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Grain Pricing and Transportation: Dynamics and Changes in Markets

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Grain Pricing and Transportation: Dynamics and Changes in Markets

Highlights

There are important challenges to the grain handling and shipping industries, as well as understanding the role of transportation, basis relationships and grain pricing. The purpose of this study is to analyze the relationships and impacts between shipping costs and basis values at origins and destinations, and grain pricing.

Detailed data were analyzed on origin and destination basis values. These were analyzed over numerous origins and during the period 2004 to 2009 and 2010 in the case of soybean and corn respectively. Detailed data were also analyzed on marketing costs and factors impacting basis values.

The major results are summarized below.

Changes in Exogenous Factors: Over the last six years there have been important changes in factors that impact grain pricing and basis values. Most important are:

- Exports have changed in several dimensions. Export levels have increased. Second, the inter-weekly variability (an indicator or risk) in exports has increased. And third, it appears exports have become more seasonally concentrated, particularly for soybeans.

- Ocean rates have increased, and have become more volatile. In addition, the US Gulf-PNW spread has increased, increasing demand for shipping to the PNW.

- Rail car on-time performance has improved. The results indicate that there were periods of shortages in 2004 and 2005 and in 2008. Since then, late car-placement performance has improved substantially with the number of cars past due dropping to low values for much of late 2008, 2009 and 2010.

- Concentration in the grain handling sector has increased, and varies geographically. Some regions are highly competitive. However, some regions have much greater concentration.

- Storage capacity has become tighter in recent years.

Basis Behavior: Origin basis values show geographical dispersions as expected. For soybeans, the basis is a larger negative value for stations in North Dakota, South Dakota, and western Nebraska. The basis values are highest for stations located near the river including Illinois, Indiana and Ohio.

Basis risk has escalated in recent years. Since 2007 the level of risk has increased substantially. The destination basis is more volatile, at least in recent periods, than the origin basis.

*Marketing Costs***:** Major marketing costs have increased and are more volatile. Results of interest are:

- The ratio of farm price to destination market price for soybeans decreased from 91 to 90% of the destination market value. For corn, the average farm price ratio decreased from 77 to 73%.

- Handling and trading margins have increased and the rate of increase has exceeded that of other market functions.

- Barge shipping costs increased by 41% and 33%, respectively for soybeans and corn. Rail tariff increases were comparable to less.

- Elements of rail shipping costs include the rail tariff, the FSC and daily car values. For soybeans, the changes were: rail tariff increased $0.20/bu.; car values decreased by $0.05/bu.; and FSC increased $0.10/bu. For corn, the changes were: rail tariff +$0.24/bu.; car values $-0.03/bu.; and FSC increased $0.16/bu.

Risk in Grain Marketing Functions: The results indicate the most risky functions are ocean rates and spreads, followed by handling margins, barge costs, and then much lower are rail car values, rail tariffs and FSCs. The risk in barge rates is greater than rail tariffs and total rail shipping costs.

Variability in secondary car values is important. The results indicate that this variable has become more risky. However, risk in the primary market value for rail cars is virtually nil. Thus, the results indicate that freight availability is guaranteed from the railroad (via its shuttle mechanism) at virtually nil premiums in the primary market. This differs drastically from what is implied in secondary market values which are much more risky, and impacts shippers and growers in terms of basis.

Taken together these results indicate that 1) origin basis values have become more risky; 2) all marketing costs have increased; 3) the increase in rail tariffs were less than those for the other modes; 4) car values, on average declined; 5) FSC's had moderate changes in absolute terms; and 6) handling margins have had fairly substantial increases, particularly at port.

Factors impacting origin basis A regression model was estimated to evaluate the impact of specific variables on origin basis values. The results indicated the following variables were significant in explaining variability in origin basis values: shipping costs, ocean rate spreads, outstanding export sales, concentration in the grain handling industry, measures of rail cars late, the ratio or grain stocks to storage capacity, futures prices, and varying measures of futures and destination spreads.

Implications: Several issues emerged that will have future implications for the industry, policy makers and influencers. One is that in demand-pull markets, the grower bears less of the shipping and handling costs, but bears more of the risk. Thus, growers need to become much more proficient in marketing. Other issues involve interpretation of rail car values and their impacts on pricing and risk, seasonal and unexpected changes in shipping demands and the role of risk and risk reducing mechanisms each of which will likely become more important.

Grain Pricing and Transportation: Dynamics and Changes in Markets

Introduction

Numerous changes are occurring in world agriculture which are having dramatic impacts on the international and domestic shipping industries. These are caused in part by the fairly robust increases in demand for grains and oilseeds which are being driven by indigenous growth (i.e., attributable to population and income growth, in addition to changes in diets, urbanization, etc.). One of the most dramatic changes is growth in the demand for soybean imports into China, which is very rapid, and far exceed previous expectations. In addition to these, new sources of demand largely attributable to the biofuel sectors now comprise 35% of the land planted to corn. Finally, these changes have resulted in intense competition among exporting countries which compete not only in production but also in shipping costs and logistical practices.

The combination of these changes has had several important effects. One is the intense battle for acres within the United States that is causing changes in the spatial distribution of production among crops in major producing regions. A second is that there is greater volatility in shipping demands, both inter- and intra-seasonally. This is caused in part by the growth in production and exports from competing countries, but also because much of this is occurring in countries that have greater uncertainty in production, and/or in countries that have contra-seasonal harvests to those in the United States. Combined, this has resulted in greater volatility in shipping demands in the United States.

One impact of these is changing intermarket relationships in the US grain marketing system. Basis relationships have become more volatile and less predictable, as have changes in seasonal behavior. The greater volatility results in more risk for producers and shippers, and exacerbates planning and investment for handling and shipping infrastructure.

These are important challenges to the handling and shipping industries. The purpose of this study is to analyze relationships and impacts between shipping costs and basis values at origins and destinations. Important is how these have changed through time, as well as intermarket relationships. There are a multitude of factors inclusive of transportation costs that impact these relationships.

First, we describe some of the background developments including results of recent studies on this subject. Second, we describe grain pricing and intermarket relationships. Third, data sets used in the project are described. The behavior of important variables is shown along with a statistical analysis of corn and soybean basis. Important here is the relationship between origins and port-area basis values. Following a description of the data, two sets of econometric results are shown that explore these relationships.

The results evaluated how basis values vary across origins, and through time as well as their relationship with destination basis values. The ratio of farm price to destination market price for soybeans from 2004-2009 decreased from 91 to 90% of the destination market value. For corn, the average farm price ratio decreased from 77 to 73%. The study evaluated changes in marketing costs for the primary grain marketing functions and quantified measures of risk. The results indicate that 1) basis risk has increased substantially; 2) all marketing costs have increased; 3) the increase in rail tariffs were less than those for the other modes; 4) car values, on average declined; 5) FSC's had moderate changes in absolute terms, but, greater percentage increases; 6) handling margins have had fairly substantial increases, particularly at port; 7) concentration in grain handling has escalated in some regions; and 8) the riskiness in rail shipping costs are less than those of competing modes and functions. The regression model explored these relationships further. The results indicated the following variables had significant impacts on origin basis values: shipping costs, ocean rate spreads, outstanding export sales, concentration in the handling industry, measures of rail cars late, the ratio of grain stocks to storage capacity, futures prices and spreads (in addition to a few other minor impacts).

Background and Related Studies

Recent studies have analyzed the role of transportation costs in grain pricing in recent years which are reviewed in the section below. First, we describe some of the major innovations in grain rail logistics that are impacting the evolution of the grain marketing system in the United States.

Major Innovations in US Grain Rail Logistics: There have been a number of changes in rail logistics and shipping which can be interpreted as varying forms of technological innovations in this sector. Taken together, these have resulted in numerous changes throughout the shipping and handling industry and have resulted in improved efficiency throughout many aspects of the industry.[1]

We identify five innovations in grain shipping. One was the shift from box-car shipping to covered hopper car shipments. This was one of the first improvements in efficiency in recent decades. Prior to about the mid-1980s the predominant rail car was the box car. Beginning in the late 1980s covered hopper cars began to be used forshipping.[2] Initially, these had a capacity of 100 tons. Since then, the capacity has

[1]These are important in part because they have resulted in logistical advantages to the United States in the case of grain shipping. Indeed, these are being studied by analysts in several competing countries as they seek to improve their logistical efficiency.

[2] Specifically, this was a long transition, extending from the 1960s into the 1980s. Many branch and secondary lines needed track upgrades to accommodate 100-ton capacity hoppers. Large main-line load-out points could make the transition earlier and some branch lines were unable to do so and were abandoned rather than making the transition. The railways apparently stopped investing in box cars for general grain service by the early 1960s, but box-car grain still could be seen into the first half of the 1980s. Covered hoppers replaced boxcars for grain in the late 1960'swhen 100 ton cars were approved

increased and the high-cube cars now have 110 tons capacity. Simply, this means more grain is shipped per car.[3]

Second was adoption of short line railroads. This commenced following interpretations of provisions in the Staggers Rail Act of 1980 (SRA). The SRA reduced restrictions on railroad operations including provisions for "downsizing or abandonment, in the form of selling off portions of light density lines in the rail network" (Fisher, Bitzan and Tolliver, 2001). Much of this light density network was taken over by smaller railroads known as short lines. The impact of this was a reduced cost of shipping for shipments originating on what came to be called short lines railways.

The third technology improvement relates to number of cars per shipment. Originally, the consignment was for a single rail car. Commencing in the late 1970s railroads began shipping in multi-car units. This was further expanded following the SRA which encouraged efficiency inducing shipping practices. In the upper-Midwest, this resulted in shipping alternatives originally to include 26 car shipments, and then 52 car shipments. These had loading requirements and were available at a reduced cost to shippers. Commencing in 1993, railroads began experimenting with varying forms of what later came to be called *shuttle* shipments. Initially, these were experimental and were consummated through private contractual relationships. Later these were standardized, and were available through public contracts. Now, most all of the railroads in North America have varying forms of shuttle shipments.

One of the most often referenced shuttle programs is the BNSF's which requires loading and unloading in a specified period, and provides a re-loading provision. These have varying incentives that are paid to the loader, receiver and shipper.[4] Shuttle trains have caused a major change in the technology of shipping, in addition to inducing massive investment in both originating and terminating capabilities.[5] For the BNSF, the number of shuttle origin elevators increased from 118 in 2000 to 263 in 2010,[6] and, virtually all export terminals have shuttle unloading capabilities. Finally, incentives for more efficient origination are resulting in further investment in origin elevators capable of faster-loading.

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by the American Association of Railroads (AAR). This happened on Penn central shortly after 1968, but both PRR and NYC had a large number of 100 ton grain cars in service on selected lines before then. 100 ton cars are 263000lb. gross rail load. That changed in the mid-1990's to 286,000lb.

[3] For comparison, and of relevance, consider: In Canada, in which the majority of rail cars are owned by varying government entities, the average load capacity are substantially less (about 89 tons).

[4]See www.bnsf for current shuttle provisions.

[5] Sarmiento and Wilson (2005) provide a detailed explanation of the adoption of shuttle train elevators, along with a spatial econometric analysis of factors impacting these decisions, notably, the impact of spatial rivalry.

[6] BNSF personal communication, 2010.

An innovation that has had less recent attention is the demurrage provision for grain loading. Prior to 1997, it was common for demurrage for rail cars to not apply for grain loaded on weekends. Thus, while shippers accrued fees for being late, they were effectively not accrued for car placements on weekends.[7] Since then, use of demurrage on grain cars has evolved[8] and serves the purpose of discouraging idle equipment. As a result, there is an incentive for shippers to load cars on weekends, and, hence has resulted in greater productivity in the use of railcars (i.e., car utilization).

The last innovation is that of forward instruments for car allocation. Prior to the late-1980's railroads did not offer any form of guarantee on forward shipments.[9] During this period, rail rates were relatively sticky with few intra year changes, the pricing mechanism was via tariffs using posted prices, cars were allocated on a *first-come-first-served* basis and there was little innovation to assure timely car placement. During the period prior to the 1980s, there was more liberal car ordering provisions resulting in frequent *phantom orders* which made rail planning highly uncertain. In the period immediately following the SRA, private contracts evolved to be the predominant pricing mechanisms (Wilson and Dahl, 2005). Commencing with the COTs program (Certificate of Transportation which had its origin in 1988), railways began offering varying forms of forward guaranteed shipments, which were tradable, included penalties, and shuttle trains shipments.

Commercial provisions of these shipping terms, along with their tradability are significant. Importantly, these provided a mechanism to allow the development of what is now commonly referred to as *secondary rail car markets.* These typically operate through cash brokers, as well as being offered by buyers, and/or bundled with grain purchases. Importantly, these provide a market for rail cars which is forward, transparent and provides a risk mitigation alternative to both changes in rail rates and assurances on rail car placements.

There have been important impacts of these technological innovations on rail operating efficiency, costs and tariffs. First, the cost of rail shipping declined (Wilson and Wilson 2001). Specifically, though dated, their model was applied to five of the leading agricultural commodities shipped by rail, and found that rates had fallen dramatically over time, but there were differences across the commodities in magnitude. They also found that the effect of partial deregulation on rates and productivity was large.

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[7]The BNSF began implementing a new policy in 1997 which required that elevators load grain cars and have them ready for release within 24 hours of the time the cars are "spotted" (brought to the elevator). If the process is not completed in 24 hours, the railroad imposed a $50-per-car, per-day fee. BNSF previously allowed 48 hours before elevators would be charged demurrage on the cars. The railroad also cut its previous limit on unloading time (Rustebakke, 1997).

[8] See Wilson, Carlson and Dahl (2004) for a description of the evolution and use of demurrage in rail, barge and ocean shipping.

[9] Wilson and Dahl (2005) provide detailed background and economic analysis on these mechanisms.

The cumulative impact of these innovations has resulted in greater rail efficiency and car placements. These are not easily documentable though several points can be made. One is that BNSF shuttles are nearly 3 times as efficient as non-shuttles. On average there are 12 car cycles per year for non-shuttle shipments, and 31.8 for shuttle shipments.[10] Efficiency of shuttle shipments on grain is approaching that of competing rail products (e.g. coal, etc.). The impact of this is to improve returns and encourages investment in grain shipping. These have resulted in improved velocity which has the impact of increasing grain car capacity. Specifically, the BNSF's capacity has increased by 18% between 2006 and 2010 due to these efficiency improvements. Finally, barges and other modes have not achieved comparable efficiency gains.

Studies on Grain Pricing and Transportation

Several studies have recently analyzed issues related to rail and grain pricing. These include the USDA (2010), and studies on soybeans (O'Neil Commodity Consulting, 2010), corn (Informa Economics, 2010) and wheat (Vachal, Benson and Berwick, 2010). Some of the important points from each of these are reported below.

The USDA study (Denicoff, et al., 2010; and Casavant and Prater, 2010) had important results. First, changes in supply or demand affect the transport system's efficiency by bringing about either shortages or surpluses in capacity. Second, lower origin prices from *transportation inefficiencies* hinder farmers from borrowing funds to purchase fertilizer, seed and machinery and reduce economic prosperity in rural areas. The insinuation here is that transportation inefficiencies result in lower prices to growers which have the impact of reducing their ability to borrow funds for inputs. Though this (and others) study makes liberal use of the term transportation inefficiency, it is not defined. In contrast, typically, transport shortages would accrue when exports are strong and prices high (not low).

Third, USDA (2010) found that higher transportation costs affect the position of US agricultural products in highly competitive export markets. The rates shippers pay for rail transportation can facilitate or inhibit US competitiveness in world markets. Fourth, the share of marketing costs (e.g., rail tariffs) as a percent of average farm price is about 11-12% in 2007-2008; down from 20% in 2005. Finally, Casavant and Prater (2010) examined issues related to rail service and, specifically on-time performance using data from *Argus Media*. They showed that on time delivery has improved and has been consistent. They also point out that "complaints being filed with the STB indicate that agricultural products are the commodity with the most complaints, and rail service has been the most common type of complaint over the past four years."

A detailed study was conducted on soybean basis relationships and how shipping costs impact inter-market relationships (O'Neil Commodity Consulting, 2010). The study was motivated to document 1) how changes in rail and barge rates impact

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[10] BNSF personal communication.

local prices; 2) how local basis is impacted by destination basis and transportation costs; 3) the incidence of changes in transport costs; and 4) to examine financial impacts of transportation cost and service disruption on producer incomes. The study involved comparing the origin basis at a number of markets with prescribed destination basis at the US Gulf and Pacific Northwest (PNW) over the period 2004-2009. The destination market and basis were determined *a priori*, versus allowing the basis to be determined by the market which maximizes payoffs. Conclusions were based on graphical comparisons among origin and destination basis, and shipping costs.

The results indicated that in most cases, basis declines exceeded the extent of changes in freight rates (hinting that part is passed on to receivers, and/or greater handling margins). Second, the allocation of transport costs should be split between that absorbed by growers vs. consumers (commonly referred to as the incidence of transport costs). Third was that the spread between origin and destination basis has increased. This is likely due to the increase in shipping costs and that there has been an increase in elevator handling costs and margins. The study suggests that handling margins may have been widening in recent years as result of consolidation, volatility, etc.

Fourth, the allocation of transportation costs should vary depending on market conditions. Specifically,

> *In times of high product demand, a larger proportion of a freight rate increase will be passed on to the consumer. But since we live in a global market, U.S. commodities can only be sold at competitive world values. It is therefore accurate to say that, most of the time, when markets are not demand driven, an increase in transportation costs cannot be passed on to the consumer and therefore must be primarily shouldered by the seller/producers (O'Neil Commodity Consulting, p. 8).*

Interpretation of who absorbs transport costs was an important motive for this study. It did so in part through observing basis differentials at different points in time. The appropriate question that can be answered from economics is who absorbs changes in shipping costs, or, more precisely, how changes in shipping costs are shared between buyers and sellers.[11] The answer depends on elasticities of supply and demand. In markets with relatively more elastic demands than supplies, changes in shipping costs are accrued more by producers than consumers. In contrast, in markets with relatively more inelastic demands than supplies, a greater share is absorbed by consumers. This is important as in commodity markets these relative elasticities likely vary through time.

There are a couple of important points about the incidence of transport costs. First, economic assessment of this issue refers to "changes" in transport costs versus assessment of the absolute value of transport costs. Second, in most all cases, the incidence of changes in shipping costs is shared by buyers and producers. Third, how

[11]This is akin to the incidence of a tax which is discussed in most all economic texts.

changes are shared depend on relative elasticities of supply and demand. More likely the elasticities vary through time, are highly seasonal, and there are random effects.

Finally, the study made suggestions about how availability of transportation equipment (though not analyzed specifically) affects producer prices. When transportation equipment or service is not available during times of high demand, the origin basis drops and farmer incomes are negatively affected. Lack of transportation equipment at such times reduces the quantity of soybeans a farmer can sell at the highest possible price. The implication of these results is that farmers should be strong advocates for a well maintained transportation system that provides reliable service at reasonable and competitive freight costs.

One comparison was made on the share of marketing costs in prices to growers. This was made to Brazil citing USDA data, it indicated:[12]

> *It is important to recognize that the U.S. transportation system is the most efficient in the world. The ability to move large volumes of commodities at relatively low cost is a great advantage to U.S. farmers. According to USDA third quarter 2009 data, a Brazilian farmer in Mato Grosso had to pay an average of $100.41 per metric ton to ship his soybeans and corn to export markets. A must Brazilian farmer in neighboring Groias state paid $54.03 per metric ton to ship soybeans to the nearest port. By contrast, over the same time frame, it cost U.S. Midwestern farmers only $ 16.57-$18.88 per metric ton to ship to New Orleans by barge and $45.35 per metric ton to ship from Iowa to the PNW. This is a substantial advantage for U.S. farmers. Whereas Brazilian soybean producers primarily move soybeans by truck, U.S. shippers enjoy the advantage of shipping in barge movements of 55,000 bushel (1,496 metric tons) and rail shuttle trains of 100-110 cars of 100 metric tons each or 10,000-11,000 metric tons per train (O'Neil Commodity Consulting, 2010, p.4).*

A related study focused on corn was done by Informa Economics (2010), on behalf of the National Corn Growers Association. The motive was to explain trends in rail rates in preparation for discussions on pending legislation. For this reason, the National Corn Growers Association commissioned a study to review and analyze rail freight rates for corn. The focus was on legislative issues including anti-trust, alternatives, revenue-to-variable-cost ratio (R/VC) analysis and legislative alternatives.

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[12]The O'Neil Commodity Consulting (2010) study was used as a reference to highlight grower concerns (American Soybean Association, 2010). Specifically, that communication indicated:

> *A study conducted for Soy Transportation Coalition (STC) shows the relationship between transportation costs and individual farmer profitability….*
>
> *The study concluded that U.S. farmers, more than any other segment of the agriculture industry, pay a disproportionate share of the cost of shipping their products through a wider, more negative basis when they deliver their crop to the elevator.*

Upon close examination, it is not apparent that the O'Neil Commodity Consulting (2010) study analyzed individual farmer profitability and it said nothing about the share of shipping soybean products versus other segments. It simply compared basis differentials for soybeans.

Some of the results of interest to this study are that the fast growing segments are for car loadings of ethanol and distillers grains. These markets have had annual increases averaging greater than 20% since 2000 and car loadings of ethanol and DDGs have more than doubled since 2005. The study points out that over time, through adoption of shuttle/incentive mechanisms, efficiency of the rail transportation system has improved.

It also examined the behavior of basis values in corn which is the topic of the current study. Their results indicated that:

> *basis values vary between the Gulf and the PNW for changes largely associated with inland transport costs. From October 2007 to October 2008, the basis spread between the two locations was at its greatest. During this time, rail tariffs to the PNW were at high levels. The fuel surcharge for rail moves to the PNW was at high levels to compensate for record fuel costs. Over some months, the fuel surcharge from some locations exceeded 40-cents per corn bushel* [long distances, high fuel costs].

The study insinuates that 100% of changes in shipping costs are absorbed by farmers, in addition to other factors.

One other study compared changes in marketing and shipping costs, in this case for wheat shipments from North Dakota (Vachal, Berwick and Benson, 2010). That study analyzed changes in wheat flows, and changes in rail shipping rates, and revenue cost ratios overtime. Major results indicated:

- When comparing 2008 vs. 2001, the revenue per ton mile has been declining;

- While single car and smaller unit train rates have been increasing, the shuttle train rates to both the east and the Pacific Northwest declined from 2005 and 2003, respectively;

- The revenue-to-variable cost ratios showed a declining trend from 2002 to 2008.

Data Sources

A detailed set of data was developed in this study to analyze intermarket basis relationships, and the impact of shipping costs on these relationships. The analysis was conducted on soybeans and corn. Weekly data were used from 2004-2009 for soybeans and 2004-August 2010 for corn.

Data for the soybean analysis was the same as that used in the O'Neil Commodity Consulting (2010) study.[13] This data set included basis data for 36 origins. Some of these were rail and some barge. That data also included barge and rail rates,

[13]This was provided by the SoyTranport Coalition.

as well as fuel service and daily car values for shipments to each origin. It included the following variables with source in ( ): Barge Freight Rates (USDA-AMS Transportation Services Div.), Rail Freight Rates (BNSF tariffs), CIF NOLA Barge Soybean Basis (Advance Trading LLC, Bloomington, IL), Secondary Rail Car Market Values (Trade West Brokerage), PNW Rail Soybean Basis (Advance Trading LLC, Bloomington, IL), Rail Fuel Surcharge rates (Trade West Brokerage Co. & BNSF website) and Origin Basis Values (DTN Prophet Market information system).

For our analytical model, we expanded the data to include more origins and destinations to be more geographically representative. We added the following origins: Venango, NE; Gurley, NE; Bradshaw, NE; Alden, IA; Hinton, IA; Pleasant Hill, IA; Red Oak, IA; Jasper, MN; Breckenridge, MN; and St. Joseph, MO. We also added the Texas Gulf as an alternative destination for soybeans. The analytical model was estimated for both the origins used by O'Neil, and separately for the broader origins defined above.

The data above was supplemented by more detailed rail rate data (described below), soybean export inspections (USDA-AMS), outstanding soybean export sales (USDA-FAS), rail car performance (BNSF) and ocean shipping rates from Gulf and PNW to Japan and spread between PNW and Gulf, the ratio of grain stocks to storage by state (ProExporter) and measures of Herfindahl's and CR4 ratios for loading capacity by state (BNSF, UP, Sosland Publishing). A map of the origins in this data set is shown in Figure 1.1.

Basis data for corn were developed from several sources. The base data for this analysis was fromUSDA-AMS Portal, Trade West Brokerage, and DTN Prophet Market Information system including local and destination basis values (USDA-AMS Portal and Trade West Brokerage Co.) and corn futures (DTN Prophet Market Information System). In order to make this data more representative of the prevailing movements and somewhat consistent with the O'Neil Commodity Consulting data, we added some shipping points. A map of the corn origins is shown in Figure 1.2.

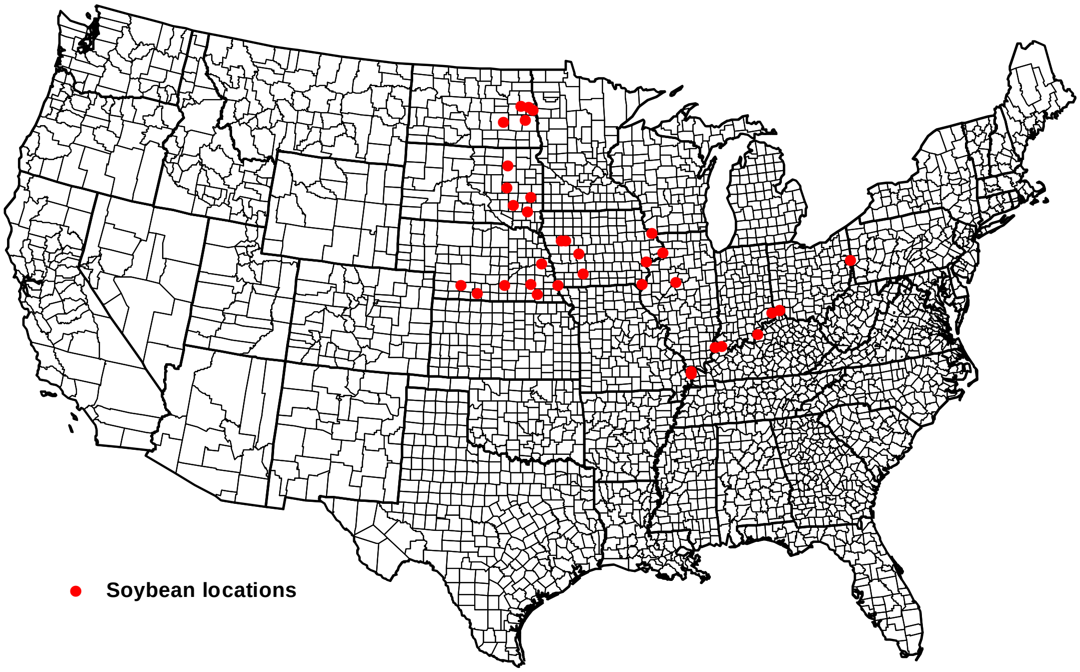

Figure 1.1. Location of Local Soybean Origins.

