Distillers Grain Prices: Spatial Relationships, Arbitrage Opportunities & Risk Management

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Executive Summary

Distillers grain (DG) production in the US has increased from less than 5 million metric tons at the start of the decade to more than 20 million metric tons in 2008. This rapidly expanding market has increased the need to better understand price relationships, determine how price discovery occurs, and to assess price risk management alternatives. This fact sheet was completed to address these specific issues. Results reveal:

1. Price and related fundamental information on distillers grain markets are sparse relative to feed grains. As such, evaluating price offers and bids is often done without a lot of market information which can contribute to variation across transaction prices.

2. Dry (10% moisture), modified wet (50-55% moisture), and wet (65-70% moisture) distillers grain prices vary relative to each other. For example, dry DG in Nebraska has been priced at from a $10/ton dry matter discount to a $30/ton dry matter premium to wet DG over the past 18 months. Similar price differences are seen in other locations. The different moisture DG product markets are segmented. Significant value exists to compare dry, modified wet, and wet prices on a dry-matter basis for buyers who can substitute across these product forms.

3. Spatially separated dry DG markets do not have strong price relationships. Prices tend to follow similar patterns across location, but they diverge from each other at times as well. Analysis of prices across different markets suggests buyers could gain by shopping around for DG across different locations at any point in time. The DG market appears to have limited geographic price information flowing.

4. Dried distillers grain does not appear to be able to be effectively cross hedged using traditional corn or soybean meal futures markets. Basis and hedge ratio relationship risk has often been more than 30% of the underlying price of DG. As such, currently available futures markets do not appear to offer viable price risk transfer for distillers grain. Development of a DG futures contract appears worth investigating.

Background and Purpose

Distillers grains (DG) are a co-product of grain-based ethanol production. DG production in the US has increased from around 3 million metric tons in 2001 to more than 20 million metric tons in 2008 paralleling the rapid expansion of the ethanol industry. As distillers grain production has increased, DG has become a valuable output of the ethanol industry and an important feed ingredient replacing primarily corn in the livestock industry. Tight margins in ethanol production have elevated the importance of DG in ethanol producer profitability. As such, DG producers are highly interested in distillers grain markets and associated prices. With growing use of DG in the livestock industry, DG buyers have greater need for understanding market conditions and prices. Despite its growing importance, little public information is available regarding DG market fundamentals, making market outlook challenging. In addition, sparse DG price reporting makes monitoring market prices both spatially and temporally difficult. Furthermore, recent volatility of agricultural and energy markets has been reflected in highly variable DG markets.

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The purpose of this fact sheet is to summarize distillers grain market price relationships. In particular, price relationships across DG markets are analyzed over time, prices of wet and dry DG are compared, and assessment is made of how well existing futures markets for corn and soybean meal appear to work as a cross hedge for distillers grains. The information contained in this fact sheet is intended for anyone involved in DG markets.

Distillers Grain Price Sources

The Renewable Fuels Association as of March 2009 lists 193 nameplate refineries in the US producing ethanol. These refineries are located in some 27 states across the nation, with the highest concentration of production located in the corn-belt states of Iowa, Nebraska, Illinois, Minnesota, Wisconsin, and South Dakota. Despite the large number of plants and dispersion of production, only a sparse amount of DG price information is publicly reported. Currently, USDA reports daily distillers grain prices for several moisture levels (dry 10%, modified wet 50-55%, and wet 65-70%) for Iowa, Illinois, Nebraska, and South Dakota. Over the last two years, these price series are generally available, though Nebraska prices are only available since late 2007 and similar problems of non-reported prices are apparent across other locations. In addition, USDA has begun price reporting of weekly prices for dry DG in Chicago; Lawrenceburg, Indiana; Kansas; and Northern Missouri. However, aside from Chicago, these price series generally only go back in time with consistent reports to about early 2008 with numerous non reports prior to that time.

