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October Monthly Average Corn Price Analysis

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OCTOBER MONTHLY AVERAGE CORN PRICE ANALYSIS

by

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A Research Paper
Submitted in Partial Fulfillment of the Requirements for the
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The objective of this study was to analyze the effect of the percent change in U.S. corn ending stocks and the world feed grain ending stocks had on the percent change of October monthly average corn prices. The research used a regression model with corn prices as the dependent variable and U.S. corn ending stocks and world feed grains ending stocks as the independent variables. The model showed U.S. corn ending stocks to have the larger effect on corn price variation, and the two variables combined to account for roughly 49% of the variation in the dependent variable. This research builds on prior knowledge of corn price movement highlighting that U.S. corn ending stocks plays a large role. Producers, analysts, and traders alike can all use this information to further their understanding of corn price variation as well as improve marketing strategies.

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CHAPTER 1

INTRODUCTION

United States number two yellow corn first began trading on the Chicago Board of Trade in 1852. Since that date, finding the true market value for corn has become the objective of marketers, producers, fund managers, and others. For finding this market value several models have been examined and tested using corn futures prices as a function of a number of independent variables. Prior research in the area used models that had independent variables such as basis values, cost insurance and freight (CIF) rates, other transportation rates, ending stocks, exports, ethanol grind, production, and many others in an attempt to help explain the price change in corn futures. The purpose of this paper is to add to the previous research findings and help further explain what causes the variation in corn prices and how much of the variation is accounted for by the independent variables. This paper will examine the October monthly price averages as a function of U.S. corn ending stocks and world feed grain ending stocks, all as a percent change. This research approach will build off previous research that has used these variables in different forms or have used corn prices as a function of other independent variables. The approach will look to see the variation accounted for by these two variables, the overall slope of the regression line caused by these variables, look at the elasticity of the independent variables, and examine other explanatory factors such mean, standard deviation, and statistical significance that are associated with the independent variables. The research then can add to the existing data and research already done while also contribute to a better understanding of the factors that account for corn price variation. Producers will be able to use this information in helping with their marketing plans and strategies. Other marketers can use the data in an attempt to have better risk management practices as well as improve their own marketing plans. Fund

managers can analyze the data to help find market signals in when to take certain positions for their portfolios as well as, they can use it to contribute to their own risk management practices. This research will contribute to the market knowledge that people have about corn prices and will hopefully be able to explain part of the variation of corn prices and reasons for its movement.

CHAPTER 2

REVIEW OF LITERATURE

Research regarding the change in corn prices has been covered extensively using a wide range of variables to have the best understanding of the movement. As price movement in corn affects a large portion of the agriculture industry, being able to explain and predict its movement has become an important aspect for producers, marketers, managers, and other market participants. Understanding the research already done over the topic and building off that are key steps that need to be taken to grow the knowledge of corn price movements and the reasons for the movements.

Good and Irwin (2014), did research to measure the error of the ending stocks forecast from each WASDE report released in the crops marketing year along with the 4 quarterly ending stocks reports released by the USDA. The data consisted of the ending stocks reports from the 1990-1991 marketing year through 2012-2013 marketing years. The marketing year for corn is defined as being from September of the year through August of the following calendar year. The USDA issues the first WASDE forecast of the marketing year ending stocks in May before harvest and our updated monthly until September of the year after that harvest with the official estimate being contained in the USDA Grain Stocks report. Through the research the authors found that the first forecasts have the highest error rates and the error rate slowly decreases with each monthly report. The research also addressed if the forecasts were biased or not. In the research conducted in the time frame 15 of the 17 reports for a marketing year show a tendency of an under estimation, while the other two reports had a tendency of over-estimation. Though from looking at those numbers one could conclude that there is bias, the research found that bias calculations are not statistically different from zero because the bias is so small in both

directions. The authors also comment on how there is a clear tendency for the USDA to "smooth" the changes in projections of year ending stocks later in the forecast cycle. The findings of this article can be summarized that the WASDE ending stocks projections for U.S. corn across the forecasting cycle are basically unbiased, having only a slight tendency towards under-estimation of final ending stocks but the bias there is not statistically significant. The next key finding is that the first ending stocks for U.S. corn, released in May before harvest, has the largest range of errors of all reports. The final finding of the research was the clear tendency for the USDA to "smooth" the changes in projections of ending stocks in later forecasts during the marketing year and forecast cycle. This falls in line with what would be assumed that as the forecast and marketing year progress the estimates for ending stocks should be losing the error and becoming more exact and accurate. This article helps elaborate on the data used in this paper's research outlining how the reports are done along with their parameters, errors, effects. This is important in understanding that as the reports near the end of the crop/marketing year their forecast becomes more accurate, and these numbers are what are used in this papers data set.