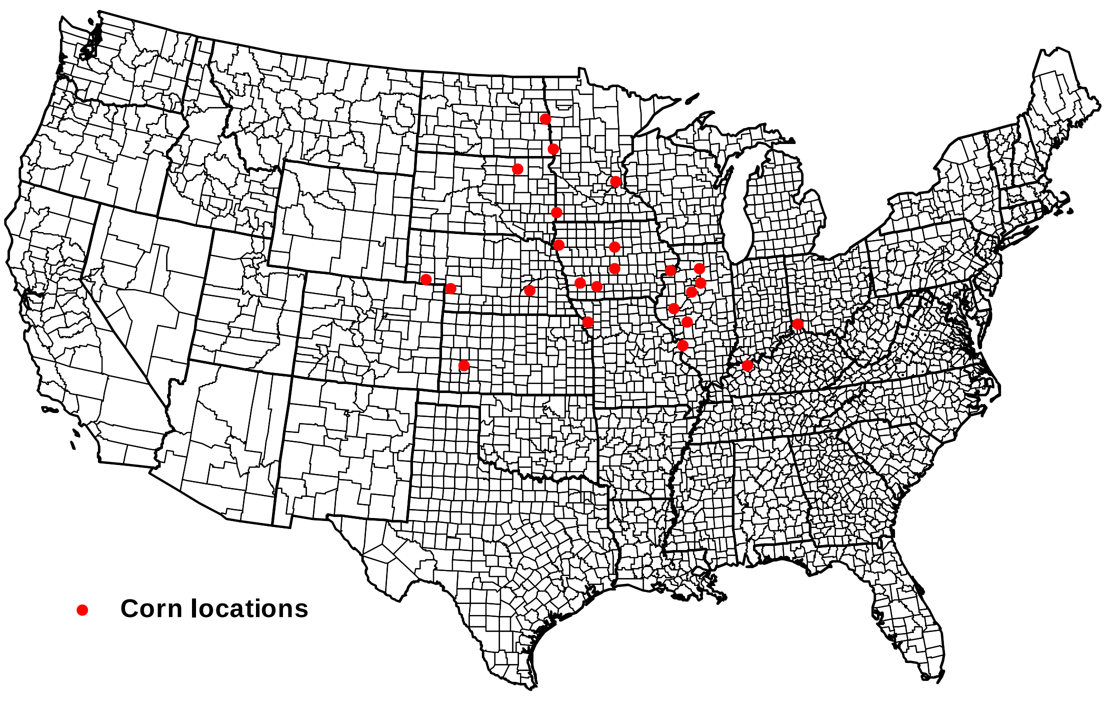

Figure 1.2 Location of Local Corn Origins.

Destination basis values for corn were for US Gulf and PNW, as well as the California feed market. The latter was included because it is so dominant in corn shipments. These were defined further as follows:

- California feed was defined as the Stockton region. This data was from the USDA/AMS Portal and is referenced there as the Stockton- Modesto-Oakdale-Turlock California region bids for No. 2 Corn delivered by truck to mills and processors.

- PNW corn: A number of values were available for this series. That reported in AMS is not appropriate as it mostly reflects values for delivery at processing locations in that region. Instead, the most refined data we could develop was from Tradewest (a cash brokerage company in Portland that has a highly detailed data set on numerous relevant values). Data from that source includes Track values (No. 2), FOB values No. 3 15% moisture and premiums for No. 2 14.5% moisture (versus No. 3, 15% moisture).

- US Gulf corn: These values were also defined as No. 3 15% moisture FOB values with premiums for No. 2 14.5% moisture (Trade West) and we also used a barge delivery bid for No. 2 to export elevators at Louisiana Gulf (USDA-AMS).

These data were used to define the destination basis for corn. It was also used to derive the implied fobbing margin.

A multitude of data sources were used for shipping costs. These include the following with the data source identified in the ( ) :Rail Freight Rates (BNSF tariffs), Secondary Rail Car Market Values (Trade West Brokerage), Rail Fuel Surcharge Rates and distance matrix (BNSF), corn export inspections (USDA-AMS), outstanding corn export sales (USDA-FAS) and rail car performance (BNSF). In all cases, the rail rate used was for the largest train size applicable. In most cases these were for shuttle shipments, otherwise it included the rate for the appropriate size shipments for each origin. If shipping capacity changed, the lower cost shipping rate was applied.

The ratio of grain stocks relative to storage was obtained from (ProExporter) by state and year from 2004-2010. We also derived measures of concentration at origins using the Herfindahl Index and CR4 ratios for loading capacity of firms within a 75 mile area surrounding local destinations. Data on export shipments for corn was from USDA-AMS and outstanding corn sales were from USDA-FAS. Ocean shipping costs were from Maritime Research Inc., as reported in USDA Grain Transportation. Futures prices and spreads were obtained from DTN Prophet Market Information system.

Finally, several specific data sets were obtained from the BNSF. These include rail rates for corn and soybean rail rates to the Texas Gulf and rail car placement performance (on-time) data.

A data set on grain elevators was developed from data for each of major railroads. Variables included were geographic location, ownership, shipping and storage capacity. This data was from the BNSF (available on-line) for each year since 2004. For other railroads, similar data is not available for other than the most current year. Thus, the data for 2010 was applied to all years. These data were used to derive measures of concentration (Herfindahl and CR4) for each origin covering a 75 mile radius around each local origin. The implication of this transformation is that we can capture the inter-origin variability in Herfindahls, but, not the inter-temporal variability.

Data Behavior

First we show some of the background data, and then we show the detailed elements of rail shipping costs. Then we show and compare changes in the values over time. The sections that follow show detailed data on basis values, and derive spreads and margins.

Background Data

<u>Export Shipments and Outstanding Sales</u>: Exports of corn and soybeans are shown in Figures 2.01-2.04. These results show that there is a high degree of seasonality in exports. It is also apparent that shipments between these ports are highly correlated. Finally, shipments in 2010 are notably higher than previous years.

Outstanding sales (USDA-FAS) indicate the volume of sales that have not yet been shipped, and as such are particularly important for understanding basis values and relationships. The volume of outstanding sales in soybeans has been increasing over time, and has been particularly high in 2010. That for corn was notably high in 2008.

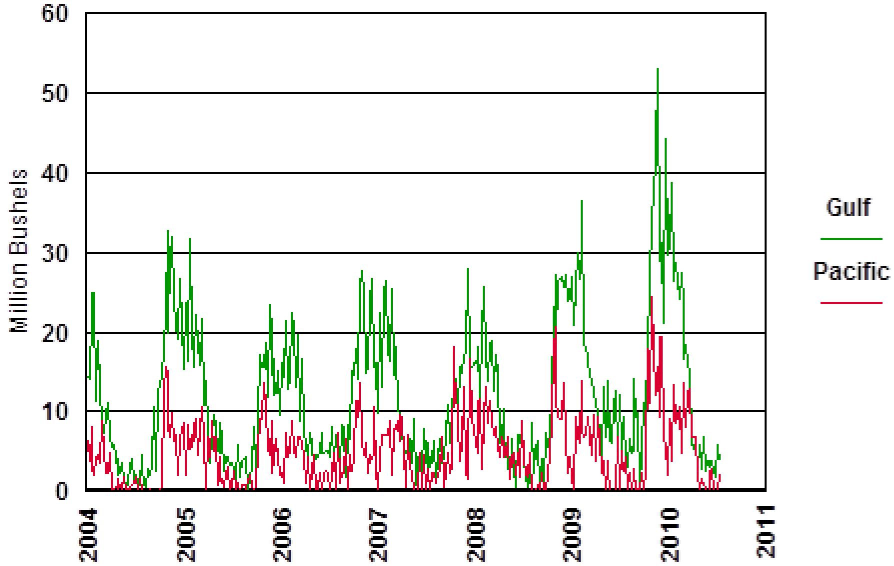

Figure 2.0.1. Soybean Export Inspections by U.S. Port Area, 2004-2010.

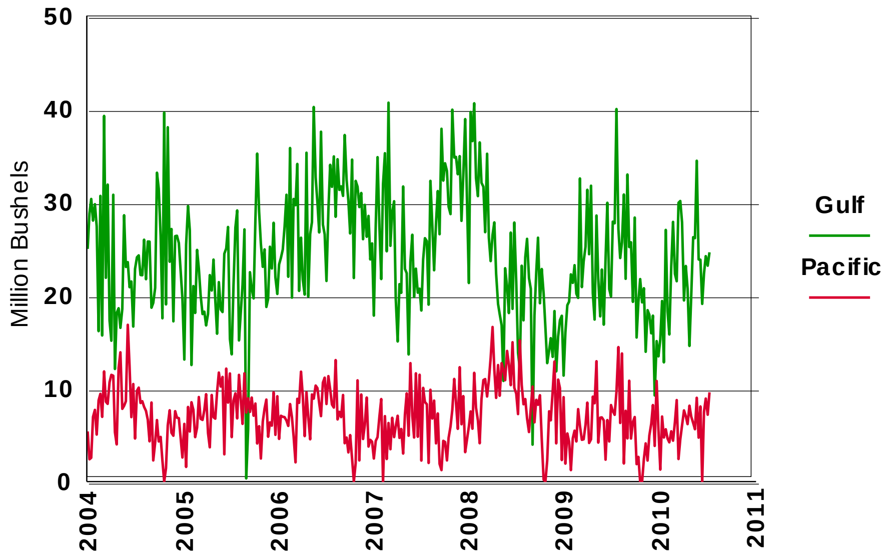

Figure 2.0.2 Corn Export Inspections by U.S. Port Area, 2004-2010.

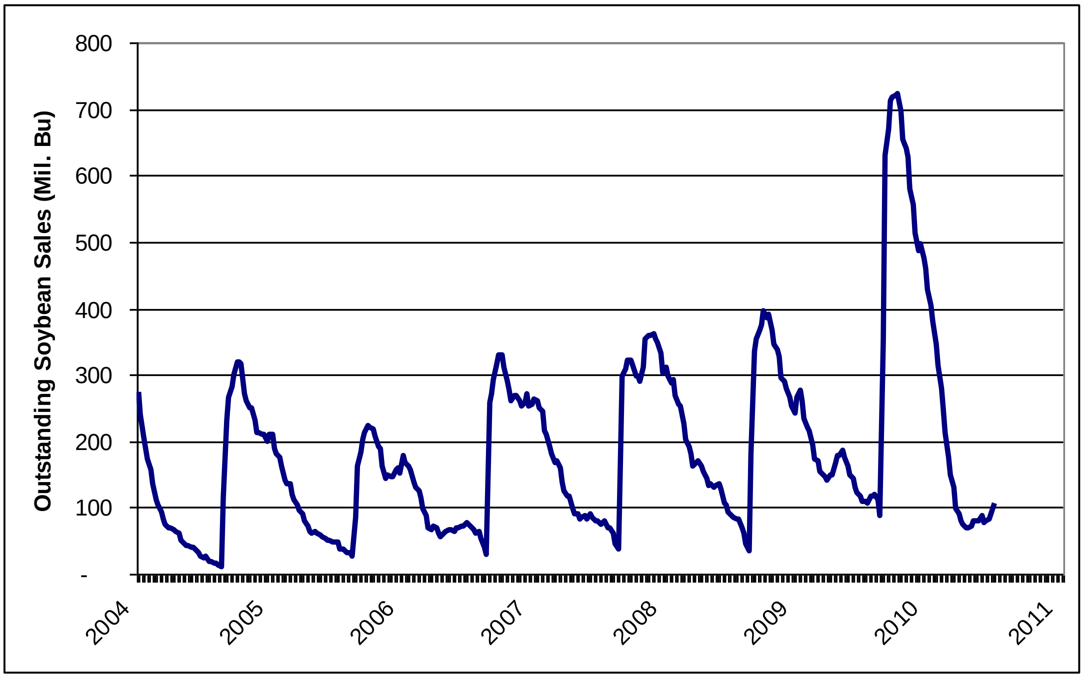

Figure 2.0.3. Soybean Outstanding Export Sales, 2004-2010.

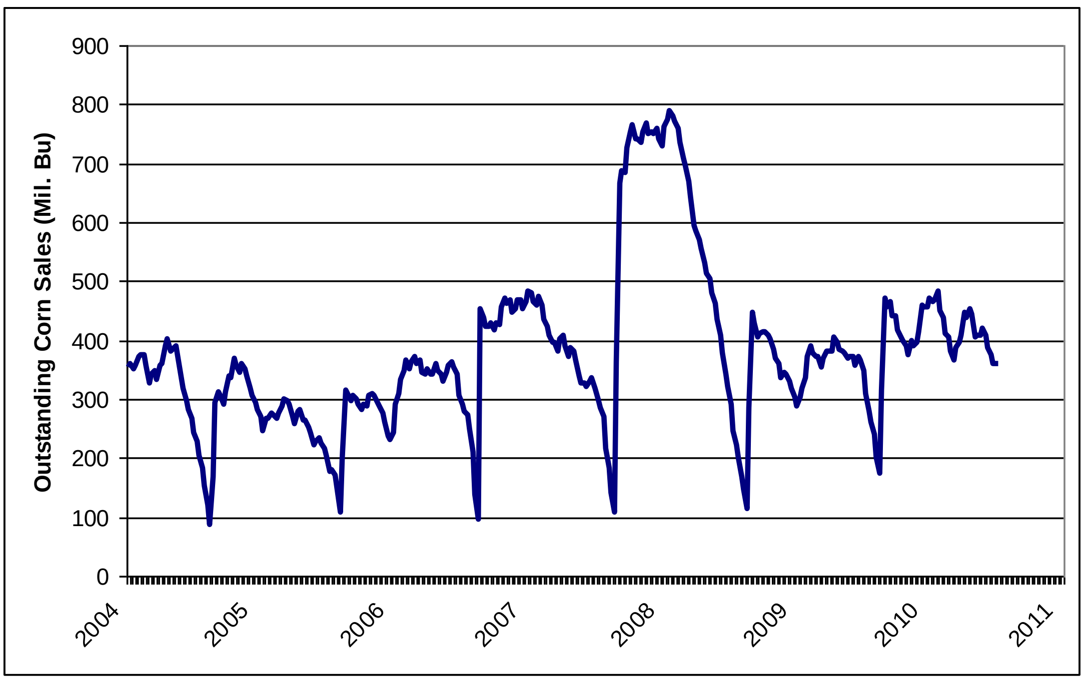

Figure 2.0.4. Corn Outstanding Export Sales, 2004-2010.

<u>Barge and Ocean Rates</u> Shipping costs for barges and ocean rates are showing in Figure 2.0.5-2.0.6.

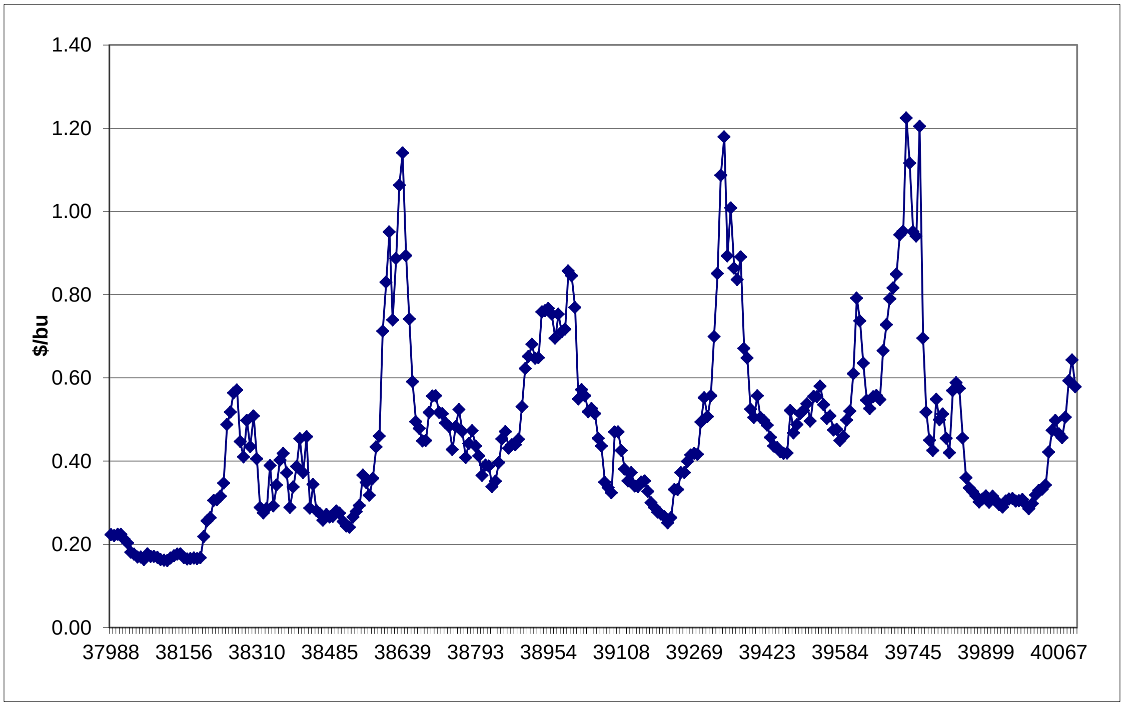

Figure 2.0.5. Average Barge Shipping Costs, 2004-2010.

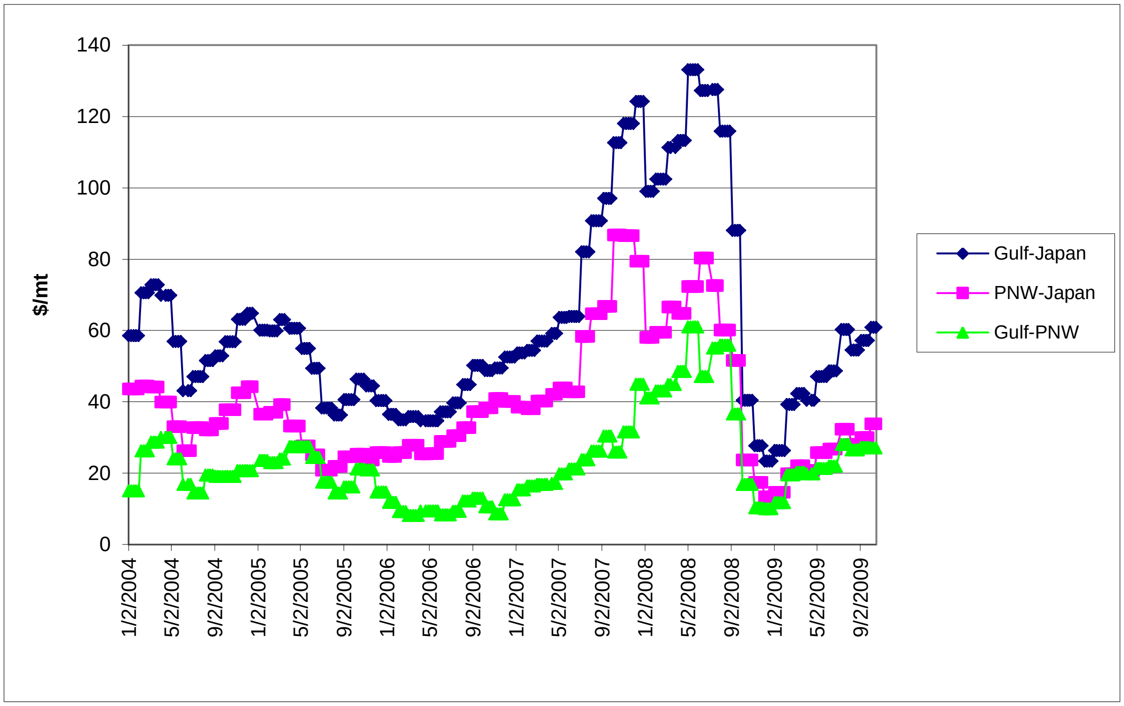

Figure 2.0.6. Ocean Shipping Rates and Spread, 2004-2010.

These rates were highly volatile during this period. Ocean shipping costs fell from record values in spring 2008 to extremely low values in early 2009. Since then, these have increased, and, the spread between the US Gulf and PNW ports to Japan has been increasing which has a major impact on inter-market relationships and basis values.

Concentration in Grain Handling: There are several measures of industry concentration, including the number of firms (N), concentration ratios (CR4) and Herfindahl indexes (H).[14] We derived these measures for country elevation shipping capacity.[15]

Data for this was described above. These could not be derived over time because most railroads do not make available this data through time. Thus, we used the data for the most recent period which was typically 2010. For each major railroad we identified shuttle train elevators, and their location, ownership, and shipping and storage capacity. From this, we combined firms that had common ownership. Using this data we derived H and CR4 for shuttle train shipping capacity (in addition to storage capacity). This was measured by identifying shipping capacity of all shuttle train facilities within a 75 mile radius using GIS techniques and then derived the Herfindahl's and CR4s for these origins. See Figures 2.0.7-2.0.10.

[14]The Herfindahl index is an indicator of the concentration of market power, considering the size distribution of rivals. It is also an indicator of the pricing power of competitors. Generally, for given levels of firm marginal costs and own-price demand elasticities, a greater value of H allows firms greater ability to raise prices (Martin, pp. 166-167, 1996).

[15] In addition, we explored doing the same at port elevators, but, this was more difficult. Further, and importantly, at least within the period of our study, there was very little change in the structure of this industry.

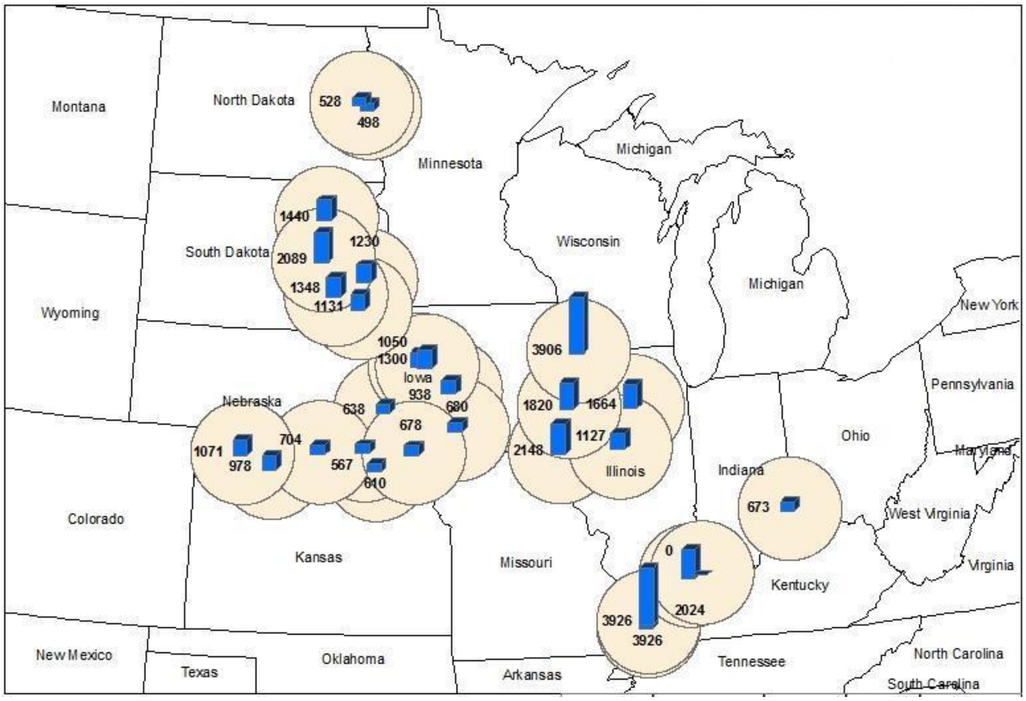

Figure 2.0.7. Herfindahl's for Soybean Loadout Capacity for Firms within 75 Mile Radius of Origin.

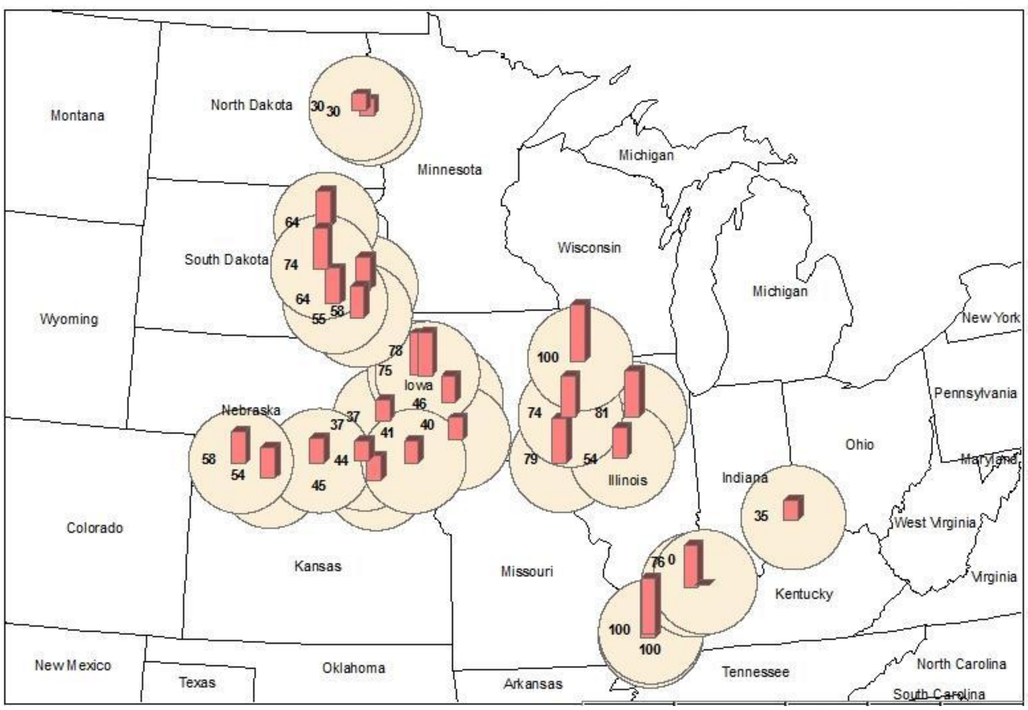

Figure 2.0.8. CR4 for Soybean Loadout Capacity for Firms within 75 Mile Radius of Origin.

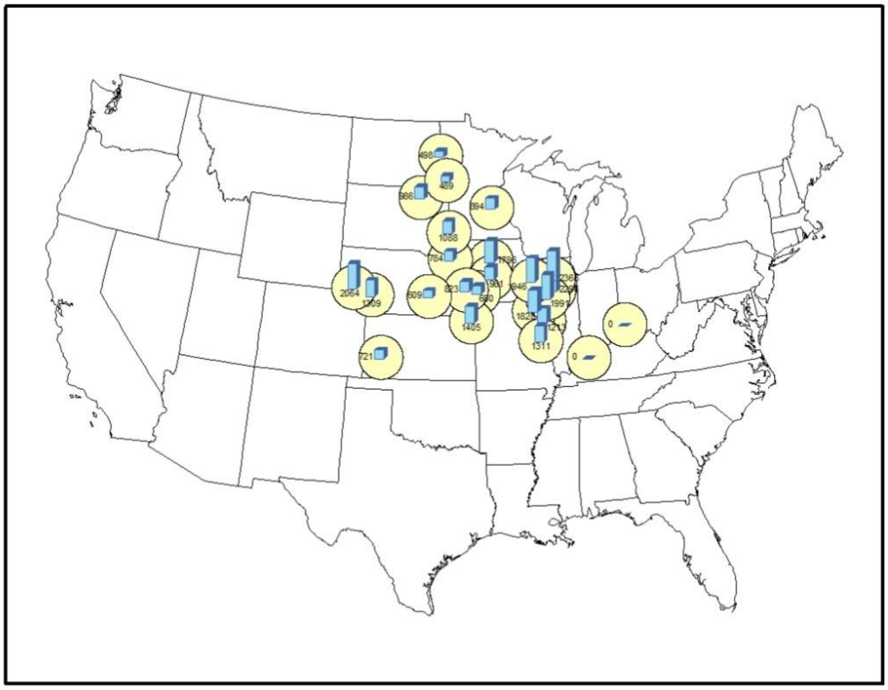

Figure 2.0.9. Herfindahl’s for Corn Loadout Capacity for Firms within 75 Mile Radius of Origin.

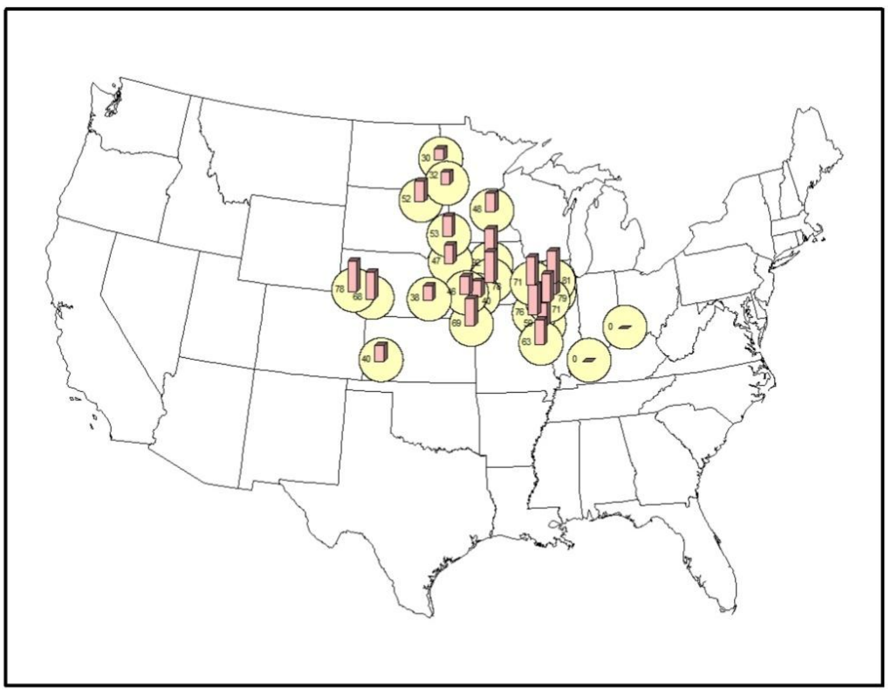

Figure 2.0.10. CR4 for Corn Loadout Capacity for Firms within 75 Mile Radius of Origin.