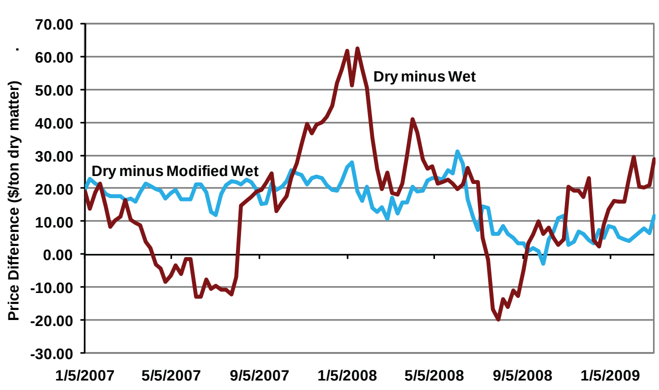
A few local or private sources report DG prices on a weekly basis. For example, University of Missouri Dairy Extension collects prices from selected DG plant locations via weekly telephone surveys and reports these on their web site. Feedstuffs magazine has reported weekly dry DG prices from brokers with several locations primarily in markets quite distant from the core ethanol production areas (e.g. east and west coast market locations). DTN reports weekly DG prices they collect on their private news service for selected locations. With a variety of sources, different collection and reporting methods and price availability, and generally limited time series of data available, analysis of DG prices is a challenge. Certainly DG price information is considerably less readily available than prices for major feed grains.

Dry, Modified Wet & Wet DG Prices

Distillers grains are generally produced in one of three different forms: 1) dry which is 10% moisture, 2) modified dry at 50-55% moisture, and 3) wet at 65-70% moisture. If the dry, modified wet, and wet distillers grain markets are closely linked with each other and efficient, the difference in prices on a dry-matter basis across these product forms, would essentially equal the cost of drying DG. That is, if dry price is greater than modified wet or wet price by more than the cost to dry DG, this would encourage more drying which would tend to reduce the dry price and increase the wet prices bringing the prices back in line with each other. If the dry price is less than the drying costs for modified wet or wet product, firms would reduce the amount of drying they do which would increase the dry and reduce the wet DG prices to realign the market prices. Because drying DG includes added fixed costs (in addition to variable drying costs), we might expect dry DG to be more likely priced at a premium relative to wet, on a dry matter basis, even after adjusting for energy costs to dry. We would certainly not expect to see moisture-adjusted dry DG price to be below wet price in well-integrated markets.

Over the past couple of years USDA has reported dry, modified wet, and wet distillers grain prices for selected locations. Converted to a 100% dry-matter basis, these price series, for the same market locations have shown considerable variation. For example, dry DG prices in Northeast Iowa have ranged from about the same as modified wet DG prices to more than $30/ton dry-matter basis higher over the 2007-March 2009 period (figure 1). Dry relative to wet DG prices have seen

Figure 1. Dry Matter Adjusted Differences in NE Iowa Dry, Modified Wet, and Wet Weekly Average DG Prices, 2007-March 2009



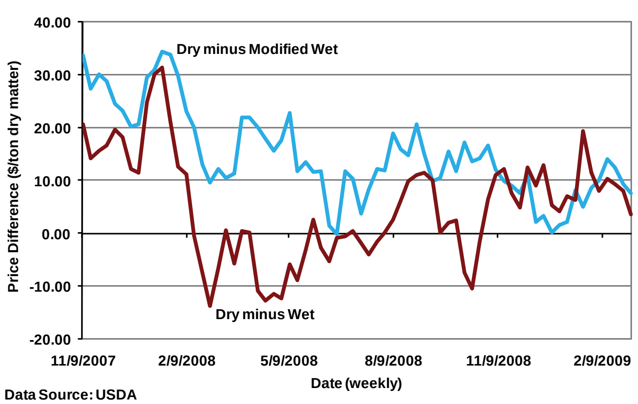
Data Source: USDA

even much greater variation with dry ranging from $20/ton dry-matter basis lower than wet, to about $60/ton dry-matter basis greater than wet DG.

Nebraska prices of dry, modified wet, and wet DG have also exhibited wide variation relative to each other on a dry-matter basis over the past year (figure 2). For example, relative to modified wet, dry DG has ranged from about the same price to more than a $30/ton dry-matter basis price premium. Dry DG has ranged from a $10/ton dry-matter discount to a $30/ton dry-matter premium to wet product in Nebraska. Other locations show similar variation as Iowa and Nebraska in dry, modified dry, and wet DG prices.

