ILLINOIS BASIS REGRESSION MODELS

by

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ABSTRACT

The commodity markets have seen a great deal of volatility over the past decade, which, for those involved, has created many challenges and opportunities. Some of those challenges and opportunities are related to the behavior of the basis – the difference between the local cash price of grain and its price in the futures market. This thesis examines factors impacting basis for corn and soybeans at an Illinois River barge terminal, inland grain terminals in central Illinois, and in the Decatur processing market.

Factors used to explain basis behavior include the price level of futures markets, the price spread in the futures market, transportation cost, local demand conditions, and seasonal patterns. Using weekly data on basis from 2000 to 2013, regression models indicate that nearby corn futures, futures spread, inverted market, days until expiration, heating oil futures, and some months are significant drivers of corn basis. For inland terminals and processor regression models nearby corn futures do not appear to have significant effects. Using the same parameters for soybean basis nearby soybean futures, futures spread, inverted market, heating oil and some months are significant drivers but days until expiration do not appear to have a significant effect.

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CHAPTER I: INTRODUCTION

During the past decade U.S. agriculture has experienced a significant amount of volatility in the commodity markets that has resulted in many different challenges and opportunities. Increased price volatility in commodity markets has been addressed in many different ways by producers and merchandisers. Producers have sought more ways to manage the risk associated with both futures prices and basis. Merchandisers have seen the need to offer additional risk management tools for producers and to manage their own risk too. Many offer tools that allow producers to lock in futures prices, use options strategies, lock in basis, and incorporate crop insurance to help mitigate risk for the producer, for multiple years of production, if desired. Both producers and merchandisers share a common interest in basis management and forecasting. As commodity markets have increased in volatility, so too has basis volatility, thereby enhancing the importance of understanding the factors that influence basis levels.

Corn and soybean futures contracts are traded primarily at the Chicago Mercantile Exchange (CME), although the contracts are still designated there as Chicago Board of Trade (CBOT) contracts. Grain futures contracts are standardized with respect to quality grade, delivery time and location, and are traded in 5,000 and 1,000 bushel sizes. Those futures contracts are an important risk management tool for both producers and merchandisers. Price risk with respect to a commodity is managed via the process of hedging, which involves taking a position in futures contracts which is the opposite of the position in the cash (or physical) market. Thus, an owner of a commodity (said to be "long" in the cash market) hedges their price risk by selling (going "short") an equivalent quantity of the commodity in the futures market. Used in this way, a hedge can be viewed as an attempt to lock in a price ahead of time for the future sale or purchase of the physical commodity in the cash market. Producers therefore sell futures contracts to hedge against the risk of a falling price for the future sale of the commodity they are producing. Thus the hedge is a price risk management tool. Merchandisers, via ownership of grain or obligations to purchase grain, may also be exposed to loss from price fluctuation and can use positions in futures contracts to hedge that price risk. For example, when a merchandiser purchases grain from a producer using a cash forward contract the merchandiser is now exposed to the same price risk as was the producer prior to the forward contract being agreed. The forward contract transfers both the ownership of the grain and the associated price risk. In that situation, the merchandiser could hedge the price risk he/she now faces via a short position in futures.

With a futures hedge however, the producer or merchandiser remains exposed to basis risk. Simply defined, basis is the difference between the producer's/merchandiser's cash price for the physical commodity and the futures price. Basis is defined as cash price minus futures price, thus is negative if the cash price is below the futures price. Basis risk refers to the fact that the price differential between the cash market price and the futures price is not constant. That price difference (basis) can fluctuate, and those fluctuations will result in gains or losses for the party using futures contracts as a hedge. For example, a grain producer who has hedged using futures will gain from a strengthening basis (where the cash price rises relative to the futures price) and lose from a weakening basis (where the cash price falls relative to the futures price). Producers may also opt to store grain and simultaneously hedge against a decline in price. In that situation, the producer is dependent on a strengthening basis to provide a profitable return on the stored grain. Grain merchandisers have even greater exposure to basis risk since they are essentially basis traders, typically seeking to profit from selling grain at a basis level that is higher (stronger) than that at which the grain was purchased. The grain merchandiser's ability to manage basis risk is critical to profitability.

Basis levels can be interpreted as reflective of local supply and demand conditions, and as such, basis will vary from location to location. In production areas where grain is in surplus and from which grain is moved out or exported, basis will typically be negative (cash price below futures price), while basis will typically be positive in regions where grain is in high demand relative to supply and to which grain is imported. Within an area, basis level will change depending on the flow of grain in the marketing pipeline. To encourage holders of commodities (e.g. producers) to sell the grain into the marketing pipeline, basis levels may need to increase. At other times when there is surplus grain in the local marketing pipeline, basis level can be expected to decline. Thus, fluctuations in the marketing pipeline throughout the year result in changes in basis levels.

1.1 Objectives

As stated above, grain merchandisers are basis traders and therefore changes in basis levels will have a direct impact on a grain merchandiser's profitability. Basis levels will also, perhaps to a lesser degree, affect profitability for grain producers and end users. Thus, an understanding of factors impacting basis level and influencing changes in basis level may be vitally important to the management of a grain merchandising operation, and may allow them to have a competitive advantage over others in the industry. Understanding basis behavior can also help grain producers and end-users make more profitable marketing decisions.

A number of factors can be viewed as potentially influencing the level of basis and the direction of its movement. Local supply/demand conditions vary somewhat predictably during a crop year with surplus supply to the market typically occurring at or shortly after the harvest period. Thus basis can be expected to display a seasonal pattern. Grain prices, and thus basis levels are influenced by the movement of grain, and thus by the cost of moving grain. It can therefore be expected that changes in the cost of moving grain will influence basis levels. As noted above, producers who opt to store grain are dependent on basis appreciation to provide a return to storage. But the decision to store is typically influenced by the spreads (price differences) between futures contracts for different delivery months (e.g., the difference between the price of March futures and December futures), thus the level of those price spreads may also be expected to have an influence on basis.

This analysis will focus on basis values at barge terminals, inland terminals, and processors in Illinois for both corn and soybeans from 2000 to 2013. The objective is to develop an understanding of basis and the factors that impact its value and direction. The analysis will employ multiple regression models using basis values as the dependent variable and variables representing factors expected to influence basis - nearby futures, spreads, market structure, transportation, and seasonality - as explanatory variables in an effort to develop basis forecasting models for locations in Illinois.

CHAPTER II: LITERATURE REVIEW

2.1 Market Transition

Agriculture commodity markets have continued to develop as globalization continues to occur, along with an increased demand for raw agriculture commodities. Developing an understanding of the increasing sophistication of how the markets fluctuate and interact is important. The importance has spurred a great deal of literature that encompasses cash and futures markets in agricultural commodities. The foundation of the agriculture commodity markets revolve around a cash price that is paid for grain. There have been many key drivers that have increased the volatility, in turn increasing the risk that producers and merchandisers are exposed to. With an increase in technology, there are many individuals and firms that participate in the futures market. In addition, they are also able to actively trade the spreads that help determine the economics for the decision to store grain or not. The supply and demand side of the grain business has also changed in the past decade. New global suppliers have entered the world stage looking to produce for the needs of the world grain pipeline. The pipeline has changed with an increasing population and the increase in bio fuels. This literature review focuses on the many factors that have been researched and those that have had strong implications on basis.

Markets traditionally have been a place where buyers and sellers could meet to determine price for the goods available. Over time, the market has increased in efficiency, which has allowed for price discovery and an increase in liquidity in agricultural commodity markets. The CBOT has been an important part of price discovery and liquidity. Buyers and sellers are able to transfer risk to others by hedging grain using the CBOT. The CBOT offers a specific commodity, quantity, and grade when transferring risk. When a producer chooses to deliver grain to an elevator or processor, a cash price is determined that the farmer is paid on. The basis is the difference between the underlying futures contract and the cash price. The basis is used to accumulate profit and compensate for the cost of handling the grain. Often producers and merchandisers take positions in a grain market in hopes to have a monetary gain in the market. The spreads are the difference between two different contract months on the CBOT in the same commodity. In a carry market, producers and merchandisers are encouraged to store grain. Basis is seasonal which allows for different levels during certain times of year, which is a predictor of supply and demand scenarios.

2.2 Basis Forecasting

In the research process there were many significant articles about basis forecasting for corn, wheat, and soybeans. Taylor, Dhuyvetter, and Kastens (2006) provide a great deal of information on forecasting. The objective of the research was to forecast basis using historical futures and basis averages and that the historical basis can be applied to determine trends in the current market. The data were accumulated from the 1982 to 2005 crop year in six locations within Kansas. The markets used were the Kansas City Board of Trade (KCBOT) for wheat and additionally the CBOT for corn and soybeans. In their research, the increase in the years observed had no benefit in forecasting future basis trends compared to basis in the short term. Research indicated, the errors in the forecasting model in the current study were higher than the original model indicating that forecasting basis could be increasing in unpredictability. With post-harvest basis and harvest basis being analyzed there is significant importance to the time frame. The representation of old crop and new crop market conditions take into account the size of the crop and other relevant market information. It is very logical that there would be a difference in the basis movement from old crop to new crop.

New crop contracting options are available to farmers that seek to manage risk. This was also evaluated for forecasting by Taylor, Dhuyvetter, and Kastens. When analyzing the post-harvest forecasting there was some predictability in forecasting basis improvements in the time frame after harvest. With an increase in the unknown, merchandisers will often assume a risk premium in the market. In addition to the risk premium, the market will also evaluate the current market condition. These conditions might be limited in scope because of the information available about new crop.

Welch, Mkrtchyan, and Power (2009) have estimated a model that has seven variables that impact corn basis within the Texas Triangle Area. These variables all lend themselves to try to determine what impacts basis within a specific geographical location in Texas. Through their research they chose to use seven variables that include: lagged basis, average cash price, average December futures price, ending stocks, transportation, off farm stocks, and a harvest dummy variable. Two of the variables were omitted after finding that they were not statistically significant. Off farm stocks and the harvest dummy variable were dropped from the model.

The seven variables used were logical choices when determining if they would impact basis in Texas. The five final variables used where deemed to have an impact. The basis lag was to determine if the nearby basis was directly correlated to deferred basis. With a direct correlation, the nearby basis would indicate the movement of the deferred basis. In their findings the lag did move with the nearby. To improve upon this, it would be important to find the movements as contracts move to delivery. As contracts move toward delivery the market expectation is that prices will converge.

The average cash price supports the general framework of how a cash price is determined, basis plus futures. As expected December futures would impact the basis and would be indirectly related. With both cash and futures as independent variables it could be assumed that there could be mulitcollinearity. They both would have to be highly correlated to the basis values. Ending stocks are a good representation of previous demand and the current supply of grain to the market. This is a very logical variable to help explain basis.

When marketing grain the additional cost of transportation should impact how producers and merchandisers market grain. Welch, Mkrtchyan, and Power found that as the transportation index increased there was an improvement in the basis level. Their explanation for this was it cost more to transport grain from other regions to Texas. This increase in transportation cost would drive basis improvement because it would be cheaper to source the grain locally compared to the increase in basis due to the need to bring grain into a specific region. The least costs method would be utilized to source grain locally compared to souring grain from other regions.

2.3 Geographic Impacts

There are many opinions on regional implications that basis has across the nation. Manfredo and Sanders (2006) approached the grain movement across the Corn Belt with the addition of Denver as an outlier in corn and soybean production. Their argument for the importance of their research was that markets intersect and challenge each other for grain in multiple regions. They observed basis at export terminals, inland terminals, and river terminals in hopes to find relationships between them to help exemplify basis movements locally. They found that there was a market that led basis higher at different locations and those that do not. Their findings explained that basis is mostly driven locally, but there are externalities that create movements in basis that are not driven locally. Markets that are not directly influenced by Toledo, Gulf, and river locations look toward them in setting their basis market locally. Toledo appears to be an important point of pricing because of the fact that the market can be sold or delivered to.