The results indicate that industry concentration varies geographically. Most regions are highly competitive with H values in the area of 1300 or less. However, some regions, notably in Western Nebraska and those in Illinois, have much greater concentration. The results are similar for corn and soybeans, but the latter appears to have a bit more concentration.

Rail Rates, Ancillary Costs and Performance:

Tariffs: Rail tariff rates were derived for each movement (origin/destination combination) for corn and soybeans. These rates are shown for illustration for a North Dakota origin in Figures 2.1.1-2.1.2. The results show continued increases from 2004. Rate increases are fairly periodic and changes retained for more extended periods (versus barge and ocean rates).

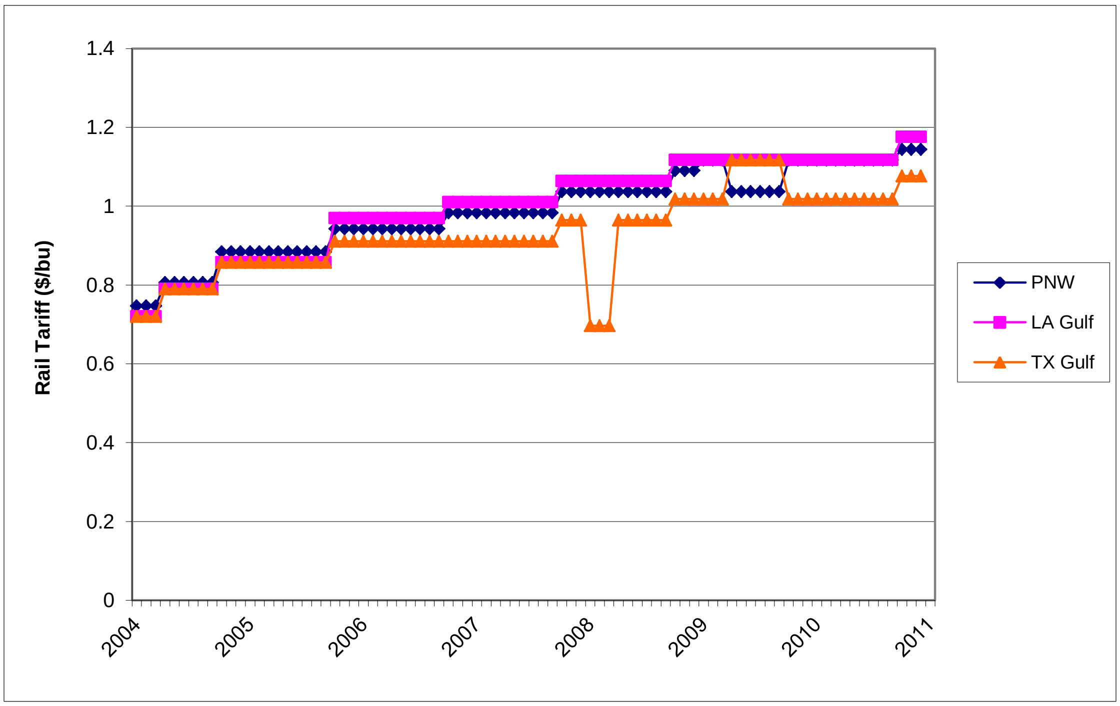

Figure 2.1.1. Tariff Rates for Rail Shipment of Soybeans from a ND Origin to PNW, LA Gulf and TX Gulf, 2004-2010.

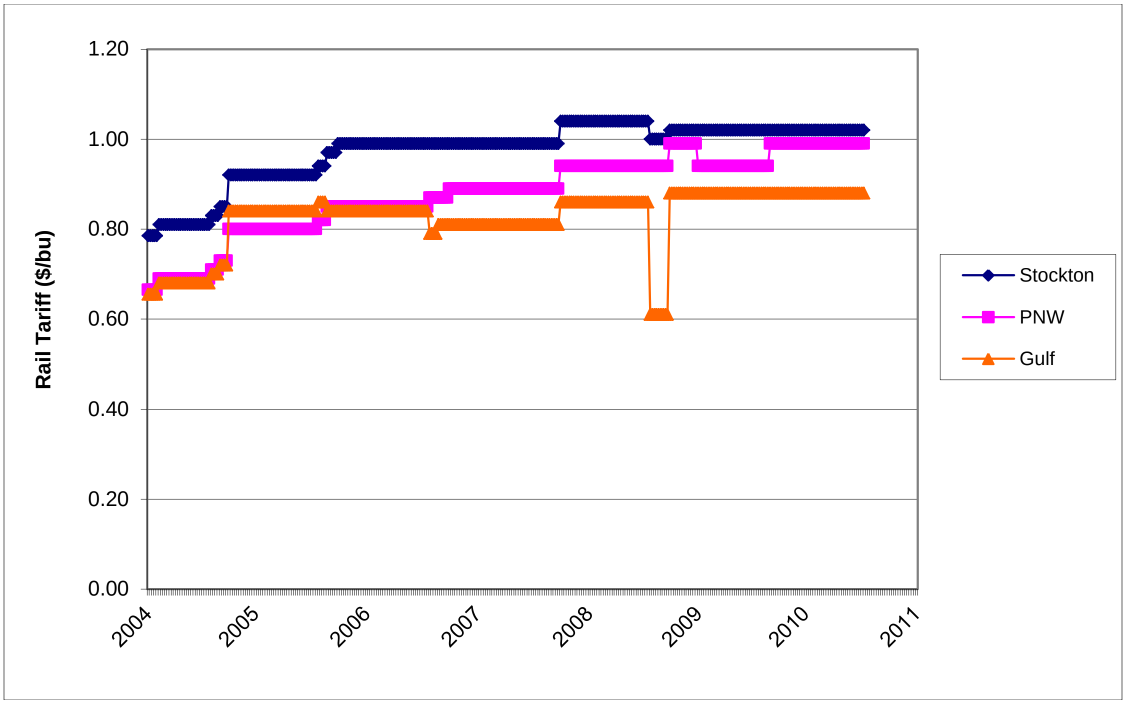

Figure 2.1.2. Tariff Rates for Rail Shipment of Corn from a ND Origin to Stockton, PNW, and Gulf, 2004-2010.

Fuel Service Charges (FSC) An important element of the cost of shipping is the FSC. Those used were from the BNSF, though all railroads have similar mechanisms.[16] These are shown in Figures 2.1.3-2.1.4 and are here translated to $/bushel for comparison to other elements of costs.

These have varied through time. They have increased from a low of less than $0.05/bu. in 2004, to a peak of $0.35-0.45/bu. in 2008. Since then, they declined to the $0.15-0.25/bu. range.

[16]FSC's have been adopted on all Class I railroads, and the application of each carriers policy varies. That for the BNSF is shown here, but, it is important that that policy is in the process of change (Sterk, 2010, p.24.).

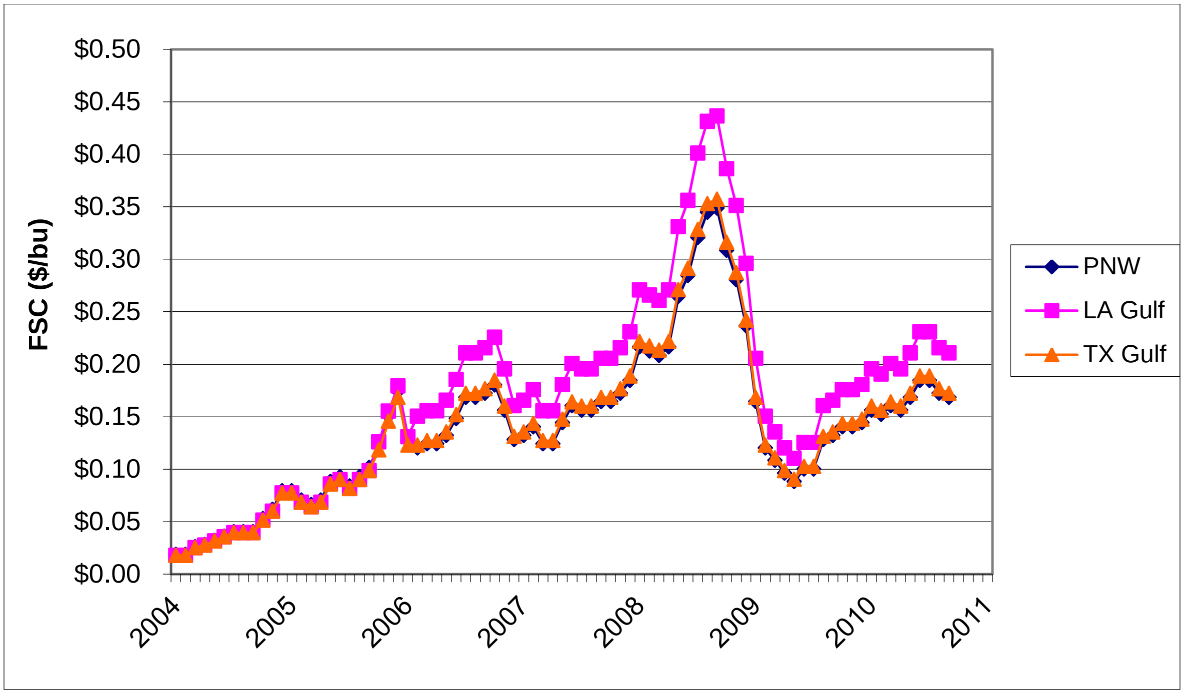

Figure 2.1.3. Fuel Service Charges for Rail Shipment of Soybeans from a ND Origin to Ports, 2004-2010.

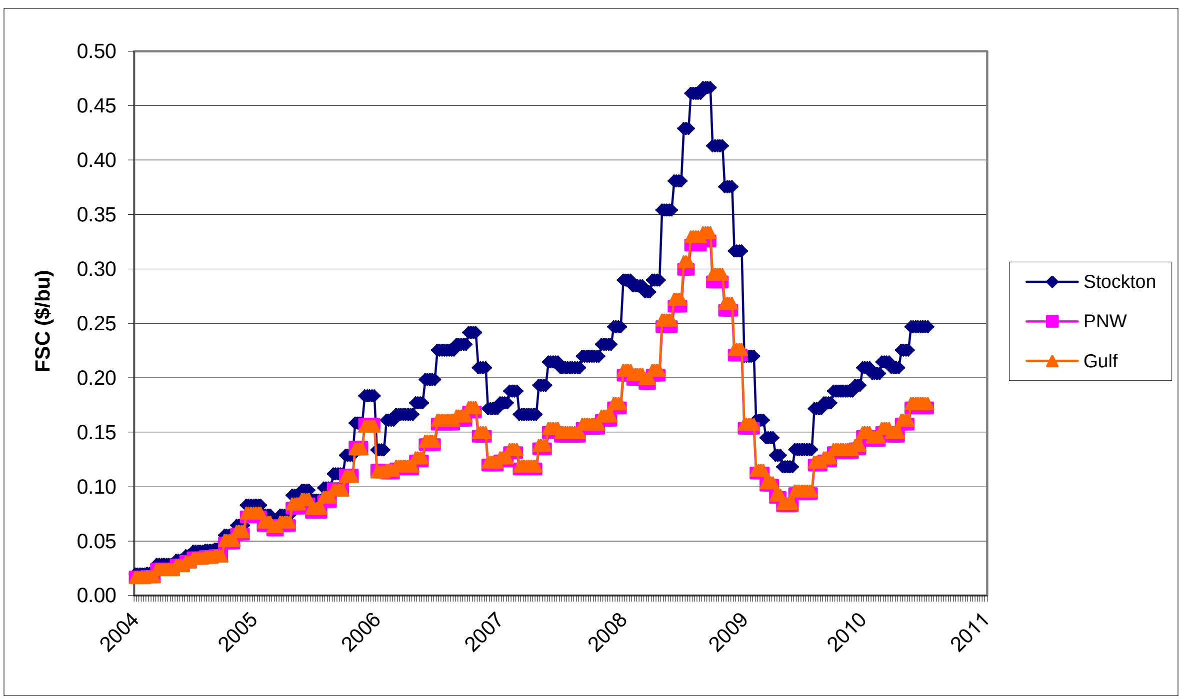

Figure 2.1.4. Fuel Service Charges for Corn from a ND Origin to Stockton, PNW and Gulf, 2004-2010.

Car Values There are two mechanisms for pricing rail car values and consequently, two sources of pricing data for what are called daily car values (DCV). This particular variable has taken on some importance in the interpretation of inter-market values, as well as inter-firm competition.[17]

One is from the primary auctions. These are the results of the original BNSF weekly auction at which the initial allocation of shuttle shipments are allocated among bidders. Values for these are reported by the BNSF and are shown for winning bids, for varying forward shipping commitments.

The other is what is referred as the *secondary car market* and sometimes as the *daily car values* (DCV). These take varying forms, and are typically available for more nearby shipping periods, deferred periods, longer-periods, as well as varying combinations. O'Neil Commodity Consulting (2010) refers to these as the daily car values (DCV). We used the data as reported in O'Neil Commodity Consulting. These were supplemented for more recent and missing dates from the original data as reported in Tradewest.[18]

A distinction that is important between these is that the results of the primary auction are revenues paid to the railroad. Secondary market values are a source of income (or loss) to the bidder that obtained the allocation in the primary market. This distinction is important in that this value is frequently added to comprise the total cost of shipping by rail (e.g., as in O'Neil Commodity Consulting, and others). Technically, it likely is an element of the total cost of shipping (to the extent it is included as a specific cost by the shipper), but, that is not a source of income to the rail carrier, but, instead to the grain firm.

These values are shown in Figures 2.1.5-2.1.6. A couple of points are reflected in this data. First, the vast majority (>90%) of primary car auctions are at nil premium. This is important as it illustrates that the initial buyers (shippers) were capable of attaining shuttle car commitments for near nil premium and rail service provide. The spike in mid-2010 was a result of the surge in demand at that time related to the emerging Russian drought. Secondary market values are much more risky and an important element to the risk accrued by grain marketers. On average these are near nil. As shown below, the distribution is skewed meaning that the mechanism rewardsthe original certificate holder for accruing the obligations of the instrument.

[17]The text below illustrates an example of the recent (fall 2010) behavior of rail car markets (Taken from market comments by Jimmy Conner, Oct 17, 2010):

> *Traders indicate that nearby BNSF shuttle freight values cratered from the record high water $2900 mark last week down to +$100 v +$500 end of this week. Unbelievable, not for the faint of heart. Nearby Illinois River barge freight listless 575%; however, harvest movement pumps prompt Upper Miss placements to 775% and Mid Miss (Iowa terminal) values to 675%....*

[18] Upon closer examination, it appears O'Neil Commodity Consulting (2010) used data for more nearby shipping. We were consistent with this interpretation in the data we used to supplement the original data.

Shippers have the ability to take coverage multiple months forward which mitigates risk of car values and availability. Without coverage, shippers would need to absorb the risk of car value changes; and, seek to pass on all or portion to growers or buyers.

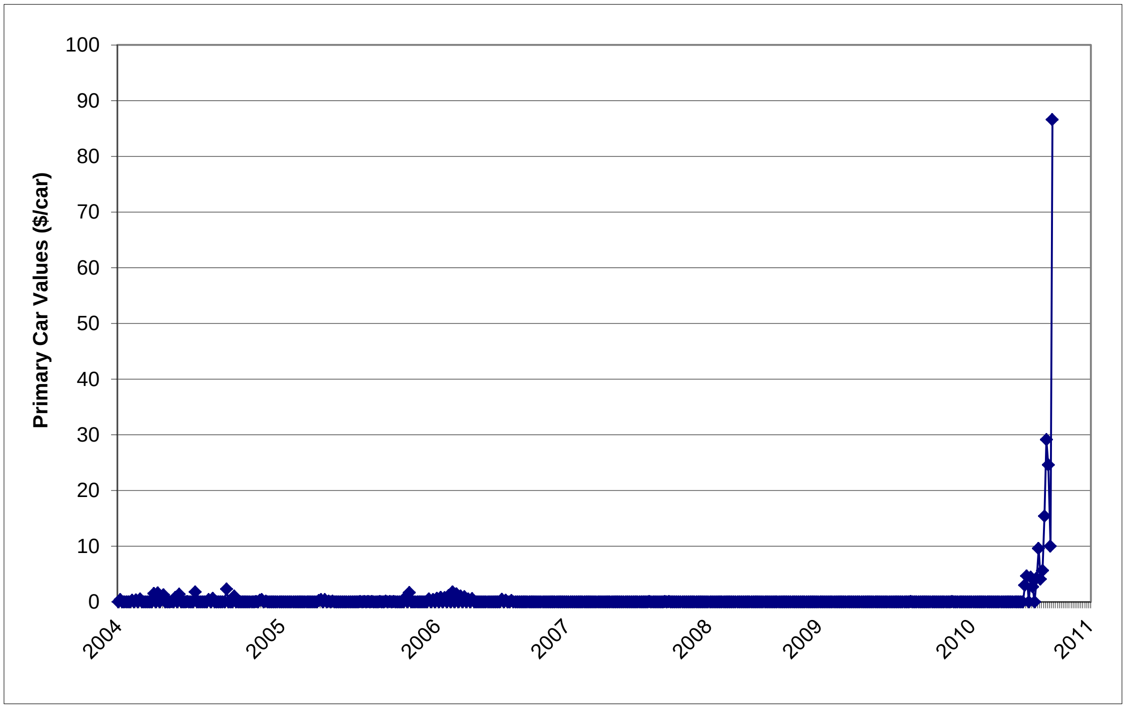

Figure 2.1.5. Primary Car Values ($/car over tariff), 2004-2010.

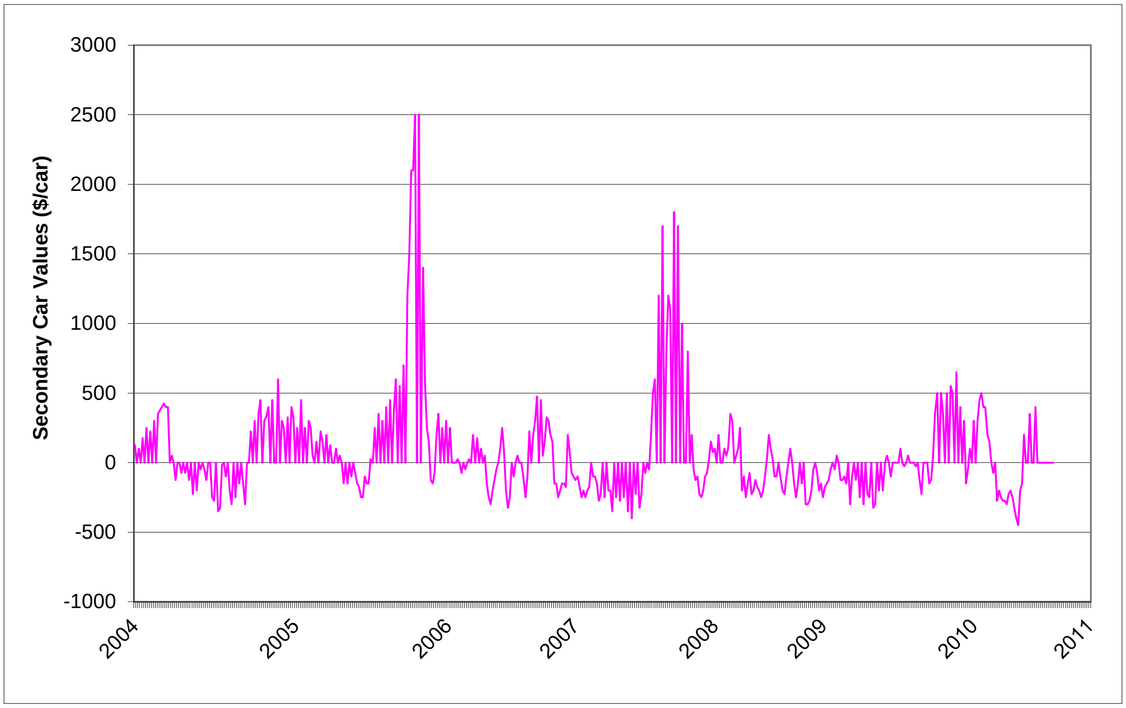

Figure 2.1.6. Secondary Car Values ($/car over tariff), 2004-2010.

This interpretation differs slightly from that insinuated in other studies. Those studies add rail car charges to rail and tariffs and FSCs to derive the cost of shipping by rail, which is correct. However, this is from a shipper perspective. It is important that the rail car charges other than that on the primary market, are accrued to/by the grain trading or elevator firm (specifically, to the original purchaser of the instrument in the primary market), not to the railroad.

Rail Car Performance: Claims are made in many studies in varying ways about transportation inefficiency, which in many cases is in reference to rail on-time performance. Different words are used to describe this including transportation efficiency, car performance, among others. In all cases, these refer to the performance of rail carriers in placing cars. None of these studies empirically examine the impact of this variable on basis values.

These data exist at least on some carriers. That for the BNSF is routinely reported in varying forms. This data is used in our study and is illustrated in Figure 2.1.7.

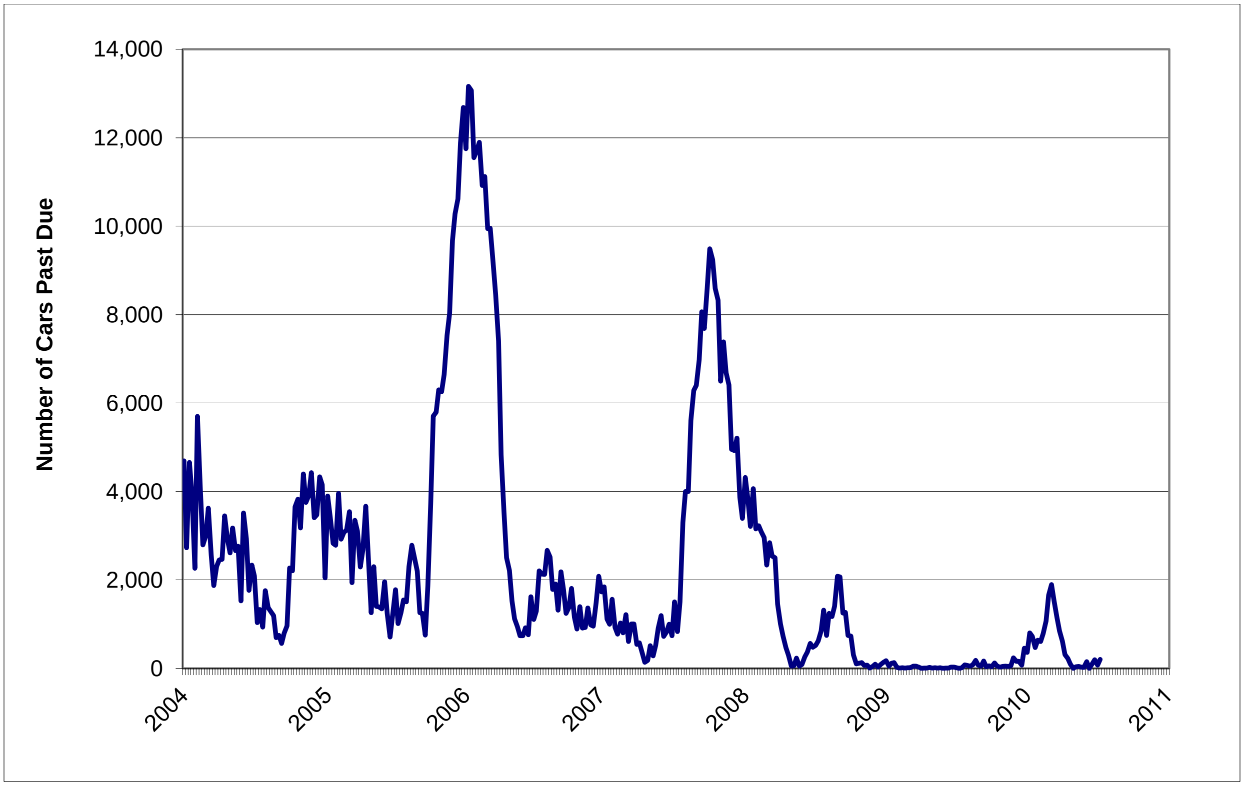

Figure 2.1.7. BNSF Performance Measure: Grain Cars Past Due, 2004-2010.

The results indicate that there were periods of shortages. Notably, the average number of cars past due ranged from 1000 to 5000 for periods in 2004 and 2005.Since then, non-performance spiked in 2006 and 2008 and has improved with number of cars past due dropping to low values for much of late 2008, 2009 and 2010.[19]

Grain Pricing

Grain pricing has traditionally been thought to be simply the cash price less futures. In this case, the basis, the difference between cash and futures, is constant and highly predictable. More broadly, it reflects some notion of a destination value, less the shipping cost to the origin. In a simple specification, this can be represented as:$B_o=B_d-T_{od}$ where B is basis, T is shipping cost and subscripts o and d represent origin and destination respectively.[20] Increasing shipping costs has the impact of

[19] In summarizing rail performance during the fall of 2010, Fatka, (2010b) indicated rail loadings for grain were the highest since 2007 and "agricultural shippers ranked BNSF and UP with highest service." The important issue is that of trying to ship a very large crop in very short period………" The operating performance during fall 2010 demonstrated that some railroads, "particularly BNSF and UP, have been more strategic in planning and more prudent in investing than others….."

[20] Hoffman (2010) is one of the most recent pieces by USDA describing grain pricing.

lowering origin basis, and increasing destination basis values has the impact of raising local basis values. Implicitly, the partial derivative of each of these equals 1.

Pricing becomes more complex in a number of dimensions that prevail in more contemporary grain marketing. Two are important.[21] Frequently shippers evaluate selling to multiple destinations, and hence it is the terminal basis at each destination that matters. This is in addition to selling to more local outlets including local processors etc.In these cases, changes in basis in one terminal market (ΔB_{d1}) results in a ΔB at competing markets. Changes in shipping costs have similar impacts.

The second complexity is that deductions for shipping costs are now more complex due to the varying elements of shipping including tariffs rates, FSC, rail car values, and rebates related to shuttle shipping. This is further compounded in that different shippers may have different coverage levels with respect to rail cars or FSC (i.e., if hedged in fuel prices), and/or may have differing abilities (likelihoods) of receiving efficiency payments. Finally, one of the more strategically important variables is not knowing the extent that rival buyers may/may not have coverage in the railcar or FSC markets.

Alternative extensions of the basic formula for basis pricing are summarized in Table 3.1.

[21] Others that are important are: 1) quality premiums and discounts vary through time, and, differ at different destination markets; and 2) the representation here and empirically is with respect to more nearby shipping positions. Indeed, these markets may trade up to 2-4 months forward and/or in some periods, may have trade into more distant deferred months.

Table 3.1. Alternative formulations of grain pricing or basis values

	Basis Definition	Comment
1	$B_o = C_o - F$	Basis is constant and highly predictable
2	$B_o = B_d - M - T$	More complex, but, still simple and predictable
3	$B_o = B_d - MAX[(B_{d1} - T_{o1}), (B_{d2} - T_{o2}), (B_{d3} - T_{o3})] - M - F$	Includes impacts of multiple destination markets; and that the basis is derived from that market yielding the maximum net returns
4	$B_o = B_d - [R_{oj} + FSC_{oj} + CAR - EP] - M - F$	Includes impacts of each of the primary elements of shipping by rail.

Variable definitions:
C_o : cash price at origin
F : futures price
B_o: basis value at origin o
B_d : basis value at destination d
B_{dj} : basis value at destination dj
T : transport costs
T_{oj} : transport costs from o to j
R_{oj} : rail tariff rates from o to j
FSC_{oj}: fuel service charge from o to j
CAR : rail car values from either primary or secondary market
EP : efficiency payments (OEP, DEP)
M : margins

The above indicates that there are numerous complexities that impact basis values. Further, and of importance is that *ex-post* margins are really the residuals of all these values. *Ex-ante* margins would have to account for expectations in each of these values. Thus, margins are truly impacted by all these values and would be expected to be much more variable both through time as well as across competitors.