The implication of the amount of variation is prices across DG product moisture levels for the same general market location suggests the markets for dry, modified wet, and wet are somewhat segmented. Drying costs undoubtedly changed over the 2007-2009 period as energy prices rapidly increased in 2008 and then substantially declined into early 2009. However, the DG price differences observed are not highly correlated with energy price patterns over time suggesting other forces are contributing to price divergence among dry, modified wet, and wet distillers grain prices. The fact that moisture-adjusted dry DG prices even drop below modified wet or wet at times reveals that across DG product moisture level in the same location these markets are not strongly linked or well integrated. Buyers can gain by comparing dry, modified wet, and wet prices (on a moisture-adjusted level) if these are feasible substitutes. Similarly, ethanol plants appear at times to be losing money when they dry DG and they could gain by closer evaluation of market opportunities for producing alternative product forms.

Figure 2. Dry Matter Adjusted Differences in Dry, Modified Wet, and Wet Weekly Average DG Prices in Nebraska, November 2007 - March 2009



Data Source: USDA

Long Term Spatial DG Price Relationships

Over time, prices for a commodity in a market that is well integrated across location should differ by no more than transportation costs between the markets. Flow of market information should help to ensure markets are spatially linked and that they quickly respond to each other. The concept of integrated markets is best carried out using time series data over several years. This is because, for a variety of reasons, during short time periods market prices at different locations can diverge from other. For example, information flow across market locations is not perfect or instantaneous and it takes time to physically move product across locations as well as secure buyers. Thus, while market prices might diverge from each other for a short period of time, well integrated markets will come back in line with each other after an adjustment time. There are a host of ways to analyze the extent to which commodity markets across location operate in linked markets. One of the more widely used methods is to statistically evaluate the degree of integration in market prices across locations over time. This concept is used here to assess the degree of long term market price relationships across spatially separated DG prices.

Because the concept we are testing is long run in nature, long run time series (several years) of weekly market prices for DG were needed across locations. This is challenging because with the recent expansion of the ethanol industry and its relatively small presence just a few years ago, locating consistent time series data for a variety of DG markets is difficult. We were able to collect from several sources an eight-year weekly time series of DG prices for 12 different market locations. The price series were collected from USDA, University of Missouri Dairy Extension, and Feedstuffs magazine. All DG prices evaluated in these long term series are for dry product form. The market locations for which consistent weekly time series DG price data were available over the eight-year period were 1) Muscatine, IA; 2) Atchison, KS; 3) Macon, MO; 4) Lawrenceburg, IN; 5) Atlanta, GA;, 6) Boston, MA; 7) Buffalo, NY; 8) Chicago, IL; 9) Los Angeles, CA; 10) Minneapolis, MN; 11) Portland, OR; and 12) Okeechobee, FL. Some of these market locations represent the heart of major DG production centers in Iowa, Indiana, Illinois, Missouri, and Minnesota. Other market locations are export market centers such as Portland and Los Angeles.

An illustration of selected locations of weekly DG prices over the 2001-2008 period is provided in figure 3. The price series tend to follow similar overall trends. However, as is apparent at times, the prices across these locations diverge from each other. For example, Muscatine, IA price was lower than Atchison, KS and Macon, MO by about $20/ton in 2001 and was nearly $40/ton higher than the other two markets during several weeks in 2008. Macon and Atchison prices tend to track each other more closely over the time period, though even they have prices that diverge by more than 10% at times. Another graphic summary of weekly DG prices is provided in figure 4 for Chicago, IL, Portland, OR, and Atlanta, GA prices. Chicago price, much like the other prices near ethanol production regions, tends to be lower than DG prices at port locations. Despite the price level differences, the prices across these locations tend to follow similar patterns.

To determine statistically whether the set of 12 markets are linked, as set of pair-wise cointegration tests were conducted on each pair of combinations of the 12 price series. In addition, a multivariate cointergration test using all the 12 markets at once was conducted. Pair-wise cointegration tests provide evidence of the extent to which two markets move together. If two markets are linked, they will be cointegrated which means the price series do not diverge from each other and tend to return to a stable relationship relative to each other. If two markets are not cointegrated, they diverge from each other and do not necessarily systematically return to a stable relationship.