Garcia's and Good's (1983), research attempted to explain some of that factors that corn producers should consider in the marketing strategies when it comes to pricing basis values. The research used several explanatory variables including but not limited to future spreads, carry charges, storage charges, CIF values, ending stocks numbers and many more to help explain the basis value. The data was categorized in "Cost Factors", "Flow Factors", and "Stock Factors". The research used a regression analysis with basis of a crop year, region, and cents per bushel as the dependent variables with the "Factors" as the independent variables. The findings of the paper were that basis values for Illinois were systematic following the three explanatory

variables. Basis became less dependent Cost and Stock Factors during harvest periods and was mainly explained by Flow Factors such as transportation. During post and pre harvest times the basis was then more reliant on the Cost and Stocks Factors such as storage rates, total supply, interest, and others. Overall, the research found that when looking at the elasticity of the factors that the Flow Factors had the greatest impact on basis values in Illinois. Farmer movement, local elevator storage capacity and movement, as well as farmer sales had the greatest impact on the movement of basis. This research using similar approach as this paper does using corn basis as function of the various dependent variables. Both use ending stocks as an explanatory variable, showing that research has been looking to identify the affect ending stocks has on corn prices for years now.

Anderson and Borsen (2007), conducted research to determine the validity of using basis and future values as a signal to the producer to store grain or not. The research used two different time frames, one from 1975-1989 and the other from 1990-2005, to measure Oklahoma wheat. Oklahoma monthly average cash wheat prices, monthly Kansas City Board of Trade December wheat cash prices, the storage rates charged by elevators, and interest were all used to help calculate and determine the results. The research used four different procedures on both time frames and their variables to draw their conclusions. According to the research, the results show that basis and not futures price is a more consistent market signal for wheat producers to use when deciding to store or sell their wheat at harvest. The research then answers that there are signals producers can use to decide whether to store or sell, and that signal is basis. The study showed that future price volatility often was high and therefore futures price often moved too much to be an accurate signal on whether to store or sell. When looking at gross revenue using a future hedged position, the basis had more consistent and predictable returns than trying to

predict returns with future prices. This should be the case as basis values are much more predictable than future values as well as not caring as much volatility as future values. Basis is the most important market signal for wheat producers to use when deciding whether to store or sell at harvest. Though this research uses wheat, one can assume that this would be correlated to corn prices and that futures prices in corn would have more volatility than basis prices. This shows the importance of understanding the causes and factors for corn price movements more market participants and their ability to achieve highest prices and max returns.

Lehecka (2013), investigated the price reactions of corn and soybean futures market to crop progress and conditions information released by the USDA from 1986-2012. For the author's study, he chose to measure the variability of price returns around the release of reports and see if they were significantly greater than the variability on days without report release. The authors used the December corn contract and the November bean contract because the crop progress and conditions would have the greatest effect on new crop prices. The research omitted returns on close to open prices over the weekend, as these returns can experience market pressure such as hedge pressure and position for end of the week and could be biased on returns. The research also assumed the market was semi-strong form efficient, using Fama's Market Efficiency Hypothesis, meaning that the only data that would cause market movement is unanticipated or private information. Three key finding were identified by the author. First, the variance on crop progress report days is significantly greater than pre- and post-report day variance for both corn and soybeans. Second, only crop progress reports containing both progress and conditions information lead to large effects in variance implying crop condition information has the major impact on future markets. Thirdly, results of the market impact analysis suggest that prices react quickly and indicate direction to changes in the crop condition

information. This research suggests that USDA's crop progress and condition reports have substantial unanticipated information. Like this research, this paper will analyze the effect of ending stocks numbers on December futures in the month of October as it will show the price movement in new crop corn.

Blue et. al. (1998), analyzed the risk that these Hedge-to-Arrive (HTA) contracts carry for farmers and local merchandisers at elevators in the years from 1948-1997. The study was conducted to address the popularity of these contracts and some merchants had modified these contracts to allow for the HTA to be rolled into a later contract month. Using soybeans contracts the study analyzed the risks of spreads inverting and therefore the risk that farmers and these merchants carried. Using an HTA contract one can lock in the desired futures price and therefore have their risk be limited to the basis movement. By allowing one to roll their contract forward this opened the risk of spreads inverting, and steep losses can happen. In a HTA contract you would have a limited upside as the spread between contract months cannot exceed the full cost of carry, but when the spreads invert there is "no practicable limit" to the inversion. To analyze this risk the study characterized the spread risk in soybeans when the current futures price exceeds the "normal price level". The normal price level was defined as "the most recent fiver year moving average of the July (May) futures price for the July-November (May-November) analysis". The data found over this time horizon that the probability of old crop-new crop spreads being in the plus/minus 10% of the normal price level, was approximately 75 percent and the probability of negative spreads exceeding 10 percent was only 25 percent. This shows that HTA contracts are effective risk management tools that still carry risk but carry the risk in short crop and inventories years. The HTA research shows the importance of managing risk and a key component of risk management is to be able to identify price movement in the market and reason

for the movement, which is the goal of this papers research.