There are many different ways that Menfredo and Sanders could have suggested an explanation of the demand picture of corn in the United States. From their research, they failed to look at how demand has changed in the past decade for corn and soybeans. Corn exports continue to be limited in the amount of supply they remove from the United States pipeline. Corn used domestically has increased as new demand has developed from an increase in ethanol production. The Gulf, Illinois River terminals, and Toledo were a significant source of basis movement for most locations in the research, but domestic demand could greatly vary from river terminals in Illinois or even an export house. The need for a longer time period of observation could improve the accuracy of the analysis. In the research, they acknowledge the importance of Toledo in the CBOT delivery system prior to 2000. Once a futures contract month goes into delivery, buyers and sellers can be issued physical bushels that must arrive to a specific delivery point designated by the CBOT. This system is a very important pricing mechanism and allows others, to obtain corn supplies if needed. This system could be a reason that the Gulf and river markets continue to see limited pricing implications in other markets.

When answering the question of whether basis was local, the researchers indicate yes. They found that basis is local but takes direction from major commodity markets like the Illinois River. If the merchandiser did not take direction from other locations there could be great opportunities for arbitrage. By taking note of key benchmarking markets the marketer is able to take in the local market conditions to set their basis appropriately. By reflecting upon the current market condition, marketers could be looking into handling cost, transportation cost, or supply and demand.

2.4 Spreads

Research done by Hatchett, Brorsen, and Anderson (2006) alludes to some important ideas that have an impact on forecasting basis. The concept of space - that is storage for stored commodities such as corn or soybeans - has implications on basis and basis movement. In recent years, storage has increased both on the farm and in the grain handling industry. These changes allow grain to be handled at different times of the year creating the opportunity to affect basis, spreads, and futures.

Hatchett, Brorsen, and Anderson also suggest that the common method of using historical moving averages for basis seems to be less reliable for forecasting basis movement. For their research they increased both the length of time and location for gathering information. They discovered that there was no significance to the length of time for a moving average that would be better for forecasting basis comparing a three to five year average. When applied to both corn and soybeans by decreasing the number of years in a moving average the forecasting was more successful when predicating basis.

Spreads in the context of this analysis are the price difference between the same commodity contracts with different future months. Kim and Leuthold (2000) discuss the movement and function of spreads. Spreads can be traded and offer many different opportunities for traders. Kim and Leuthold define corn as a storable commodity that responds to spreads more effectively. Spreads are used to determine the effectiveness of carrying grain throughout the year. Spreads can also be used as a tool to manage basis risk. In a carry market it can often mean basis levels must create more of the incentive to bring grain to the market. In inverted markets basis can operate in different capacities based on local supply and demand. It could continue to keep the cash market inverted or increase to a carry into the cash market.

2.5 Transportation

Transportation cost can be interpreted in many ways. Its impact on basis is important for both producers and merchandisers to understand. As volatility in the energy sector has been significant over time and cannot be excluded from its impact on basis. In the literature review process there were two differing opinions on basis by researchers.

Welch, Mkrtchyan, and Power found that as their transportation index increased basis levels improved as well. Their discussion was based on the idea that it was cheaper to source the grain locally by incremental basis improvements compared to the large improvement needed to bring grain into the region.

Fischer, Isengildina-Massa, Curtis, and Boys (2011) found a different outcome for the cost of transportation. By using heating oil futures they concluded that as heating oil increased in price, basis would weaken. Heating oil is the key pricing component in diesel fuel which is the most common type of fuel used in transporting agricultural commodities.

Welch, Mkrtchyan, and Power’s interpretation of transportation cost provided guide line for this theory compared to Fischer, Isengildina-Massa, Curtis, and Boys. Welch, Mkrtchyan, and Power's theory of basis improvement as transportation cost increased seems logical. To move grain to the area where grain is in demand or the supply locally has been utilized. Their results could have been an indicator of a grain deficit area that had great demand and the need to source more grain. Overall, it provides a great indicator for the theory of adding transportation cost to a forecasting model.

There is an abundant amount of information on basis, spreads, and futures markets for agricultural products. The ability to forecast basis continues to be valuable for producers and merchandisers. By analyzing the market properly it will help create profits and a more efficient market place. The literature work reviewed has been valuable in the process of determining the proper variables that need to be used to help forecast basis. Supply and demand will continue to help the market in price discovery in many regions that were evaluated.

CHAPTER III: DATA

3.1 Basis

Basis information was collected for four separate locations (or geographic regions), for each of which cash price data is available from USDA for both corn and soybeans. For each location a high and low price was available, and these were averaged before calculating the basis. The four regions are Central Illinois elevators, North of Lake Peoria, South of Lake Peoria, and Decatur processors. The data for North and South of Lake Peoria are from river terminals. North of Lake Peoria represents the area from mile marker 161 to mile marker 333 on the Illinois River, while South of Lake Peoria represents from mile marker 0 to 161, also on the Illinois River. Grain typically moves south on the Illinois River to the Mississippi River which ends in the Gulf of Mexico. Ports on the Gulf represent the large export region for agricultural commodities.

Central Illinois elevator basis represents the inland terminals. Those elevators are typically large locations that handle, store, and ship grain in high volumes, and to which producers can bring grain year round and receive a cash price. The elevators ability to be an intermediate part of the supply chain for grain movement throughout the year allows merchandising opportunities. Elevators can ship to export markets that are influenced by the Gulf market[1], to rail markets[2], and to container markets[3]. They may also ship to a local processor, or may facilitate markets in which producers ship grain directly to processors.

[1] Gulf Market is a traded market that is used to export commodities out of the Gulf of Mexico using barges as the mode for transportation.
[2] Rail Market defines the markets that use railroads as the mode of transportation for domestic markets and export markets.
[3] Container Markets use large shipping containers as the mode of transportation to help increase efficiency in transporting goods back overseas.

Figure 3.1 shows the area within Illinois that the basis values were observed for the regression.

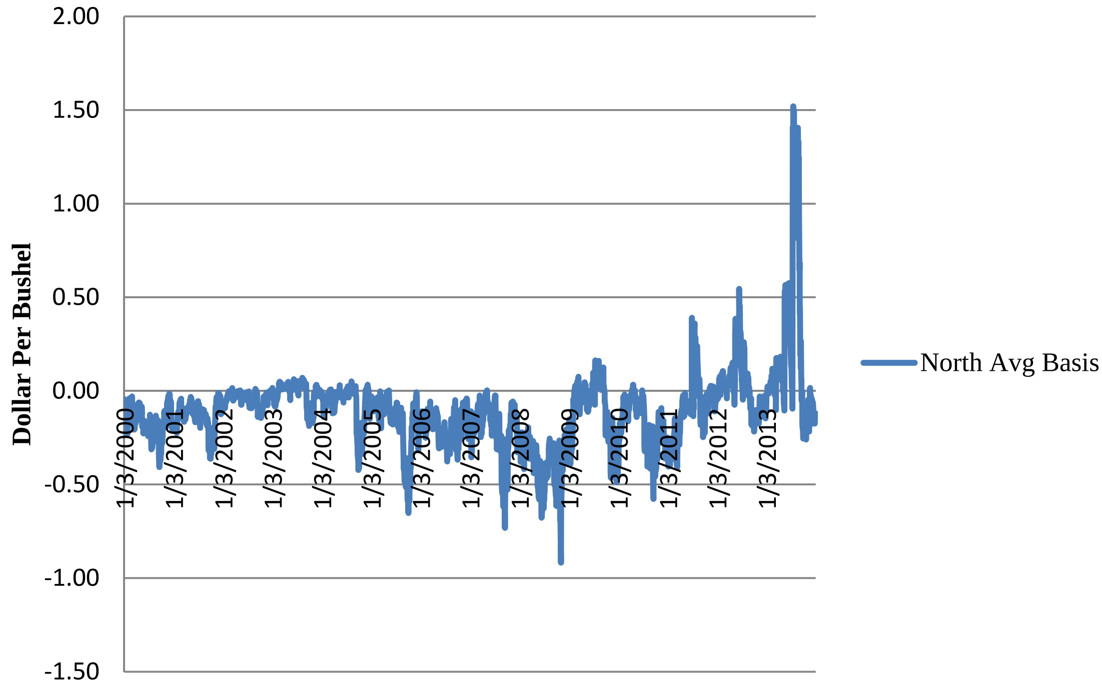
Figure 3.1: Illinois Basis Observed

Decatur processor information represents the processor market. Processors are end-users of the grain. They process the grain into other products such as corn syrup, meal, or bio-fuels. Processors obtain their grain from producers or merchants of grain. Their demand for grain is finite given the capacity of the facility, but can vary over time.

Daily data on cash prices were gathered from USDA for the period from January 2000 until January 2013. As noted above, USDA publishes a low and high cash value daily. Basis was calculated using the average of the high and low cash price, and the price of the nearby futures. Basis is measured in dollars per bushel. Figures 3.2 and 3.3

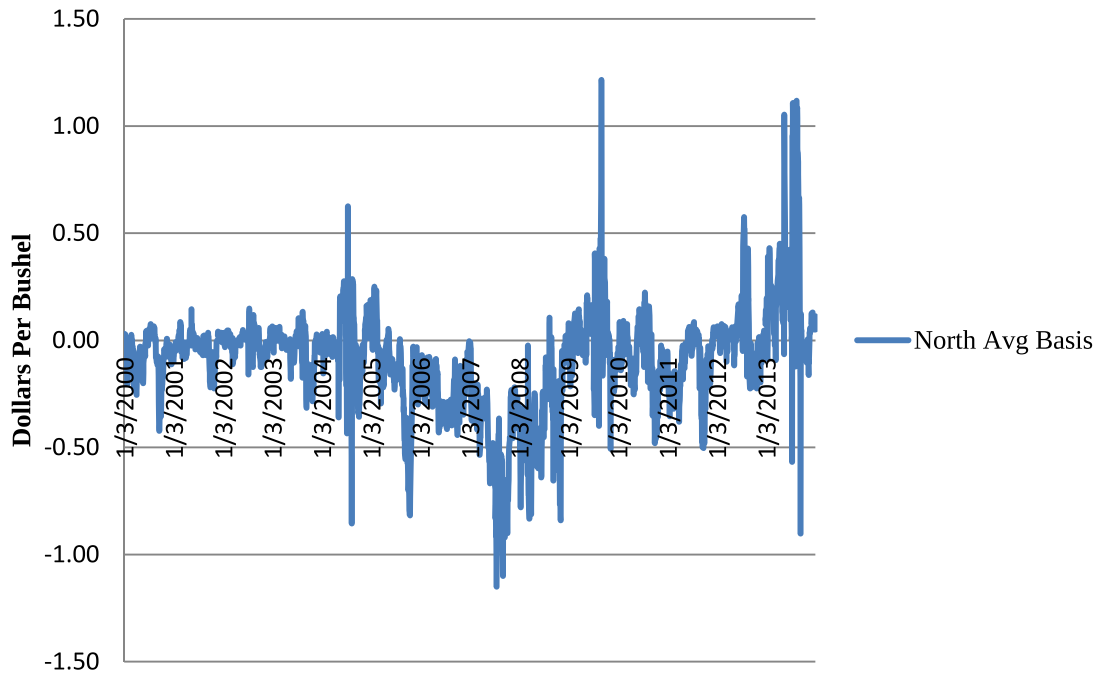
summarize the basis data for corn and soybeans respectively at the North Barge. To view all basis levels can be found in the Appendix.

Figure 3.2: Illinois Corn Basis Levels (January 2000 to January 2013)



Source: USDA

Figure 3.3: Illinois Soybean Basis Levels (January 2000 to January 2013)



Source: USDA

Summary statistics for corn and soybean basis are presented in Tables 3.1 and 3.2. The data indicate that the widest (i.e., weakest) basis values occurred at the North and South barge terminals. Median basis however was weakest at the inland terminals – at -$0.16 for both corn and soybeans. Median basis was strongest at the processor locations – at -$0.02 for corn and +$0.03 for soybeans. This suggests that producers could potentially benefit from arrangements whereby they ship grain directly to processors. The difference in the basis values across locations presumably reflects transport costs. Since grain typically moves south on the river we would expect to see weaker basis value at more northerly locations on the Illinois river, and the median basis values reflect that expectation.