Figure 3. Weekly Dry DG Prices, Muscatine, IA; Atchison, KS; and Macon, MO, 2001-2008

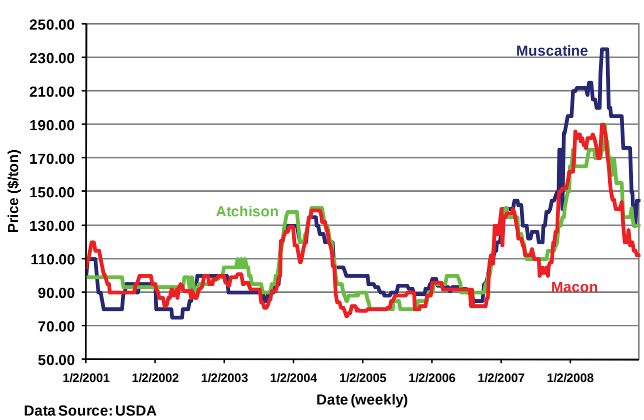
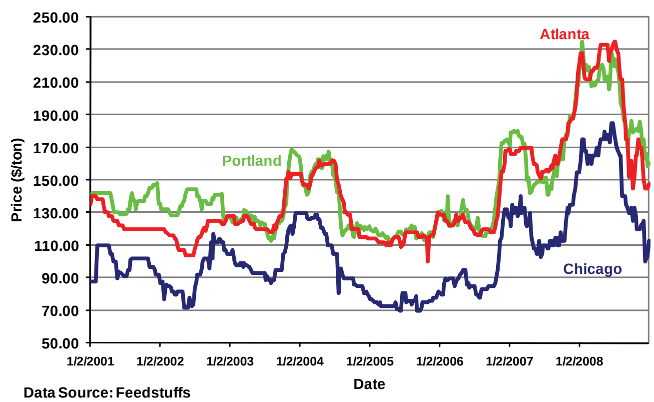


Figure 4. Weekly Average Dry DG Prices, Atlanta, GA, Chicago, IL, and Porland, OR, 2001-2008



The cointegration test results revealed relatively limited cointegration among the 12 spatially separated DG markets. In total of the 66 pair-wise comparisons, only 26 (39%) were cointegrated. Some markets were not cointegrated with any other markets. In particular, Chicago, Muscatine, and Okeechobee markets were not cointegrated with any of the remaining DG markets over the 2001-2008 period. This suggests that these markets are not closely linked with markets in the other locations and that

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prices for DG in these markets are likely discovered somewhat independent of the other locations. Macon, Minneapolis, Lawrenceburg, Boston, Buffalo, and Portland were conitegrated with at least half of the 12 markets. This suggests that these markets tend to be more closely linked with DG markets in other locations. The generally low levels of cointegration across DG markets reveals the need for buyers and sellers to monitor prices at different locations because no one price point tends to be a strong indicator of DG price at other locations. In other words, there is not a single representative national price for DG as price variation across location over time is notable.

DG Price Risk Management

Given the variability over time in DG prices, of interest is ways to reduce price risk. In particular, one way to potentially reduce price risk is through hedging. No DG futures contract currently exists, so one possibility to it cross hedge distillers grains However, to cross hedge effectively, requires first determining whether existing futures markets are viable cross hedging instruments for DG. Given the nature of the DG product and its uses, the most probable markets to consider for cross hedging are corn or soybean meal futures.

First consider corn futures as a potential cross hedge. Figure 5 shows the weekly Macon, MO, dry distillers grain price and the nearby contract corn future price over the 2001-2008 period. The two prices follow similar long run patterns, however, considerable divergence is also apparent.

One particularly interesting pattern in DG and corn futures are revealed in figure 6 where the ratio of DG ($/ton) to corn futures ($/bu) is illustrated. From 2001 to 2008, the ratio of DG price to corn price varies substantially from more than 55 to less than 25. Furthermore, there is a distinct trend over time where DG price relative to corn was much greater prior to 2006 than it has been since that time. Prior to 2006, DG ($/ton) price was generally at least 35 times the corn ($/bu) price. However, since 2006, the ratio is more in the 25-30 range. Nonetheless, even during