Kenyon and Cooper (1980), did research that used December future prices during the growing season as a function of estimated ending stocks and estimated production that incorporated the estimated December futures price into pricing strategies for producers. The research was composed of 9 different pricing strategies that ranged from hedging practices, to identifying target prices to make sales, using moving averages, and trend lines. The research found that all these strategies reduced price variability in December futures as they all ended with a smaller standard deviation compared to a strategy of doing nothing and making random cash sales. The data found that out of the 9 strategies that technical strategy that used a 10-day moving average to identify target prices had the highest mean prices and lowest variability when compared to the other strategies. The authors also noted that the strategies that used technical approaches opposed to fundamentals approaches had higher average prices and lower variability. The authors concluded that in the short run, technical indicators have more merit than fundamental models when discerning changes in price direction. The research in this paper looks to build on the research of Kenyon and Cooper and elaborate further on the effects that ending stocks have on the corn futures prices. Using similar data for the dependent variable of corn prices and using ending stocks as an explanatory variable the understanding of their effect should be broadened.

Good and Irwin (2015), conducted to explain the relationship of average corn prices for the marketing year as a function of the stocks to use ratio on the WASDE balance sheet. This created a curvilinear model, that is the curve becomes steeper and steeper as the stocks-to-use ratio declines, and vice versa. This is to be expected as if the stocks to use ratio declines that means either ending stocks are declining or that demand is increasing, either way both of those

factors will translate into an increase in prices. The research was split into two eras, 1990-91 through 2005-06 and 2007-08 through 2014-15. This split allowed for further observations as they found the latter era accounted for 86% of total variation in the average corn prices for the marketing year. They also found the regression curve to be much steeper in the latter era than in the first which they contribute largely to the boom in ethanol production in 07-08 marketing year that lowered the ending stocks number greatly compared to earlier years. This increase in ethanol production has made a large impact on the balance sheet and the ability to keep ending corn stocks number lower. Ethanol production has become an important factor of the corn balance sheet as during periods of increased production in can increase demand and lower ending stocks by wide margins. Ethanol production can account for a large portion of variation in ending stocks and ultimately in corn prices. The research of this paper uses ending stocks as an explanatory variable for corn prices, so the importance of understanding how ethanol effects ending stocks is important to this research.

Westcott, Hull, and Green (1985), estimated a model relating quarterly corn prices to quarterly corn stocks for 1971-1981. This model is similar to the model used in this paper's research as both use a variation of ending corn stocks as an explanatory variable of corn prices. The authors used the nearest futures month contract price variation, relative to the quarterly stocks report as the dependent variable. The quarterly stocks report was the explanatory variable in this model, as the authors look to see how much this report accounts for variation in the price corn on the day of the release. The authors finding were consistent with expectations that higher ending stocks values in any specific circumstances lead lower corn prices. The authors also found, "Preharvest information on the new crop affects prices in the June-September quarter. The relationships estimated here enables analysts to forecast corn prices and to respond to other

situations and outlook questions" (pg. 1). These findings should be used with caution as with today's technological advancements and knowledge of the market lower ending stocks numbers may not always cause higher prices in the short run. This knowledge from the reports may already be priced into the market and if the report differs largely from estimates it could actually lower prices in the short run. With that in the long run span this should generally hold true that lower ending stocks leads to higher corn prices. This research paper will continue to build on past knowledge of how ending stocks numbers affect corn prices in both the long and short run situations.

Baldi et. al. (2011), investigates the long run relationship between spot and futures prices for corn and soybeans, during the time period January 2004 through September 2010. The authors main study was the causality relationships between spot and futures prices within each of sub-periods that they identified in the research. Understanding that future prices play a role in price discovery of the respected commodity, the research suggest that the level of world agricultural stocks have been lowered to levels unseen in 25 years. Citing increase in demand from China and India, as well as other countries with increasingly "higher standards of living", the demand for energy and therefore ethanol in this case was on the rise. For the time period the authors applied the econometric methodology, allow them to test for multiple structural changes in the cointegrated system between spot liquidity of commodity futures over physical commodities. The authors found that futures market react more quickly to new or unexpected information than the underlying spot market does. However, in times of crisis and particularly in phases of strong price increase, the cash market becomes a more important variable in the price discovery process as local demand may have a larger effect on the underlying commodity. The research showed that futures markets often react to market news the quickest but in times of

large movement the cash market will be just as significant. The findings may be important for producers, commercial operations, and other users in order to better manage price risk, and for traders and their ability to speculate and or arbitrage opportunities. Overall, changes in the supply and demand fundamentals are important in explaining the volatility and price movements in the corn and soybean markets, as well as adding insight that relates to the markets at an industry level.

Johnson, Mathew, and Fulton (2016), conducted a study to analyze the substitution for feed grains of Corn, DDGS, and soybean meals as prices for the underlying commodity change. With the boom of ethanol production in the U.S. corn stocks have been allocated towards supplying the ethanol industry, leaving the livestock industry with the task of finding more new feed replacements. DDGS, and other grain replacements emerged quickly, and the purpose of the research down by the authors was to identify the price relationship between corn and their substitute feed grains. As expected, the findings varied across geographic regions certain areas had the larger demand for feed grains as they were the larger livestock sectors. Supply and ability to bring in the various grains was also a significant factor in the relationship of prices between the feed grains. Corn prices were found to have the biggest impact on variation in the other feed grains prices, as well as the geographic location had a large impact on price variation as well. The findings by Johnson, Mathew, and Fulton shows that corn prices largely effect usage of feed grains, which shows the supply of feed grains would influence corn prices in years where corn prices are high. The ability to substitute these feed grains for corn in years of high corn prices will affect ending stocks of both and corn and feed grains. The close relationship that these commodities share helps to explain the relationship their ending stocks numbers have on corn prices.