Table 3.1: Corn Data Summary Dependent Variables

Dependent Variables	Mean	Median	Minimum	Maximum	Standard Deviation	Observations
North Barge Basis	-0.104	-0.100	-0.918	1.520	0.216	3,489
South Barge Basis	-0.091	-0.090	-0.803	1.523	0.193	3,489
Elevator Basis	-0.142	-0.163	-0.615	1.473	0.194	3,490
Processor Basis	0.010	-0.015	-0.368	1.725	0.200	3,502

Table 3.2: Soybean Data Summary Dependent Variables

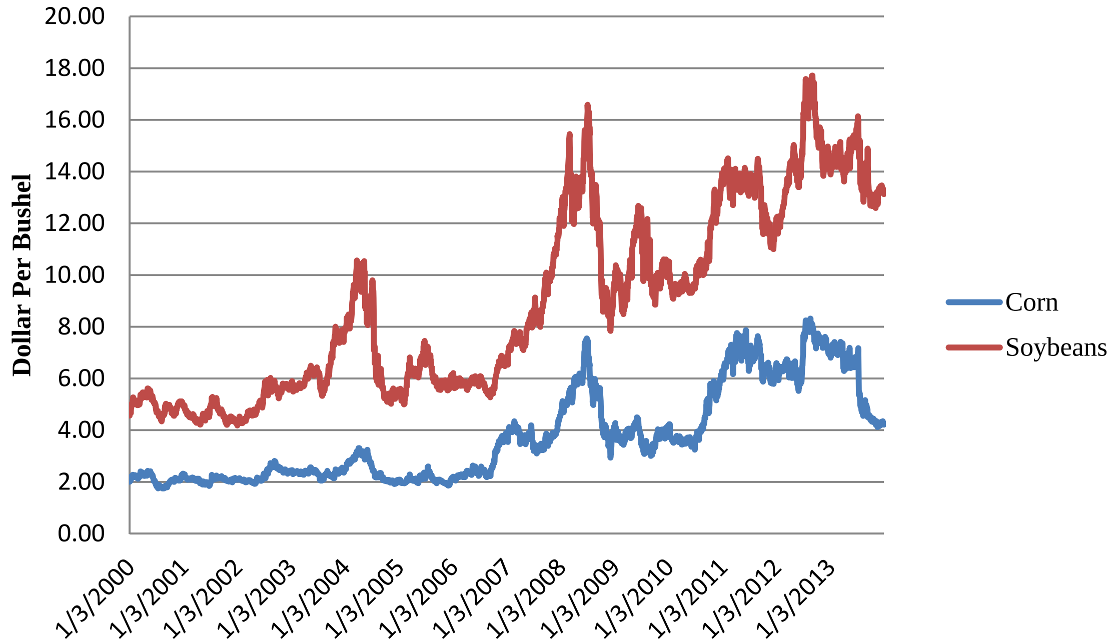
Dependent Variables	Mean	Median	Minimum	Maximum	Standard Deviation	Observations
North Barge Basis	-0.097	-0.055	-1.150	1.215	0.232	3,489
South Barge Basis	-0.085	-0.048	-1.110	1.088	0.223	3,489
Elevator Basis	-0.162	-0.158	-4.513	1.218	0.216	3,491
Processor Basis	0.037	0.029	-4.513	1.693	0.229	3,504

3.2 Nearby Futures

Data on the daily settlement price of the nearby (closest to expiration) futures contract were obtained from Bloomberg. Corn contracts are traded for the months of March, May, July, September and December, while soybean contracts are traded for the months of January, March, May, July, August, September and November. Figure 3.4 shows the daily settlement of the nearby corn and soybean contracts between January 2000 and December 2013.

The date of the first observation in the dataset is January 3, 2000. On that day, the nearby corn contract was the March 2000 contract while the nearby soybean contract was the January 2000 contract. The final day of trade for the January 2000 soybean contract was Friday, January 14, 2000. On the next business day, Tuesday, January 18, the nearby contract is the March 2000 contract. Both the March 2000 corn and soybean contracts expired (had their final trade) on Tuesday March 14. Thus, on Wednesday March 15, the nearby contract for both corn and soybeans is the contract for May delivery. The price in the futures market reflects the overall supply-demand situation in the U.S. market and as such may have an impact on basis levels.

Figure 3.4: Corn and Soybean Futures (January 2000 to January 2013)



Source: Bloomberg

3.3 Futures market spreads and inverses

The futures market spread refers to the difference in price between contracts with different delivery dates. The spread is calculated as the difference in price between the nearby contract and the contract that is next closest to expiration (referred to as the deferred contract). For example, on January 3, 2000 the nearby corn contract (March 2000) settled at $2.0075 /bu. On the same day, the May 2000 corn contract (the deferred contract) settled at $2.08 /bu. The difference of $0.0725 /bu is the spread.

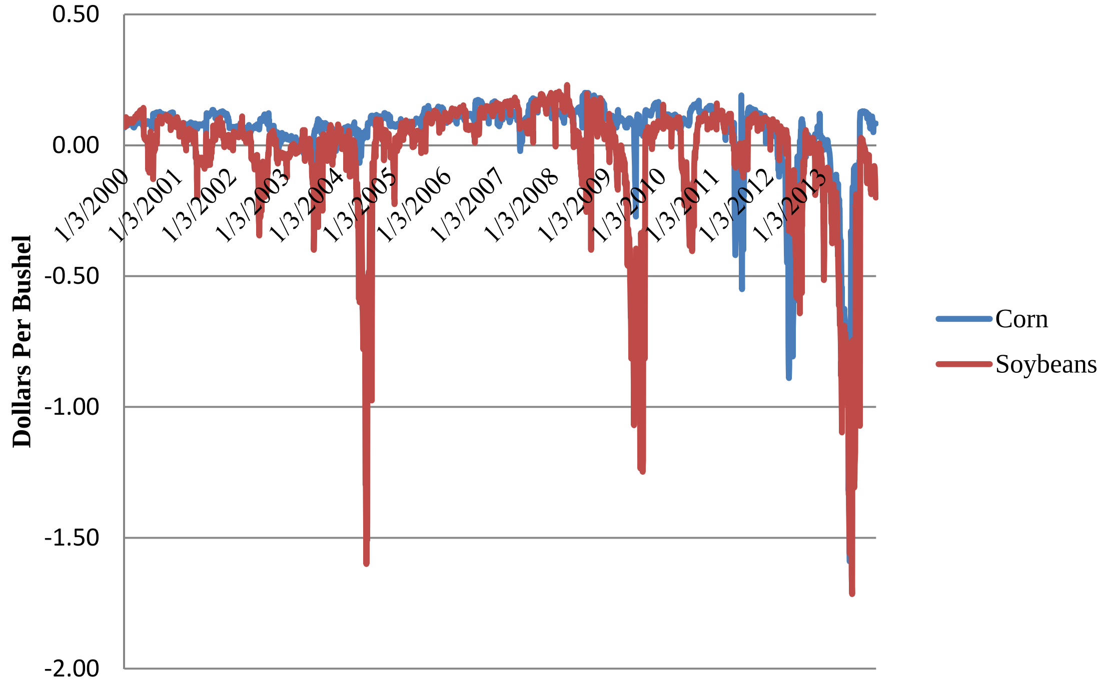
Because the gap in time between futures expiration dates is not the same for all contracts, we standardized the spread to reflect the price difference that would be implied for a gap of 61 days. As mentioned previously, corn contracts trade for delivery in the months of March, May, July, September and December. Between the expirations of the March and May contracts is a time gap of 2 months. Similarly, there is a gap of 2 months between May and July, July and September, and December and March, but the gap between September and December is 3 months. To standardize the spread we first divided the actual spread by the number of days between the expiration dates of the two contracts. Thus, on January 3, 2000, with a gap of 59 days between the expiration of the nearby (March) and deferred (May) contracts, we divide the actual spread by 59 to find the implied daily spread. We then multiply that implied daily spread by 61 to estimate a standardized 61-day spread. In that instance the actual spread of $0.0725/bu is standardized to a value of $0.0749/bu. While this standardization results in a very small adjustment in most cases, in the case of the September-December spread the conversion will have a greater effect. Thus, on July 17, 2000 the actual spread of $0.12/bu between the nearby (September) and deferred (December) contracts is standardized to a 61-day spread value of $0.0804c/bu. The 61 day value was used since it represents the average length of a 2-month period (i.e., 365 divided 6).

Spreads between futures months typically reflect the economic incentive for storage – i.e., when the deferred contract trades at a higher price than the nearby contract the spread reflects what the market is prepared to pay in the form of a higher price to those who store grain from one period to the next. The situation when the deferred contract trades at a higher price than the nearby contract is referred to as a “normal” or “carry” market. In that situation, the terms “spread” and “carry” are used interchangeably – they both refer to the price difference. The price gap in a carry market is constrained by the actual cost of storing grain and the fact that the market can be arbitraged. If the gap in price were to get too large relative to the cost of storing grain a risk-free profit would be available.

The opposite of a carry market is an inverted market – a situation in which the nearby contract trades at a higher price than the deferred contract. The spread in an inverted market cannot be arbitraged because, for example, grain that will only become available to the market at harvest cannot be used to meet demand for grain before that harvest. Thus the price gap in an inverted market can become quite large. Figure 3.5 shows the actual (not standardized) spread for corn and soybeans between January 2000 and December 2013 and illustrates some large inversions in the soybean market that occurred in 2005, 2010, and again in 2013.

Because spreads reflect the economic return to storage they may have an effect on basis. In an inverted market there is strong current demand for grain, which may result in stronger basis levels as the market tries to entice grain into the marketing channel to meet the demand. Wide carries in the market reflect abundant grain supply and may be associated with weaker basis levels. The subsequent analysis will investigate the possible effect of those spreads on basis, and given the particular and typically short-lived nature of inverted markets, the analysis will use a dummy variable to investigate whether the presence of a market inverse has an effect independent of the actual spread.

Figure 3.5: Corn and Soybean Spreads (January 2000 to January 2013)



Source: Bloomberg

Table 3.4 summarizes the data on nearby futures prices, spreads, and market inverses for corn and soybeans. During the time period examined, nearby corn futures displayed considerable volatility with a range from $1.75/bu. up to $8.31/bu. while nearby soybeans ranged from $4.18/bu. up to $17.71/bu. The median spread for corn futures was 40.09 with a range from -$1.59 to $0.20, while for soybeans the median spread was $0.04 with a range from -$1.72 to $0.68. The corn market was inverted for 11% of observations compared to 35% for soybeans.

Table 3.3: Data Summary Dependent Variables

Independent Variables	Mean	Median	Minimum	Maximum	Standard Deviation	Observations
Nearby Corn Futures	3.755	3.243	1.748	8.313	1.821	3,527
Spread Per Day	0.038	0.077	-1.540	0.187	0.149	3,527
Inverted Market	0.120	0.000	0.000	1.000	0.325	3,527
Days Until Expiration	43.557	36.000	0.000	90.000	23.405	3,527
Heating Oil	1.816	1.778	0.500	4.106	0.898	3,513
Ethanol Demand	9.014	9.000	4.000	13.000	3.412	3,527
Nearby Soybean Futures	8.878	8.185	4.18	17.71	3.644	3,527
Spread 61 Day	-0.085	0.045	-3.487	0.678	0.431	3,527
Inverted Market	0.364	0	0	1	0.481	3,527
Days Until Expiration	26.809	25	0	60	17.287	3,527
Heating Oil	1.816	1.778	0.5	4.106	0.898	3,513