***Basis Values*:** This section describes the basis values used in this study. First origin basis values are shown, then those for destinations, and then standard deviations.

<u>Origin Basis Values:</u> Figures 3.1and 3.2 show the average basis for all origins for soybeans and corn, respectively. These show geographical dispersions as expected. For soybeans, the basis is a larger negative value for stations in North Dakota, South Dakota, and western Nebraska. Basis values are highest for stations located near the river including Illinois, Indiana and Ohio.

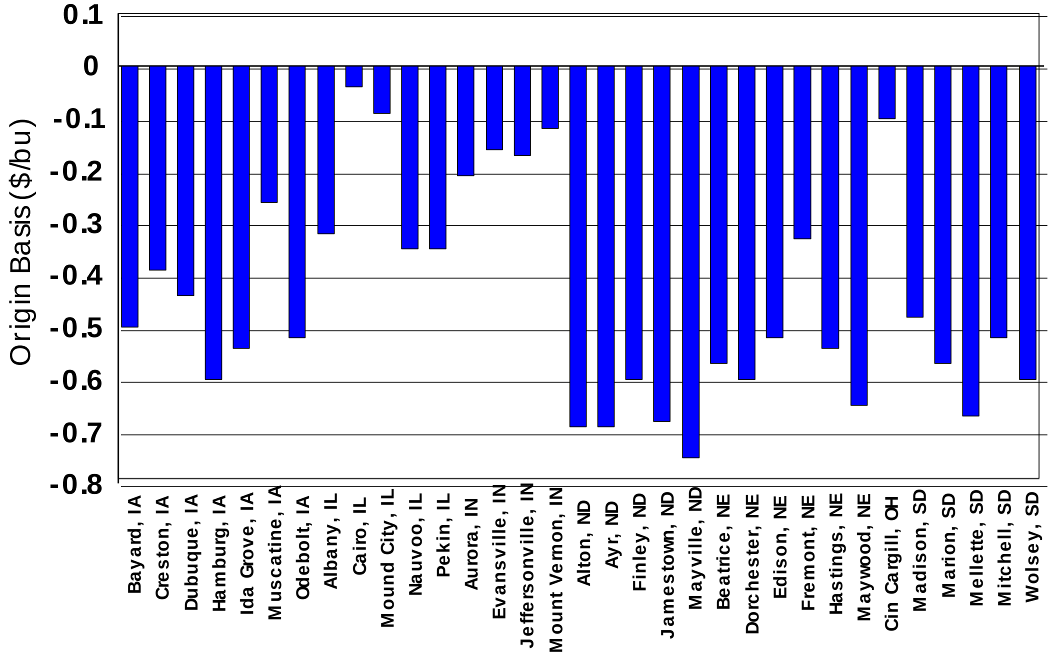

Figure 3.1. Soybean Average Origin Basis Values, Average 2004-2009.

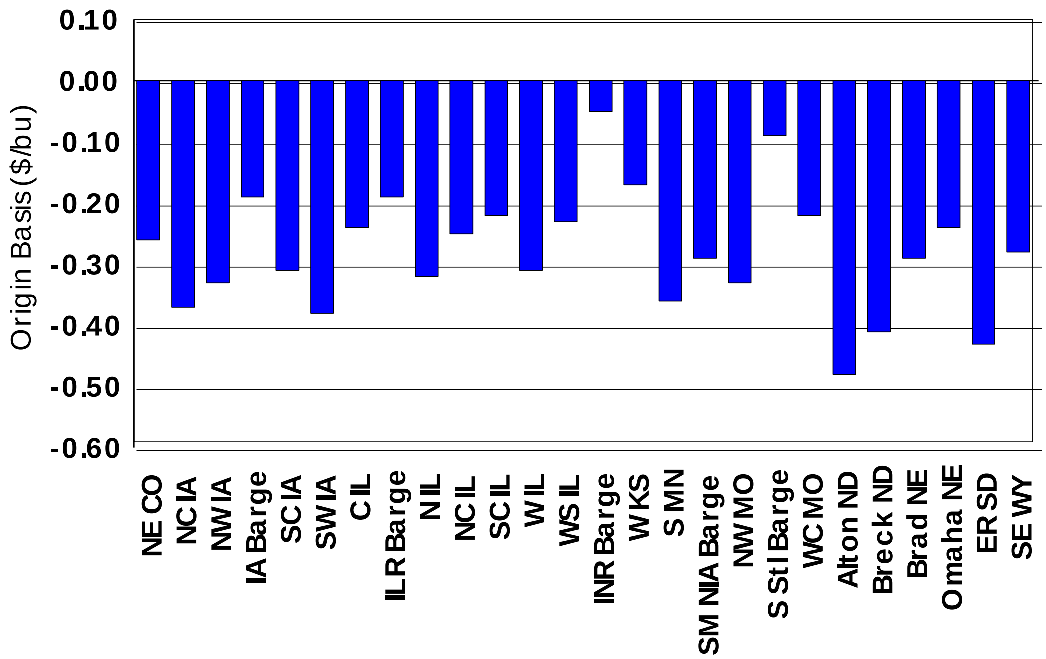

Figure 3.2. Corn Average Origin Basis Values, Average 2004-2010.

The geographic dispersion in the basis for corn is not as great. Basis values are greatest for North Dakota, but not as large a value as the case of soybeans. Basis values are lesser for stations in Illinois, and at barge origins.

Figures 3.3 and 3.4 show the time series of basis at selected origins for a North Dakota origin, for illustration. Soybean basis were in the $-0.50 range, though quite volatile in 2004. Then, the basis began a longer term decline reaching lows of $-1.70 in July 2007 and April 2008. Following these periods, the basis increased to more normal levels at about $-0.50, though it is quite volatile.

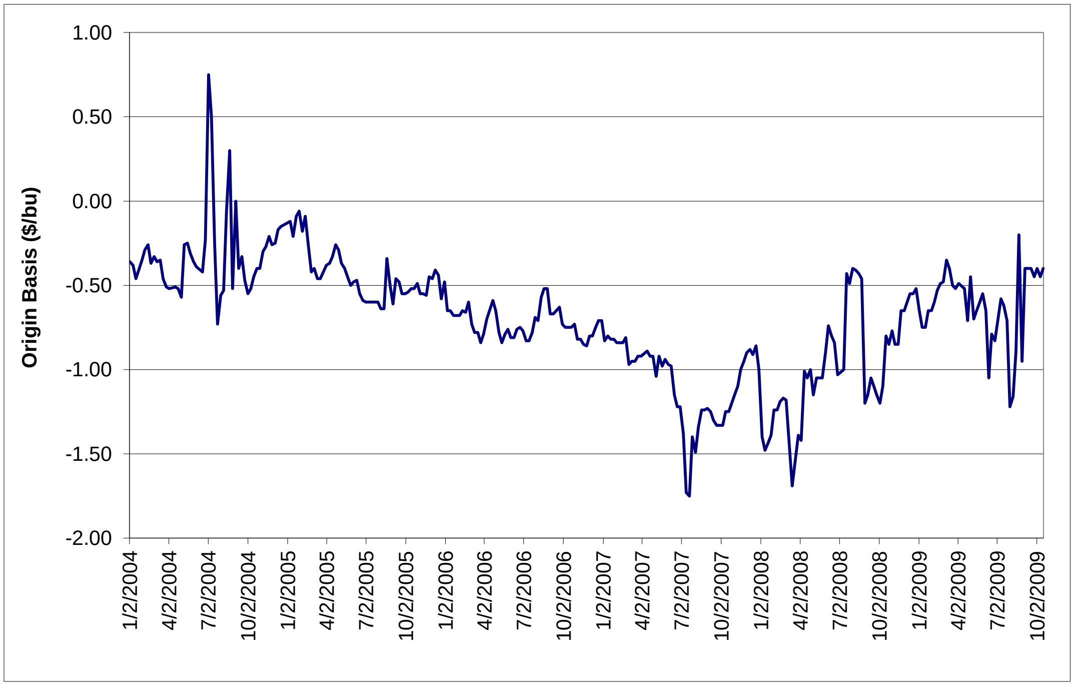

Figure 3.3. Soybean Origin Basis for a ND origin 2004-2009.

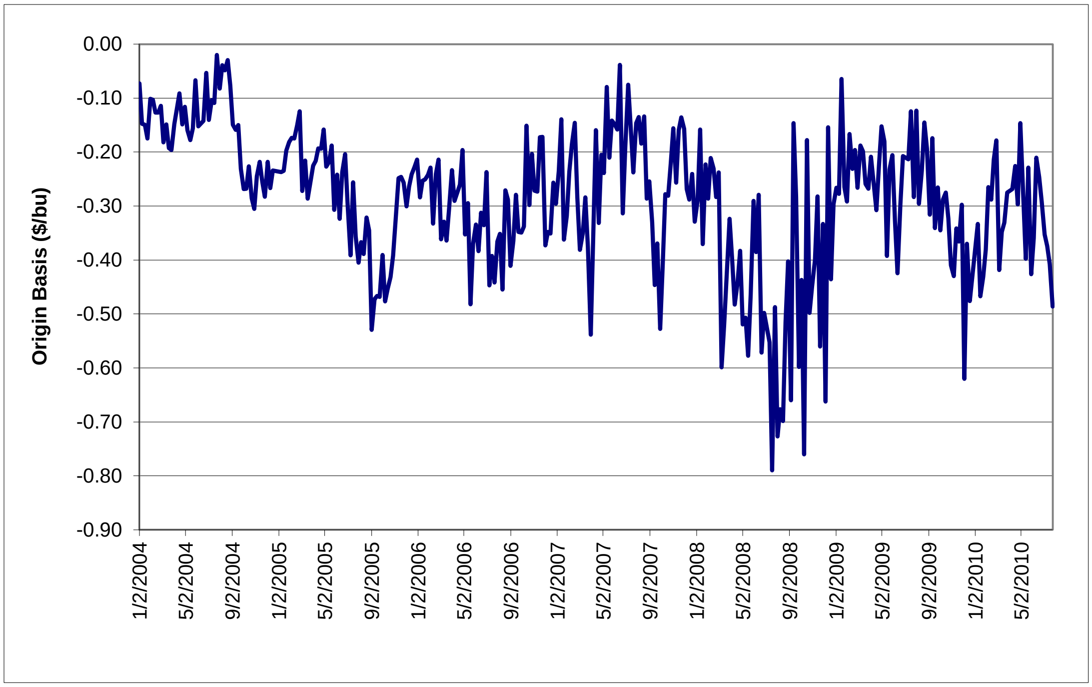

Figure 3.4. Corn Origin Basis for a ND Origin 2004-2010.

The corn basis behaved somewhat similarly, but not exactly. Values in 2004 were in the range of $-0.10 to $-0.20/bu. These then declined moderately to the $-0.10 to $-0.40/bu. range in 2005 through 2007. In 2008, it declined to a low of $-0.80/bu. and remained there from about May 2008 through September 2008. Following that period, the basis jumped back to the more normal levels of $-0.20 to $-0.40/bu. The latter period remained a bit more volatile with a sharp downward spike in early 2010.

<u>Destination Basis</u> Destination basis values are shown in Figures 3.5-3.6, and 3.7-3.8 for soybeans and corn, respectively.

For soybeans the basis has been quite variable. In 2004 the basis was about $+0.50 at the PNW, but then it spiked to about $+1.75/bu. It then moderated downward through 2007 and into 2008 reaching lows. After 2008, the basis increased at both markets. In late 2009, the basis spiked at New Orleans (NOLA) and in fact went to a premium to the Pacific Northwest (PNW), at about $+1.50/bu. It is also apparent these basis values have become more volatile in recent years.

The PNW vs. NOLA spread in the basis is also shown. For soybeans, the basis at PNW is normally higher than at NOLA. However, there are periods where the NOLA basis is higher than for PNW.

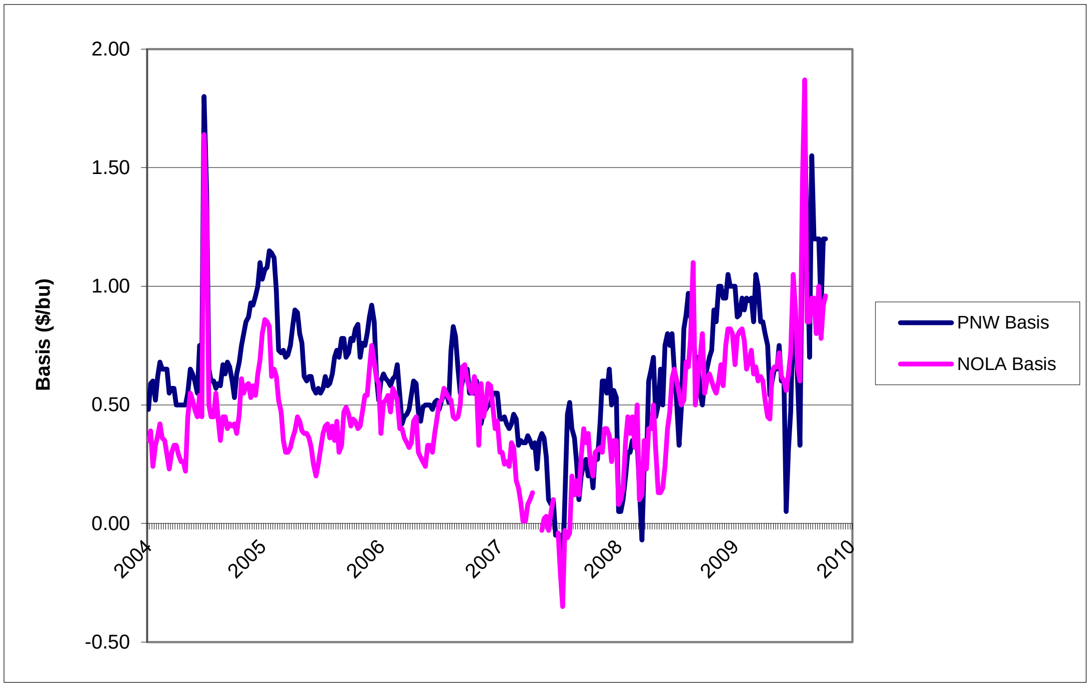

Figure 3.5. Soybean Destination Basis, by Destination, 2004-2009.

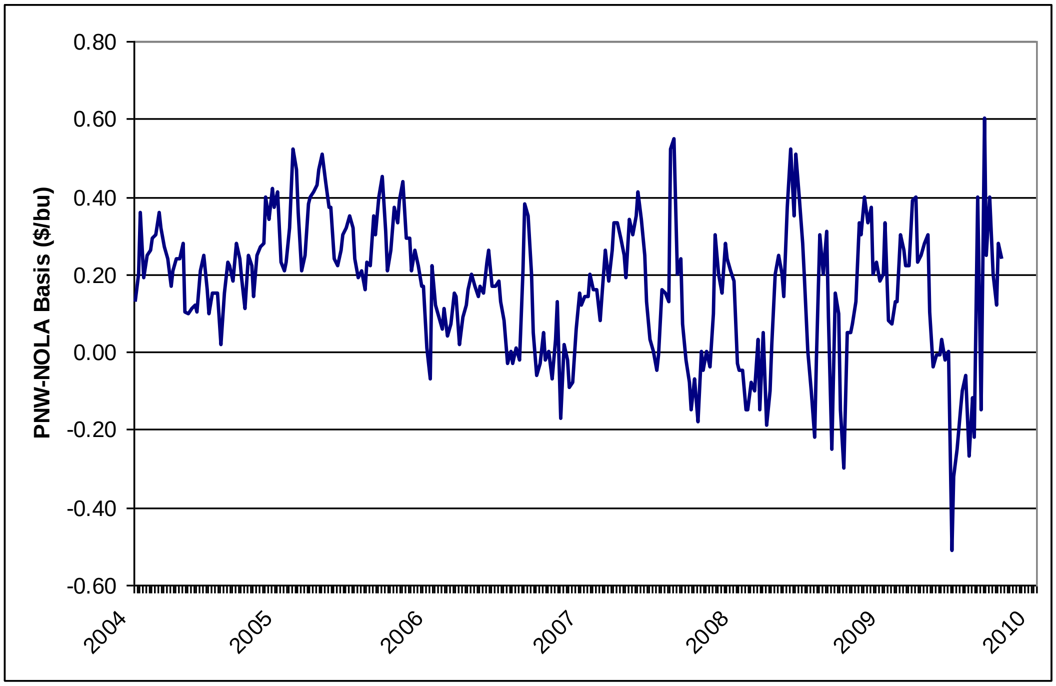

Figure 3.6. Soybean PNW-NOLA Basis, 2004-2009.

The corn basis is shown for each of the PNW, US Gulf and Stockton (Figure 3.7). The latter was included as a dominant domestic feed market. The values are not as volatile as for soybeans. The PNW seems to follow Stockton fairly closely, and US Gulf to a lesser extent. Basis was in the $0.75/bu. range in 2004. The basis increased sharply in later 2007 and remained there through 2008, falling sharply in early 2009. Since then, the PNW basis has increased a bit more than that at the US Gulf.

The spread between the PNW and Stockton, and PNW vs. US Gulf are shown in Figure 3.8. The PNW basis trended higher than the US Gulf basis from 2007-2009, when it fell to near nil, and has since returned to $0.50 to $1.00/bu. over US Gulf basis.

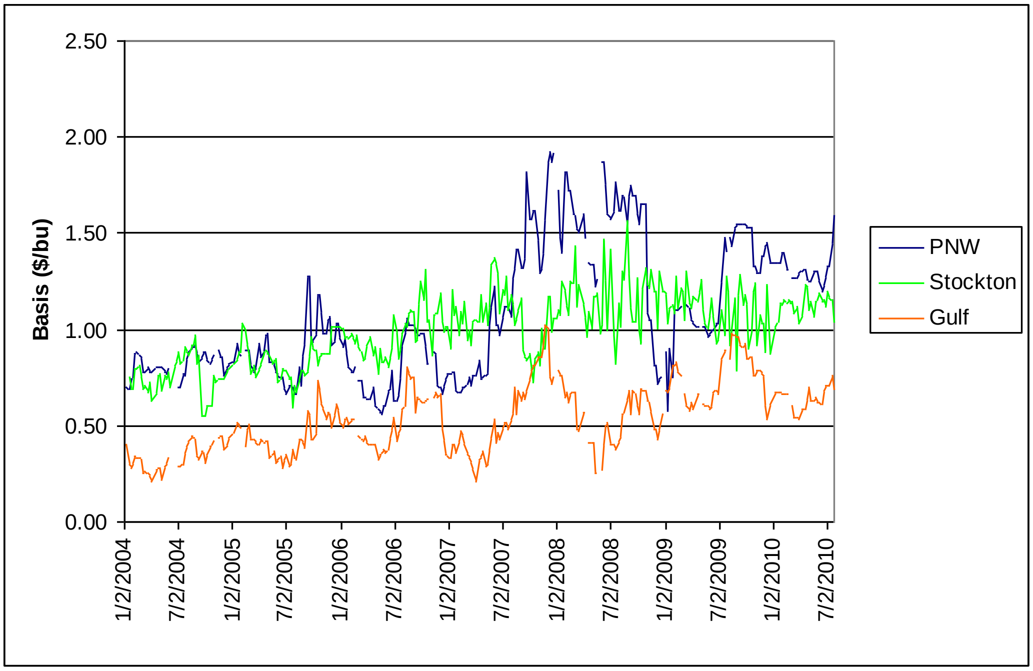

Figure 3.7. Corn Destination Basis by Destination, 2004-2010.

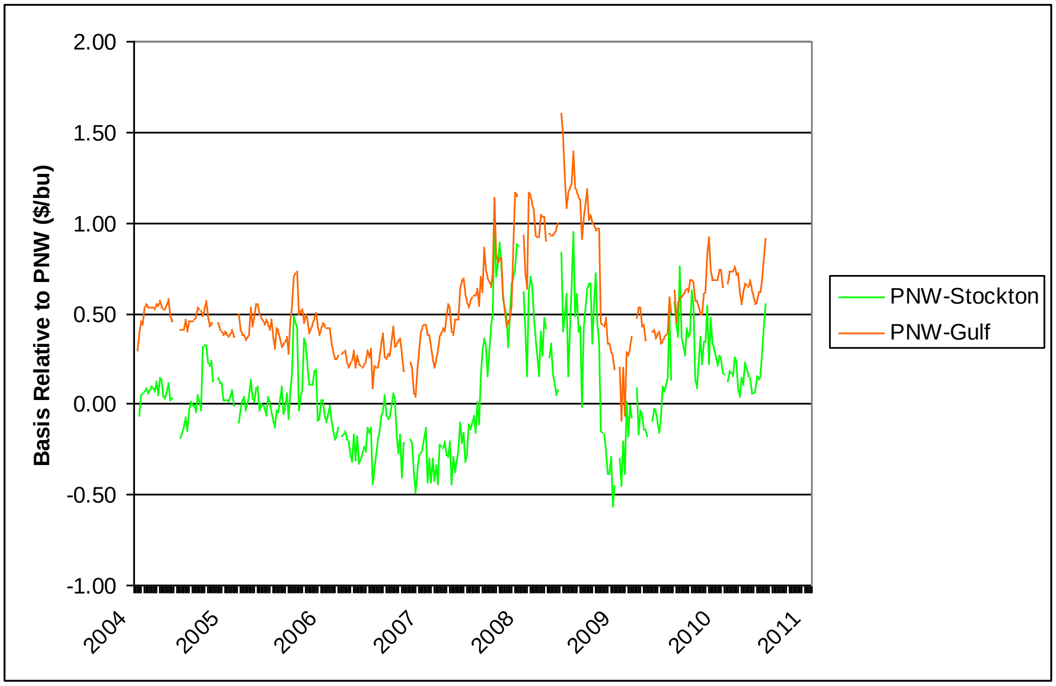

Figure 3.8. Corn Destination Basis (PNW-Stockton and PNW-Gulf), 2004-2010.

The corn basis at PNW and US Gulf were carefully developed. The values that are reported include Track and FOB and differentials for No. 2 vs. No. 3. These are shown in Figures 3.9-3.10. For PNW, values were derived for each of Track No. 2, FOB No.3, and the implied/derived value for FOB No. 2. For the US Gulf, values are shown for FOB No. 2 and No. 3.

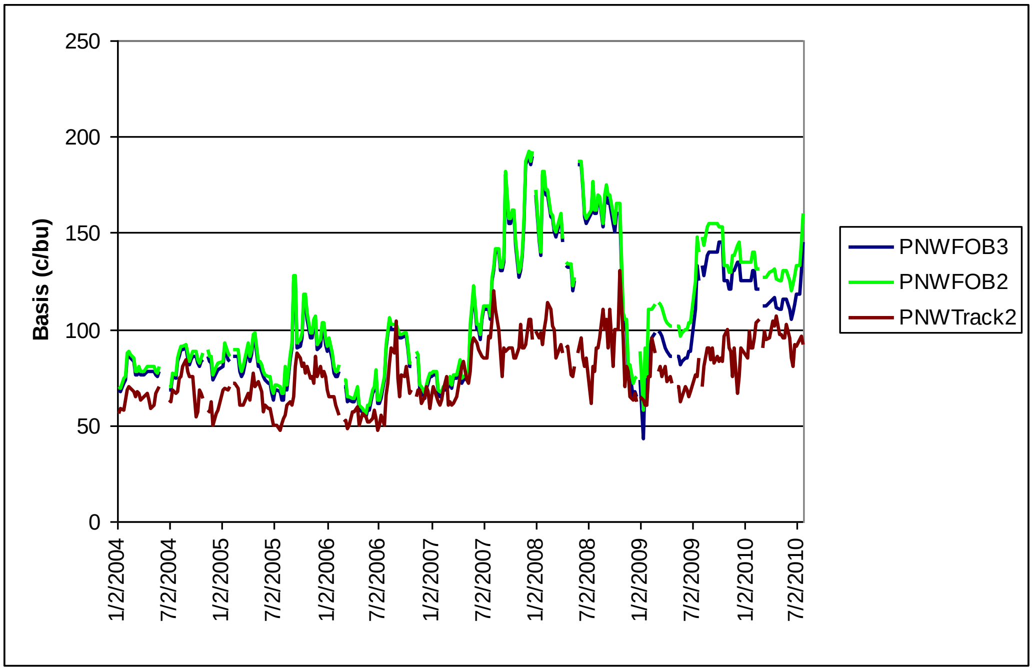

Figure 3.9. Comparison of PNW Corn Basis for No. 2 and 3 Corn FOB and No. 2 Corn Track.

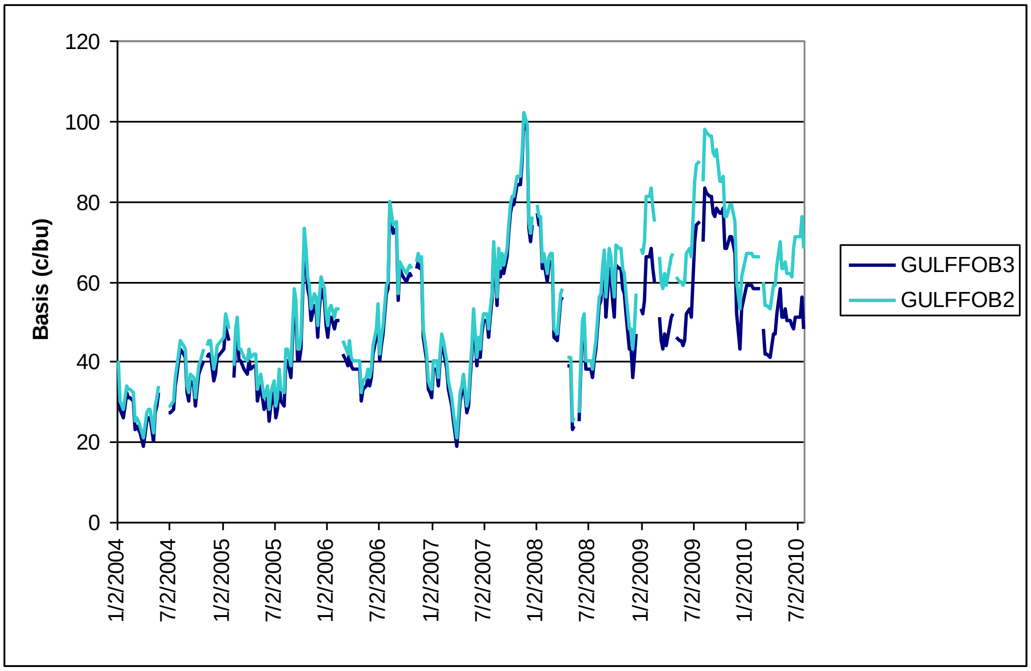

Figure 3.10. Comparison of Gulf Corn Basis for No. 2 and No. 3 Corn FOB.

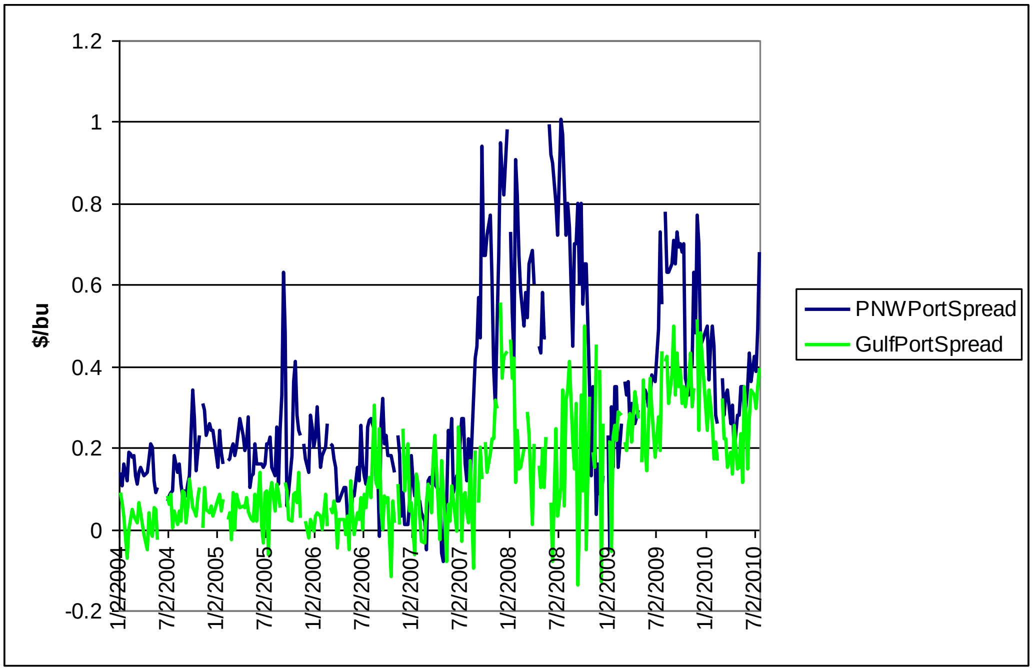

Figure 3.11. Comparison of PNW and Gulf Port Spreads for Corn (No. 2 FOB-No. 2 Track Prices).

