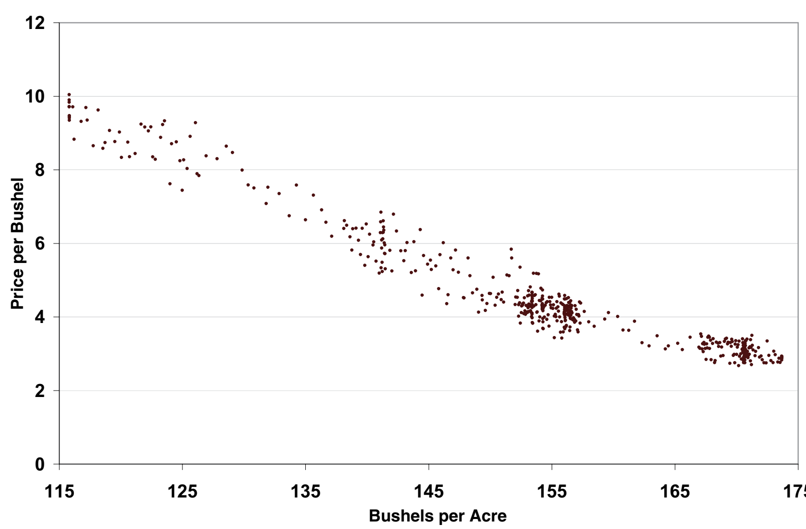
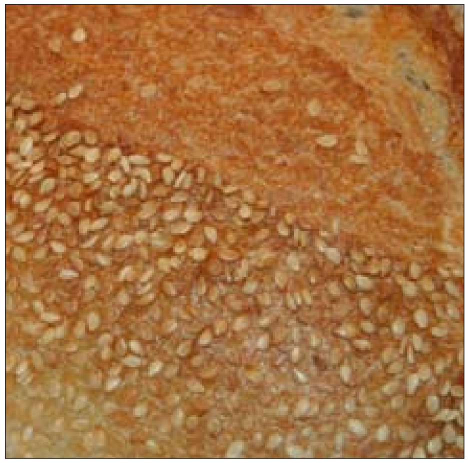


Figure 9.1: Scatter Plot of Possible Price and Yield Combinations in 2008.

10 Economic Impacts of Higher Corn Prices on the Texas Economy



The economic impacts to the grain and livestock sectors from higher corn and grain sorghum prices are calculated using 2007 livestock numbers. Total corn and grain sorghum fed to all cattle (beef and dairy) in 2007 was about 366.8 million bushels based on the number of fed steers sold, cow and bull herd inventory January 1, calves marketed, dairy cows, and bushels of grain fed per head. Grain fed to hogs and poultry in Texas was an estimated 25 and 175 million bushels, respectively. Feedgrain output was estimated using 2007 production and the change in feedgrain price.

The average corn price in the Texas Triangle Area increased $2.41/bu between 2005 and January 2008 and grain sorghum increased $2.39/bu over the same period. The increased market prices for corn and grain sorghum in 2007 led to increased receipts of $1.1 billion for the Texas feedgrain sector (Table 10.1). The direct, indirect, and induced effects of the higher receipts for corn and grain sorghum are summarized in the table below. Direct effects represent the initial change in the industry in this case, the direct effects resulting from the increase in gross value of corn production. Indirect effects result from inter-industry transactions as supplying industries respond to increased demands. Induced effects reflect changes in local spending that result from income changes in the directly and indirectly affected industry sectors. The combined indirect and induced output effects total about $893 million and the total effect is to increase economic output for Texas from the corn and grain sorghum industries by $1.99 billion. But, those higher prices for feedgrains are paid by livestock producers. The combined total livestock output effect is a -$2.59 billion. The combination of feedgrains and livestock results in a net reduction in economic output of $602 million.