Figure 5. Weekly Macon, MO DG and Nearby Corn Futures Prices, 2001-2008

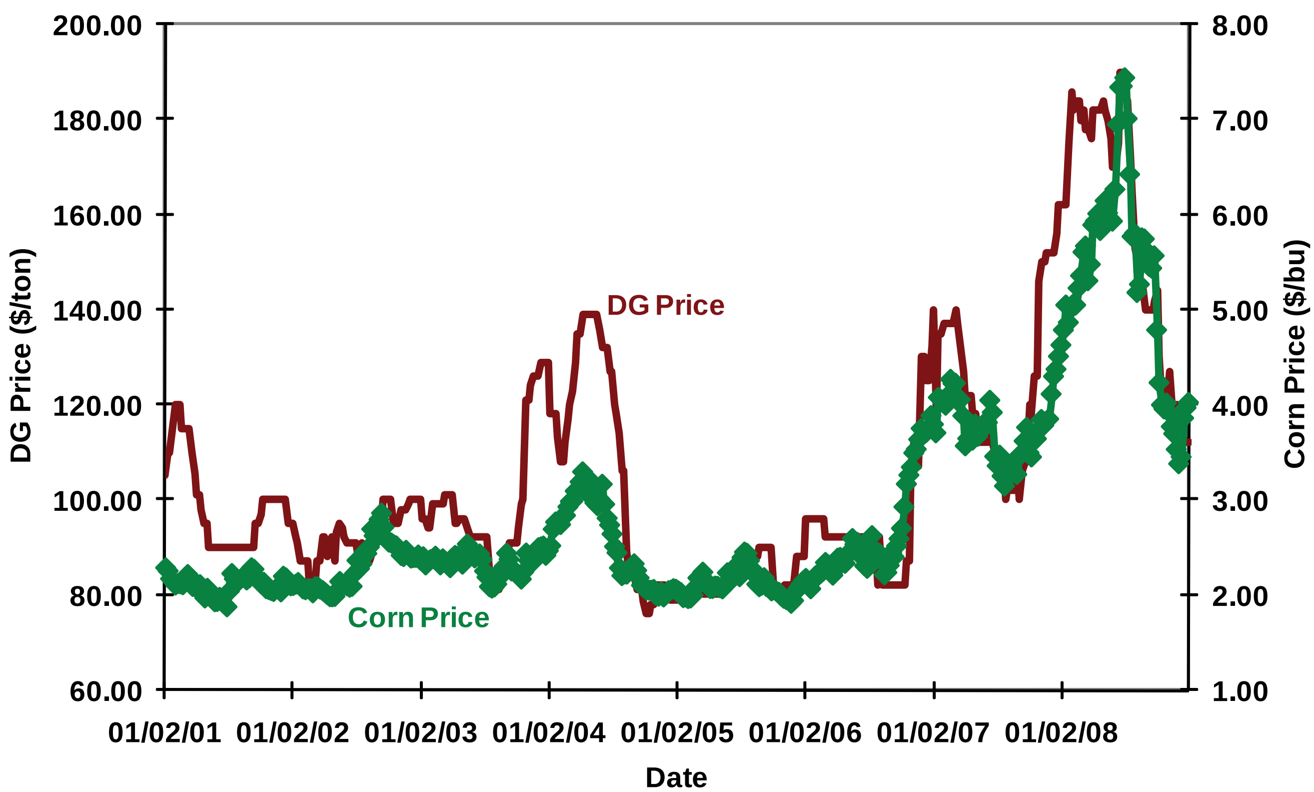


Figure 6. Ratio of Weekly