These were used to derive implied fobbing margins (Figure 3.11).[22] There are several interesting observations. First, the margin at the PNW is clearly greater than that to the US Gulf. Second, margins are particularly volatile. And, third, there has been a notable increase in the margin through this period. In 2004 values were typically about $0.10 to 0.20/bu. Over time, these values escalated up to $1.00/bu. at the PNW during 2008. During that same period, the US Gulf margin was lesser. The fobbing margin at the US Gulf increased from $0.04/bu. to what appears to be values in 2010 at about $0.40/bu. Comparable values at the PNW have been increasing as well, increasing from typical values in 2007 at about $0.20/bu. to values in 2010 at about $0.40 to $0.60/bu. In more recent periods during later 2010, margins have been escalating from their values in early 2010.

There are a multitude of effects reflected in this data. In part, the spread between No. 3 and No. 2 is important. That spread was large in 2009/10.

<u>Standard Deviation of Basis Values:</u> The data were used to derive a measure of risk related to basis changes. Specifically, we derived a 20 day moving standard deviation for each of the origin and destination basis values. These are shown in Figures 3.12-3.13 for soybeans and corn, respectively.

Results show that the soybean basis had a high degree of risk in 2004. It was less than $0.10/bu. in 2005-2007. Since then, the basis risk increased to $0.20/bu. in 2008, and increased to over $0.30/bu. in 2009. The destination basis is more volatile, at least in recent periods, than the origin basis.

[22]The implied fobbing margin was defined as FOB 2 – Track 2 at PNW and FOB 2 - CIFNOLA at US Gulf.

For corn, the volatility of the basis has varied, but, to a lesser extent than the soybean basis. Values in early periods were in the area of \$0.05 to \$0.15/bu. During 2007-2008 it increased to \$0.20/bu, and then moderated downward. In recent periods, the basis volatility has declined with the exception being that at the PNW.

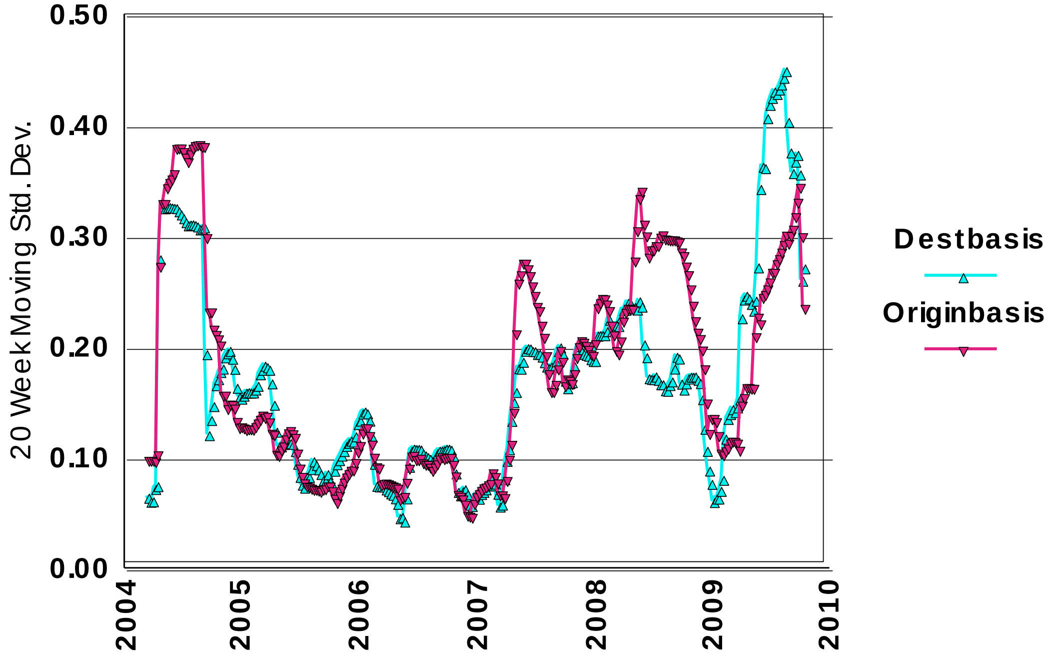

Figure 3.12. 20 Week Moving Standard Deviation of Soybean Origin and Destination Basis, 2004-2009.

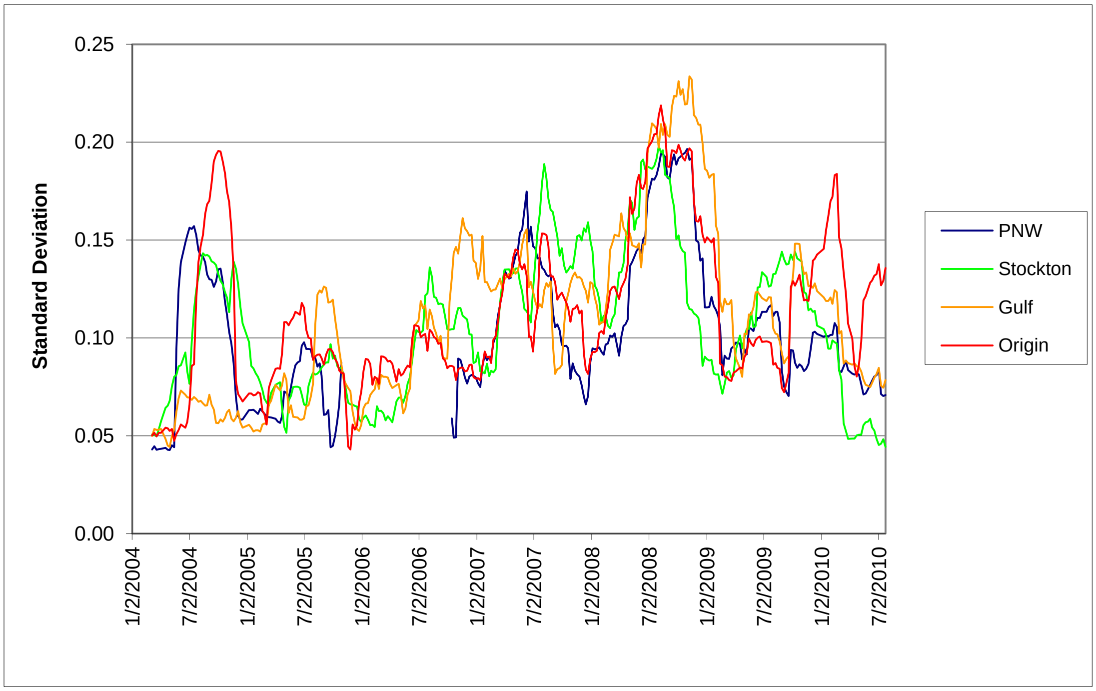

Figure 3.13. 20 Week Moving Standard Deviation of Corn Origin and Destination Basis, 2004-2010.

Spreads and Margins

The data were transformed to derive the spread and margin for each origin and commodity. The spread was defined as the difference between the destination and origin basis. This was done for each origin/destination combination.

The implied margin was defined further by deducting shipping costs from the spread. The margin so derived should be interpreted as the implied margin associated with handling and trading net of shipping costs for shipments to the specified market that yields the maximum net return. Margins were estimated for each of the destinations PNW, Stockton, and Gulf for corn and then a preferred market was determined based on which market returned the maximum return. For barge origins, the barge shipping cost was deducted. For rail origins, the sum of the elements of rail costs (Tariff, FSC, and Daily Car Values) was deducted.

For each market we evaluated the destination market that yielded the greatest net returns. Specifically, for each origin we evaluated:

$$M_m = MAX[(B_{usg} - T_{usg},\ B_{PNW} - T_{PNW}, B_{calif} - T_{calif}] - B_o$$

where B_d is the basis value for destination d (for USGulf, PNW and California--in the case of corn; and only the former two in the case of soybeans); B_o is the origin basis; and T_{od} is the shipping cost from origin o to destination d. For origins near the river, we evaluated the MIN (rail, barge) for shipping to the USGulf. The transport cost in this calculation included either the barge shipping cost, or the sum of the cost elements for shipping by rail including tariff rates, car values and FSC.

Values were derived for each origin and summarized as the mean in the section below. We show the results for a representative origin in Figures 4.1 and 4.2 for soybean and corn, respectively. The results illustrate a number of important points. First, the spread for each market is quite volatile. For soybeans it had been just over $1.00/bu in 2004, and since then has increased to more typical values at $1.50/bu. For corn, the spread has increased similarly.

The implied margin also increased. That for soybeans, in this case increased from about $0.20/bu.to about $0.50/bu. For corn, the margin is a bit more volatile. It has increased from values in the $0.20/bu. range in 2004 to more recent observations in the $0.50/bu. range.

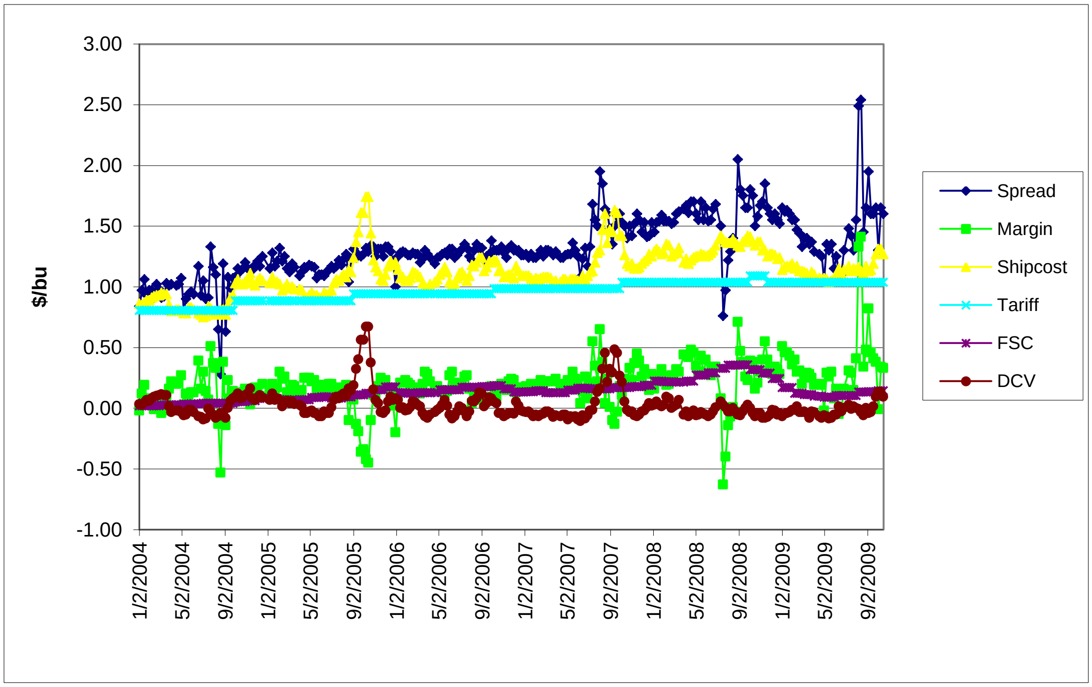

Figure 4.1. Soybean Spreads, Margins, Total Shipping Costs, Rail Tariff, FSC and DCV, 2004-2009.

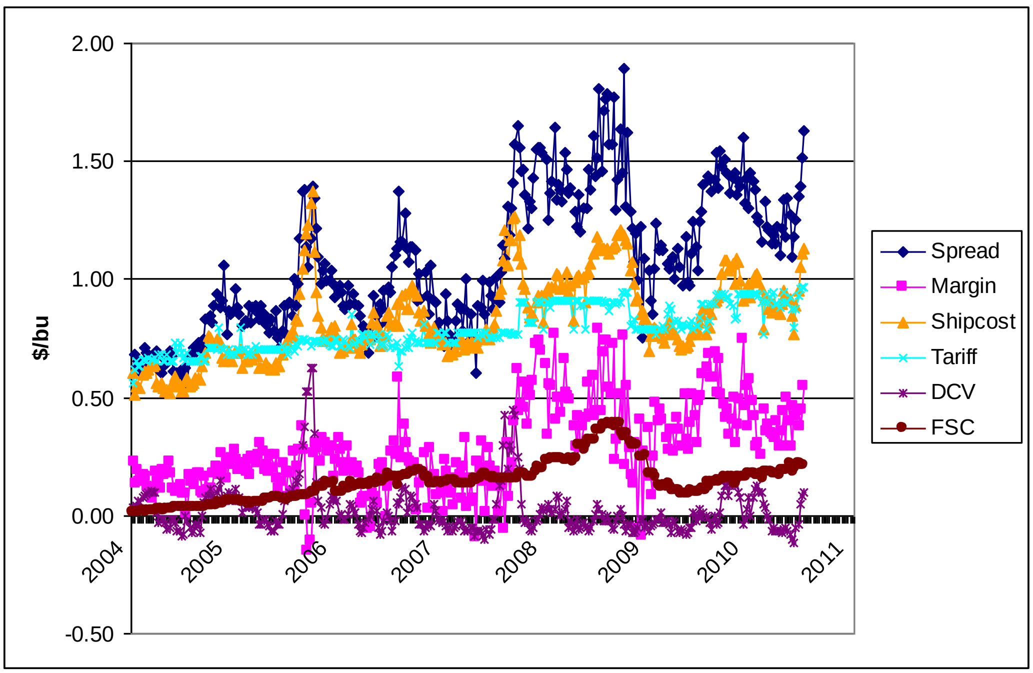

Figure 4.2. Corn Spreads, Margins, Total Shipping Costs, Rail Tariff, FSC and DCV, 2004-2010.

Changes in Values and Correlations: Total Shipping Costs and Changes in values: 2004 to 2009/10

The data described above was used to evaluate how these values changed since 2004. That for soybeans was compared to the average in 2009 to be compatible with the O'Neil Commodity Consulting (2010) study. That for corn was evaluated through mid-2010, the most current period for which the data were available. Changes in the values of selected data are shown in Table 5.1 and correlations in Tables 5.2 and 5.3. Results from these data suggest a number of important observations:

Basis: The average origin basis declined by $0.17 and $0.18/bu., respectively for corn and soybeans and the average destination basis increased by $0.40 and $0.23/bu.[23] the basis risk for both corn and soybeans has increased, as shown above.

Implied Margins and Spreads: The margins implied in these data were derived and averages across origins and at different points in time are reported. For soybeans, the implied margin increased from $0.18 to $0.26/bu., or, by 47%. For corn, the comparable margin increased from $0.15 to $0.39/bu., or by 164%. For corn, we also derived the implied fobbing margin at each port (defined previously). That for the PNW increased from $0.16 to $0.36/bu., and that for the US Gulf increased from $0.04 to $0.24/bu., or, by 129% and 533%, respectively.

The average spread between origin and destination basis increased by $0.40 and $0.57/bu., respectively. The standard deviation for each of these has increased over time.

The ratio of farm price to destination market price was derived, which is a measure frequently used to describe efficiency in grain marketing (e.g., USDA, and suggested by O'Neil Commodity Consulting, and also for comparison to Brazil). The average farm price ratio for soybeans decreased from 91 to 90% of the destination market value. For corn, the average farm price ratio decreased from 77 to 73%. For comparison, USDA reported changes in the case of wheat increasing from 80% in 2005 to 88% in 2007/08; and, O'Neil Commodity Consulting reported comparable values in Brazil at about 62%.

Shipping Costs: Barge shipping costs increased by 41% and 33%, respectively for soybeans and corn. Rail tariff increases were less at 25% and 36%, respectively.

Importantly, there has been much greater volatility or risk in barge and ocean shipping, than in rail. The standard deviations for barge rates were in the area of $0.14/bu., and increased to $0.21/bu. In contrast, the standard deviation for rail was less at $0.05/bu. in the case of soybeans, and $0.12 and $0.13/bu. for corn.

[23]The basis used for the destination basis was from the market that resulted in the maximum payoff to the shipper amongst the primary destination markets, as defined above.

Elements of Rail Shipping Costs: There are three elements of rail shipping costs and include the rail tariff, the FSC and the daily car value. The latter is typically measured as the secondary market value, but as noted above, this is not a source of revenue for the carrier, but, is a source of opportunity (or, replacement) cost for buyers of the certificates.

These values are averages derived across the origins used in the study. The results show that for soybeans, the changes were: rail tariff increased $0.20/bu.; car values decreased by $0.05/bu.; and FSC increased $0.10/bu. For corn, the changes were: rail tariff +$0.24/bu.; car values $-0.03/bu.; and FSC increased $0.16/bu. The standard deviations for these are relatively modest and less than that for the other modes.

Taken together these results indicate that 1) origin basis values have become more risky; 2) all marketing costs have increased; 3) the increase in rail tariffs were less than those for the other modes; 4) car values, on average declined; 5) FSC's had moderate changes in absolute terms, but, greater percentage increases; and 6) handling margins have had fairly substantial increases, particularly at port. Finally, the share of the marketing cost reflected in the origin price to growers has declined through time.

Correlations among these variables are shown in Tables 5.2 and 5.3. Results suggest a few observations of interest:

- There is a weak correlation between the origin and destination basis, suggesting there are many other factors impacting this relationship;

- The origin basis are impacted by modal shipping costs and spreads, including those for rail, ocean shipping and barge;

- Farm ratio (origin price/destination price) for soybeans is highly negatively correlated with barge shipping costs and weakly correlated with rail shipping costs. Corn is negatively correlated with both barge and rail shipping costs with a higher correlation for total rail shipping costs than for barge shipping costs.

Table 5.1. Soybean: Change in Shipping Costs and Values, 2004-2009.

	Mean $/b		Change		Std. Dev.	
	2004	2009	$/bu	%	2004	2009
Origin Basis	-0.08	-0.26	-0.18	228%	0.34	0.40
Dest. Basis	0.60	0.83	0.23	37%	0.26	0.30
Spread	0.69	1.09	0.40	58%	0.36	0.51
Farm Ratio	0.91	0.90	-0.01	-1%	0.06	0.05
Barge Shipcost	0.28	0.40	0.12	41%	0.14	0.14
Ocean Rate Gulf	1.60	1.28	-0.32	-20%	0.24	0.29
Ocean Rate PNW	1.03	0.68	-0.35	-34%	0.15	0.16
Ocean Spread	0.57	0.60	0.03	5%	0.13	0.14
Rail Tariff	0.80	1.01	0.20	25%	0.05	0.04
DCV	0.03	-0.02	-0.05	-153%	0.07	0.05
FSC	0.04	0.14	0.10	240%	0.02	0.03
Rail Shipping Cost	0.88	1.12	0.25	28%	0.12	0.07
Margin	0.18	0.26	0.08	47%	0.33	0.38

Corn: Change in Shipping costs and values, 2004-2010

Origin Basis	-0.15	-0.32	-0.17	108%	0.13	0.18
Dest. Basis	0.56	0.95	0.40	71%	0.24	0.34
Spread	0.71	1.28	0.57	80%	0.31	0.46
Farm Ratio	0.77	0.73	-0.04	-5%	0.10	0.08
Barge Cost	0.25	0.34	0.08	33%	0.14	0.21
Ocean Ship Gulf	1.50	1.74	0.24	16%	0.22	0.07
Ocean Ship PNW	0.96	1.00	0.04	4%	0.14	0.08
Ocean Spread	0.53	0.74	0.21	40%	0.13	0.06
Rail Tariff	0.67	0.91	0.24	36%	0.12	0.13
DCV	0.02	0.00	-0.03	-107%	0.07	0.07
FSC	0.03	0.19	0.16	475%	0.01	0.04
Rail Ship Cost	0.72	0.99	0.27	37%	0.16	0.26
Ship Cost all modes	0.61	0.93	0.32	53%	0.26	0.36
Margin	0.15	0.39	0.24	164%	0.18	0.36
Gulf Port Spread	0.04	0.24	0.21	533%	0.04	0.08
PNW Port Spread	0.16	0.36	0.21	129%	0.07	0.10

*Changes for components of corn rail costs were derived through July 2010, which makes them not directly comparable to soybeans. To be comparable, these were derived from 2004 to 2009 (Jan.-Oct. 2009) and the changes were similar to those for soybeans. Percentage changes in rail Tariff, DCV, FSC, and total rail cost were 25%, -138%, 289%, and 30%, respectively.

Table 5.2 Soybean Data Correlations, 2004-2009.

	Origin Basis	Dest. Basis	Spread	Farm Ratio	Barge Shipcost	Ocean Gulf to Japan	Ocean PNW to Japan	Ocean Spread	Rail Tariff	DCV	FSC	Rail Ship Cost	Margin
Origin Basis	1	0.32	-0.77	0.53	-0.54	-0.42	-0.46	-0.29	-0.47	-0.11	-0.53	-0.49	-0.24
Dest. Basis		1	0.36	-0.34	0.03	-0.28	-0.37	-0.09	-0.10	0.03	-0.32	-0.13	0.27
Spread			1	-0.75	0.62	0.23	0.20	0.22	0.46	0.16	0.31	0.44	0.42
Farm Ratio				1	-0.70	0.21	0.14	0.27	0.06	-0.31		-0.21	-0.21
Barge Shipcost					1	0.16	0.20	0.07					
Ocean Rate Gulf						1	0.95	0.90	0.23	0.10	0.33	0.30	0.12
Ocean Rate PNW							1	0.72	0.20	0.09	0.37	0.30	0.08
Ocean Spread								1	0.23	0.07	0.16	0.22	0.16
Rail Tariff									1	-0.10	0.60	0.61	0.11
DCV										1	-0.05	0.68	-0.27
FSC											1	0.59	-0.04
Rail Shipping Cost												1	-0.17
Margin													1

Table 5.3 Corn Data Correlations, 2004-2010.

	Origin Basis	Dest. Basis	Spread	Farm Ratio	Barge Shipcost	Ocean Gulf to Japan	Ocean PNW to Japan	Ocean Spread	Rail Tariff	DCV	FSC	Rail Ship Cost	Total Ship Cost	Margin	Gulf Port Spread	PNW Port Spread
Origin Basis	1	-0.30	-0.64	0.54	-0.51	-0.16	-0.10	-0.21	-0.39	-0.12	-0.40	-0.36	-0.56	-0.39	-0.34	-0.26
Dest. Basis		1	0.92	-0.57	0.28	0.34	0.29	0.34	0.63	0.07	0.44	0.78	0.66	0.70	0.40	0.51
Spread			1	-0.67	0.57	0.33	0.26	0.36	0.68	0.11	0.52	0.79	0.76	0.71	0.46	0.52
Farm Ratio				1	-0.50	0.19	0.18	0.17	-0.35	-0.34	0.06	-0.55	-0.57	-0.39	-0.11	-0.06
Barge Shipcost					1	0.13	0.16	0.06		0.30			1.00	-0.49	0.08	0.28
Ocean Rate Gulf						1	0.95	0.89	0.25	0.03	0.43	0.20	0.22	0.29	0.25	0.67
Ocean Rate PNW							1	0.70	0.19	0.06	0.37	0.18	0.20	0.22	0.15	0.56
Ocean Spread								1	0.29		0.45	0.20	0.22	0.34	0.36	0.71
Rail Tariff									1	-0.06	0.59	0.67	0.88	0.27	0.34	0.38
DCV										1	-0.16	0.33	0.24	-0.09	-0.06	0.09
FSC											1	0.47	0.71	0.19	0.32	0.51
Rail Shipping Cost												1	0.77	0.51	0.22	0.32
Total Ship Cost													1	0.08	0.21	0.34
Margin														1	0.47	0.45
Gulf Port Spread															1	0.53
PNW Port Spread																1

Risk in Grain Marketing Functions

These data were used to derive measures of risk for each of the critical marketing functions. We derived the standard deviation and the coefficient of variation (CV) for each. The CV is defined as the standard deviation divided by the mean and can be interpreted directly as a measure of relative risk.

Results are shown in Table 6.1. Using the CV as a measure, the daily car value (DCV) is the most risky variable for both crops. The next most risky variables in the case of soybeans are: margins, ocean rate spreads, barge rates, ocean rates and FSC's and all the other marketing functions are very minor in terms of relative risk. For corn, the next most risky marketing functions are margins, followed by barge rates and FSC's that are comparable, and ocean shipping costs. All the other functions have relatively minor variability in values as reflected in the CV.

The standard deviations are all measured in common terms, $/bushel, and can be used to compare the magnitude of relative risk. The daily car value as mentioned above is the most risky variable due to its low mean value. Interpreting risk using the standard deviation, the conclusions in terms of relative risks are the same, but, differences are not as drastic. In the case of soybeans, ranking the marketing functions in terms of risk results in: ocean rates and spreads are most risky; followed by handling margins, barge costs, and then much lower are car values, rail tariffs and FSCs. Indeed, the risk in barge rates is greater than rail tariffs and total rail shipping costs. Similar conclusions are apparent in comparing risks in corn marketing functions.

Table 6.1. Means and Variability of Elements of Grain Marketing Functions ($/bu)

	Mean	Std. Dev.	CV	Min	Max
Soybeans					
Rail Shipping	1.10	0.17	15	0.67	1.75
Tariff	0.93	0.08	9	0.73	1.05
DCV	0.03	0.13	403	-0.11	0.67
FSC	0.14	0.06	43	0.02	0.27
Barge	0.49	0.24	49	0.12	1.60
Ocean Gulf to Japan	1.70	0.75	45	0.63	3.62
Ocean PNW to Japan	1.07	0.48	45	0.36	2.36
Ocean Spread	0.62	0.33	53	0.22	1.66
Spread	0.99	0.42	43	-0.49	3.31
Margin	0.16	0.31	194	-1.00	2.76
Corn					
Rail Shipping	0.93	0.26	29	0.33	1.64
Tariff	0.79	0.17	22	0.40	1.05
DCV	0.02	0.11	497	-0.11	0.63
FSC	0.15	0.09	63	0.01	0.49
Barge	0.43	0.27	62		1.41
Ocean Gulf to Japan	1.60	0.67	42	0.59	3.38
Ocean PNW to Japan	1.00	0.43	43	0.34	2.20
Ocean Spread	0.60	0.30	50	0.21	1.55
Spread	1.08	0.47	44	0.04	2.78
Margin	0.29	0.32	110	-1.44	1.52
Gulf Port Spread	0.14	0.14	101	-0.14	0.56
PNW Port Spread	0.31	0.24	75	-0.08	1.01

Distributions for the values for some of the marketing functions are shown in Figures 6.1 to 6.3. These are cumulative probabilities (CDFs)[24] which show the probability of outcomes on the vertical axis and the horizontal axes are fixed so they can be compared across market functions. CDFs are shown for elements of rail shipping costs, barge rates and implied margins in Figures 6.1, 6.2 and 6.3 respectively.

[24]Probability density functions for these same distributions are in the appendix as well as the distribution type and parameters for each.

The distributions for rail shipping elements indicate there is relatively lesser variability in these values. The CDF for the tariff is due to it changing periodically, as opposed to on a continuous basis. That CDF illustrates it is not highly variable and, hence the risk associated with this function is relatively minimal. Similar is the case of the CDF for the FSC.

The CDF for daily car values are more risky and the value is highly skewed. Technically, the mean is near about $0.02/bu. but, there is a small probability of large values. This implies that there is a small chance of prices having a very high value. The distribution shows that: 1) 50% of observations are less than $-0.013/bu.; 2) there is an 80% chance the value will be less than $0.075/bu.; and 3) there is a 5% chance of the value being lower than $-0.075/bu., or 5% chance of being higher than $0.175/bu. The latter is the characteristic of this market which is noted to be highly skewed.

Results illustrate barge rates and margins have greater variability than rail shipping costs, and are skewed (similar to daily car values), with greater chance of upward deviations in prices. Figure 6.3 shows the distribution for grain handling margins. As is apparent in these figures, there is greater variability and therefore risk in implied margins and in barge shipping costs than for rail shipping costs.