Value added can be thought of as similar to the cost of goods sold in an accounting sense. It represents the value that each sector adds to the product not counting the intermediate product purchased. For example, a feedlot adds value to the feeder calf they purchased. Each industry segment adds some value to the whole. The total feedgrain value added impact for Texas is $710.8 million. As in the case of total output, that value added is offset by losses in the livestock sector resulting in net total value added of -$116 million.

Table 10.1: Economic Impacts of Higher Grain Prices on Grain and Feeding Sectors in Texas.

	Direct	*Indirect*	*Induced*	*Total*
	Millions of Dollars			
Total Output Effects				
Grains	1,099.8	497.8	395.00	1,992.6
Cattle	(799.5)	(811.1)	(184.8)	(1,795.5)
Poultry	(420.9)	(162.7)	(104.3)	(687.9)
Swine	(60.2)	(39.3)	(12.4)	(111.9)
Livestock Effects	(1,280.6)	(1,013.2)	(301.5)	(2,595.3)
Crop and Livestock	(180.8)	(515.4)	93.5	(602.6)
Total Value Added Effects				
Grains	110.0	451.3	149.5	710.8
Cattle	(80.0)	(328.1)	(108.7)	(516.7)
Poultry	(42.1)	(172.7)	(57.2)	(272.0)
Swine	(6.0)	(24.7)	8.2)	(38.9)
Livestock Effects	(128.1)	525.5)	(174.1)	(827.6)
Crop and Livestock	(18.1)	(74.2)	(24.6)	(116.8)

11 Effects of a Renewable Fuel Standard Waiver

The initial renewable fuels standard (RFS), instituted under the energy bill of 2005, always had a limited probability of binding or needing to insure the mandated level of ethanol blending given the powerful market incentives for ethanol production that prevailed in the two years following its establishment (Bryant and Outlaw, 2006). There may have been some indirect effect, as the initial RFS served as a guarantee of minimum blending levels and, therefore, production levels affording prospective ethanol producers protection from the specter of less favorable market conditions. However, industry expansion has been so dramatic that ethanol production volumes now would still be at risk of significant contraction under the old RFS. This dramatic expansion has resulted in feedstock prices being bid up significantly.

The new RFS, instituted under the 2007 energy bill, requires significantly higher levels of blending. Moreover, some flexibility has been removed, vis-a-vis the old RFS. There is now a specific grain-based ethanol ("conventional biofuel") requirement, whereas previously the RFS could be satisfied by the blending of either ethanol or biodiesel (from any feedstock). The conventional biofuel portion of the new RFS starts at 9 billion gallons in 2008 and rises to 13.2 billion gallons in 2012 (cf., 5 and 7.5 billion gallons, respectively, under the old, flexible RFS). Ethanol production in 2007 was approximately 6.5 billion gallons – so production of 9 billion gallons in 2008 in the absence of a government mandate cannot be comfortably assumed. A short corn crop could very well result in the new RFS binding, or insuring ethanol production, given the already high levels of grain prices and shrunken profitability of ethanol production.

In this section, we analyze possible market outcomes under the new conventional biofuel RFS, and under partial waivers of one-quarter and one-half of the conventional biofuel RFS. The waivers are assumed to be immediate and permanent, although we note that information regarding the conditions under which waivers might be granted, and the extent to which the RFS might be relaxed, is very limited. The 2007 energy bill does not discuss alterations to the waiver process for conventional biofuels, so it appears that the rules emanating from the 2005 energy bill should still apply. In broad terms, a waiver could be possible if the RFS would "severely harm the economy or the environment of a State, a region, or the United States," or if there was an inadequate domestic supply of renewable fuel. Further guidelines are not forthcoming. EPA states in the rules governing RFS administration that they had "not finalized regulations providing more specificity regarding the criteria for a waiver or the ramifications of Agency approval of such a waiver in terms of the level or applicability of the standard," and that "each situation in which a waiver may be granted will be unique, and promulgating a list of more specific criteria may be counter-productive." (Environmental Protection Agency, 2007). They do, however, state unambiguously that any waiver would be of national applicability (i.e. there will be no waivers that apply only to select states or regions), and that waivers may be full or partial.