CHAPTER 3

DATA

The data used in this research consisted as the October monthly average corn price as the dependent variable with U.S. corn ending stocks number and the world feed grain ending stocks number as the independent variables. All variables are used in the form as a percent change from the previous year. The data started in 1975 and ended in 2019 for all variables, so taking into account the loss of one year for the percent change, there is a total of 44 observations used in the data. This data was chosen for several reasons, most importantly being that these variables showed the best results when used in the regression model. Other variables were considered, and in the original model the independent variables were going to be both the United States and world ending stocks numbers for all corn, wheat, and feed grains. When using all six of the original independent variables, multicollinearity problems were suspected and arose in the model, which lead to four of the variables being cut and leaving just U.S. corn ending stocks, and world feed grain ending stocks as the independent variables. The data was used as percent changes as using the percent change from the previous year was a more precise representation of the data and had more meaningful and applicable results.

The dependent variable in the model is the October average monthly corn futures prices. This data is the average closing price of the December futures contract for the month of October as percent change from year over year. The 1976 data point is the percent change from 1975 to 1976 of the forementioned corn price, and the following observations all follow that pattern. The data starts in 1975 and ended in September of 2020, which is why the time horizon for the data is from 1975 to 2019. Previous research has used December corn futures prices as the dependent variable as in the research of Lehecka (2013) and Kenyon and Cooper (1980), but this research

decided to go more precise and use the October monthly averages of the December contract. This was partly to coincide with the last USDA WASDE report for a marketing crop year is released in August, which would be the final number for world ending stocks. This number would have the most impact on October prices for the new crop year. Good and Irwin (2014), found that the August report is the most accurate WASDE report for the marketing year, stating that the first reports have the highest error rates, and the error rate slowly decreases with each monthly report and becomes more accurate to true value of ending stocks near the end of the marketing year.

One of the independent variables used was the U.S. ending corn stocks number as a percent change from the previous year. This variable being an obvious choice to use as one would expect and assume that the United States corn ending stocks would have a large impact on corn prices for the year. The data used in this research was obtained from the USDA Production, Supply, and Distribution (PS&D) website. Several, other researchers have used U.S. corn ending stocks in their data, but over different time horizons and in different ways. Westcott, Hull, and Green (1985), used quarterly ending stocks unlike this research that uses the yearly ending number, and Good and Irwin (2015) used the stocks-to-use number. Both papers identified that the United States corn ending stocks number plays a large role in the determination in the corn price. The corn ending stocks number is a result of the WASDE for the United States, so it includes factors like production from yield and acreage, as well as the demand side from ethanol, exports, and feed usage.

The other independent variable used in this research was the world feed grain ending stocks number as percent change from the previous year. The feed grains variable is a combination of the ending stocks of sorghum, barley, oats, rye, millet, and mixed grains. Like the U.S. corn ending stocks number these numbers were obtained from the USDA Production,

Supply, and Distribution website. To calculate the values the research first found the world ending feed grains stocks number and then subtracted out the United States feed grains stock number. This data seemed appropriate to use in the research as Johnson, Mathew, and Fulton (2016), found that the relationship between corn prices and feed grain usage are closely related. If the relationship of prices ranges out to far then substitutions for one or the other are quickly used. This shows that feed grains supply will have an impact on corn prices and will account for some of the variation in those prices.

CHAPTER 4

METHODS

The method used in this research was used to observe the effects that the independent variables had on the percent change in corn price and explain how much of the variation is accounted for by the independent variables. A multiple regression analysis was used as the method for the data in order to observe the linear relationship of the variables in the model. The model was percent change in the October monthly average corn prices (corn price) as a function of percent change in United States corn ending stocks (U.S. corn ending stocks), and percent change in world feed grain ending stocks (world feed grain ending stocks).

$$\text{Corn price} = \beta_0 + \beta_1(\text{U.S. corn ending stocks}) + \beta_2\ (\text{world feed grain ending stocks}) + e_i$$

Garcia and Good (1983) used a similar model in their research of Illinois corn basis as a function of "cost factors", "flow factors", and "stock factors". Several other researchers have chosen to use regression models when analyzing variables effect on corn prices, which makes this method and model appropriate and accurate to use. The ordinary least squares (OLS) estimator will be used to find the coefficients of the explanatory variables and the intercept of the equation the regression model generates. The goal of the OLS estimator is to minimize the error of the sum of squares which will predict a line of best fit, also known as the regression line, where predicted values are the closet to the actual observations observed in the data set.