3.4 Days Until Expiration

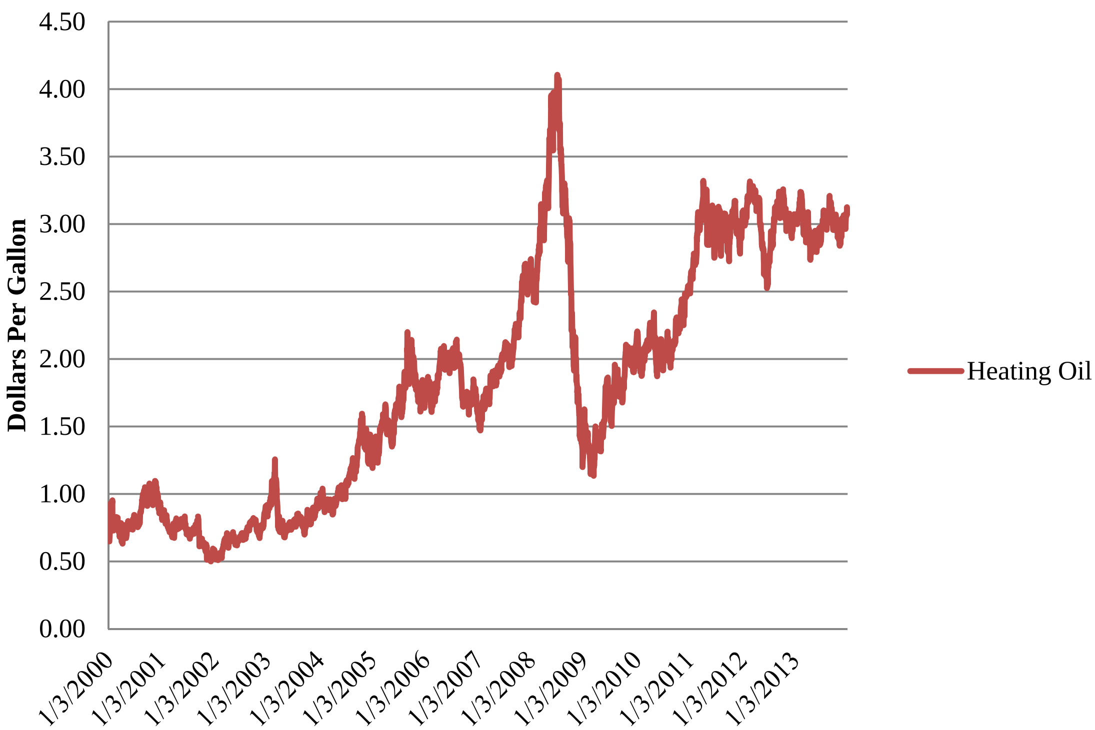
Days until expiration is simply the number of days until the contract is no longer traded. For corn and soybean contracts, contract specifications provided by the CME indicate that the last day a contract will trade is “the last business prior to the 15th calendar day of the contract month.” In theory, the price difference between the cash and futures markets at a delivery location should converge to zero at the time the contract can be settled by physical delivery of the commodity. Absent convergence, and with the ability to make or receive delivery of the physical commodity via the futures market, there would, in theory, be opportunities to make a risk free profit.

Prior to delivery however, there will be a price difference between the cash and futures markets. Similar to the situation in a market carry, the price difference (i.e., basis) at a delivery location may be reflective of the economic incentive to store grain, and thus the greater the number of days until contract expiration typically the greater the price difference will be.

3.5 Heating Oil

Because basis reflects differences in location as well as differences in time, it may be affected by the cost of transporting grain to a futures market delivery location. In this analysis we use the price of heating oil to represent the cost of transportation. Heating oil futures are often used to determine diesel fuel prices, and diesel is the most common fuel used for transporting grain by truck, rail, and barge. The heating oil contracts are traded in 42,000 gallon contracts. Prices are quoted in dollars per gallon and were observed from January 2000 to January 2013 (Figure 3.5).

Figure 3.6: Heating Oil (January 2000 to January 2013)



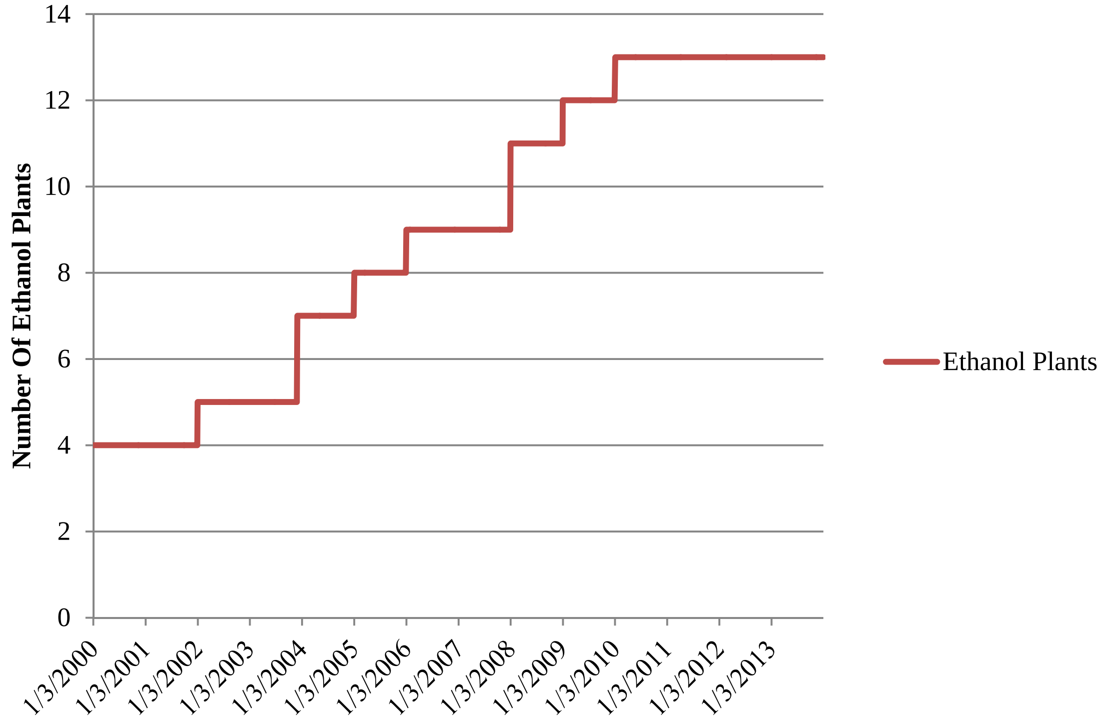
Source: Bloomberg

3.6 Ethanol Demand

Demand for grains for the production of ethanol and other biofuels has increased over the past decade with the introduction of the 2007 Energy Independence and Security Act. The implementation of the act increased the demand for ethanol and bio fuels leading to an increase in production. As a result, the demand for corn in particular has increased leading to higher prices. Increased ethanol production in a local market will also have an impact on basis since it represents an increase in local demand for corn.

Over the time period analyzed the number of ethanol plants in Illinois increased from 4 in 2000 to 13 at the end of 2013. The number of plants is included in our analysis in order to investigate its impact on corn basis. Data were obtained from the Illinois Corn Growers Association and Illinois Corn Marketing Board website. While soybeans are also used for biofuel production, the number of biodiesel plants in Illinois did not increase during the time period analyzed.

Figure 3.7: Ethanol Plants In Illinois (January 2000 to January 2013)



Source: Illinois Corn Growers Association

3.7 Monthly Seasonality

Grain basis reflects local supply-demand conditions which, given seasonal production patterns, would be expected to have a seasonal pattern. During harvest for example, the supply of commodities is ample and handling the grain is highly valued creating a more negative basis. Demand may also have a seasonal dimension given the US role as a major exporter and seasonal production patterns in other parts of the world. To account for seasonality, we use monthly dummy variables in the analysis. Thus, for an observation in January, the monthly dummy variable for January takes a value if 1, while that for the other monthly dummy variables takes a value of zero. Eleven of the twelve dummy variables are included as explanatory variables in the basis model, with December serving as the omitted baseline month.

CHAPTER IV: METHODS

Basis has increased in volatility and has increased the ability for producers to participate in basis appreciation at a different level than before. Grain merchandiser's understanding of how the basis market functions is very important to managing risk. Grain merchandisers are basis traders and basis trading accounts for the majority of their profits made. What is referred to as "buying basis" is the basis level at which a grain merchandiser can purchase grain from producers or other grain traders. Similarly, "selling basis" is the basis level at which a merchandiser can sell grain to the next step in the supply chain or to other grain traders. The difference between the buying and selling basis provides the merchandiser's margin, in addition to covering and transportation cost, handling and other costs associated with the moving the grain. As basis has become more volatile, and as producers have begun to focus more on their exposure to basis changes, it has become more important of merchandisers, who rely on basis to provide their margins, to understand basis behavior.

Basis movements can be seasonal and depend on the movement of grain. As the flow of grain shifts the market presents different opportunities. For example, basis is often very wide during harvest time. During this time transportation costs are typically high and the supply of grain is abundant, causing the market to encourage grain to be stored. Basis can appreciate over time during different parts of the year that allows for different marketing opportunities if basis could be forecasted. Basis forecasting is difficult however, both because so many factors influence basis and because in order to forecast the basis those variables themselves would need to be forecasted. But basis may also have some predictable seasonal patterns, an understanding of which may be very useful to a merchandiser.

The objective of this thesis is to produce an Ordinary Least Squares (OLS) that helps movement, and thereby help manage basis risk. If basis continues to increase in volatility it will become more important to manage it the same way one would manage price volatility using futures positions. In the same way that there are multiple tools available for futures risk management, there are also tools that can be used to lock in and trade basis.

The variables that are used in the regression models in an effort to explain basis behavior are listed in Table 4.1 along with the expected sign for their coefficients.

Table 4.1: Expected Coefficient Signs

	Corn Expected Coefficients	**Soybean Expected Coefficients**
Nearby_Futures	-	-
Spread_61_Days	-	-
Inverted_Market	+	+
Days_Until_Expiration	-	-
Heating_Oil	-	-
Ethanol_Demand	+	N/A

The level of the nearby futures is expected to have a negative impact on basis –i.e., as futures rise, we expect basis to weaken or to become more negative. The hypothesized sign reflects the idea that as the overall futures level rises, the higher price level provides incentive to move grain into the marketing channel. Grain buyers (elevators, terminals, processors) may find in that situation that they do not need to increase their cash bids in lock-step with the futures market, i.e., they can allow basis to weaken and still source adequate supplies of grain.

As described in Chapter 3, the spread in the futures market reflects the economic incentive to store grain. Wide spreads, with deferred months trading at higher prices reflect both a positive return to storage and relatively weak current demand. Weak current demand may then be reflected in a weaker basis. In an inverted market (where the spread is negative), reflecting strong current demand, basis levels are hypothesized to be stronger. Hence we expect to see a negative coefficient on the spread variable, and similarly, a positive coefficient on the dummy variable for an inverted market.

As the futures contracts moves toward expiration the cash and futures prices will converge. When basis is negative, convergence means that basis is strengthening and thus the expected coefficient on days to expiration is negative –i.e. the more days we are away from expiration the more negative the basis is expect to be. Given that the data we have is for a grain surplus region where basis is typically negative, the expected coefficient sign is negative.

Heating oil representing transportation cost and is expected to have a negative coefficient. This reflects the idea that as transportation cost increases the basis in the grain export area is expected to weaken. Finally, the corn basis models include a variable counting the number of ethanol plants in the state, the increase in which represents increasing local demand for corn.

The regression models for corn basis at barge terminals north and south, inland terminals, and processors is thus expressed as:

$$Basis = \beta_0 + \beta_1 \text{ (Corn Nearby)} + \beta_2 \text{ (Spread 61 Days)} + \beta_3 \text{ (Inverted Market)}$$
$$+ \beta_4 \text{ (Days Until Expiration)} + \beta_5 \text{ (Heating Oil)} + \beta_6 \text{ (Ethanol Demand)}$$

The soybean model is similar, except that because the number of soybean processing plants in Illinois did not vary during the period being studied, it does not include a variable to capture the changes in local demand. Thus, the estimated model for soybean basis is:

$$Basis = \beta_0 + \beta_1\ (Soybean\ Nearby) + \beta_2\ (Spread\ 61\ Days) + \beta_3\ (Inverted\ Market) + \beta_4\ (Days\ Until\ Expiration) + \beta_5\ (Heating\ Oil)$$

CHAPTER V: RESULTS

5.1 Corn Basis

Results from the corn basis models are provided in Table 5.1. The nearby corn futures price (Corn Nearby) was expected to have a negative effect on basis, i.e., as nearby futures increase basis is expected to weaken. The estimated coefficient was negative and statistically significant for both the North and South Barge locations, but was insignificant at the Processor and Inland Terminal locations. Where significant, the estimated coefficient is small indicating that the impact on basis is minimal. At North Barge, the estimated coefficient of -0.012 indicates that for every dollar increase in futures, basis is expected to weaken by $0.012 /bu ceteris paribus. The estimated coefficient at South Barge is similar in magnitude.