This lack of information regarding the nature of any possible waiver makes the specification of scenarios for our analysis difficult. It appears as though potential petitions for waivers that are currently being considered are based on arguments that current feedgrain prices are already causing economic hardship. It further appears that ongoing, rather than temporary, reductions in the RFS would be the relief desired by potential petitioners. These considerations motivate our specifying scenarios that feature immediate and permanent reductions in the RFS.

The effects of a higher RFS were already considered in Bryant (2008, but based on analysis conducted in the spring of 2007), when various plans for a higher RFS were being considered by Congress. This report, however, updates that analysis in three ways. First, an updated underlying agricultural market baseline is employed. Second, this analysis reflects recent, substantial increases in crude oil prices. Third, the exact specifications of the new RFS are used, including the reduced flexibility described above, and some different scenarios are considered.

Analysis

The model used for this analysis is described in Bryant (2008) and Bryant

and Outlaw (2006). Very briefly, we employ a hybrid stochastic simulation model with three components. First, random future paths of crude oil and natural gas prices are generated based on observed NYMEX futures and futures options prices. Second, possible future agricultural market conditions are reflected by the stochastic output of a large-scale econometric model of the agricultural economy developed and maintained by the Food and Agricultural Policy Research Institute. Third, the agricultural market equilibria under possible future states of the world are displaced based on the optimizing behavior of representative biofuels producers, given fossil fuels and agricultural market conditions, and constraints on production levels due to capacity limitations and government regulation. The results presented below reflect the distributions of market variables over 500 realizations of possible future states of the world.

We consider three scenarios. First, the current RFS, and all other government programs, proceed under their currently planned configurations. In the second scenario, the conventional biofuel RFS is immediately and permanently reduced by one-quarter. In the third scenario, the conventional biofuel RFS is reduced by one-half. In all scenarios, the tax credits for ethanol and biodiesel blending are assumed to persist, and the new biodiesel-specific RFS is assumed to continue at the 1 billion gallon level after 2012.[1] Closing market prices for NYMEX contracts for Friday, March 28, 2008, are employed in the fossil energy component of the model.

The high levels of fossil energy prices expected over the next few years result in powerful market incentives for ethanol production, in the absence of a supply-related spike in corn prices. Figure 11.1 illustrates the expected levels (averages across 500 possible future states of the world) of national average wholesale market prices for ethanol. Prices are likely to remain in the mid-$2.00 per gallon neighborhood, with expected prices being somewhat lower if the RFS is relaxed by one-quarter, and somewhat lower still (albeit by less than the first increment) if the RFS is relaxed by one-half. These lower expected prices reflect the fact that less ethanol production will be mandated under poor market conditions that could be realized in some years (a short corn crop) that would result in high costs of production, or lower demand (low crude oil prices).

Expected levels of ethanol production are illustrated in Figure 11.2. Under all scenarios these expected levels are above the newly-instituted conventional renewable fuels RFS by a billion gallons or more, except for in 2008 when the margin is much smaller. This again reflects the fact that high fossil energy prices will result in high demand for ethanol as a fuel extender (i.e., use above the levels required for satisfying constraints on oxygen content of blended motor fuel). Partial relaxation of the conventional biofuel RFS would result

[1] This is a slight deviation from the current specification, wherein the biodiesel RFS rises to 1 billion gallons in 2012, then goes to zero.