Macon, MO DG and Nearby Corn Futures Prices, 2001-2008

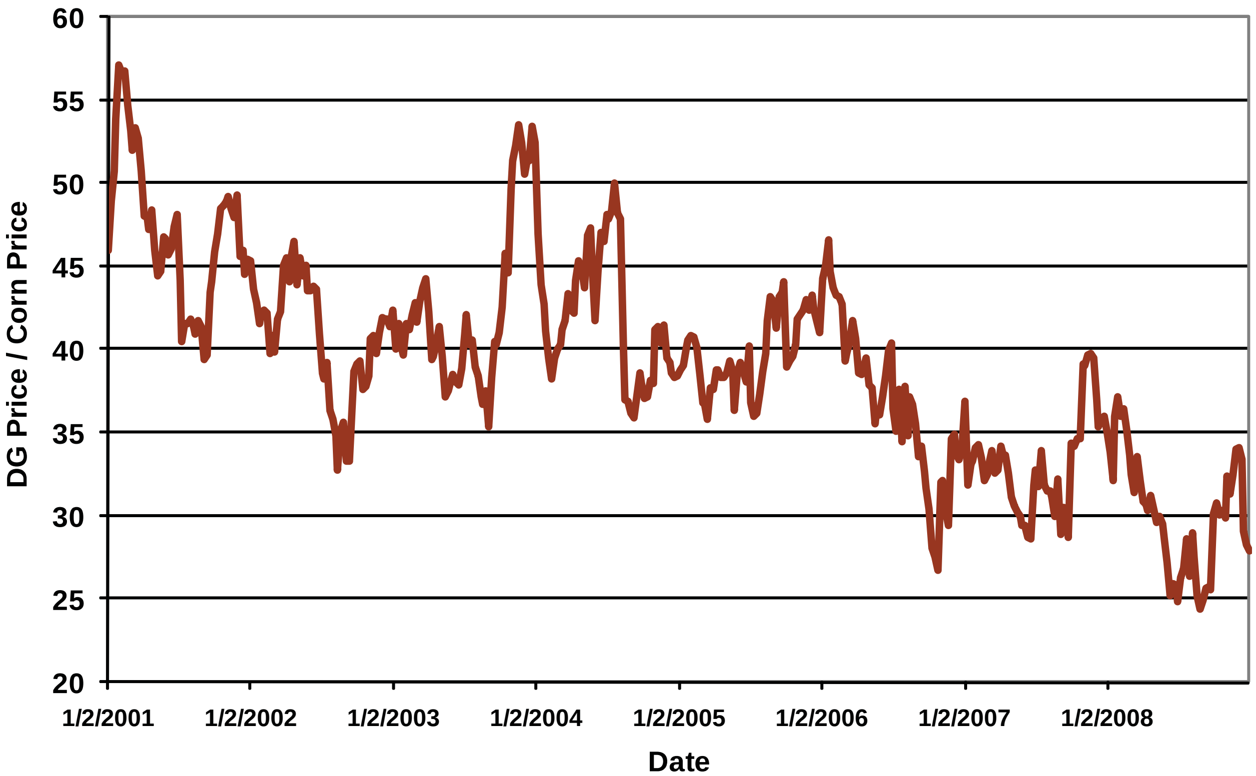
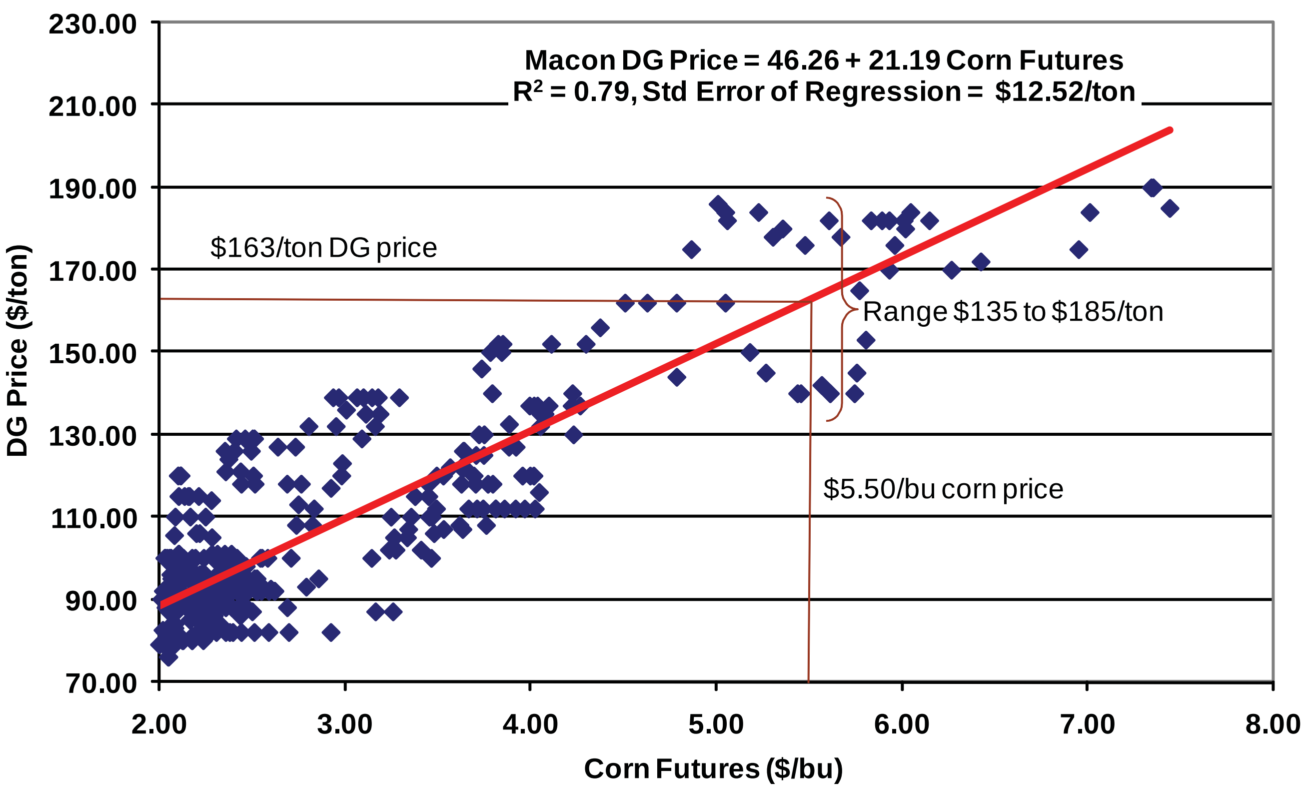