Multiple assumptions need to be made when using the OLS estimator in order for the estimation of the regression line to be accurate, unbiased, and significant. The first assumption made is the percent change in corn prices are a linear function of percent change in U.S. corn ending stocks and percent change in world feed grain ending stocks. If this relationship were not linear the estimator would not give accurate results, and the research would need to use some

form of a non-linear equation, such as semi-log or double log model. The next assumption made is the independent variables are random numbers with their own variance, which means that variation in the independent variables will cause variation in the dependent variable. Another assumption of the OLS estimator is that the error term has a mean of zero and is normally distributed, which would then lead to the beta values or coefficients of the independent variables to also be normally distributed. Homoscedasticity and no multicollinearity issues were also assumed after the removal of four of the original data sets mentioned in this paper. With these assumptions the OLS estimator was used as it is unbiased and efficient, producing the line of best fit for the regression model.

Other methods were used in the research in an attempt to further explain the findings in more depth. Based off the findings from the regression model, elasticities were calculated by using the beta or coefficient of the independent variables, multiplied by the quotient of the average of the independent variable divided by the average of the dependent variable.

$$\text{Elasticity of U.S. corn stocks} = \beta_1 * (\bar{X}_1 / \bar{Y})$$

$$\text{Elasticity of world feed grains stocks} = \beta_2 * (\bar{X}_2 / \bar{Y})$$

This standardized the regression coefficients which allowed for them to be analyzed and compared to one another. The regression model also calculated standard error and t-values which will allow for determination of statistical significance of the variables. Hypothesis testing was then conducted using the t-values to determine the statistical significance of the independent variables using degrees of freedom equal to 43 and an alpha level of .05, or confidence level of 95%. Hypothesis testing was also conducted on R^2 using the F-statistic, calculated in the ANOVA table. The degrees of freedom for the numerator are two, while the degrees of freedom for the denominator is 41, an alpha level of .05 is assumed again as well. Each data set of each variable also has the mean, standard deviation, minimum value, and maximum value calculated,

given a full representation of the data sets.

Hypothesis Testing:

1) H_0: $\beta_1 = 0$ H_a : $\beta_1 \neq 0$ df = 43 alpha = 0.05

2) H_0: $\beta_2 = 0$ H_a : $\beta_2 \neq 0$ df = 43 alpha = 0.05

3) H_0 : $R^2 = 0$ H_a: $R^2 \neq 0$ df numerator = 2 df denominator = 41 alpha = 0.05

CHAPTER 5

RESULTS

Running the regression analysis, the output produced the equation of percent change in October average monthly corn prices as a function of percent change of U.S. corn ending stocks and percent change in world feed grain ending stocks as:

Corn price = 0.077 - 0.317(U.S. corn stocks) - 0.0897(world feed grain stocks)

The equation followed the predictions and assumptions that increases in the ending stocks number would lead to decreases in corn prices as supply would be larger than demand in these scenarios. Percent change in October average monthly corn price data set showed to have a mean of 0.032% change and a standard deviation of 0.236. The max change in corn price was 0.582% while the minimum change was 0.00011%, and over the 44 observations it had a range of nearly 1 percent at 0.996%. The intercept of the equation is given as 0.077, showing that with the two independent variables held at zero the percent change in corn price will be equal to 0.077%, reflecting a long-run inflationary trend in nominal prices.

Examining the independent variables more closely, the paper will first examine the percent change in U.S. corn ending stocks coefficient and its statistical significance. The coefficient for percent change in U.S. corn ending stocks was -0.317%, meaning that for a 1% increase in U.S. corn ending stocks, October monthly average corn prices will decrease by 0.317%. This is in line with predictions, because as corn ending stocks increase that means supply is increasing more than demand resulting in a surplus and therefore lower prices in the commodity. Observing the data of 44 observations of U.S. corn ending stocks, the research found it to have a mean of .140% change and a standard deviation of 0.502. The maximum percent change year over year this variable experienced was 1.451%, while the minimum was 0.00339%.

The range over the observations in the data set was 2.177% showing that U.S. corn ending stocks has higher variation than the other two variables. Elasticity was also calculated in order to observe the effect more in depth, and percent change in U.S. corn ending stocks had an elasticity of -1.405. The research also conducted a t-test on the coefficient to determine if it was statistically significant. The parameters were set as:

$$H_0: \beta_1 = 0 \qquad H_a: \beta_1 \neq 0 \qquad df = 43 \quad alpha = 0.05$$

The t-critical value, calculated from the t-table, was equal to 2.017 using a two tailed test, and the t-statistic was equal to 5.599. 5.599 > 2.017, or t-statistic > t-critical value showing that the null hypothesis would be rejected, and the coefficient is statistically significant. This means that we are 95% confident that $\beta_1 \neq 0$ and has an effect on the dependent variable.