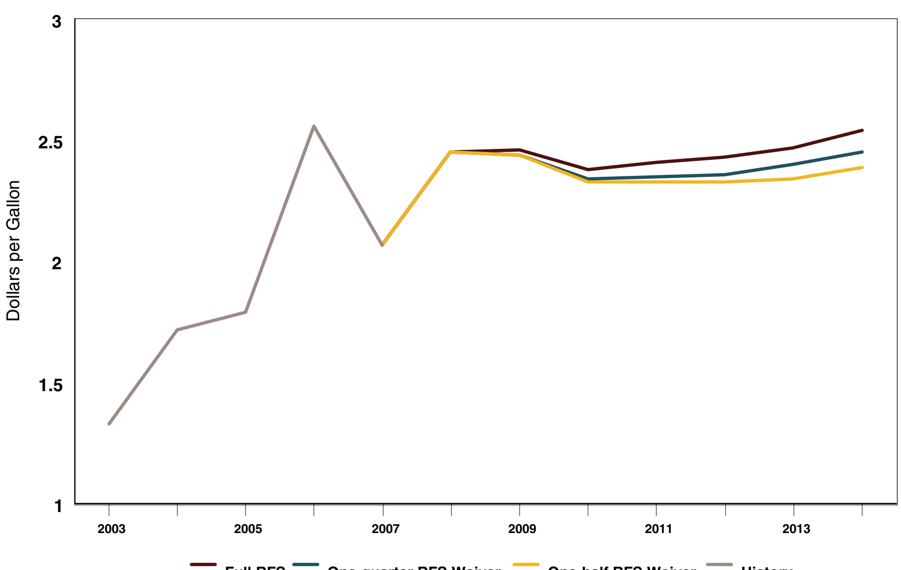


Figure 11.1: Expected Ethanol Price.

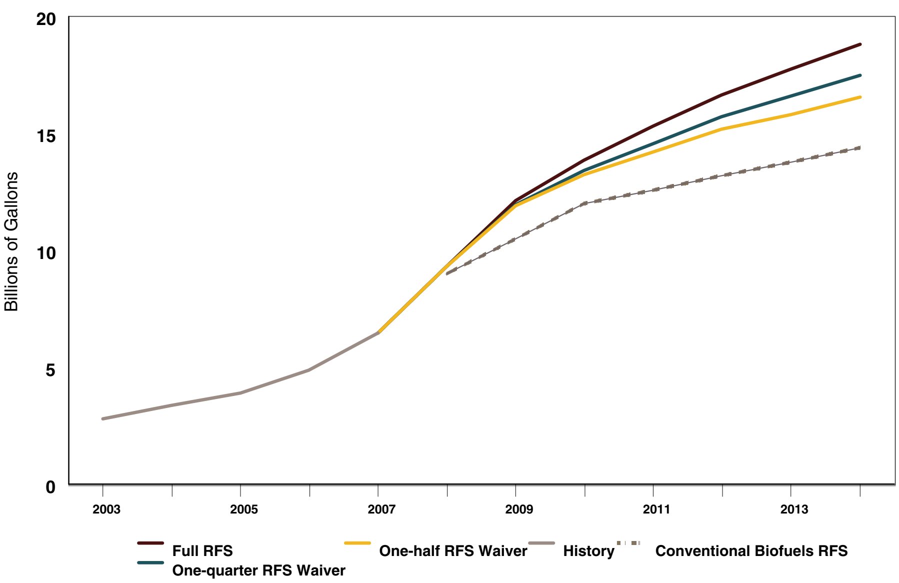


Figure 11.2: Expected Ethanol Production.