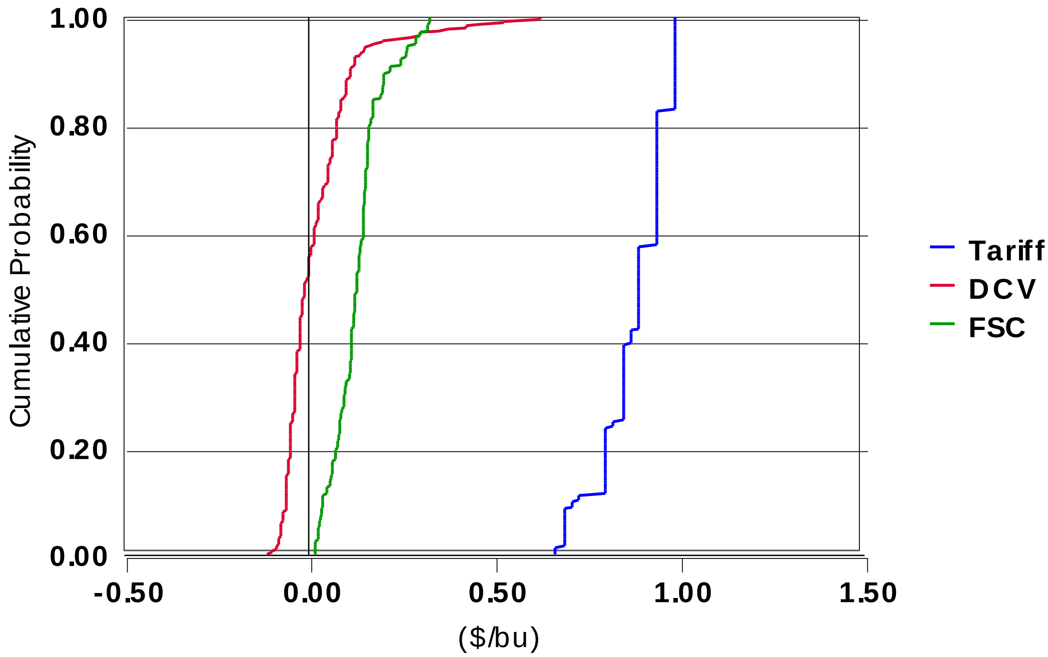

Figure 6.1. Cumulative Distribution for Rail Shipping Cost Components, Tariff, DCV and FSC.

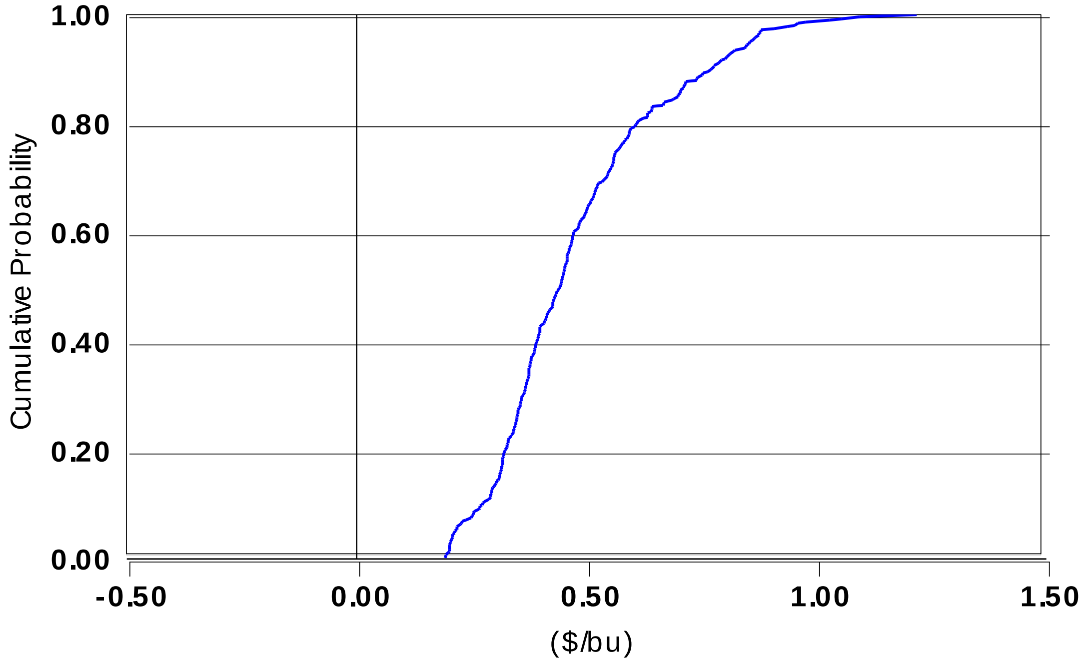

Figure 6.2. Cumulative Distribution for Barge Shipping Costs.

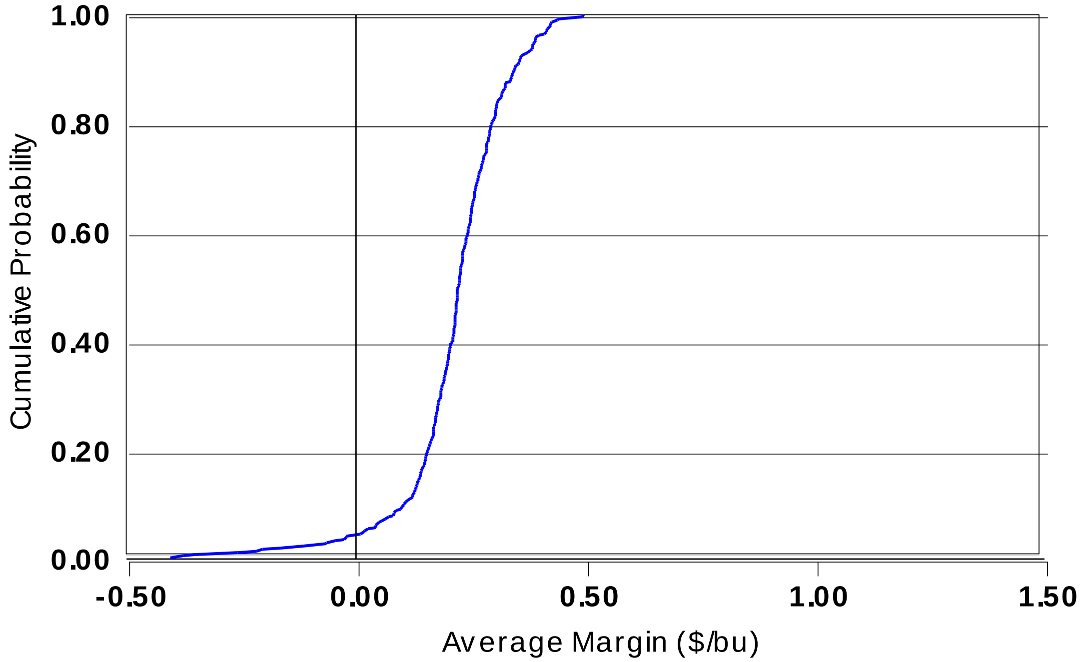

Figure 6.3. Cumulative Distribution for Average Margin.

Factors Impacting Intermarket Behavior

The previous studies suggest there is a direct and inverse relationship between transportation costs and origin basis values. These studies implied that rail rates are the primary determinant of the origin basis. The above data suggest that these relationships may be more complicated.

This section conducts two sets of regression analysis to determine the factors that impact the relationship among basis values at origins and destinations, and shipping costs. The first is a simple linear regression. The second regression analysis is more exploratory to identify factors that have a statistically significant impact on these relationships.

Simple Linear Regressions: The first analysis examines a very simple relationship implied in grain marketing. We explore the extent that origin basis values are impacted by destination basis and shipping costs. To do so, we conduct simple regressions as follows:

$B_{ot}=f(B_{dt}, S_{odt})$

where B_{ot} is the origin basis, B_{dt} is the destination basis, and S_{odt} is the shipping cost from o to d at time t. The destination market was defined for each origin and for each observation (point in time) as that market which yielded the maximum net return during each period t as described above (i.e., using the relationship $M_m=MAX[(B_{usg}-T_{usg}, B_{PNW}-T_{PNW}, B_{calif}-T_{calif}]-B_o$). The value of the shipping cost used in the analysis was determined from this evaluation. For rail it included the sum of rail tariffs, FSCs and car values.

In competitive markets, assuming the prescribed destination markets always dominate others, with perfect information and no risk, there should be a 1:1 relationship between the origin and destination basis; and a 1:-1 relationship between origin basis and shipping costs. Simply, if the destination basis changes, the local basis would change by the same value; and if shipping costs change, there would be a comparable though inverse change in the local basis.

The simple model was estimated for the pooled sample, as well as for each individual origin. The results are shown in Tables 7.1 and 7.2, and illustrated in Figure 7.1. The pooled results (across origins and through time) for soybeans indicate relatively good explanatory power. Technically, this means that 57% of the variability in origin basis values is explained by the destination basis value and shipping costs. Thus, a portion of the variability in origin basis is random, or, accounted by other factors. The slope coefficient with respect to the destination basis is .64 for the pooled sample, and .64 and .72 for rail and barge respectively indicating there is less than a 1 to 1 relationship between origin and destination basis values. The coefficient with respect to shipping costs is -.53 for rail origins and -.98 for barge origins. The model was also run for individual origins. The results indicate that there is substantial variability across origins.

The functional relationship is shown in Figure 7.1 for individual origins. The horizontal and vertical axes are the origin and destination basis. If there were a 1:1 relationship between these, the line would be a 45 degree line. However, as shown, the slope is less than 1:1.

These results can be used to interpret grain pricing with respect to the origin basis. On average (i.e., across origins and through time), a $0.10 increase in the destination basis results in a $0.064 increase in origin basis; and a $0.10 increase in shipping costs results in a $0.071 decrease in origin basis. Thus, on average, growers absorb (in terms of lower origin basis values), about 71% of the changes in shipping costs, implying that the remainder is absorbed by buyers in terms of higher destination basis values. Indeed, the data in Table 6.1 indicated the origin basis decreased by a lesser amount than the increase in destination basis. This indicates that changes in shipping and handling costs are reflected in lower prices to growers, and higher prices to buyers.

The results for are corn are significant, but, are less consistent compared to soybeans. The R^2 s lower, meaning there is greater unexplained variability, and the slope coefficients are generally less. Each of the regression slope coefficients is much less than their expected values. The lowest R^2 for barge origins are for MN (3) and IA (2) (the more Northern Barge Loading Regions). The highest R^2 is for IL River (4), S INR (5) and St. Louis (1). Thus, there is greater explanatory ability for the more southern river origins, than the more northern origins.

These results indicate a number of important observations. First, there is more randomness than conventionally considered. Most representations of these types of relationships presume there is nearly a perfect relationship among these variables, and 1:1 relationships between origin and destination basis, and a similar inverse relationship with respect to shipping costs. Second, there is substantial variability in these relationships across origins. Reasons for these differences are likely due to a combination of: 1) origins having other viable destination markets that impact their pricing---this is likely more true in corn due to the growth in ethanol processing and local feeding; 2) local competitive conditions which vary with respect demand for storage and competing elevators; and 3) that there are other costs, implicit or explicit, besides shipping costs that impact local grain pricing.

Table 7.1 Soybean: Simple Linear Regressions Describing Origin Basis as Function of Destination Basis and Shipping Cost.

Type	State	Location	Intercept	Destination Basis	Shipping Cost	R2
Pooled		All	-0.20	0.64	-0.71	0.57
Type		Rail	-0.41	0.64	-0.53	0.47
		Barge	-0.09	0.72	-0.98	0.52
Location	ND	Ayr	0.02	0.76	-1.07	0.73
	ND	Finley	-0.49	0.49	-0.38	0.28
	ND	Jamestown	-0.43	0.67	-0.60	0.58
	ND	Alton	-0.19	0.83	-0.91	0.70
	ND	Mayville	-0.82	0.46	-0.25	0.46
	NE	Beatrice	0.29	0.61	-1.15	0.70
	NE	Dorchester	0.55	0.63	-1.44	0.69
	NE	Edison	-0.15	0.50	-0.66	0.50
	NE	Fremont	0.21	0.62	-0.86	0.63
	NE	Hastings	-0.50	0.39	-0.35	0.50
	NE	Maywood	0.26	0.69	-1.29	0.60
	OH	East Liverpool	-0.22	0.63	-0.77	0.49
	OH	Cin CGB	-0.13	0.99	-1.19	0.48
	OH	Cin Bunge	-0.08	0.58	-0.76	0.57
	OH	Cin Cargill	0.00	0.67	-0.92	0.73
	IL	Cairo	-0.12	0.70	-0.77	0.35
	IL	Albany	-0.06	0.70	-0.95	0.80
	IL	Mound City	-0.10	0.64	-0.92	0.53
	IL	Nauvoo	-0.03	0.73	-1.17	0.64
	IL	Pekin	-0.25	0.67	-0.76	0.56
	IN	Jeffersonville	-0.13	0.79	-0.96	0.56
	IN	Mount Vernon	-0.04	0.80	-1.18	0.37
	IN	Aurora	-0.11	0.91	-1.18	0.54
	IN	Evansville	-0.11	0.93	-1.29	0.46
	IA	Bayard	-0.32	0.65	-0.56	0.75
	IA	Creston	-0.38	0.66	-0.41	0.64
	IA	Ida Grove	-0.39	0.78	-0.63	0.60
	IA	Odebolt	-0.35	0.67	-0.58	0.67
	IA	Hamburg	0.08	0.61	-0.88	0.51
	IA	Muscatine	-0.02	0.48	-0.82	0.52
	IA	Dubuque	0.01	0.46	-1.01	0.51
	SD	Madison	0.04	0.53	-0.75	0.49
	SD	Marion	0.38	0.60	-1.17	0.68
	SD	Mellette	0.53	0.83	-1.50	0.74
	SD	Mitchell	0.07	0.50	-0.79	0.43
	SD	Wolsey	0.49	0.69	-1.33	0.61

Table 7.2 Corn: Simple Linear Regressions Describing Origin Basis as Function of Destination Basis and Shipping Cost.

Location	Intercept	Destination Basis	Shipping Cost	R2
Rail Shipping Only				
Pooled	-0.01	0.10	-0.44	0.22
Alton, ND	0.16	0.07	-0.68	0.34
Brad, NE	0.02	0.18	-0.52	0.21
Breck, MN	0.17	0.12	-0.68	0.32
C IL	-0.07	0.17	-0.42	0.29
ER SD	-0.04	0.07	-0.45	0.10
N IL	-0.11	0.16	-0.46	0.30
NC IA	0.16	0.07	-0.52	0.14
NC IL	-0.07	0.16	-0.41	0.26
NE CO	0.05	-0.20	-0.11	0.18
NW IA	-0.06	0.23	-0.52	0.24
NW MO	-0.28	0.20	-0.30	0.10
Omaha, NE	-0.05	0.32	-0.55	0.27
S MN	0.00	0.21	-0.57	0.31
SC IA	-0.02	0.18	-0.49	0.26
SE WY	0.09	-0.08	-0.32	0.20
SW IA	-0.11	0.25	-0.55	0.30
W IL	-0.21	-0.11	0.02	-0.02
W KS	0.09	-0.30	-0.16	0.18
Barge Shipping Only				
Pooled	-0.09	0.18	-0.40	0.28
IL River	-0.01	0.36	-0.77	0.55
S IA Barge	-0.18	0.17	-0.26	0.20
S INR Barge	0.03	0.33	-0.71	0.48
St Louis Barge	0.01	0.27	-0.70	0.40
SM NIA Barge	-0.23	0.08	-0.22	0.20

*Note:*St Louis Barge=Reach 1, S IA Barge=Reach2, SM NIA Barge=Reach 3, IL River=Reach4, and S INR Barge=Reach 5

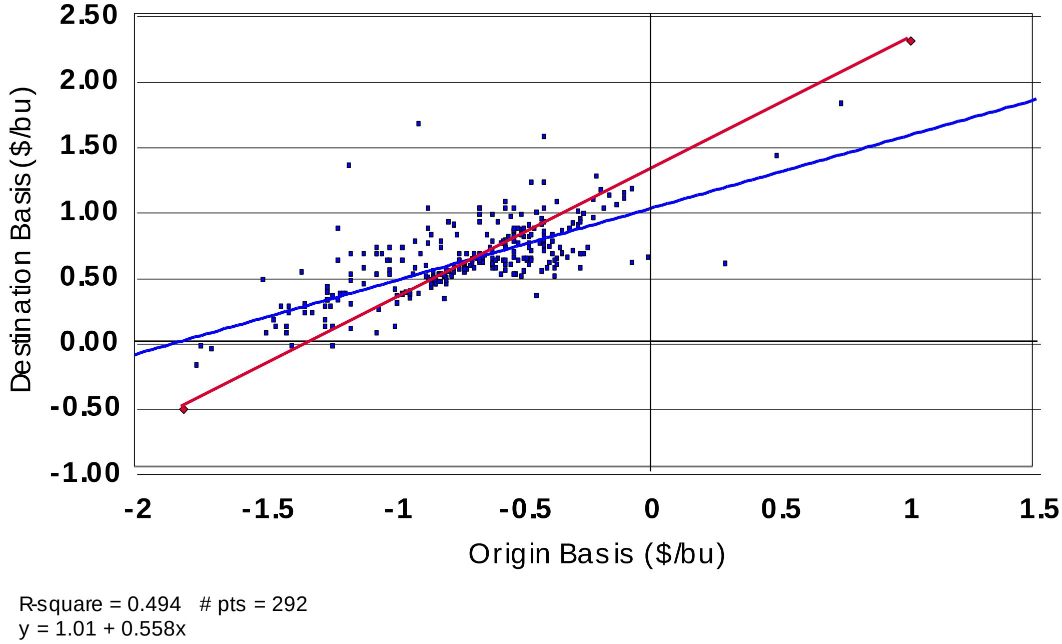

Figure 7.1. Estimated Relationship for ND Origin Basis and Destination Basis, Soybeans.

Regressions Explaining Intermarket Basis Relationships A second regression analysis was conducted to explore these relationships further. This is more comprehensive than that above and includes an effort to determine other factors that impact origin basis values.

<u>Model Specification and Estimation</u> A general model was specified to include a number of variables that would logically explain origin basis values. Specifically, the model specified is:

$B_{ot}=f(S_{odt}, OS_t, OE_t, C_t, R_{ot}, F_t, FS_t, CONC_{o,} B_{dt}, State_o)$

where subscripts o, d and t are for origin, destination and time t respectively, and B is the basis at the origin o, and destination d that maximizes the net payoff, S is shipping cost, OS is the ocean rate spread, OE is outstanding export sales, C is an indicator or rail cars late, R is the ratio of stocks to storage in the state of the origin, F and FS are futures prices and spreads (deferred less nearby), CONC is the measure of concentration using either the Herfindahl or CR4, and State is a binary variable indicating the state of the origin.

The model captures the major impacts that impact origin basis and intermarket relationships. Shipping costs are clear. Ocean spreads impact the attractiveness of shipping through the US Gulf or PNW. Outstanding export sales represent unshipped sales and as such are an indicator of the demand for shipments. Rail cars late is a measure of rail on-time performance and is expected to impact the origin basis. The ratio of grain stocks to storage is an indicator of tightness in storage. Given that shipping demand competes with storage demand, this variable captures part of the tradeoff. Futures prices are normally inversely related to basis values and the impact is important. The futures price spread is an indication of the carrying charge and the incentive to store, which also competes with shipping.

We used two measures of concentration, the Herfindahl and CR4 and retained that which provided the best explanation for the model. Finally, State is included as a binary variable to capture any autonomous variability related to individual states. Other variables were examined but rejected through the estimation process due to their insignificance. The data were pooled and the observations were used to estimate the relationship.[25]

Results The results are shown in Table 7.3.[26] Important variables that are statistically significant include shipping costs, ocean rate spreads, export outstanding sales, measures of cars late, the ratio of grain stocks to storage capacity, futures prices and varying measures of futures and destination spreads. In addition, there is a significant difference in these relationships across states.

The relationships of the critical variables are described below and illustrated in Figures 7.3-7.7 for soybeans and 7.8-7.12 for corn. The figures were parameterized around the range of values observed for minimum and maximum values for parameters examined.

Shipping costs: There is an inverse relationship between origin basis and shipping costs. However, that effect is less than 1:1 meaning that on average, changes in shipping costs have less than a 1:1 change in origin basis.

The fact that this value (absolute) is less than 1 needs some explanation. More likely this is caused by a number of factors. One is that intermarket competition would impact this, on the margin. Increases in shipping costs to one destination, would result in other destinations being more attractive for some origins. Second, are local competitive conditions, including concentration, storage, etc. Third, there are several additional destinations other than those included in our analysis (PNW, US Gulf and California feed in the case of corn). These include existence of local markets, notably feeding, ethanol demands, and crushing plants. Fourth, is that we are using the total shipping costs inclusive of current car charges, tariff rates and FSCs. Some shippers may not use these full values for varying reasons, in their derivations of local basis values. Finally, and probably most important is that this is a pooled data set. Thus, the parameter represents the average impact, averaged across all origins and through time.

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[25] Technically the data were pooled, but, due to the data construction, panel procedures could not be used.

[26] Appendix Table B.1 makes comparison of the estimates for the soybean expanded data to that using the narrower data used by O'Neil Commodity Consulting.

Futures values and spreads: Both these had expected signs and were significant for both corn and soybeans. The results indicate there is an inverse relationship between origin basis and futures values. A similar negative correlation exists in many other commodities. Simply, when futures values are higher, the origin basis tends to decline. This means that with high commodity prices, handlers are likely capturing a greater margin.

The futures spread is the difference between deferred and nearby options and hence, it is included as an indicator of the returns to storage. In a normal market, storage is encouraged which detracts from (competes with) shipping demand, and vice versa for inverted markets. The sign is expected to be negative meaning that a larger positive spread, encourages storage. The results indicate large carrying charges (as represented by the intermonth futures price differential) would also result in a lower origin basis which would simultaneously provide reasons to store and not ship.

Ratio of grain stocks to storage capacity: This is significant for corn, but not soybeans. The relationship indicates that at times, or for those origins, with a high ratio of grain stocks to storage capacity, basis levels decline. Simply, if there is a shortage of storage capacity, basis levels are lower, no doubt reflecting the impact of the shortage of storage capacity on local basis values.

Outstanding sales: O'Neil Commodity Consulting implied that basis values were impacted by export levels (i.e., outstanding export sales would be high during periods of demand-pull). These results are expected and support this claim and the impact is significant for both soybeans and corn. A large amount of outstanding sales indicates there is a large demand for shipments, and, *vice versa*.[27]

The specific impact is manifested in the level of outstanding export sales (i.e., sales that have been made, but, not shipped). These results indicate that the origin basis increases with increases in outstanding sales. During periods of strong (weak) outstanding sales, the basis will be higher (weaker). The relationship is non-linear meaning the rate of increase, increases with the level of outstanding sales.

Interpretation of this relationship for soybeans is that an increase in outstanding sales from 400,000 to 700,000 bushels would result in an increase in the basis from about $-0.42 to $-0.15/bu., which is fairly substantial (Figure 7.5). In the case of corn, an increase in outstanding sales from 450,000 to 750,000 increases the origin basis from $-.32 to $-.17/bu., which is also substantial (Figure 7.10).

[27]There are several variables that could be used to represent the rate of exports. These include weekly export shipments, and outstanding sales.The former represents past shipment, whereas the latter represents sales that have not been shipped. The latter is a more appropriate measure of the impact of exports on shipping demand, and thus, that is the value we used. We experimented with each of these values and retained those that were most consistent.

Rail car placement performance: Other studies have alluded in varying ways that rail on-time performance may impact origin basis. These results indicate the extent of that relationship. There is a negative relationship between rail car placements and origin basis and the effect is significant.

For soybeans, this relationship is nonlinear, whereas that for corn is linear (at least over the observed range of the independent variable). In the case of soybeans (Figure 7.6), increasing the measure of cars late from 2000 to 3000, reduces the basis, on average, from about -$0.50 to -$0.54/bu. For corn (Figure 7.11), increasing the measure of cars late from 2000 to 3000 reduces the origin basis from -$0.30 to -$0.32/bu. Thus, rail performance, as measured by cars late, does have a negative impact of origin basis, but, considering all the other factors, this impact is relatively modest.

Grain Handling Concentration: We explored use of both the CR4 and Herfindahl Index to measure this effect. Both are comparable. For soybean, the CR4 worked best while the Herfindahl index worked best for corn. This impact captures the inter-spatial differences in industry concentration, but not the inter-temporal variability since time series does not exist for this data.

The effect is significant in both cases. The results indicated that increasing concentration has a negative impact on origin basis values. Increasing industry concentration has the impact of reducing origin basis. For corn (Figure 7.12), increasing the Herfindahl from 900 to 2000 has the impact of reducing the origin basis by about $0.02/bu. For soybeans (Figure 7.7), increasing the CR4 from 40 to 80 has the impact of reducing the origin basis by about $0.07/bu.

State level impacts and time trend: Finally, there are differences across states, i.e. considering all the other impacts, there are still significant differences across states. The time trend coefficient is significant for soybeans. The reason for this is likely reflecting the growth in soybean production in more westerly and northerly regions over this period. These origins would have greater interior shipping costs than traditional regions.

Table 7.3. Estimated Functional Relationships for Origin Basis by Crop.

	Soybeans		Corn	
Item	Parameter	T Value	Parameter	T Value
Intercept	.24	11.5	.48	15.0
Shipcost	-.36	-29.0	-.27	-22.9
Ocean Ship Spread	-.07	-4.6	-.07	-6.0
Outstanding Sales	-7.1E-7	-12.0	-6.4E-7	-9.1
Outstanding Sales^2	1.2E-12	13.8	9.3E-13	12.1
BN Cars Late	-5.3E-5	-14.4	.00001	11.8
BN Cars Late^2	3.9E-9	12.1		
Ratio: Stocks to Storage Capacity	Ns		-.26	-11.2
Trend	-.08	-25.3	Ns	
Futures Nearby	-.02	-6.7	-.04	-14.3
Futures 1 Spread (NB-Deferred)	-.31	-20.1	-1.27	-19.2
Destination PNW			-.07	-5.8
Destination Basis	.56	47.1	.31	24.2
Herfindahl	NS		-.000028	-5.1
CR4	-.002	-10.7		
Gulf Port Spread	Ns		-.54	-28.0
S1 (ND)	-.24	-15.4	-.20	-10.5
S2 (NE)	-.14	-12.9		
S3 (IL)	.21	15.5	.07	8.6
S4 (IN)	.17	11.0	.17	16.3
S6 (SD)	-.05	-4.0	-.08	-5.4
S7 (IA)	.03	2.5		
S9 (KS)			.14	12.5
S10 (MN)			-.07	-8.9
S11 (MO)			.05	6.2
R^2	.61		.60	

NS is not significant

Soybeans Functional Relationships (Expanded Dataset)

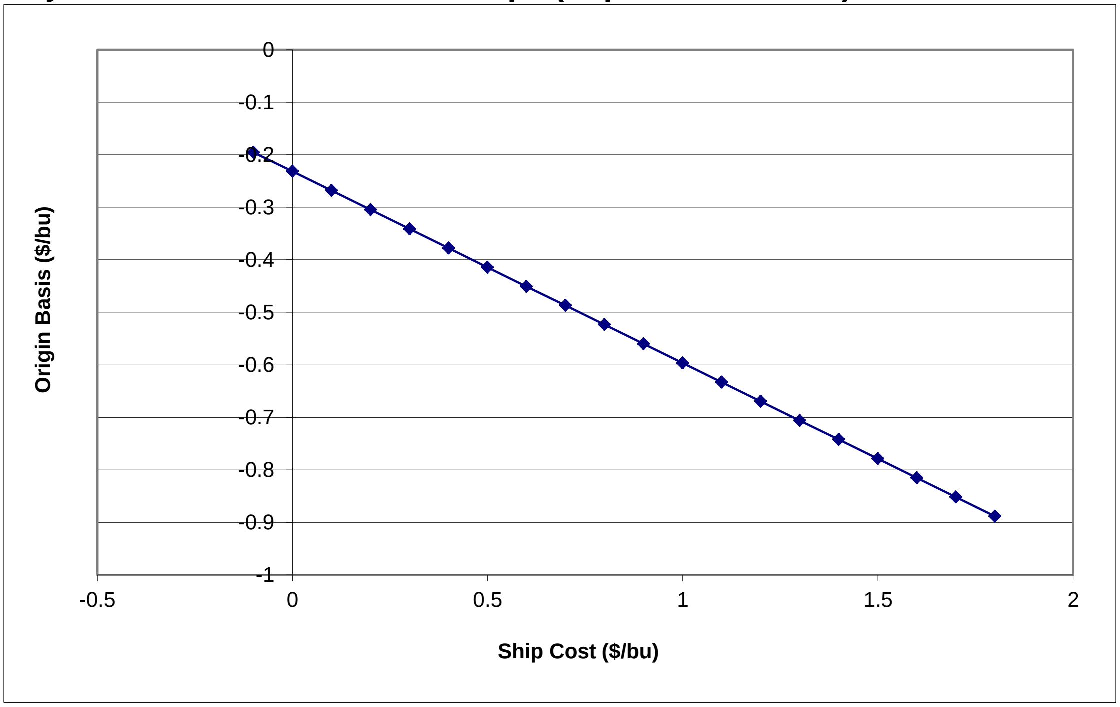

Figure 7.3. Soybeans: Sensitivity of Origin Basis to Changes in Shipping Cost to Preferred Market.