The second independent variable, percent change in world feed grain ending stocks, had a coefficient of -0.0897, explaining that a 1% increase in world feed grain ending stocks leads to a 0.0897% decrease in the dependent variable. This follows assumptions as world feed grain ending stocks increases there will be a large supply of substitute feed grains that producers will buy at lower prices than corn, leading to an increase in the supply of corn and as the previous variable explained an increase in the supply of corn leads to a decrease in corn prices. The data set of world feed grains was analyzed and shown to have mean of 0.009% change and a standard deviation of 0.177. The maximum percent change year over year in the data was 0.459% while the minimum 0.0012% change, and the range over the 44 observations was 0.778%. Looking at these numbers world feed grains ending stocks has less variation than U.S. corn ending stocks. Elasticity was also calculated for the variable and it was found as -0.027, again showing that it has less of an effect on the dependent variable than U.S. corn ending stocks. A t-test was then calculated to determine the statistical significance of the coefficient using the parameters of:

$H_0: \beta_2 = 0$ $H_a: \beta_2 \neq 0$ df = 43 alpha = 0.05

The t-critical value was found as 2.017 from the t-table, while the t-statistic was 0.563 from the regression output. 0.563 < 2.017, or t-stat < t-critical value, meaning that the data fails to reject the null hypothesis and is not statistically significant. This means that we are 95% confident that $\beta_2 = 0$ and cannot say that world feed grains ending stocks influences the dependent variable. Even though the data is not statistically significant, one can still draw conclusions about the effect of world feed grain ending stocks on corn prices, but the magnitude of the effect is uncertain.

The R^2 was 0.4931 or 49.31%, which shows that 49.31% of the variation in the percent change in October average monthly corn prices can be attributed to the percent changes in U.S. corn ending stocks and world feed grain ending stocks. This also leaves just over 50% of the variation in corn prices to be determined by factors not included in the model or due to random variation. To test the statistical significance of the R^2 value, an F-test was run under the parameters of:

$H_0: R^2 = 0$ $H_a: R^2 \neq 0$ df numerator = 2 df denominator = 41 alpha = 0.05

The F-Critical value was equal to 3.44, which was pulled for an F-statistics table. The F-statistic, which was pulled from the ANOVA table of the regression output was equal to 19.95. 19.95>3.44, or F-stat > F- critical value, which leads to the rejection of the null hypothesis: H_0: $R^2 = 0$, and that R^2 is statistically significant. This shows that we are 95% confident that R^2 is not equal to zero and that the two independent variables have an effect on the variation of the dependent variable.

The overall results show the percent change in U.S. corn ending stocks has a larger impact on percent change in October average monthly corn prices than percent change in world

feed grain ending stocks. U.S. corn had the larger coefficient and elasticity, while also being statistically significant, assuring that it influences the dependent variable. Though world feed grain ending stocks was not statistically significant, it showed its relationship with the dependent variable and adds to the knowledge of price movement with its own movement. The R^2 being statistically significant confirmed that at least one of the independent variables has an effect on the dependent variable and the data used in this research is statistically significant. The results followed pre-made assumptions and findings of others' research. Anderson and Borsen (2007), found that corn stocks were a key variable in determining the futures price to sell and store at. This research will help analysist and other marketers determine the importance of ending stocks on price variation and be able to use the findings to improve marketing strategies.

CHAPTER 6

SUMMARY AND CONCLUSIONS

The research done in this paper analyzed the percent change in October monthly corn price variation in respect to the variation in percent change of U.S. corn ending stocks and world feed grain ending stocks. The key findings of the research were that U.S. corn ending stocks has the larger impact on corn price variation and when looking at ending stocks number should be the main focus of analysts. World feed grains ending stocks were found to be statistically unsignificant, but the results can still be useful in that as world feed grains supply increases, corn prices should decrease and unless there is a large change in world feed grains supply little attention should be given to it by analysts. These finding can help analysts, producers, and any other traders improve their marketing strategies and risk management practices by understanding that change in U.S. corn stocks is one of the most important factors in the variation of corn prices. This understanding will allow them to better understand risk-reward payoffs before reports are released, as well as be able to give more sound advisement on marketing strategies. Though this research shows corn be a significant factor it had only an R^2 of .4931 meaning that there is another 50% corn price variation accounted for by other potentially random factors. After conducting this research, future research should consider analyzing other components of the WASDE balance sheet. The production of corn in the U.S. should show statistically significant results, as well as U.S. corn exports, ethanol, production, and other factors of the demand portion. This will closely relate to the corn ending stocks numbers used in this research and would help give a better understanding of corn price variation.

BIBLIOGRAPHY

Anderson and B. W. Brorsen. 2007. “Using Basis and Futures Prices as a Barometer in Deciding Whether to Store Grain or Not.” Proceedings of the NCCC-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management. Chicago, IL.

Baldi, Lucia & Peri, Massimo & Vandone, Daniela, 2011. “Spot and Futures prices in Agricultural Commodities: Fundamentals and Speculation" 2011 International European Forum, February 14-18, 2011, Innsbruck-Igls, Austria 122002, International European Forum on System Dynamics and Innovation in Food Networks.

Blue, E. N., Marvin H., S. Lence, and E. D. Baldwin. 1998. “Futures Spread Risk in Soybean Hedge-to-Arrive Contracts.” Proceedings of the NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management. Chicago, IL.