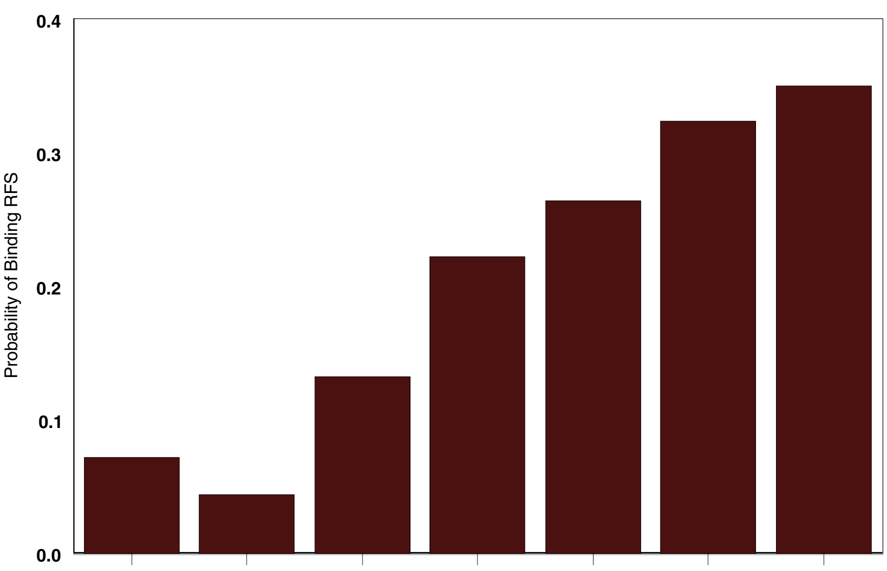


Figure 11.3: Probability of a Binding RFS.

in somewhat lower expected levels of production, as production would be lower if unfavorable market conditions were realized (high corn prices or low crude oil prices).

Model results also provide information regarding the probability of the conventional biofuel RFS (at its full level) binding, as depicted in Figure 11.3. This probability is fairly low for 2008 and 2009 (see a caveat below related to this result), and gradually increases further into the future. This does not so much reflect the rising level of the RFS, as expected levels of ethanol production are rising faster than the RFS (see Figure 11.2). Rather, this reflects the cumulative uncertainty regarding crude oil prices as we forecast further into the future and the commensurately rising uncertainty over market incentives for ethanol production.

Results across scenarios with respect to corn prices are not too surprising, given the expected levels of ethanol prices described above and uncertainty about those expected levels. Like ethanol prices, expected corn prices (Figure 11.4) are fairly steady near current levels under all scenarios. Expected prices across scenarios gradually diverge, with the one-quarter RFS waiver price falling about $0.30 per bushel below the full RFS price a few years hence, and the one-half RFS waiver price falling about $0.50 to $0.60 per bushel below the full RFS expected price. Again, these results reflect the tail events – those possible future states of the world in which

the RFS would be binding, and the levels of ethanol production that would be mandated under those conditions. The probabilities of various corn prices being realized under the three different scenarios are illustrated in Figure 11.5. Corn prices below $4.00 per bushel are unlikely under any scenario, given the high energy prices expected.

Some caveats bear mention. The agricultural baseline used in this analysis reflects a noticeably higher level of acres planted with corn in 2008 than recent USDA reports are suggesting (93.6 versus 86 million acres). Our model therefore generates corn price forecasts that are lower than might be realized in 2008. Moreover, corn price uncertainty is believed to be understated in the agricultural baseline that is an input for our model. A short corn crop in 2008 could very well result in substantially higher prices in the '08/'09 crop year than the baseline reflects, particularly given that the RFS is likely to be close to binding for 2008 (Figure 11.3). A final caveat is that the growth in ethanol production capacity is exogenously specified. Significantly negative profits for ethanol producers, especially in the early years of our forecast horizon, would almost certainly result in lower growth in production capacity than we assume and lower levels of ethanol production in later years, even if favorable market conditions return.