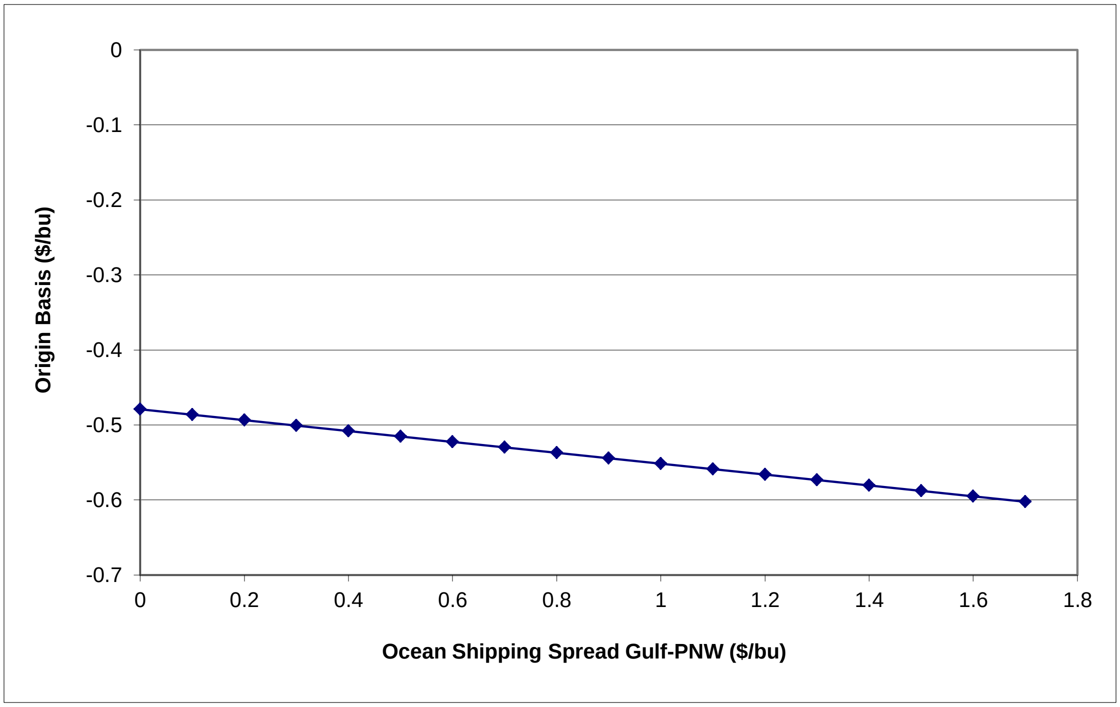

Figure 7.4. Soybeans: Sensitivity of Origin Basis to Changes in Ocean Shipping Spread.

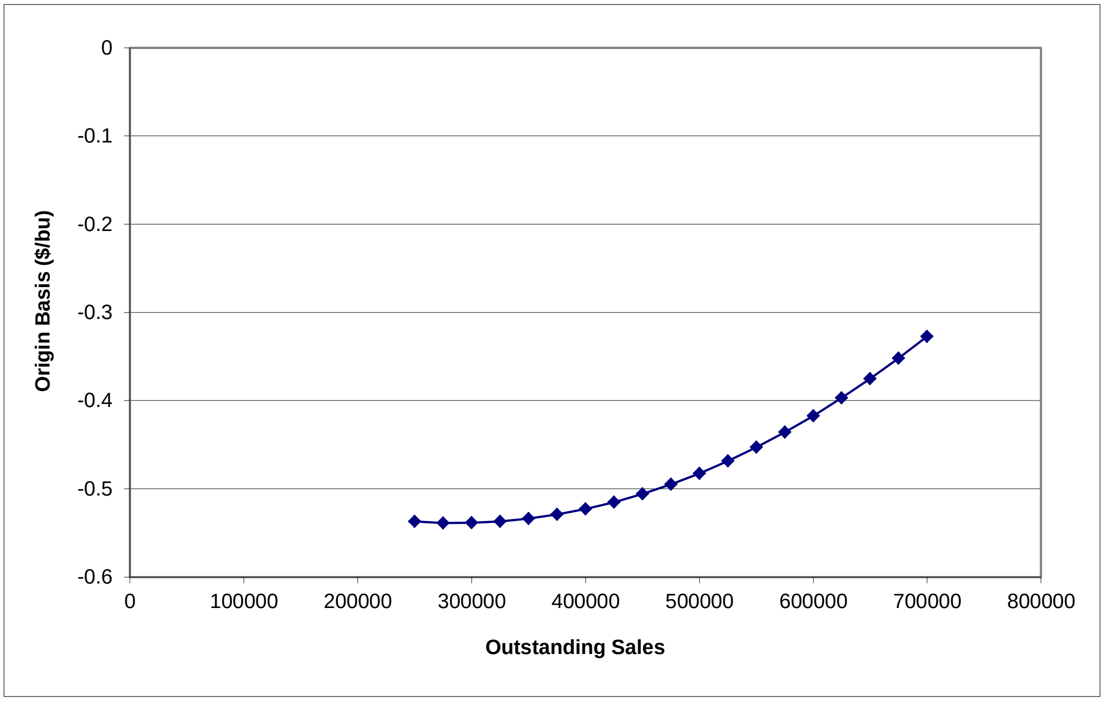

Figure 7.5. Soybeans: Sensitivity of Origin Basis to Level of Outstanding Sales.

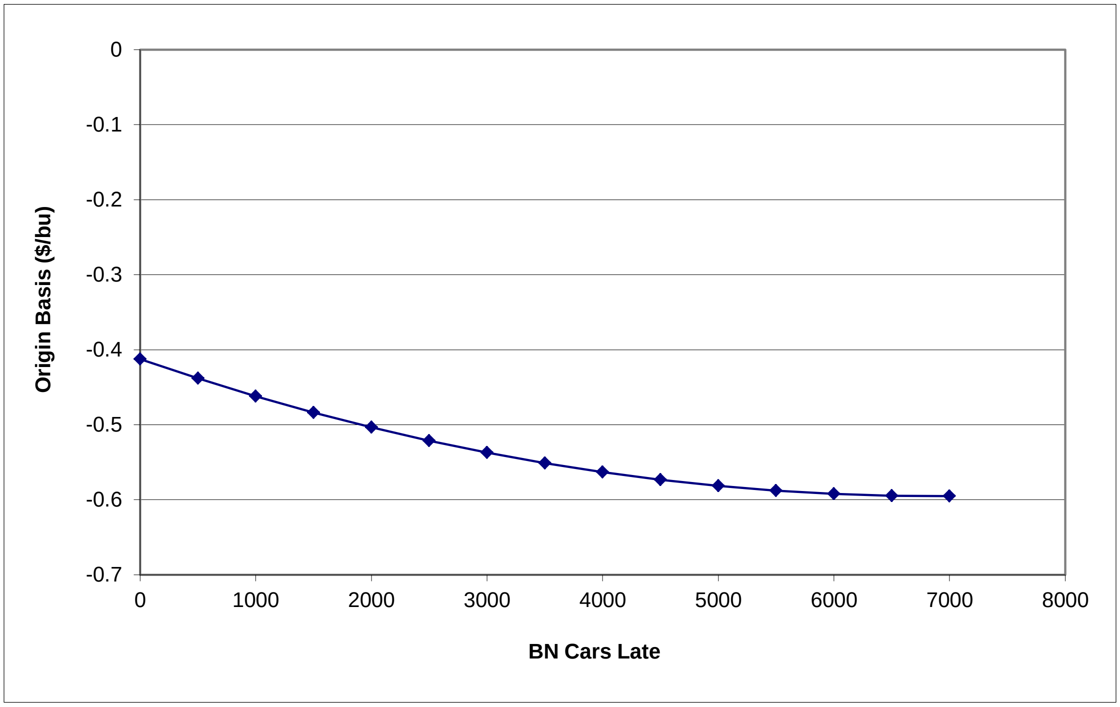

Figure 7.6. Soybeans: Sensitivity of Origin Basis to BN Cars Late.

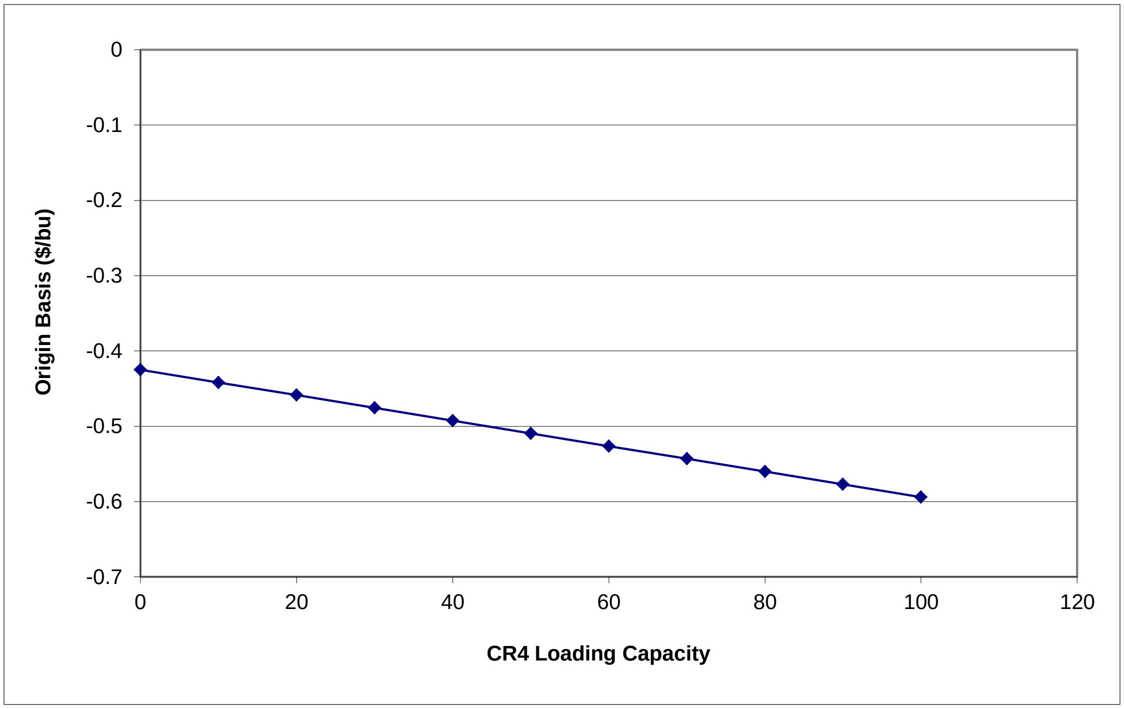

Figure 7.7. Soybeans: Sensitivity of Origin Basis to CR4 for Loading Capacity for Firms within 75 Mile Radius.

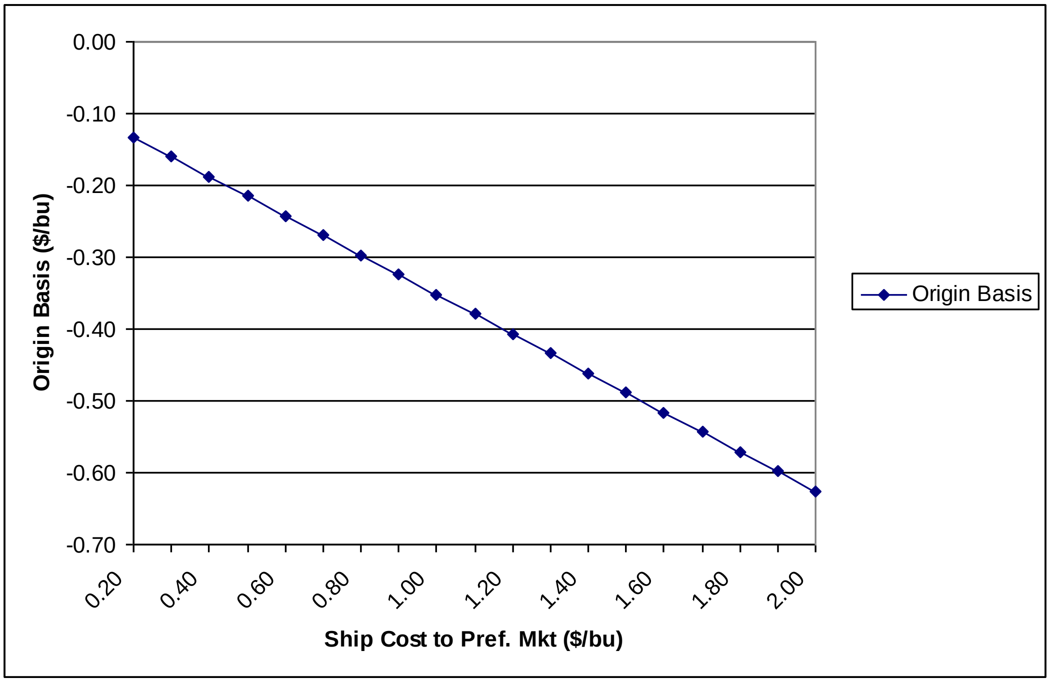

Figure 7.8. Corn: Sensitivity of Origin Basis to Shipping Cost to Preferred Market.

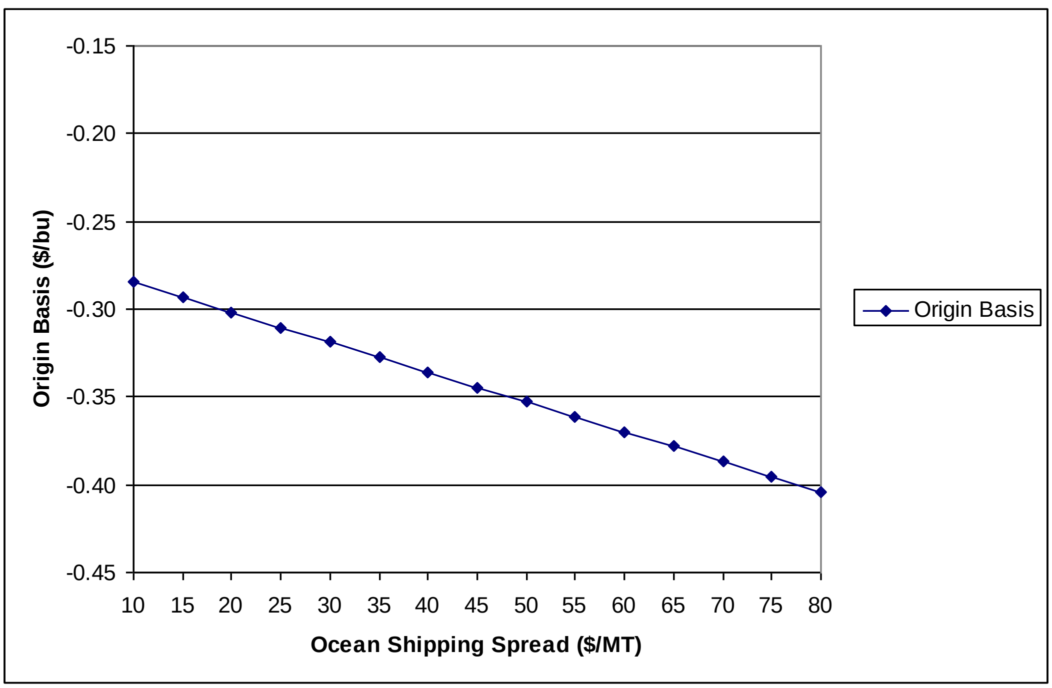

Figure 7.9. Corn: Sensitivity of Origin Basis to Ocean Shipping Spread.

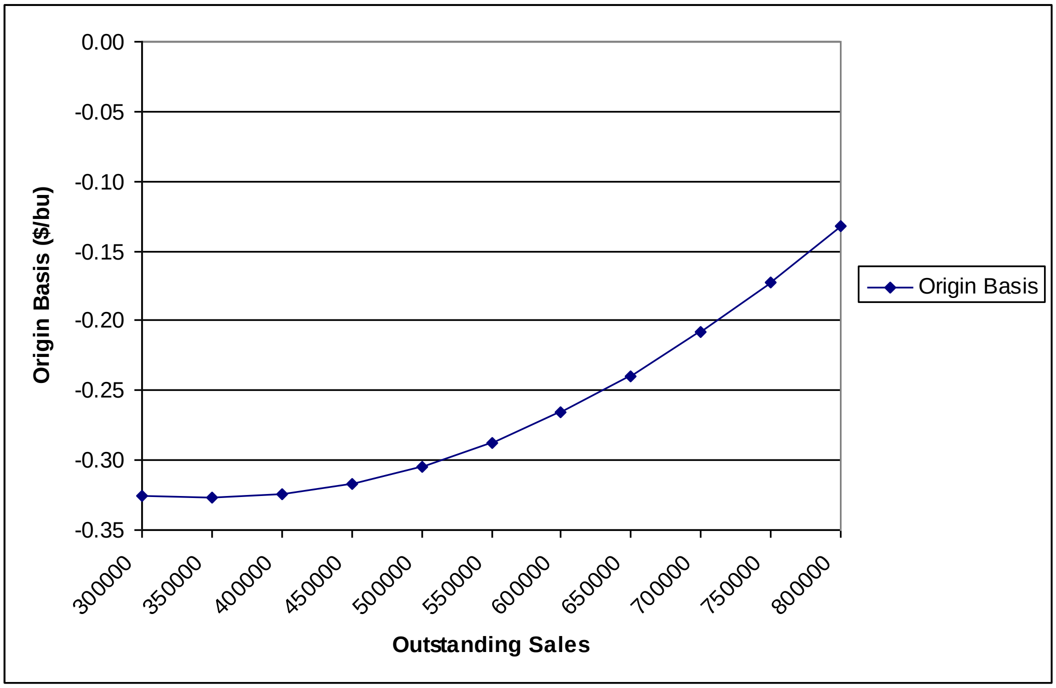

Figure 7.10. Corn: Sensitivity of Origin Basis to Level of Outstanding Sales.

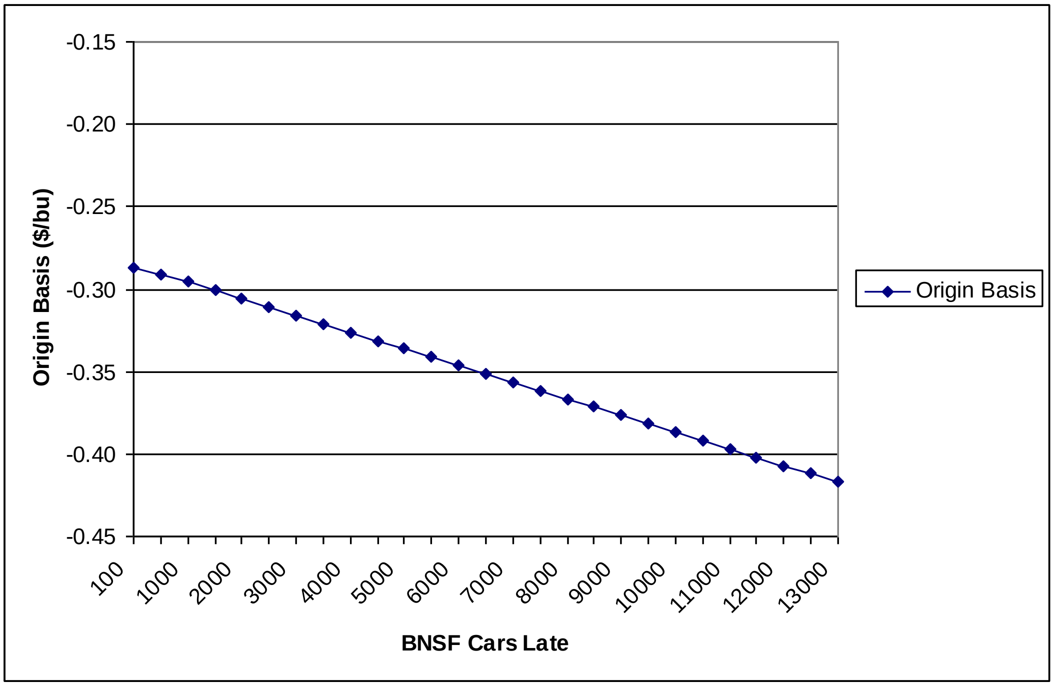

Figure 7.11. Corn: Sensitivity of Origin Basis to BNSF Cars Late.

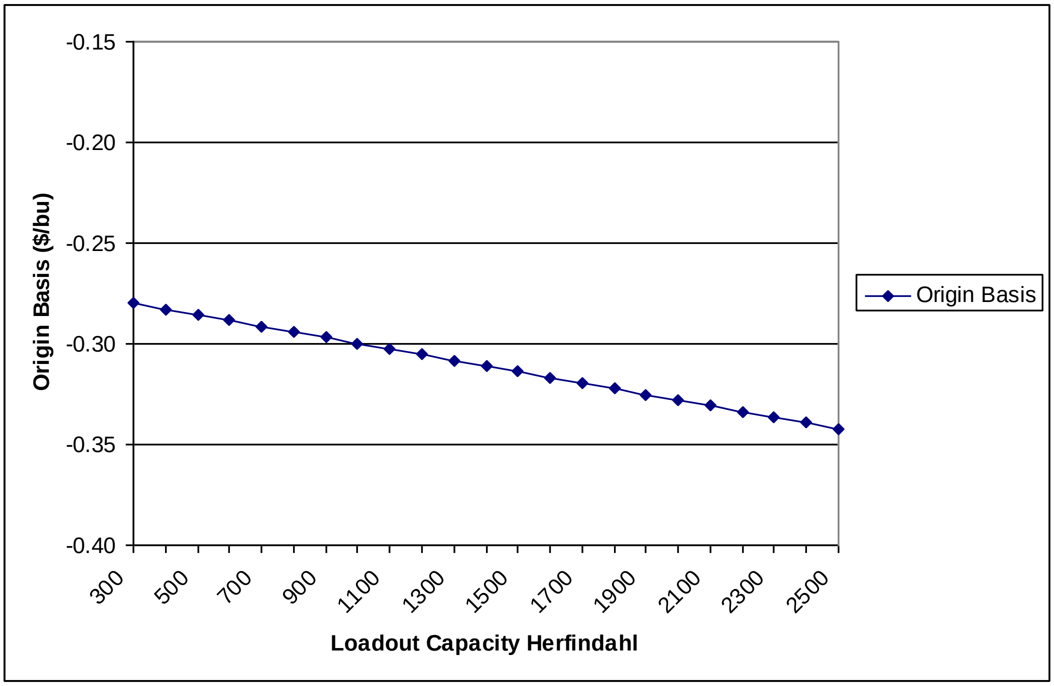

Figure 7.12. Corn: Sensitivity of Origin Basis to Loadout Capacity Herfindahl for 75 Mile Radius around Origin.

<u>*Interpretation of origin basis values:*</u> Taken together, the results can be used to explain how these factors impact origin basis values. First, it is important that the R^2s on these regressions, as well as those shown above, are not extremely high. This is to be expected from pooled data and the level of R^2s would be typical of pooled regressions. Nevertheless, these do suggest that there is still quite a bit of unexplained variability.

Second, the parameters and graphics can be used to explain why basis values behave as they are observed. The impacts of the most important variables are summarized below:

- Outstanding sales: strong sales result in higher origin basis values;
- Futures prices: high prices are correlated with lower origin basis and large futures spreads result in lower origin basis values;
- Ratio of grain stocks to storage capacity: tight capacity lowers origin basis values;
- Rail Cars late: impact is negative, but, only slight for most observed levels of cars late; and
- Concentration: basis at locations states that have greater concentration results in lower origin basis.

During 2007-2008 origin basis were quite low by historical and recent comparisons. In contrast by later 2009 and 2010, the origin basis values increased. Likely reasons for the low basis during 2007-2008 were a combination of these variable and qualitative comparisons between the periods and are shown in Table 7.4. The weaker basis during 2007 (prior to the peak in February 2008) was caused by comparable weak export sales, lower futures prices, wider carrying charges, large ocean rate spreads, and some lateness, though improved rail cars late. In comparison in 2009/10, the basis has been increasing and likely caused by somewhat opposite behavior of these factors.

Table 7.4: Impact of Selected Variable Impacting Origin Basis Levels in 2007 vs. 2009-10.

Variable	**2007**		**2009/10**	
Origin Basis	**Weak**		**Strong**	
	Factors having the Impact to Weaken/Strengthen the Basis During 2007		***Factors having the Impact to Weaken/Strengthen the Basis During 2009/10***	
	Weaken	*Strengthen*	*Weaken*	*Strengthen*
Outstanding sales	Weak		Strong	
Futures Prices	Lower		Higher	
Futures Spreads	Wider		Narrowing	
Ratio of grain stocks to storage		Surplus storage capacity	Tightening storage capacity	
Ocean Spreads		High	Lower	
Rail cars late	2000 cars late but decreasing			500 cars late, and improving
Concentration	Varies geographically			

Conclusions and Implications

This study was initiated to analyze some of the changes in the United States grain marketing system in the past decade, and how these impact origin basis values. Many changes have occurred in grain marketing and these have resulted in a very dynamic marketing system and changing market relationships.

Motivations: Changing underlying market fundamentals have resulted in a more robust outlook for grain shipping from the United States. This has resulted in changes in the spatial distribution of production among crops in major producing regions and greater volatility in shipping demands, both intra- and inter-seasonally. The impact of these is for changing intermarket relationships in the US grain marketing system. Specifically, basis relationships have become more volatile and less predictable. The greater volatility results in more risk for producers and shippers, and also exacerbates planning and investment for handling and shipping infrastructure.

The purpose of this study is to analyze the relationships between shipping costs and basis values at origins and destinations and to understand the role of transportation on grain pricing.

There have been a number of innovations or technological changes in rail logistics for grain. These include adoption of covered hopper rail cars, rail car demurrage policies and practices, development of short line railroads, unit train and shuttle shipping, and adoption of forward guaranteed shipping mechanisms. Taken together, these are resulting in highly dynamic changes that have resulted in numerous changes throughout the shipping and handling industry. Ultimately, these have resulted in improved efficiency throughout many aspects of the industry.

Finally, whereas grain pricing has traditionally been thought to be simply the terminal cash price less shipping cost, it has become much more complicated. Grain pricing has become more complex in a number of dimensions that prevail in more contemporary grain marketing. This is partly due to that shippers evaluate selling to multiple destinations, and hence it is the net return to each market that matters. This is in addition to selling to more local outlets including local processors, etc. Shipping costs are now more differentiated including varying elements of shipping. Finally, one of the more strategically important values is that shippers may not know the extent that rival buyers may/may not have coverage in the railcar, or FSC markets.

Major Results: This study used very detailed data on origin and destination basis values over time for corn and soybeans. It also assembled detailed data on marketing functions and costs for the same periods and origins, as well as a set of factors prospectively impacting these relationships. The period of the study was weekly data from 2004 to 2009 for soybeans and mid-2010 for corn. The major findings are summarized here.

Changes in Exogenous Factors: Over the last six years there have been what appear to be important changes in factors that impact grain pricing and basis values. Most important are:

- Exports have changed in several dimensions. First, export levels have increased. Second, it appears the inter-weekly variability (an indicator or risk) in exports has increased. And third, it appears exports have become more seasonally concentrated, particularly for soybeans.

- Ocean rates have increased, and have become more volatile. In addition, the US Gulf-PNW spread has increased, increasing demand for shipping to the PNW.

- Rail car on-time performance has improved. The results indicate that there were periods of shortages in 2004 and 2005 and in 2008. Since then, late car-placement performance has improved substantially with the number of cars past due dropping to low values for much of late 2008, 2009 and 2010.