The 61-day-spread variable has the expected negative coefficient and is statistically significant at all four locations. Thus, wider spreads between nearby and deferred futures are associated with weaker basis levels. The estimated coefficient ranges in magnitude from -0.22 at Inland Terminals to -0.357 at South Barge indicating that a $0.10 increase in the 61-day-spread is associated with a $0.22 to $0.36 /bu weakening in basis.

Market inversions, indicating strong current demand, were expected to be associated with stronger basis levels and the estimated coefficient values are in agreement with this expectation. The estimated coefficient on the dummy variable representing an inverted market condition is positive and statistically significant at all four locations and ranges in magnitude from 0.233 to 0.269. Thus, an inverted market condition, in comparison with a normal market, is associated with a $0.23 to $0.27stronger basis on average.

Table 5.1: Corn Basis Regressions

	North Barge		South Barge		Inland Terminal		Processor	
Constant	-0.091	***	-0.080	***	-0.134	***	-0.051	***
Corn Nearby	-0.012	***	-0.017	***	0.005		-0.003	
Spread_61_Days	-0.362	***	-0.357	***	-0.226	***	-0.282	***
Inverted Market	0.260	***	0.233	***	0.269	***	0.259	***
Days to Expiration	-0.0003	***	-0.0003	***	-0.0003	***	-0.0003	***
Heating Oil	-0.080	***	-0.061	***	-0.038	***	-0.036	***
Ethanol Demand	0.019	***	0.018	***	0.007	***	0.017	***
January	-0.010		-0.009		-0.038	***	-0.037	***
February	0.042	***	0.045	***	-0.004		-0.001	
March	0.004		0.001		-0.060	***	-0.051	***
April	0.037	***	0.029	**	-0.047	***	-0.037	***
May	-0.037	**	-0.035	***	-0.098	***	-0.091	***
June	-0.024	*	-0.024	*	-0.061	***	-0.065	***
July	0.004		0.001		-0.031	**	-0.036	***
August	0.108	***	0.064	***	0.076	***	0.089	***
September	-0.066	***	-0.079	***	-0.038	***	-0.027	**
October	-0.089	***	-0.063	***	-0.065	***	-0.050	***
November	0.026		0.029	**	0.004		0.014	

*, **, *** denote significance at the 10%, 5%, and 1% levels

The coefficient on the Days to Expiration variable has the expected negative value and is statistically significant at all locations. The estimated coefficient value of -0.0003 is similar at all locations and indicates that with every additional day until contract expiration the basis is expected to be three hundredths of a cent weaker. In other words, when basis is negative, convergence takes place at a rate of approximately $0.01 /bu per month, a value which is surprisingly small. However, the estimated coefficient value is undoubtedly affected by the presence of several instances in the dataset where basis values are positive, implying that convergence with the approach of contract maturity would require a basis that is getting weaker (i.e., less positive), rather than stronger with the passage of time.

The price of heating oil, used as a proxy for transportation cost, has the expected negative coefficient and is statistically significant at all locations. Values range from -0.03 to -0.08 indicating that a $1.00 /gallon increase in the heating oil price is associated with weaker basis values of between $0.03 and $0.08 /bu. During the time period examined, heating oil prices increased by around $2.00 /gallon suggesting that, ceteris paribus, basis levels would be expected to weaken by between $0.06 and $0.16 /bu. The relative size of the heating oil coefficient has the expected pattern between the North and South Barge locations, having a greater (negative) value at North Barge. Because grain moves down-river, grain from locations further north will require more transportation and are thus likely to be more affected by any increase in transportation cost.

The Ethanol Demand variable measures the number of ethanol plant operating in Illinois and has the expected positive effect on basis in all four models. The estimated coefficient value ranges from 0.007 to 0.019 indicating that each additional ethanol plant is predicted to strengthen corn basis by between $0.007 to $0.019 /bu. The estimated coefficients are statistically significant at all locations.

A set of monthly dummy variables was included in order to investigate seasonal effect on basis, with December used as a baseline. Compared to the December baseline, positive and statistically significant coefficients were observed for the months of February, April, and August. The negative and statistically significant coefficient for May is perhaps surprising but may reflect the end of corn harvest and a surge exports from the Southern Hemisphere, while the positive coefficient for August may reflect relative scarcity prior to the beginning of the US harvest. The estimated coefficients for September and October are negative and statistically significant indicating that basis is weaker during harvest.

5.2 Soybean Basis

Results from the soybean basis models are provided in Table 5.2. The nearby soybean futures price (Soybean Nearby) was expected to have a negative effect on basis, i.e., as nearby futures increase basis is expected to weaken. However, for all four locations the estimated coefficient was actually positive and statistically significant, indicating that higher futures prices were associated with stronger basis levels. Coefficient values range from 0.008 to 0.016 indicating that, ceteris paribus, a $1.00 /bu increase in nearby futures is associated with a $0.008 /bu to $0.016 /bu strengthening in basis. The unexpected positive sign may reflect the relatively high frequency of market inverses which occurred for over one-third of the observations in the data set. High nearby futures, if associated with market inverses, would be expected to be accompanied by stronger basis levels.

The 61-day-spread variable has the expected negative coefficient and is statistically significant at all four locations. Thus, wider spreads between nearby and deferred futures are associated with weaker basis levels. The estimated coefficient ranges in magnitude from -0.094 at Inland Terminals to -0.131 at North Barge indicating that a 10c increase in the 61-day-spread is associated with an approximate $0.01/bu weakening in basis. The effect of the spread in soybeans is only about one-third the magnitude as was found in the corn basis models.

As in the corn models, market inversions are associated with stronger basis levels and the estimated coefficient values are in all cases statistically significant. Magnitudes range from 0.148 to 0.165 indicating that inverted market condition, in comparison with a normal market, are associated with a $0.15 to $0.16 stronger basis on average.

Table 5.2: Soybean Basis Regressions

	North Barge		South Barge		Inland Elevator		Processor	
Constant	-0.071	***	-0.054	***	-0.167	***	-0.076	***
Soybean Nearby	0.016	***	0.016	***	0.008	***	0.014	***
Spread_61_Days	-0.131	***	-0.117	***	-0.094	***	-0.099	***
Inverted Market	0.165	***	0.154	***	0.148	***	0.156	***
Day to Expiration	0.0001		0.0003		-0.0001		-0.0003	
Heating Oil	-0.088	***	-0.080	***	-0.054	***	-0.038	***
January	-0.019		-0.023		-0.036	**	-0.030	**
February	-0.008		-0.014		-0.007		-0.002	
March	-0.074	***	-0.086	***	-0.047	***	-0.026	
April	-0.032	**	-0.049	***	-0.014		0.017	
May	-0.103	***	-0.115	***	-0.031	**	0.009	
June	-0.126	***	-0.126	***	-0.039	***	-0.001	
July	-0.166	***	-0.168	***	-0.073	***	-0.054	***
August	-0.073	***	-0.144	***	0.029	**	0.076	***
September	-0.132	***	-0.195	***	0.014		0.076	***
October	-0.161	***	-0.163	***	-0.071	***	-0.041	***
November	-0.058	***	-0.070	***	-0.031	**	0.005	

*, **, *** denote significance at the 10%, 5%, and 1% levels

The estimated coefficients on the Days to Expiration variable is small and statistically insignificant in all four models. As in the corn models, the effect of this coefficient is likely influenced by the frequency of positive basis levels. Similar to the findings from the corn models, the price of heating oil has the expected negative coefficient and is statistically significant at all locations. Values are similar to those from the corn models, averaging approximately -0.06 indicating that a $1.00 /gallon increase in the heating oil price is associated with a $0.06 /bu weaker basis.

The monthly dummy variables in the soybean models, with December as a baseline, indicate that, with almost all coefficients negative and statistically significant, basis tends to be strongest in the December to February period. Interestingly, fewer of the monthly coefficients were significant in the Processor model, perhaps indicating the fact that for a processor it is important that soybeans need to be available year round.

CHAPTER VI: CONCLUSION

The estimated regression models provide some insights into the determinants of basis levels for corn and soybeans. Understanding the behavior of basis, to the extent that that behavior exhibits predictable patterns, can result in better and more profitable marketing decisions for either grain merchandisers or producers.

The corn regression models indicate that basis levels tend to be negatively associated with the nearby futures price, and while the effect is statistically significant it is relatively small in magnitude. Thus, for producers with a hedge in futures, higher futures prices that results in margin calls are also associated with weaker basis levels. Meanwhile, for elevators on the buying side of HTA contracts with producers, the weaker basis levels may somewhat compensate for the cash flow implications associated with margining the HTA contract. Interestingly however, the opposite effect was found in the soybean models where a higher futures price was associated with an, albeit small, improvement in basis.

In both the corn and soybean models a widening in the 61-day-spread was associated with a weaker basis level. Since wider spreads reflect the return to storing grain, the weaker basis and wider spread provide a signal to either producers or grain merchandisers that grain storage may be more likely to provide positive returns. Meanwhile, in both the corn and soybean markets, market inversions were associated with stronger basis levels – with an average impact of about $0.25 /bu in the corn markets examined, and about $0.15 /bu in the soybean markets.

A greater number of days to expiration was associated with weaker basis levels in the corn markets but the effect was insignificant in the soybean markets. In production areas, where basis is typically negative, convergence would imply a strengthening basis as the number of days to contract expiration diminishes – and thus, a negative coefficient would be expected. While this was confirmed in the corn models, the magnitude of the coefficient was extremely small. A more detailed examination of this effect is warranted. In particular, a more detailed analysis will need to explicitly account for the fact that when basis is positive, convergence as contract maturity approaches would imply a weakening, as opposed to a strengthening basis. This factor probably accounts for our finding of an insignificant effect in the soybean models, due to the fact that positive basis levels were more frequent in the soybean market (32% of observations) than in the corn market (18% of observations).

Transportation costs, represented in these models with the price of heating oil futures, had the expected negative effect on basis in all cases. For corn, the effect of a $1.00 /gallon increase in heating oil was associated with between a $0.03 and $0.08 /bu weakening in basis, while for soybeans the effect was similar averaging $0.06 /bu.

The number of ethanol plants in the state had a positive and statistically significant effect on corn basis. Each additional plant was estimated to enhance basis by between $0.007 to $0.019 /bu. depending on location. The average effect across locations was $0.015/bu. Given 2013 Illinois corn production of approximately 2.1 billion bushels, this translates to around $31.5 million additional returns to Illinois corn producers for each additional ethanol plant.

The models also revealed some strong seasonal effects revealed by the estimated coefficients on monthly dummy variables. In soybeans, the strongest basis levels were found for December, indicating that, in an inverted market it is important not to keep soybean past December. As indicated in the regression results for all soybean models except for processors, basis continue to deteriorate after the base month December. This clearly indicated a high demand time frame that starts in December. When producers look at holding soybeans basis appreciation needs to surpass their expense of storage. If the benefits are there soybeans producers could realize a higher return by holding out of harvest to sell in December. The processor results suggested that they need soybean supplies year round and need to provide continuous incentives for soybeans to come to the market thus resulting in a less distinct seasonal pattern. Seasonal patterns were also evident in the corn market, again pointing to the possibility of enhanced returns for producers or merchandisers in a position to gain from any predictable pattern in basis behavior.

6.1 Model Improvements

Overall the models indicated that several variables were significant in terms of explaining basis behavior. In any analysis however, there is room for improvement. In these models, the addition of variables measuring the availability of local supplies throughout the year (corn or bean in local storage) would probably enhance explanatory power. Furthermore, as indicated earlier, the modeling of convergence behavior need to distinguish between times when basis is positive or negative. Other variables measuring local demand for soybeans such as processing capacity would also be expected to improve model performance, as would a more refined measure of demand for ethanol production such as weekly ethanol production in the state, or perhaps some measures of average grain quality. Several of these variables were not available for the present analysis, but would be important in developing better models.

As the global market for grains continues to grow it seems as though price volatility and therefore the risk exposure of participants in the grains markets continues to increase.

In that environment it will be increasingly important for those actors to be able to manage that risk exposure. A better understanding of basis behavior and its drivers, as attempted in this analysis, will clearly be an important factor in that effort. Although the model developed herein has some limitations it can still provide beneficial information that could help with marketing decisions.