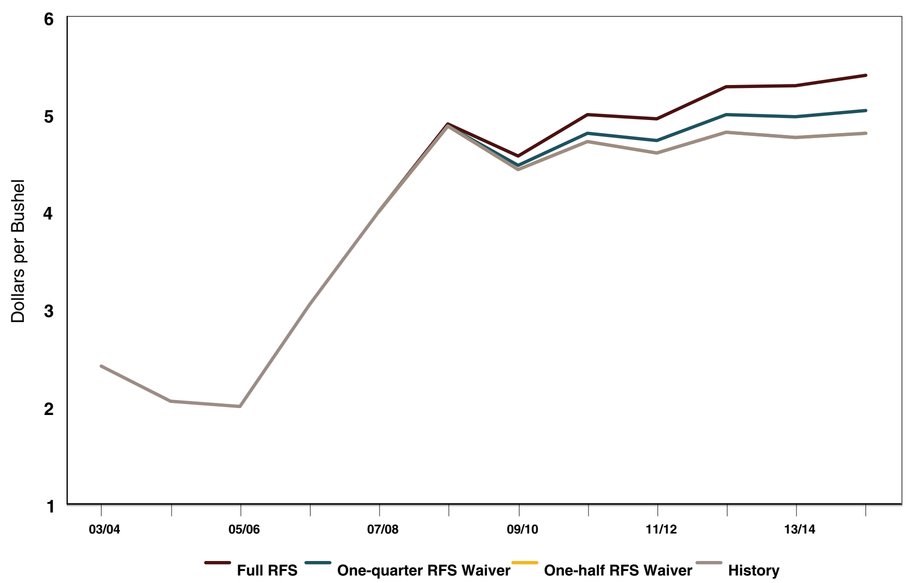


Figure 11.4: Probability of a Binding RFS.

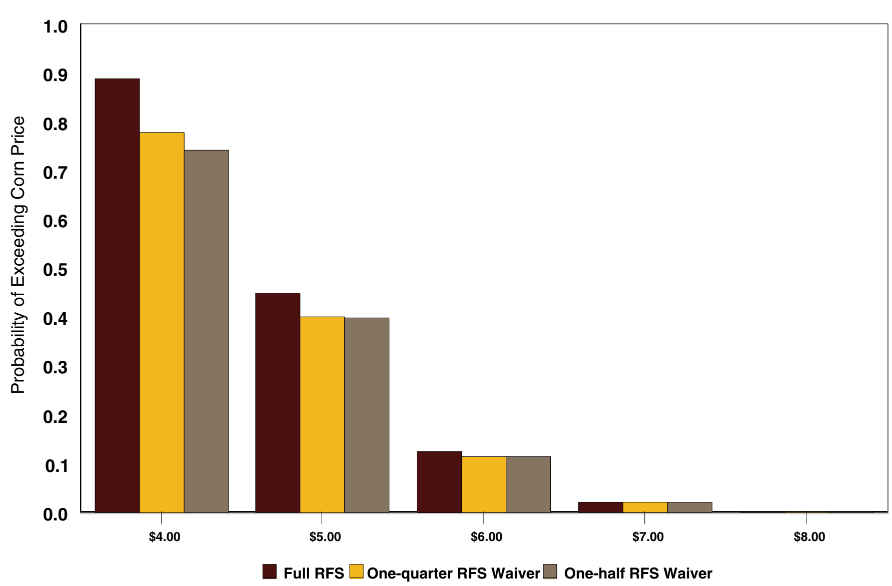


Figure 11.5: Probabilities of Various Corn Prices.

12 References

Agricultural & Food Policy Center. Representative Farms Economic Outlook for the January 2008 FAPRI/AFPC Baseline. AFPC Working Paper 08-1. Texas A&M University, February 2008.

Anderson, D.P. The Interaction Between Renewable Energy Production and the Livestock Industry." Texas Ag Forum. Austin, TX. February 23, 2007.

Anderson, D.P., J.D. Anderson, and J.Sawyer. "Livestock and Dairy: What are They Going to Eat?" *Journal of Agricultural and Applied Economics*. Forthcoming.

Anderson, J.D. and K. Zeuli. 2001. "The Revenue Risk of Value-based Pricing of Fed Cattle: A Simulation of Grid vs. Average Pricing." *International Food and Agribusiness Management Review* 4:275-86.

Anderson, D.P., E. Daley, and J.L. Outlaw. 2007. "The Interaction between Ethanol and Cattle Feeding: Economics and Issues." Paper presented at Biofuels, Food, and Feed Tradeoffs Conference. St. Louis, Missouri: April 12-13.

Brock, Richard. Quoted in "Markets volatile with index funds influence, bio-fuel requirements." *Delta Farm Press*, March 5, 2008.