Figure 7. Scatter Plot of Weekly DG Prices, Macon, MO and Nearby Corn Futures, 2001-2008



2008, the ratio ranged from less than 25 to more than 35.

Another way to observe cross hedging potential of DG in corn futures is to observe an x-y scatter plot of the two price series. Figure 7 shows the scatter plot between weekly Macon, MO DG and nearby corn futures prices over the 2001-2008 period. In addition, a regression model fit of regressing DG as a function of corn futures is summarized in the graph. The strong positive correlation between DG and corn prices is evident with an R-squared of 0.79. However, also apparent is the risk associated with cross hedging DG in corn futures. The diamonds scattered around the regression trend line in figure 7 are actual weekly DG and corn price pairings over time. As can be seen, if for example one used the regression equation to cross hedge DG using a hedge ratio of 21.19 with a $5.50 corn price, the expected DG price being hedged would be 46.26 + 21.19($5.50/bu) = $163/ton. However, the historical range of DG prices with an approximate $5.50/bu corn price are from around $135/ton to $185/ton indicating the cross hedging relationship has considerable uncertainty in realized DG price.

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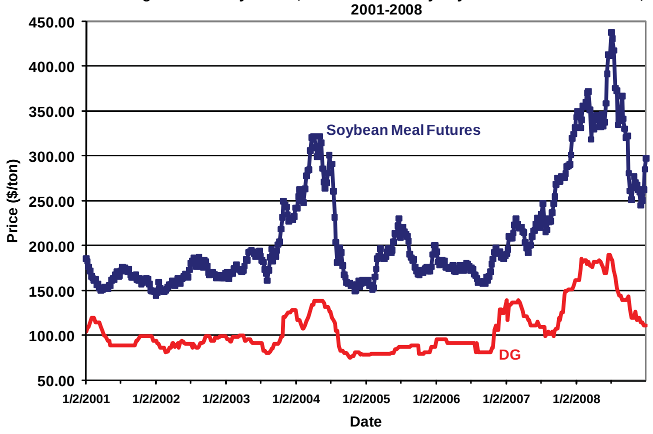
An alternative for cross hedging DG in corn futures is to use soybean meal futures instead. Because distillers grains tend to have higher protein levels than corn, DG may be considered a better substitute for soybean meal than corn in certain uses. The weekly prices of Macon, MO DG and nearby contract soybean futures over the 2001-2008 time period are provided in figure 8. The general price patterns between DG and soybean meal futures are similar over time. However, more detailed comparisons and analysis are needed to evaluate potential for cross hedging.

Figure 8. Weekly Macon, MO DG and Nearby Soybean Meal Futures Prices, 2001-2008



The ratio of Macon, MO weekly DG ($/ton) to nearby soybean meal futures ($/ton) over 2001-2008 is presented in figure 9. The ratio of the DG to soybean meal futures shows wide variation ranging from under 0.40 to more than 0.75. Much of the time the ratio is in the 0.40 to 0.55 range. However, in 2001 and again in 2007, the ratio exceeded 0.70 during some weeks. There is not the same pronounced downward trend in DG relative to soybean meal futures as was apparent with the DG relative to corn futures price though, a gradual downward trend is present.