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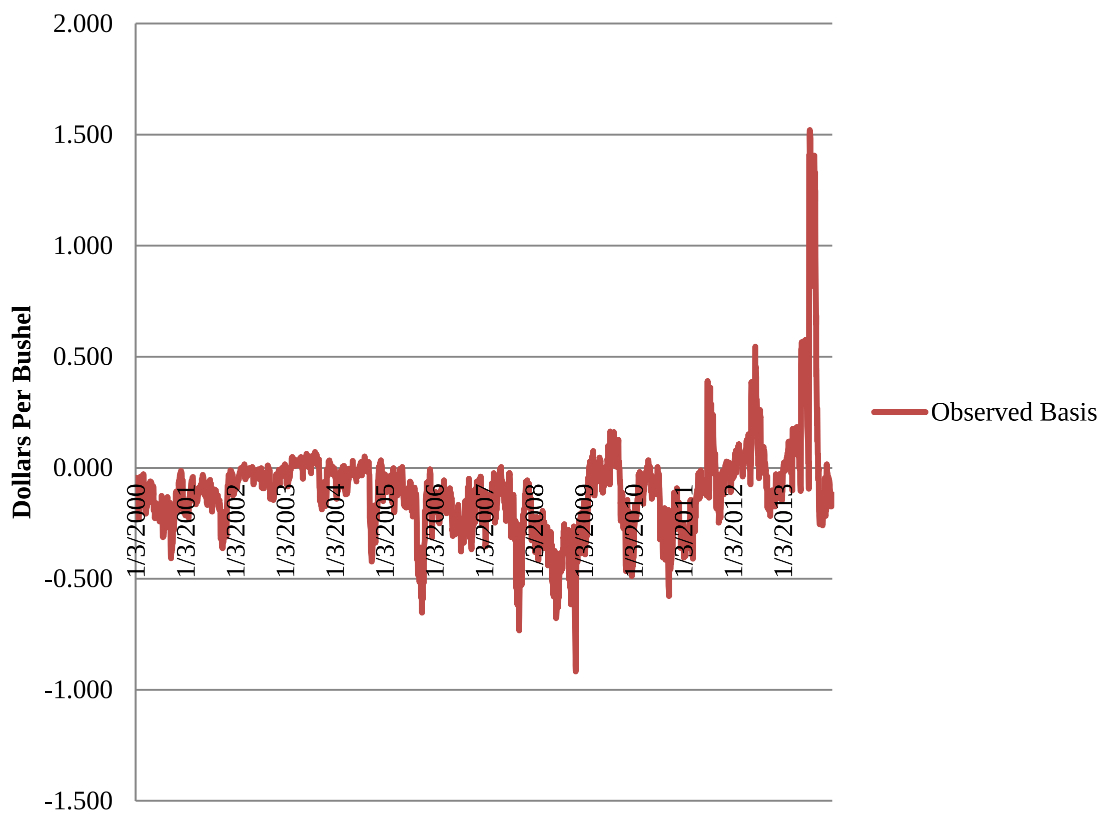
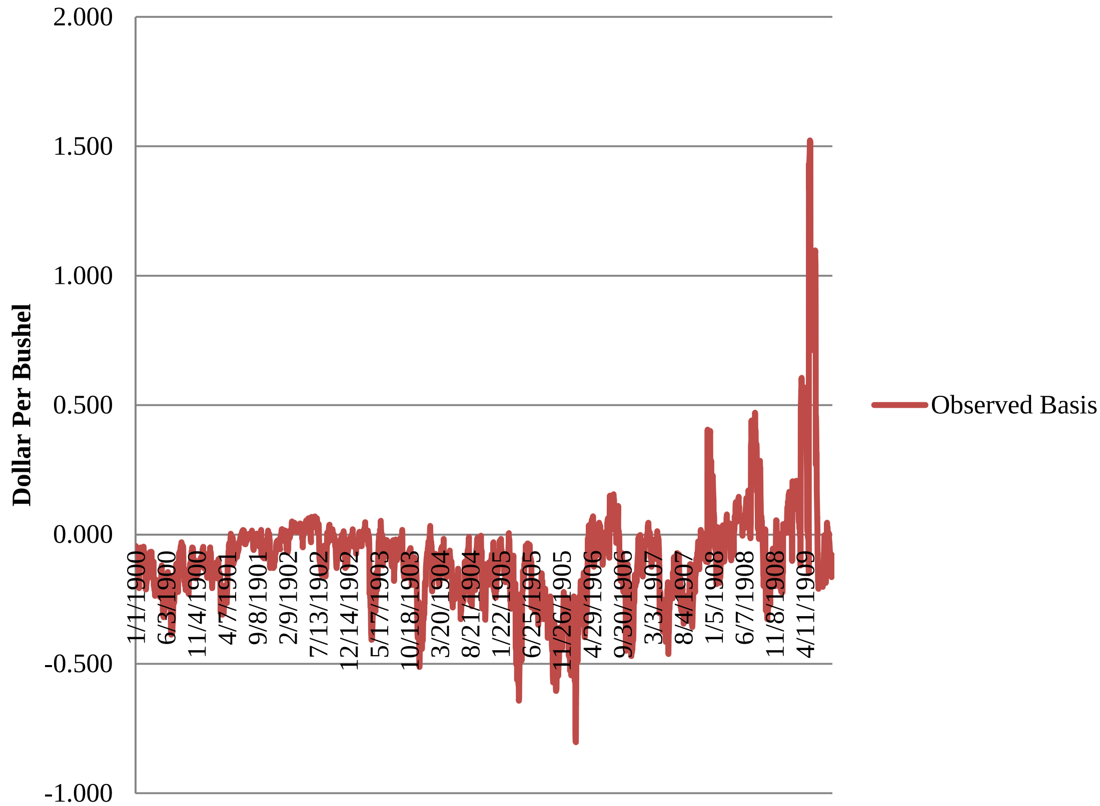
APPENDIX A

Table 1A: North Barge Corn Basis (2000 to 2013)



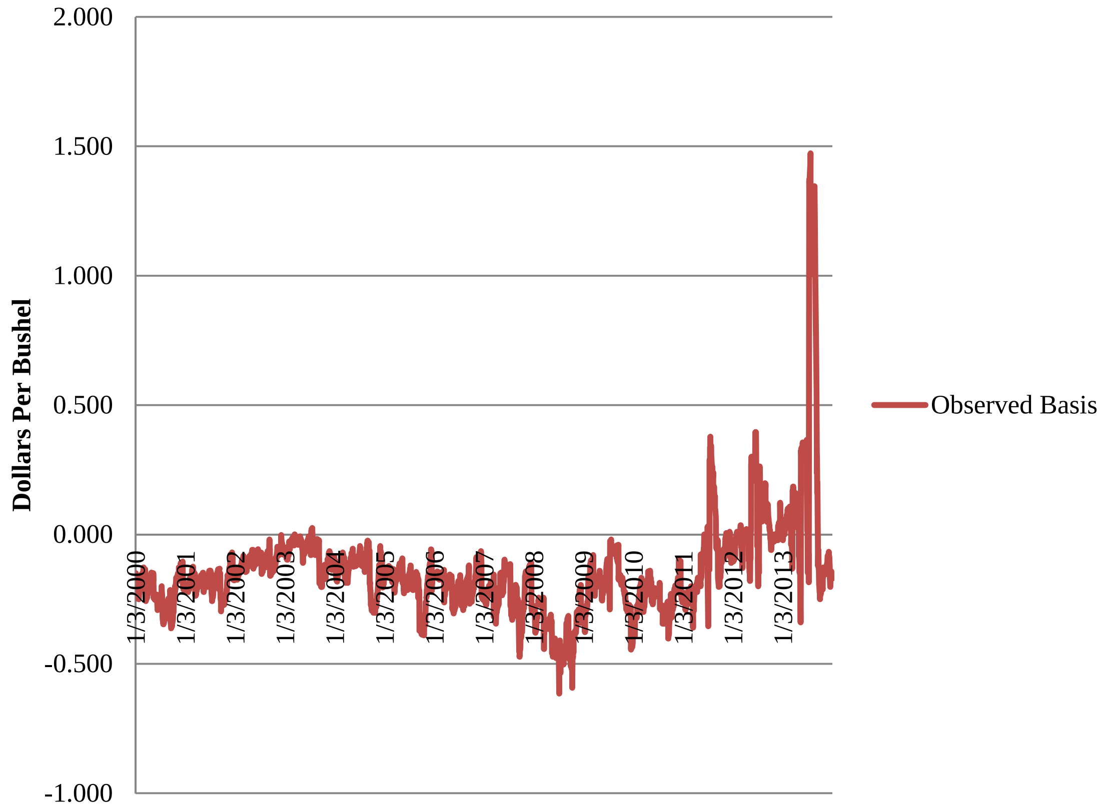
Source: USDA

Table 2A: South Barge Corn Basis (2000 to 2013)



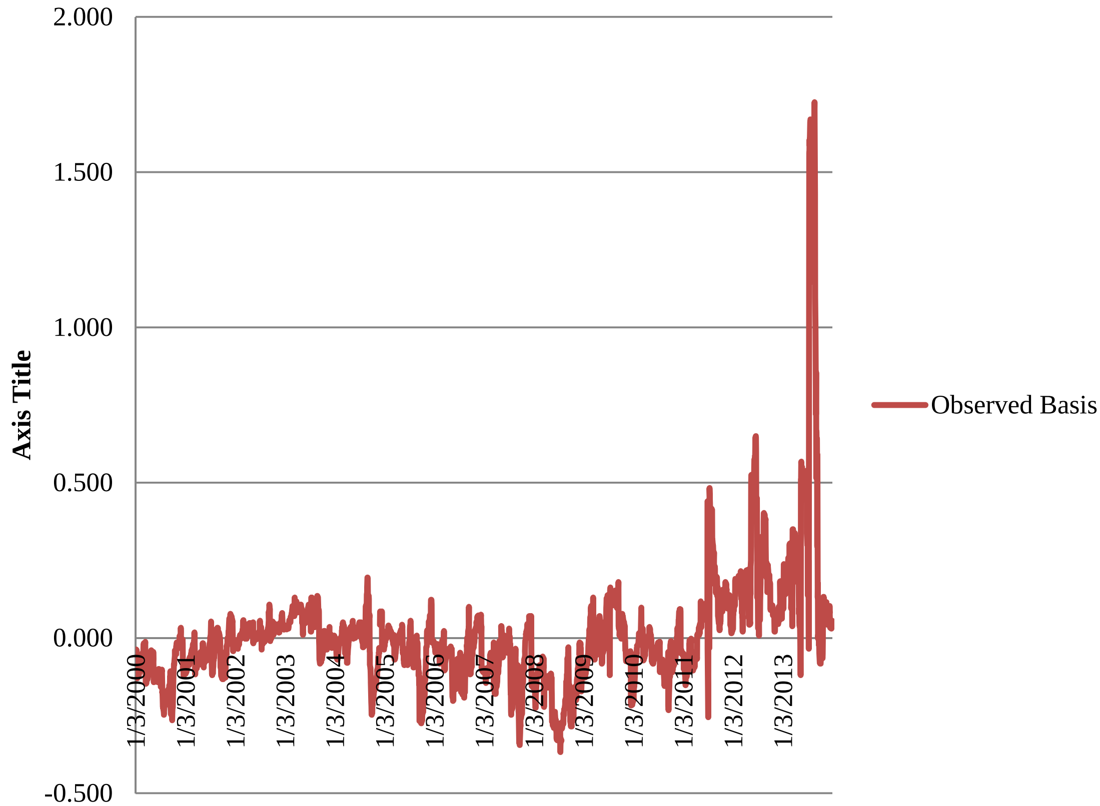
Source: USDA

Table 3A: Inland Terminal Corn Basis (2000 to 2013)