Garcia, P., and D. Good. 1983. “An Analysis of the Factors Influencing the Illinois Corn Basis, 1971-1981.” Proceedings of the NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management. Des Moines, IA.

Good, D., and S. Irwin. “The Relationship between Stocks-to-Use and Corn Prices Revisited.” farmdoc daily (5):65, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, April 9, 2015.

Good, D. And S. Irwin. “Accuracy of USDA Forecasts of Corn Ending Stocks.” *Farmdoc daily* (4):94, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, May 21, 2014.

Johnson, Matthew Fulton, "Regional Dynamic Price Relationships of Distillers Dried Grains in U.S. Feed Markets. " Master's Thesis, University of Tennessee, 2016.

Lehecka, Georg V., 2013. “The Reaction of Corn and Soybean Futures Markets to USDA Crop

Progress and Condition Information," 2013 Annual Meeting, February 2-5, 2013, Orlando, Florida. Southern Agricultural Economics Association.

Selected Fundamental and Technical Pricing Strategies for Corn Author(s): David Kenyon and Craig Cooper Source: North Central Journal of Agricultural Economics, Jul., 1980, Vol. 2, No. 2 (Jul., 1980), pp. 137-144 Published by: Oxford University Press on behalf of Agricultural & Applied Economics

United States Department of Agriculture. Production, Supply, and Distribution Database, 2021.

Westcott, P., D. B. Hull and R. C. Green. "Relationships between Quarterly Corn Prices and Stocks."*Agricultural Economics Research* 37 (1985): 1-7.