Bryant, Henry, "Effects of a Variable Ethanol Subsidy or Higher Renewable Fuels Standard on US Agriculture," in *Biofuels, Food, and Feed Tradeoffs*, J. Outlaw, J. Duffield, D. Ernstes (editors), Farm Foundation, Oak Brook, Illinois (2008 forthcoming)

Bryant, Henry L. and Joe L. Outlaw. "US Production and Use of Ethanol Under Alternative Policy Scenarios." AFPC research report 06-1, August 2006.

Cohn, Laura and William C. Symonds. "Striking Gold in Commodities". *Business Week*, October 25, 2004.

Cole, N. A., M.L. Galyean, J. Drouillard, L.W. Greene, F.T. McCollum, P.J. Defoor, and C.R. Richardson. 2006. "Recent Research with Distiller's Grains and Corn Milling Byproducts- Southern Plains." Paper presented at Plains Nutrition Council Spring Conference, San Antonio, TX, 6-7 April.

Doan, Thomas. *RATS User's Guide*, Version 6, Estima: Evanston, Illinois, 2004.

Enders, Walter. *Applied Econometric Time Series*, John Wiley & Sons: New York, New York, 1995.

Environmental Protection Agency. "Regulation of Fuels and Fuel Additives: Renewable Fuel Standard Program," Federal Register, Vol. 72, No. 83 (May 1, 2007), pp. 23900-24014.

Goldman Sachs Group, Inc. "Standard and Poor's to Acquire Goldman Sach's GSCI". Press release, February 6, 2007.

Gorton, G. and K.G. Rouwenhorst. "Facts and Fantasies About Commodity Futures." Financial Analysts Journal. Vol. 62, No. 2, pp. 47-68.

Grete, Brian. *Pro Farmer*, Vol. 36, No. 12, March 22, 2008, page 4.

Hardaker, J.B., R.B.M. Huirne, and J.R. Anderson. 1997. *Coping with Risk in Agriculture*. New York: CAB International.

Henderson, Jason. "What is Driving Food Price Inflation?" *The Main Street Economist*, Federal Reserve Bank of Kansas City, vol. III, issue I, 2008.

Informa. "Analysis of Potential Causes of Consumer Food Price Inflation," Research Report prepared for the Renewable Fuels Foundation, Informa Economics, Memphis, Tennessee, 2007.

Iowa State University Cooperative Extension. "Estimated Returns for Farrowing and Finishing Hogs or Producing Feeder Pigs in Iowa." Various Issues.

Kuhl, G. *Focus on Feedlots*. Various Editions. Data compiled by the Livestock Marketing Information Center.

Lam, Pauline P. "Commodity Investments Help Diversify Portfolios. *Financial Advisor Magazine*, August 2004. Available online at http://www.fa-mag.com/past_issues.php?idArticle=137&idPastIssue=86# (accessed April 9, 2008).

Larson, E.M., R.A. Stock, T.J. Klopfenstein, M.H. Sindt, and R.P. Huffman. 1993. Feeding Value of Wet Distiller's Byproducts for Finishing Ruminants. *Journal of Animal Science* 71:2228-2236.

Livestock Marketing Information Center. Cattle Feeding Returns. 2008.

Naylor, T.H., J.L. Balintfy, D.S. Burdick, and K. Chu. 1966. *Computer Simulation Techniques*. New York: John Wiley and Sons, Inc.

Nerlove, Marc; David M. Grether; Jose L. Carvalho.: Analysis of Economic Time Series, Academic Press: New York, New York, 1979.

Paul, Catherine J. and James M. MacDonald. "Tracing the Effects of Agricultural Commodity Prices and Food Costs," American Journal of Agricultural Economics, 85 (2003):633-646.

Renewable Fuels Association. 2008. "Industry Statistics." Available at www.ethanol.org/industry/statistics, Accessed 1 April 2008.

Sims, Chris (1980): "Macroeconomics and Reality," *Econometrica*, 48(1980):1-49.