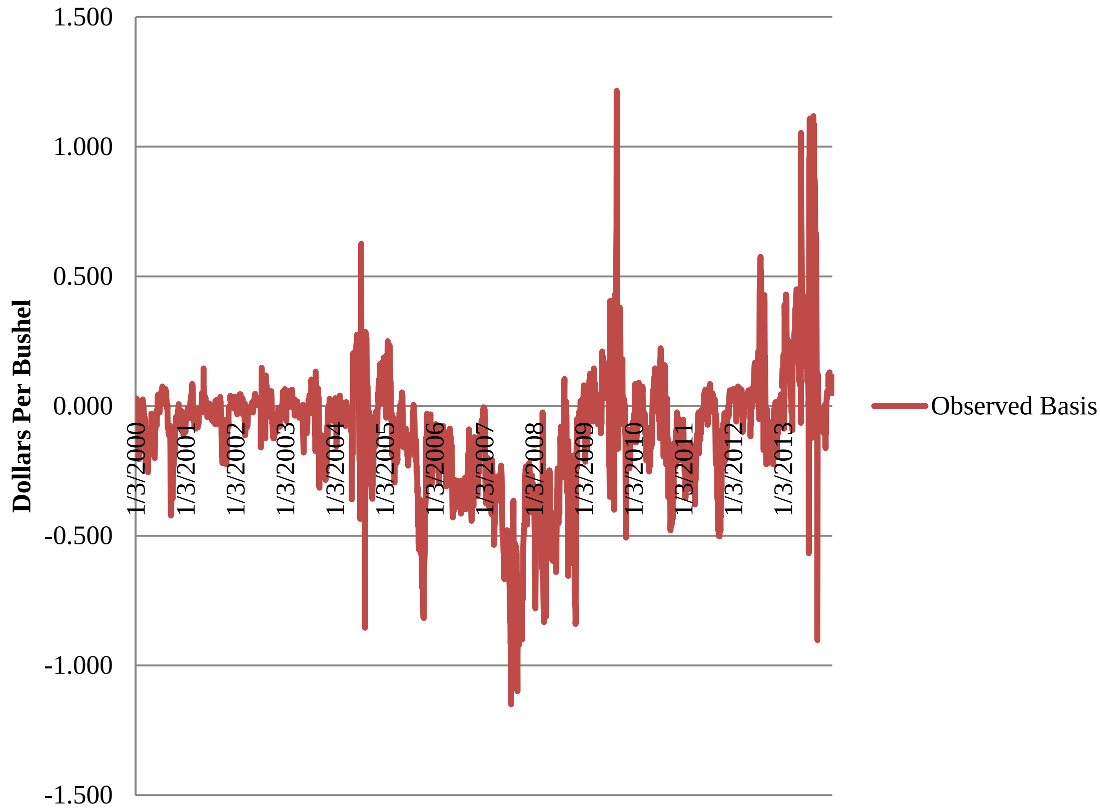
Source: USDA

Table 4A: Processor Corn Basis (2000 to 2013)



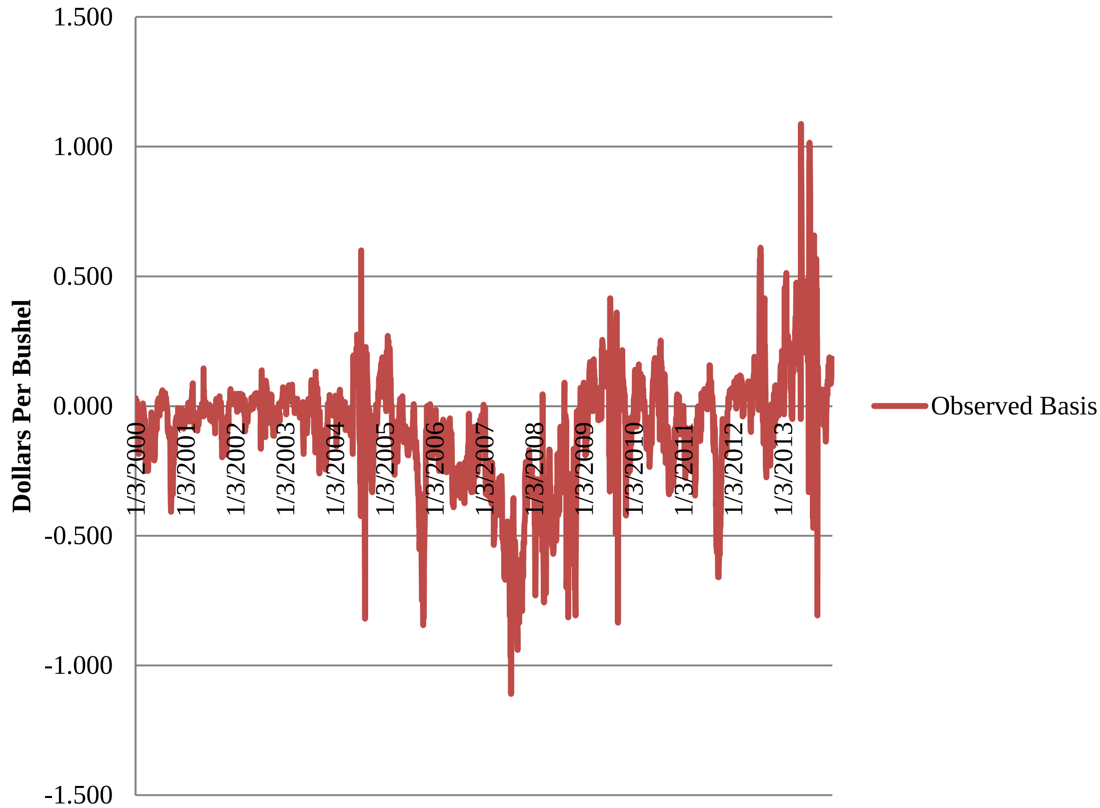
Source: USDA

Table 5A: North Barge Soybean Basis (2000 to 2013)



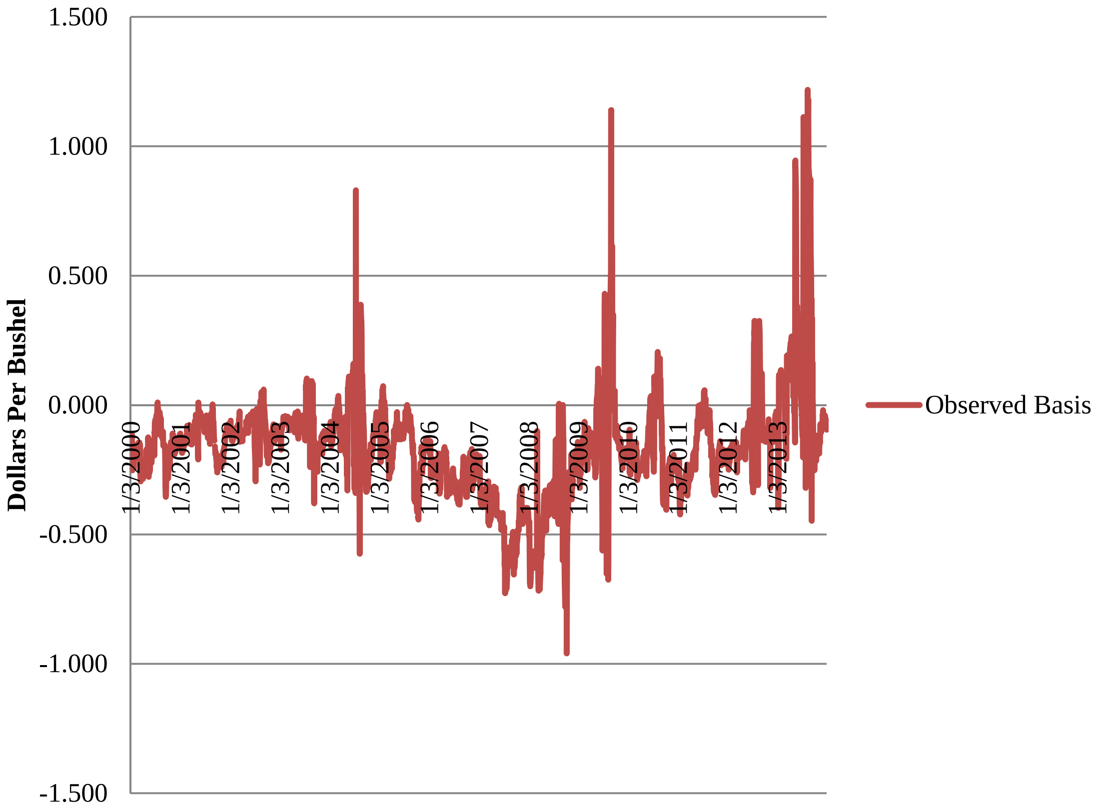
Source: USDA

Table 6A: South Barge Soybean Basis (2000 to 2013)



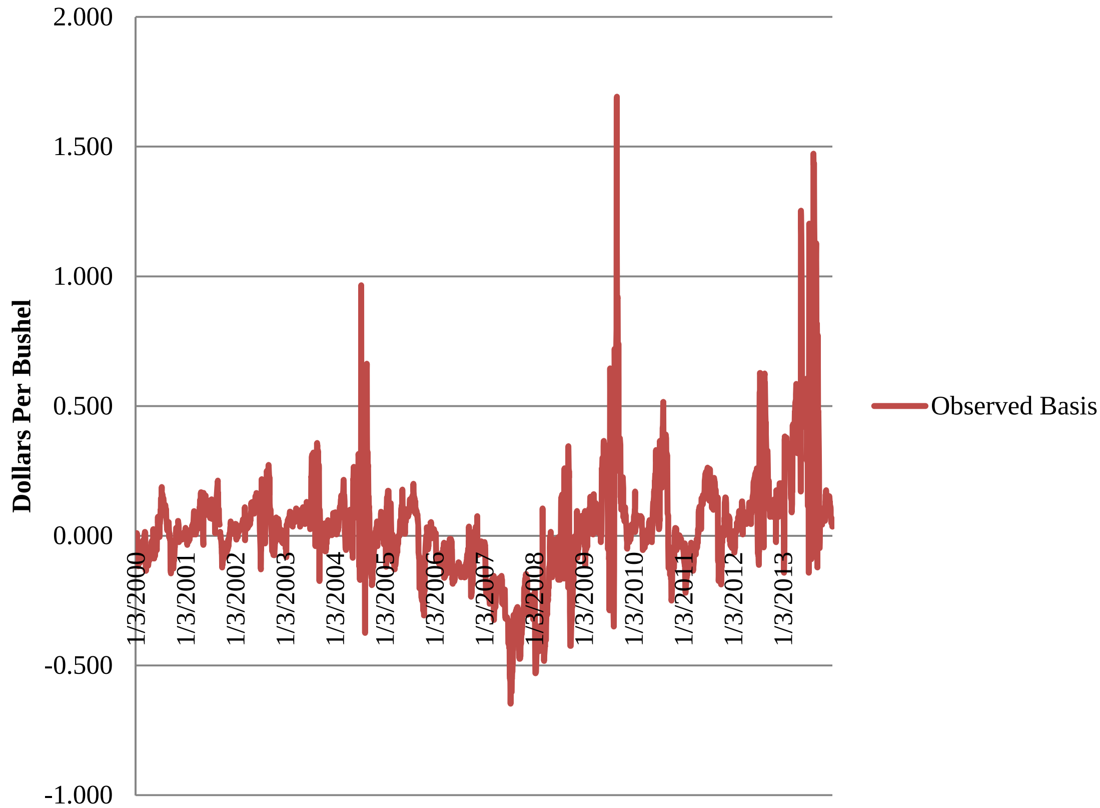
Source: USDA

Table 7A: Inland Terminal Soybean Basis (2000 to 2013)



Source: USDA

Table 8A: Processor Soybean Basis (2000 to 2013)