FIGURES

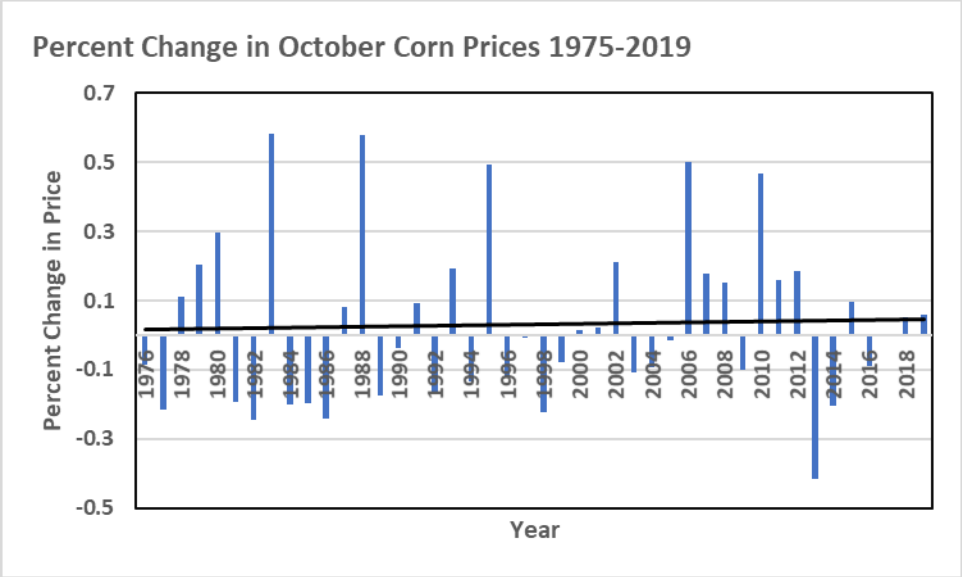

Figure 1: 1975-2019 Percent Change in October Corn Prices

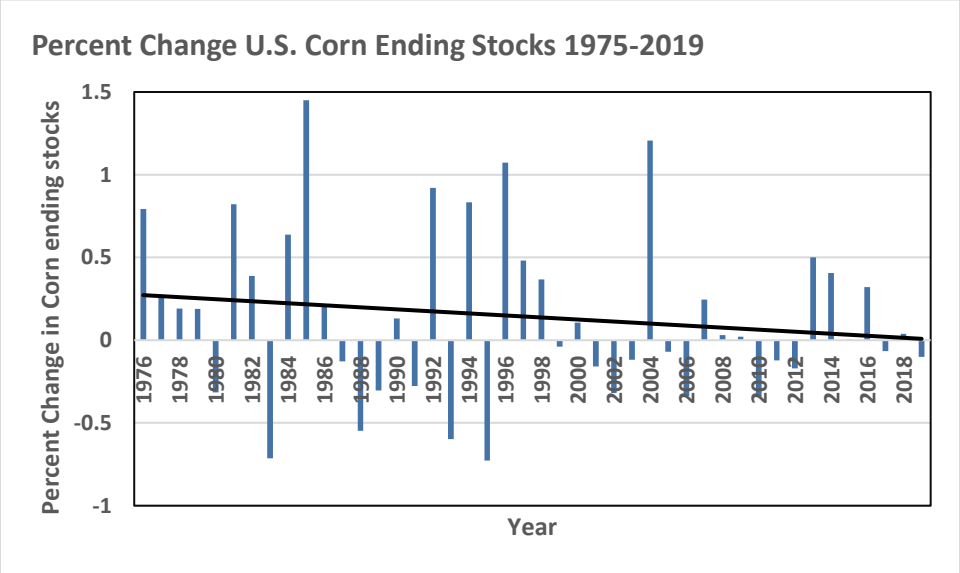

Figure 2: 1975-2019 Percent Change in Corn Ending Stocks

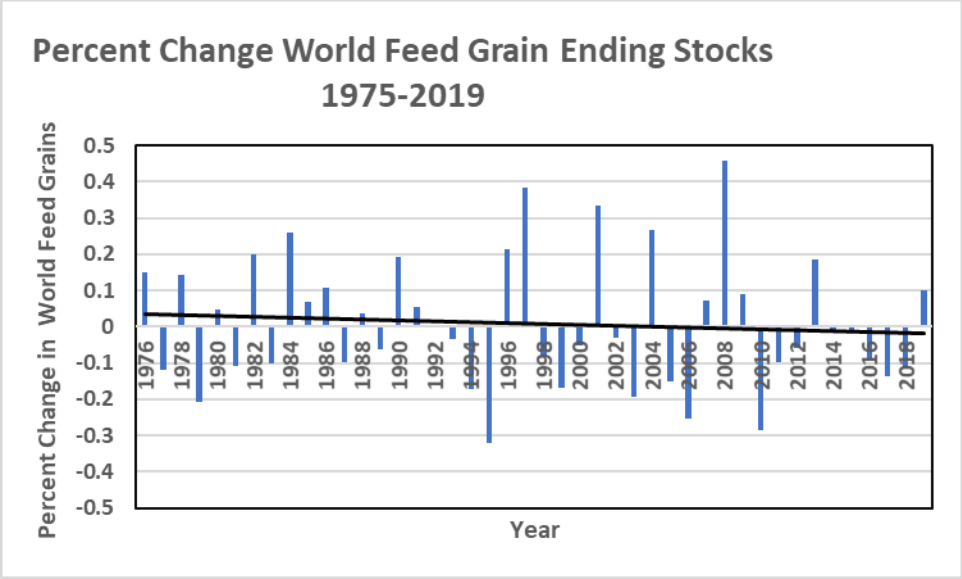

Figure 3: 1975-202 Percent Change in world Feed Grains Ending Stocks

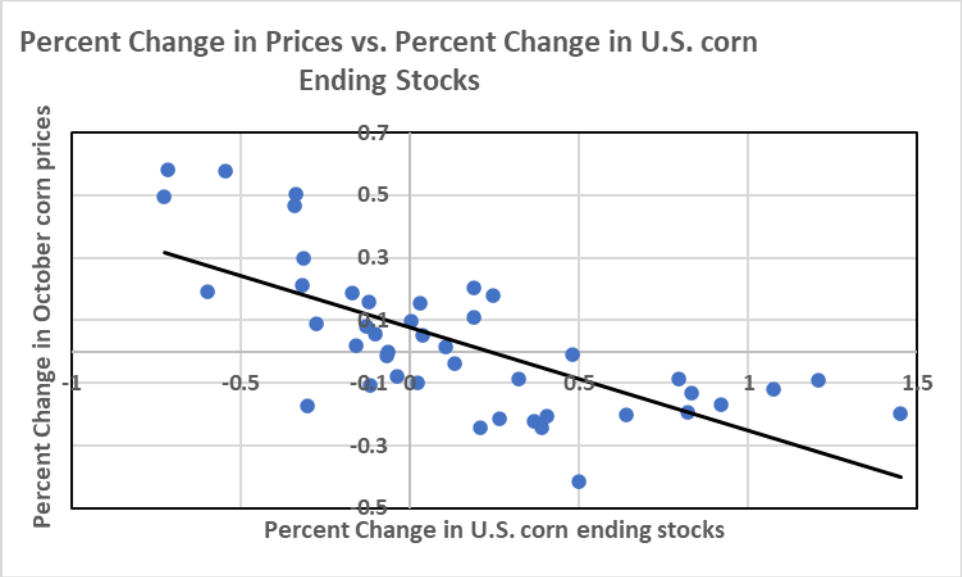

Figure 4: Percent Change in Corn prices vs. Percent Change in U.S. corn ending stocks

TABLE

Table 1: Regression output

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.702243414							
R Square	0.493145813							
Adjusted R Square	0.468421219							
Standard Error	0.172334841							
Observations	44							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	2	1.184738072	0.592369036	19.94555718	8.91461E-07			
Residual	41	1.217671197	0.029699297					
Total	43	2.402409269						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.077082349	0.027044332	2.850221953	0.006807244	0.022465212	0.131699485	0.022465212	0.131699485
US Corn	-0.317327306	0.056675306	-5.599040015	1.60623E-06	-0.431785409	-0.202869204	-0.431785409	-0.202869204
World Feed	-0.089666377	0.159180425	-0.563300275	0.576298366	-0.411137766	0.231805013	-0.411137766	0.231805013

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