Texas AgriLife Extension Service. "Texas Crop and Livestock Budgets." http://agecoext.tamu.edu/resources/crop-livestock-budgets/by-district.html. (accessed March 26, 2008).

Tokgoz, Simla, et al. "Emerging Biofules: Outlook of Effects on U.S. Grain, Oilseed, and Livestock Markets," Staff Report 07-SR 101, Center for Agricultural and Rural Development, Iowa State University: Ames, Iowa, 2007.

U.S. Department of Agriculture, Agricultural Marketing Service. www.usda.ams. (accessed December 1, 2007).

U.S. Department of Agriculture – Economic Research Service. "U.S. Fertilizer Use and Price." http://www.ers.usda.gov/Data/FertilizerUse/Tables/Table7.xls. (accessed March 28, 2008).

U.S. Department of Agriculture – Economic Research Service. "Agricultural Outlook: Statistical Indicators." http://www.ers.usda.gov/Publications/AgOutlook/AOTables/. (accessed March 28, 2008).

U.S. Department of Agriculture – National Agricultural Statistics Service. "USDA-NASS Quick Stats: Monthly Indexes of Prices Paid (1990-1992)." http://www.nass.usda.gov/QuickStats/. (accessed April 7, 2008).

U.S. Department of Agriculture. 2008. "Food CPI, Prices, and Expenditures: CPI for Food Forecasts", ERS, Food CPI, Prices and Expenditures Briefing Room. Available at http://www.ers.usda.gov/Briefing/CPIFoodAndExpenditures/Data/cpiforecasts.htm. Accessed 27 March 2008.

U.S. Department of Energy, Energy Information Administration. http://www.eia.doe.gov. (accessed April 7, 2008).

U.S. Department of Energy – Energy Information Administration. "U.S. On-Highway Diesel Prices."http://tonto.eia.doe.gov/oog/ftparea/wogirs/xls/psw18vwall.xls. (accessed March 28, 2008).

U.S. Department of Labor – Bureau of Labor Statistics. "Consumer Price Index." http://www.bls.gov/cpi/. (accessed March 18, 2008).

U.S. Department of Labor – Bureau of Labor Statistics. "Current Employment Statistics." http://www.bls.gov/cpi/. (accessed March 27, 2008).

Urbanchuck, John M. "The Relative Impact of Corn and Energy Prices in the Grocery Aisle," Research Report, LECG L.L.C.: Emeryville, California, 2007.

Vander Griend, D. 2006. "The Impact of the Fuel Ethanol Industry on Rural America." Paper presented at the Farm Foundation Round Table meeting titled, Energy from Agriculture – Exploring the Future. Wichita, Kansas, June 16.

van Essen, Emil. "Profiting from Spread Trading", January 5, 2007. Available on line at http://partners.futuresource.com/fbp/2007/0105.htm (accessed March 24, 2008).

A policy research report presents the final results of a research project undertaken by AFPC faculty. At least a portion of the contents of this report may have been published previously as an AFPC issue paper or working paper. Since issue and working papers are preliminary reports, the final results contained in a research paper may differ - but, hopefully, in only marginal terms. Research reports are viewed by faculty of AFPC and the Department of Agricultural Economics, Texas A&M University. AFPC welcomes comments and discussions of these results and their implications. Address such comments to the author(s) at:

Agricultural and Food Policy Center
Department of Agricultural Economics
Texas A&M University
College Station, Texas 77843-2124

or call (979) 845-5913.

Copies of this publication have been deposited with the Texas State Library in compliance with the State Depository Law.

Mention of a trademark or a proprietary product does not constitute a guarantee or a warranty of the product by Texas AgriLife Research or Texas AgriLife Extension Service and does not imply its approval to the exclusion of other products that also may be suitable.

All programs and information of Texas AgriLife Research or Texas AgriLife Extension Service are available to everyone without regard to race, color, religion, sex, age, handicap, or national origin.