As with the DG and corn cross hedging analysis, we can also assess cross hedging risk with soybean meal futures using an x-y scatter plot of the DG and soybean meal prices. The weekly Macon, MO dry DG and nearby contract soybean meal futures prices over the 2001-2008 period are plotted in a scatter diagram in figure 10. The strong correlation between DG and soybean meal futures prices is evident with an R-squared of 0.77 regressing DG price on Soybean meal futures. The regression line indicates that DG price = 26.82 + 0.38 Soybean meal futures is the predicted price associated with hedging DG using the 0.38 hedge ratio. However, as shown in the scatter plot, with a $350/ton soybean futures price, the historical price range on DG has been from about $140/ton to $185/ton indicating there remains quite a bit of price risk (basis and hedge ratio variation) if DG were cross hedged using soybean meal futures.

Figure 9. Ratio of Weekly Macon, MO DG and Nearby Soybean Meal Futures Prices, 2001-2008

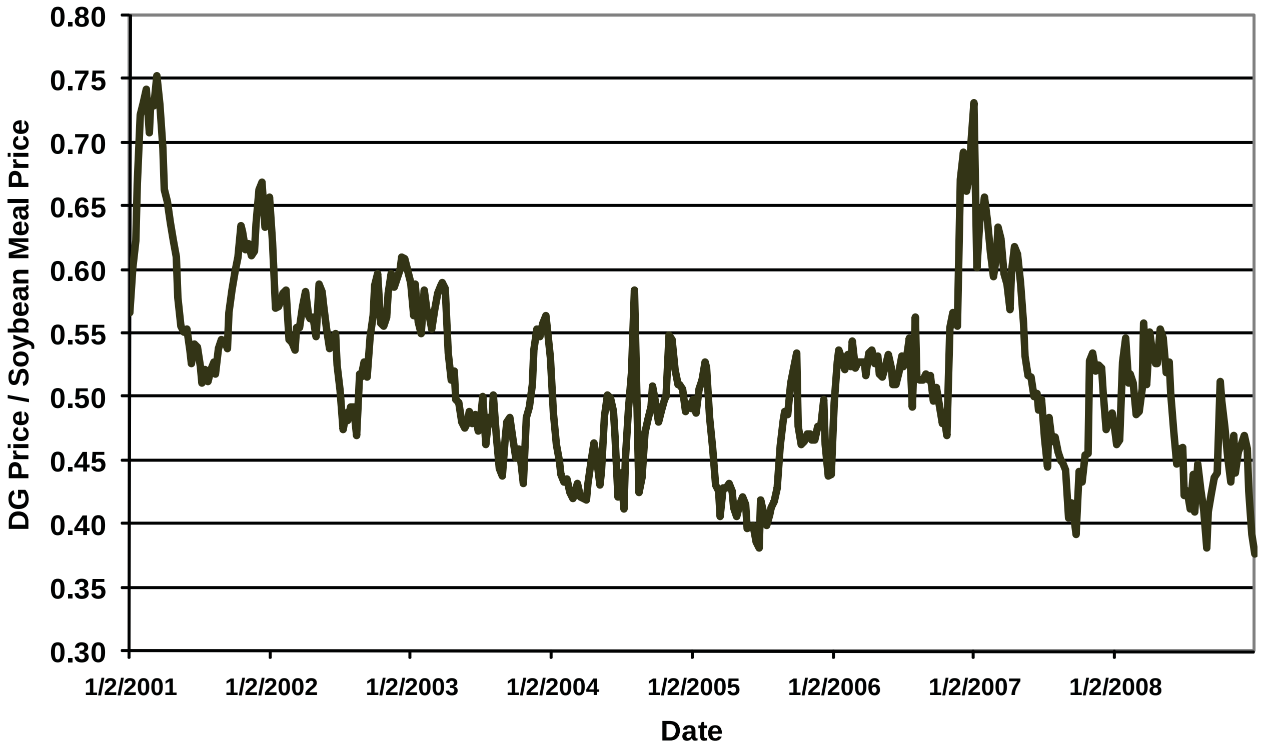


Figure 10. Scatter Plot of Weekly Macon, MO DG Prices and Nearby Soybean Meal Futures, 2001-2008