Source: USDA

APPENDIX B

Table 1B: Corn North Barge Results

	Coefficient	Std. Error	t-ratio	p-value	
const	-0.090820	0.0134276	-6.7637	<0.00001	***
Corn_Nearby	-0.011540	0.0034991	-3.298	0.00098	***
Spread_61_Day	-0.362162	0.0270829	-13.372	<0.00001	***
Inverted_Market	0.259577	0.0128499	20.2007	<0.00001	***
Day_Until_Experation	-0.000319	5.67E-05	-5.6215	<0.00001	***
Heating_Oil	-0.079812	0.0081395	-9.8055	<0.00001	***
Ethanol_Demand	0.018951	0.0017899	10.5879	<0.00001	***
January	-0.010453	0.014217	-0.7353	0.46222	
February	0.041587	0.0145246	2.8632	0.00422	***
March	0.004165	0.0140618	0.2962	0.76709	
April	0.037028	0.0142783	2.5933	0.00955	***
May	-0.036999	0.0143687	-2.575	0.01007	**
June	-0.023646	0.0143568	-1.647	0.09964	*
July	0.003708	0.0143776	0.2579	0.79652	
August	0.107982	0.0139636	7.7331	<0.00001	***
September	-0.065659	0.0142326	-4.6133	<0.00001	***
October	-0.089112	0.0141045	-6.3179	<0.00001	***
November	0.025803	0.0143145	1.8026	0.07154	*

*, **, *** denote significance at the 10%, 5%, and 1% levels

Mean dependent var	-0.104194
Sum squared resid	99.0239
R-squared	0.39127
S.D. dependent var	0.216113
S.E. of regression	0.169027
Adjusted R-squared	0.388284

Table 2B: Corn South Barge Results

	Coefficient	Std. Error	t-ratio	p-value	
const	-0.080190	0.0118698	-6.7558	<0.00001	***
Corn_Nearby	-0.016571	0.0030931	-5.3575	<0.00001	***
Spread_61_Day	-0.356594	0.0239408	-14.895	<0.00001	***
Inverted_Market	0.233294	0.0113591	20.5381	<0.00001	***
Day_Until_Experation	-0.000331	5.02E-05	-6.5914	<0.00001	***
Heating_Oil	-0.060805	0.0071952	-8.4508	<0.00001	***
Ethanol_Demand	0.018241	0.0015822	11.5286	<0.00001	***
January	-0.009107	0.0125676	-0.7246	0.46872	
February	0.045246	0.0128395	3.5239	0.00043	***
March	0.001201	0.0124304	0.0966	0.92304	
April	0.029119	0.0126218	2.307	0.02111	**
May	-0.035228	0.0127017	-2.7735	0.00558	***
June	-0.023977	0.0126911	-1.8893	0.05894	*
July	0.001305	0.0127095	0.1027	0.91822	
August	0.063760	0.0123436	5.1655	<0.00001	***
September	-0.078676	0.0125813	-6.2534	<0.00001	***
October	-0.062957	0.0124682	-5.0494	<0.00001	***
November	0.028582	0.0126538	2.2587	0.02396	**

*, **, *** denote significance at the 10%, 5%, and 1% levels

Mean dependent var	-0.091077
Sum squared resid	77.37996
R-squared	0.40439
S.D. dependent var	0.193133
S.E. of regression	0.149417
Adjusted R-squared	0.401469

Table 3B: Corn Inland Terminal Results

	Coefficient	Std. Error	t-ratio	p-value	
const	-0.134468	0.0123316	-10.904	<0.00001	***
Corn_Nearby	0.004975	0.0032044	1.5526	0.1206	
Spread_61_Day	-0.226161	0.0248243	-9.1104	<0.00001	***
Inverted_Market	0.269123	0.0117691	22.8669	<0.00001	***
Day_Until_Experation	-0.000285	5.20E-05	-5.4837	<0.00001	***
Heating_Oil	-0.038232	0.0074564	-5.1274	<0.00001	***
Ethanol_Demand	0.006805	0.0016412	4.1464	0.00003	***
January	-0.038192	0.0130861	-2.9185	0.00354	***
February	-0.004492	0.0133835	-0.3356	0.73716	
March	-0.060050	0.0129301	-4.6442	<0.00001	***
April	-0.047346	0.013118	-3.6092	0.00031	***
May	-0.098010	0.0132001	-7.4249	<0.00001	***
June	-0.061438	0.0131894	-4.6581	<0.00001	***
July	-0.030824	0.0132083	-2.3337	0.01967	**
August	0.075869	0.0128302	5.9133	<0.00001	***
September	-0.037735	0.0130762	-2.8858	0.00393	***
October	-0.064866	0.0128446	-5.0501	<0.00001	***
November	0.004205	0.0131636	0.3194	0.74941	

*, **, *** denote significance at the 10%, 5%, and 1% levels

Mean dependent var	-0.14244
Sum squared resid	83.34906
R-squared	0.366067
S.D. dependent var	0.194235
S.E. of regression	0.155028
Adjusted R-squared	0.362959

Table 4B: Corn Processors Results

	Coefficient	Std. Error	t-ratio	p-value	
const	-0.051256	0.0124194	-4.1271	0.00004	***
Corn_Nearby	-0.003381	0.0032253	-1.0482	0.29462	
Spread_61_Day	-0.281812	0.0250448	-11.252	<0.00001	***
Inverted_Market	0.259057	0.0118729	21.8192	<0.00001	***
Day_Until_Experation	-0.000217	5.25E-05	-4.1329	0.00004	***
Heating_Oil	-0.035819	0.0075139	-4.767	<0.00001	***
Ethanol_Demand	0.016811	0.0016559	10.1526	<0.00001	***
January	-0.036661	0.0131572	-2.7863	0.00536	***
February	-0.001013	0.0134168	-0.0755	0.9398	
March	-0.050965	0.0130134	-3.9164	0.00009	***
April	-0.036924	0.0132138	-2.7943	0.00523	***
May	-0.090971	0.0132973	-6.8413	<0.00001	***
June	-0.065048	0.0132864	-4.8959	<0.00001	***
July	-0.036207	0.013317	-2.7188	0.00658	***
August	0.088889	0.0129227	6.8785	<0.00001	***
September	-0.026722	0.0131719	-2.0287	0.04256	**
October	-0.049693	0.0129287	-3.8437	0.00012	***
November	0.013641	0.0132477	1.0297	0.30322	

*, **, *** denote significance at the 10%, 5%, and 1% levels

Mean dependent var	0.00961
Sum squared resid	85.13276
R-squared	0.393996
S.D. dependent var	0.200459
S.E. of regression	0.15643
Adjusted R-squared	0.391035

Table 5B: Soybean North Barge Results

	Coefficient	Std. Error	t-ratio	p-value	
const	-0.070892	0.0149962	-4.7273	<0.00001	***
Soybean_Nearby	0.015851	0.002149	7.3762	<0.00001	***
Spread_61_Day	-0.131417	0.00971236	-13.531	<0.00001	***
Inverted_Market	0.164853	0.00854827	19.285	<0.00001	***
Days_Until_Experation	0.000101	1.93E-04	0.5224	0.6014	
Heating_Oil	-0.088391	0.00835544	-10.579	<0.00001	***
January	-0.018586	0.0156661	-1.1864	0.23556	
February	-0.007585	0.0159087	-0.4768	0.63355	
March	-0.074163	0.015364	-4.827	<0.00001	***
April	-0.031632	0.015579	-2.0304	0.04239	**
May	-0.103100	0.0156067	-6.6062	<0.00001	***
June	-0.125849	0.0159237	-7.9033	<0.00001	***
July	-0.165744	0.0168759	-9.8213	<0.00001	***
August	-0.073376	0.0158977	-4.6155	<0.00001	***
September	-0.132288	0.0157237	-8.4133	<0.00001	***
October	-0.160953	0.015516	-10.373	<0.00001	***
November	-0.058038	0.0158062	-3.6718	0.00024	***

*, **, *** denote significance at the 10%, 5%, and 1% levels

Mean dependent var	-0.096741
Sum squared resid	120.8169
R-squared	0.357262
S.D. dependent var	0.232311
S.E. of regression	0.186675
Adjusted R-squared	0.354295

Table 6B: Soybean South Barge Results

	Coefficient	Std. Error	t-ratio	p-value	
const	-0.053516	0.0144756	-3.6969	0.00022	***
Soybean_Nearby	0.015532	0.00207441	7.4872	<0.00001	***
Spread_61_Day	-0.116581	0.00937522	-12.435	<0.00001	***
Inverted_Market	0.153806	0.00825154	18.6397	<0.00001	***
Days_Until_Experation	0.000257	1.87E-04	1.3785	0.16814	
Heating_Oil	-0.079624	0.00806541	-9.8722	<0.00001	***
January	-0.022577	0.0151223	-1.493	0.13554	
February	-0.013808	0.0153565	-0.8992	0.36861	
March	-0.086147	0.0148307	-5.8087	<0.00001	***
April	-0.049281	0.0150382	-3.277	0.00106	***
May	-0.115424	0.015065	-7.6618	<0.00001	***
June	-0.126442	0.0153709	-8.2261	<0.00001	***
July	-0.168382	0.0162902	-10.336	<0.00001	***
August	-0.144344	0.0153458	-9.4061	<0.00001	***
September	-0.195128	0.0151779	-12.856	<0.00001	***
October	-0.163293	0.0149774	-10.903	<0.00001	***
November	-0.069649	0.0152575	-4.5649	<0.00001	***

*, **, *** denote significance at the 10%, 5%, and 1% levels

Mean dependent var	-0.084623
Sum squared resid	112.575
R-squared	0.349704
S.D. dependent var	0.22294
S.E. of regression	0.180196
Adjusted R-squared	0.346703

Table 7B: Soybean Inland Terminal Results

	Coefficient	Std. Error	t-ratio	p-value	
const	-0.166952	0.0137081	-12.179	<0.00001	***
Soybean_Nearby	0.007970	0.00196578	4.0545	0.00005	***
Spread_61_Day	-0.093522	0.00886586	-10.549	<0.00001	***
Inverted_Market	0.148239	0.00776164	19.0989	<0.00001	***
Days_Until_Experation	-0.000110	1.77E-04	-0.6216	0.53423	
Heating_Oil	-0.054009	0.00762815	-7.0802	<0.00001	***
January	-0.036120	0.014351	-2.5169	0.01188	**
February	-0.007075	0.0145885	-0.485	0.6277	
March	-0.047414	0.0140626	-3.3717	0.00076	***
April	-0.014195	0.0142467	-0.9963	0.31915	
May	-0.031441	0.0142733	-2.2028	0.02767	**
June	-0.038765	0.0145628	-2.6619	0.00781	***
July	-0.072784	0.0154337	-4.7159	<0.00001	***
August	0.029185	0.0145415	2.007	0.04482	**
September	0.014095	0.0143788	0.9802	0.32704	
October	-0.070870	0.0140535	-5.0429	<0.00001	***
November	-0.030527	0.0144676	-2.11	0.03493	**

*, **, *** denote significance at the 10%, 5%, and 1% levels

Mean dependent var	-0.160649
Sum squared resid	100.7466
R-squared	0.29694
S.D. dependent var	0.202777
S.E. of regression	0.170417
Adjusted R-squared	0.293698

Table 8B: Soybean Processors Results

	Coefficient	Std. Error	t-ratio	p-value	
const	-0.076327	0.0141835	-5.3814	<0.00001	***
Soybean_Nearby	0.013854	0.0020334	6.8131	<0.00001	***
Spread_61_Day	-0.098590	0.00919825	-10.718	<0.00001	***
Inverted_Market	0.155671	0.00804727	19.3445	<0.00001	***
Days_Until_Expiration	-0.000258	1.83E-04	-1.4091	0.1589	
Heating_Oil	-0.037997	0.00790134	-4.8089	<0.00001	***
January	-0.029770	0.0148444	-2.0055	0.04499	**
February	-0.002424	0.0150458	-0.1611	0.87201	
March	-0.025556	0.0145583	-1.7554	0.07928	*
April	0.017394	0.014762	1.1783	0.23877	
May	0.008857	0.0147876	0.5989	0.54925	
June	-0.001006	0.0150869	-0.0667	0.94683	
July	-0.054061	0.0159886	-3.3812	0.00073	***
August	0.076334	0.0150621	5.068	<0.00001	***
September	0.075792	0.014899	5.0871	<0.00001	***
October	-0.041054	0.0145504	-2.8215	0.00481	***
November	0.005465	0.0149773	0.3649	0.7152	

*, **, *** denote significance at the 10%, 5%, and 1% levels

Mean dependent var	0.038435
Sum squared resid	108.9162
R-squared	0.333252
S.D. dependent var	0.216131
S.E. of regression	0.176886
Adjusted R-squared	0.330187