- Concentration in the grain handling sector appears to have increased, and varies geographically. Some regions are highly competitive. However, some regions, notably in Western Nebraska and those in Illinois, have much greater concentration.

- Storage capacity has become tighter in recent years. Throughout most of the United States the ratio of grain stocks to storage capacity has increased which impacts inter-month price spreads, and the demand for shipping.

Basis Behavior: Origin basis values show geographical dispersions as expected. For soybeans, the basis is a larger negative value for stations in North Dakota, South Dakota, and western Nebraska. The basis values are highest for stations located near the river including Illinois, Indiana and Ohio. The geographic dispersion in the basis is not as great for corn

Destination basis values behave similarly to some extent and are also quite variable. In 2004 the basis was about $+0.50/bu. at the PNW, but then it spiked up to about $+1.75/bu. It then moderated downward through 2007 and into 2008 reaching lows. After 2008, the basis has been increasing at both markets. In late 2009, the basis spiked at New Orleans (NOLA) and in fact went to a premium to the Pacific Northwest (PNW), at about $+1.50/bu.

Basis risk has escalated in recent years. Since 2007 the level of risk has increased substantially. The destination basis is more volatile, at least in recent periods, than the origin basis.

Marketing Costs: The behavior of the major marketing costs and functions illustrate that all have increased through time, and are more volatile. Results of particular interest are:

- Farm price as a function of market values: The ratio of farm price to destination market price for soybeans decreased from 91 to 90% of the destination market value. For corn, the average farm price ratio decreased from 77 to 73%.

- Handling and trading margins have increased: For soybeans, the implied margin increased from $0.18 to $0.26/bu., or, by 47%. For corn, the comparable margin increased from $0.15 to $0.39/bu., or by 164%. In addition the fobbing spread has increased.

- Barge shipping costs increased by 41% and 33%, respectively for soybeans and corn. In comparison, rail tariff increases were comparable to less at 25% and 36%, respectively.[28]

[28] These numbers are not strictly comparable as they were derived for different periods. As noted above, they are comparable when compared over the same periods.

- Elements of rail shipping costs include the rail tariff, the FSC and daily car values. The latter is not a source of revenue for the carrier, but, is a source of opportunity (or, replacement) cost for the initial buyers of the certificates.

  These results show that for soybeans, the changes were: rail tariff increased $0.20/bu.; car values decreased by $0.05/bu.; and FSC increased $0.10/bu. For corn, the changes were: rail tariff +$0.24/bu.; car values $-0.03/bu.; and FSC increased $0.16/bu.

  Standard deviations for these are relatively modest and less than that for the other modes.

Risk in Grain Marketing Functions: There is greater risk in barge and ocean shipping, than in rail. The results indicate (ranking marketing functions in terms of risk using the standard deviation) the most risky functions are ocean rates and spreads, followed by handling margins, barge costs, and then much lower are rail car values, rail tariffs and FSCs. Indeed, the risk in barge rates is greater than rail tariffs and total rail shipping costs.

Variability in secondary car values is important. The results indicate that this variable has become more risky. However, risk in the primary market value for rail cars is virtually nil. Thus, it is important that freight availability is guaranteed from the railroad (via its shuttle mechanism) at virtually nil premiums in the primary market. This differs drastically from what is implied in secondary market values which are much more risky, and impacts shippers and growers in terms of basis.

Taken together these results indicate that 1) origin basis values have become more risky; 2) all marketing costs have increased; 3) the increase in rail tariffs were less than those for the other modes; 4) car values, on average declined; 5) FSC's had moderate changes in absolute terms; and 6) handling margins have had fairly substantial increases, particularly at port.

Factors impacting origin basis A regression model was estimated to evaluate the impact of specific variables on origin basis values. Though the variables were significant and had the expected impact, the explanatory variability of the model indicated there remains a fair amount of unexplained variability in the relationships.

The results indicated the following variables were significant in explaining variability in origin basis values: shipping costs, ocean rate spreads, outstanding export sales, concentration in the grain handling industry, measures of rail cars late, the ratio or grain stocks to storage capacity, futures prices, and varying measures of futures and destination spreads. In addition, there are significant differences in these relationships across states.

While each variable has a specific interpretation, the results can be generalized in terms of relative importance. The impacts of the most important variables are summarized below:

- Outstanding export sales: This variable has a very strong and nonlinear impact on origin basis values. Simply, strong sales results in higher origin basis values (i.e., outstanding export sales would be high during periods of demand-pull);

- Futures prices: High prices are correlated with lower origin basis and large futures spreads result in lower origin basis values;

- Ratio of grain stocks to storage capacity: Tight capacity lowers origin basis values;

- Rail Cars late: This impact is negative but is relatively modest, and only slight for most observed levels of cars late; and

- Concentration: Basis values in states that have greater concentration have lower origin basis.

A few observations can be made from these results compared to some of the other recent studies on the role of transportation costs on grain pricing. First, it corroborates some of their conclusions, and validates others quantitatively. The farmer share and change in farmer share of the market price is comparable. In addition, each shows that the basis values have become more volatile. The results quantify some of the factors alleged in the other studies. One is that outstanding export sales have a very important impact on origin basis. Simply, strong export sales (i.e. demand-pull) results in higher basis and vice versa. Second, it quantifies the impacts of performance in rail car placements. Where other studies highlighted this impact as being extremely important, these results indicate this impact is relatively more modest suggesting the impact is probably overstated in other studies. Finally, our study shows that other variables, notably storage capacity, futures prices and spreads, and industry concentration (also suggested in O'Neil) also impact origin basis.

Another insinuation is made about the incidence of transport costs. While others refer to that the farmer absorbs all changes in shipping costs, O'Neil Commodity Consulting suggests this varies through time depending on whether the market is demand-pull versus supply- push. This is highly dependent on supply and demand elasticities, and these vary through time. Our results imply that the farmer absorbs about 30% (on average)[29] of the change in shipping costs through lower origin basis values, though this varies through time and across origins. It is expected that this would be less than 1.0 as suggested by frequently used elasticities of supply and demand. The data used in this study indicated there was substantial variability in the origin and destination basis. The origin basis decreased by a lesser amount than the increase in destination basis which suggests that changes in shipping and handling costs are reflected in lower prices to growers, and higher prices to buyers. Thus, the grower bears less of the change in shipping costs in demand-pull markets, but, is bear greater risk.

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[29]Specifically, this was inferred from the relationship between origin basis and shipping costs: i.e., $\partial B_o/\partial S_{od.}$

Implications: An overall conclusion is that numerous factors impact basis values and these are as expected, and their impacts are highly dynamic. Several issues emerged that will have future implications for the industry, policy makers and influencers.

One relates to the incidence of shipping costs and risks. These results suggest that the grower absorbs a portion of the change in shipping costs. Increases (decreases) in exports increase (decreases) the origin basis. But, associated with this is greater volatility in the basis. In demand-pull markets, the grower bears less of the shipping and handling costs, but, bears more of the volatility. Thus, growers need to become much more proficient in marketing.

Second relates to rail car values. There are two aspects of this variable. It is clear that values observed in the secondary market are not a source of revenue to carriers. These are a source of revenue to shippers, as well as an incentive or value of the guarantee and obligation of this shipping mechanism. Second, the study shows that these values are highly volatile. On average, their value in the primary market is essentially nil. These results indicate that freight availability is guaranteed from the railroad (via its shuttle mechanism) at virtually nil premiums in the primary market. This differs drastically from what is implied in secondary market values which are much more risky, and this impacts shippers and growers in terms of basis. Nevertheless, the incidence of car value changes, and the volatility of this market function is an important issue for the industry.

Third, relates to seasonal demands, capacity and pricing. Changes in the world market place have essentially resulted in greater demands for shipping grains from the United States during more concentrated (shorter) shipping periods. Indeed, growth in production and exports from contra-seasonal countries, results in pressure in the United States for shipments to occur more seasonally. Issues related to this are compounded in that most logistics capacity virtually requires an annual commitment.

Related to this is the impact of unexpected changes in demand on capacity and pricing. It is important to acknowledge there is greater “peakedness” in demand for shipping, and shipping requiring peak capacity. Current rail pricing mechanisms do not specifically address this problem. At best is the daily car value but this affects shipper’s payoffs, and though it provides a signal to carriers, it does not impact their returns. In other logistics industries, more elaborate mechanisms (e.g., priority pricing systems; reservation systems) have evolved to address these problems.

Finally, the impacts and role of risk, forward coverage, and risk reducing mechanisms should escalate in importance. Risk in most markets and marketing functions has escalated. These include greater volatility in agriculture markets (futures, basis, input costs, etc.), in addition to marketing functions (modal costs, availability, and margins). Eventually, there will be challenges to develop mechanisms to mitigate these risks. Producers can readily manage risks in futures (hedging) and basis variability (basis contracts) or through forward contracts. There are mechanisms for rail shipping, though not perfect, nor obvious (i.e., forward car coverage, hedging FSC, etc.) to reduce risks. Use of these is compounded when considering uncertainty of the size, timing and commitment of long-grain positions. Ultimately, reducing this risk puts more pressure on growers to be able to make more irrevocable forward commitments. The impact of this should be to create greater demands for more forward coverage which would simultaneously resolve problems for shippers, growers and railroads.

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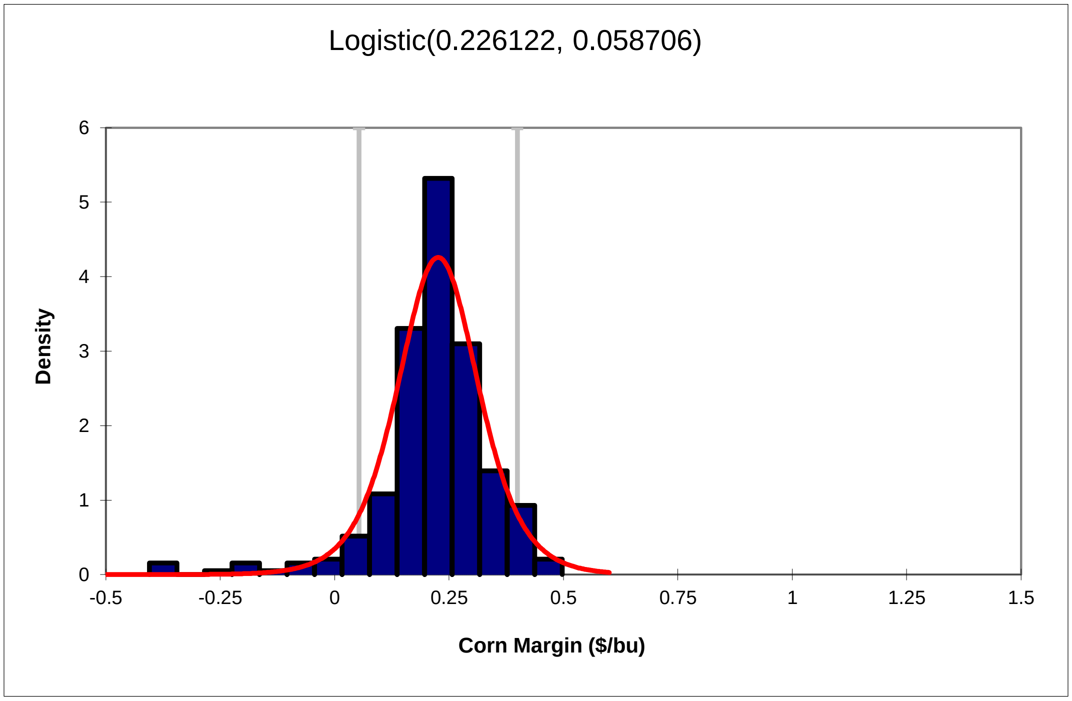
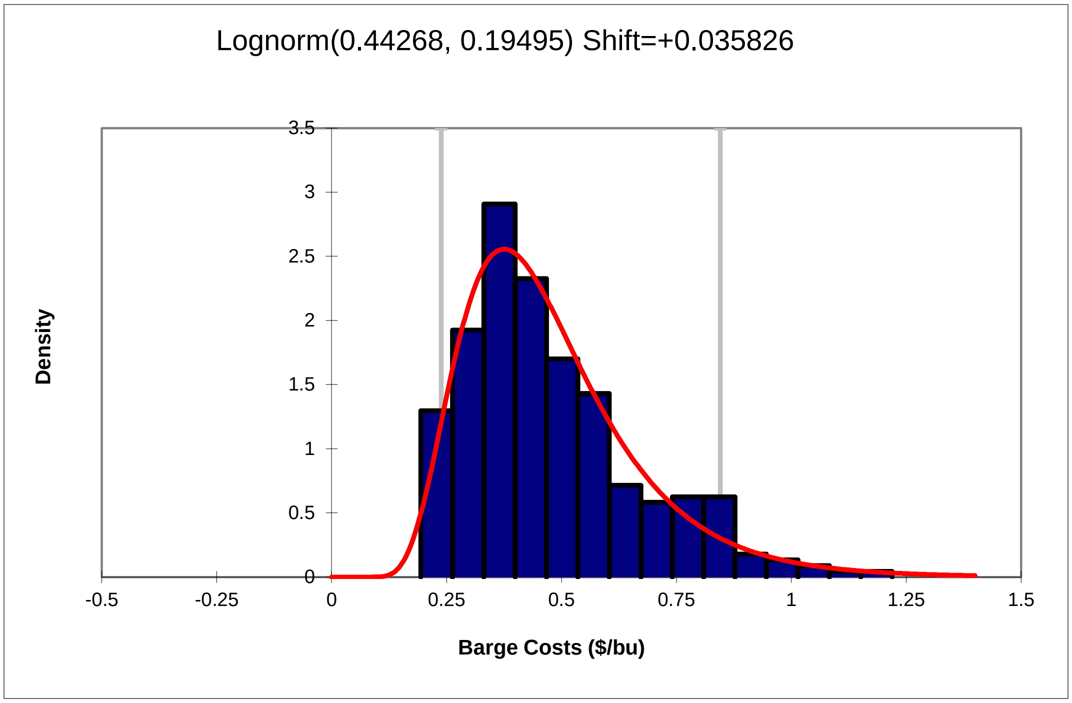
Appendix Figures[30] and Tables

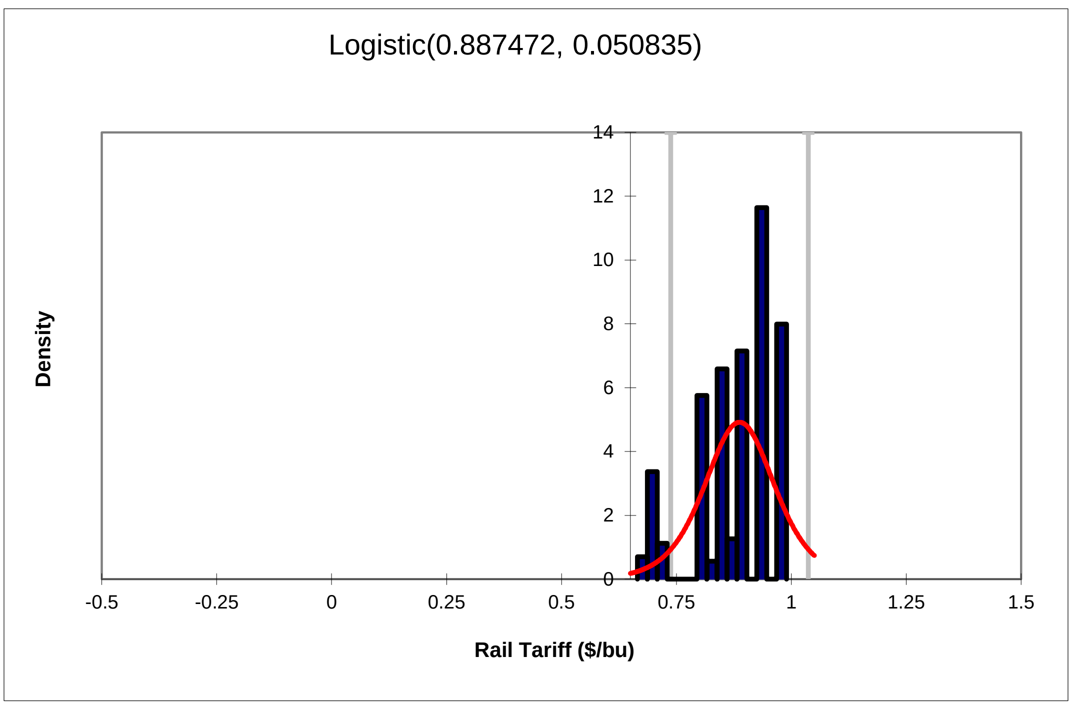


Appendix Figure A1.1. Probability Density Function and Fitted Distribution for Corn Margins, 2004-2010.

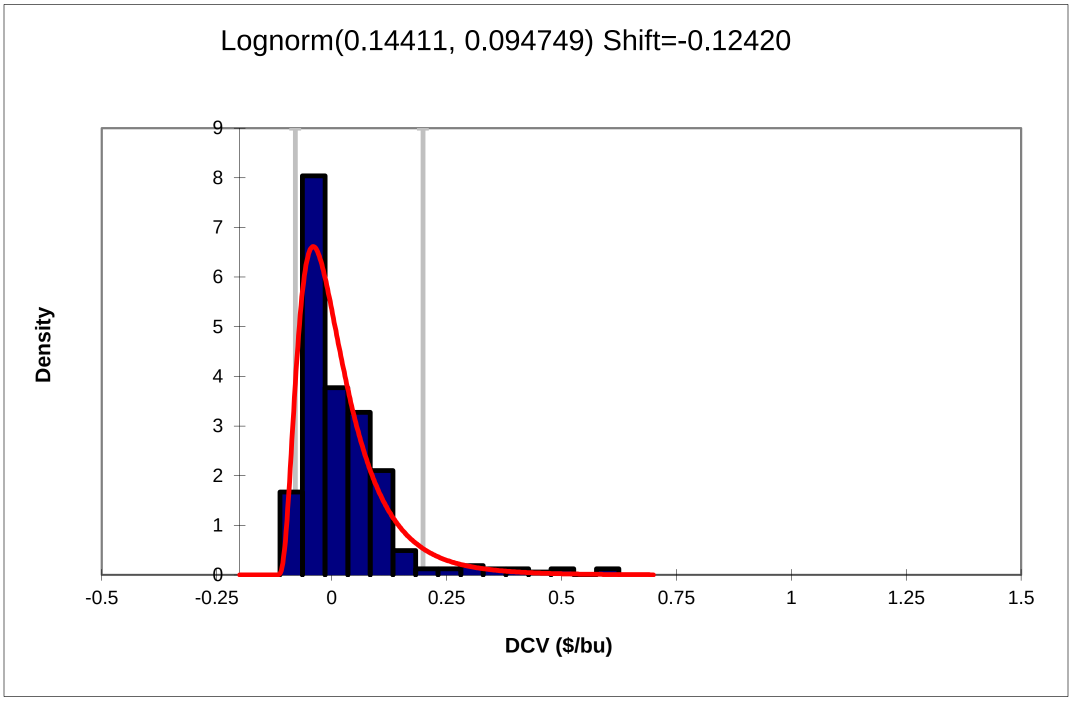
[30]The distribution type and parameters are shown above each distribution, for reference.



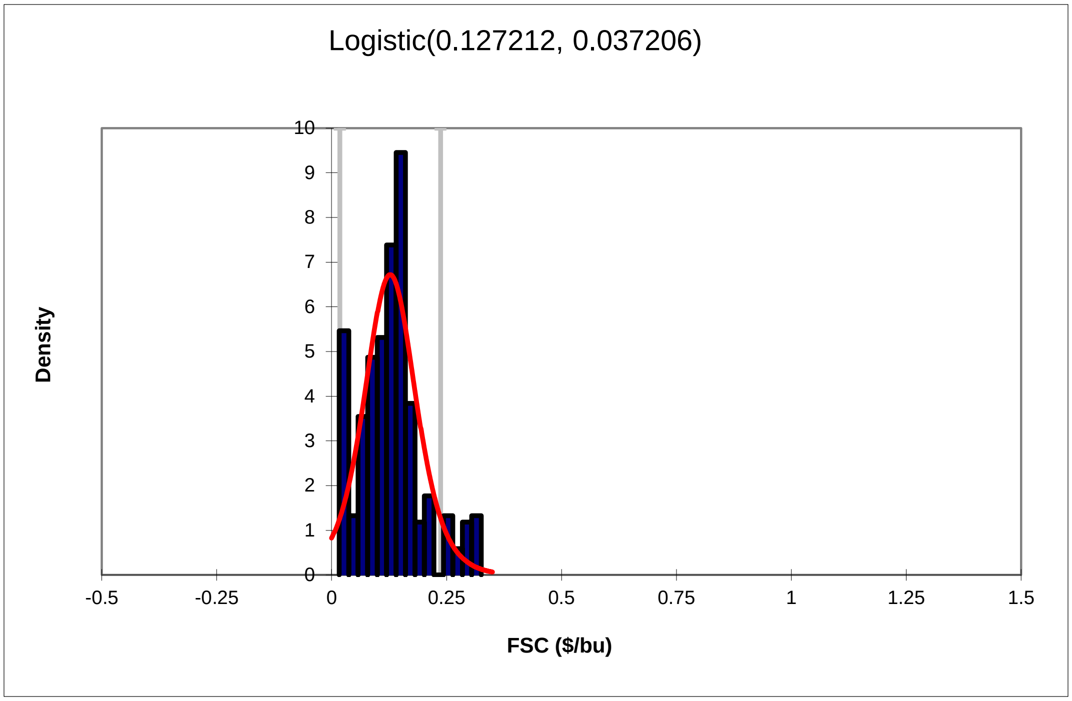
Appendix Figure A1.2. Probability Density Function and Fitted Distribution for Barge Shipping Costs, 2004-2010.



Appendix Figure A1.3. Probability Density Function and Fitted Distribution for Rail Tariff Costs, 2004-2010.



Appendix Figure A1.4. Probability Density Function and Fitted Distribution for Daily Car Values (DCV), 2004-2010.



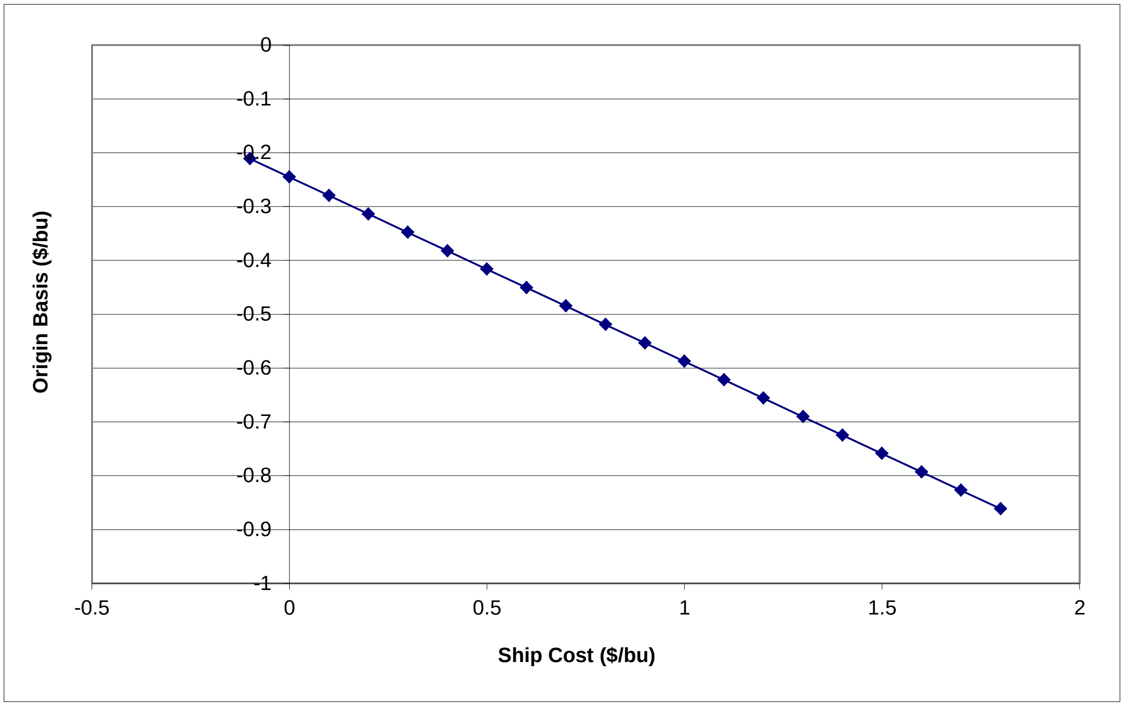
Appendix Figure A1.5. Probability Density Function for Fuel Service Charge (FSC), 2004-2010.

Soybean Functional Relationships: O'Neil Commodity Consulting Dataset

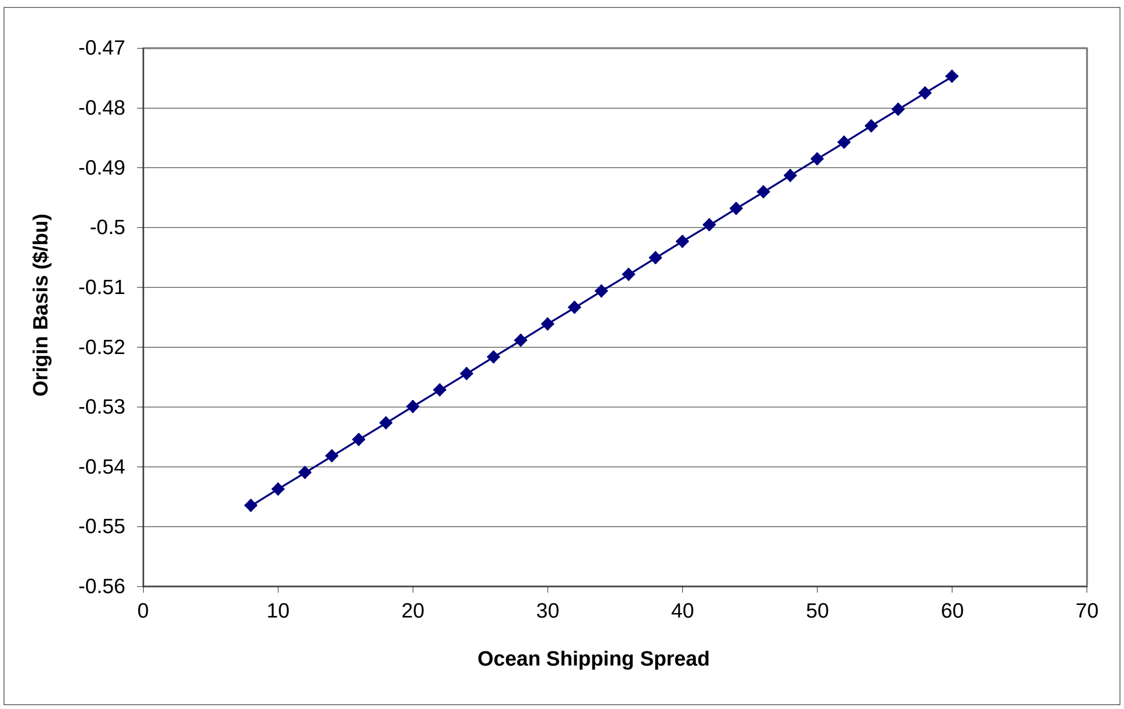
Table B.1. Estimated Functional Relationships for Origin Basis for Soybeans O'Neil Commodity Consulting Data vs. Expanded Dataset.

Item	Parameter	T Value	Parameter	T Value
	Soybeans: O'Neil Data		Soybeans: Expanded Data	
Intercept	.38	18.76	.24	11.48
Shipcost	-.34	-27.33	-.36	-28.96
Ocean Ship Spread	.05	3.23	-.07	-4.56
Outstanding Sales	-1.4E-7	-2.35	-7.1E-7	-12.01
Outstanding $Sales^2$	9.8E-13	10.66	1.2E-12	13.75
BN Cars Late	-6.8E-5	-18.58	-5.3E-5	-14.38
BN Cars $Late^2$	5.4E-9	16.58	3.9E-9	12.05
Ratio: Stocks to Storage Capacity	Ns			
Trend	-.05	-16.03	-.08	-25.25
Futures Nearby	-.04	-17.70	-.02	-6.7
Futures 1 Spread (NB-Deferred)	-.60	-44.10	-.31	-20.07
Destination PNW	.03	1.96		
Destination Basis	Ni		.56	47.09
CR4	NS		-.002	-10.74
S1 (ND)	-.14	14.0	-.24	-15.4
S2 (NE)	NS		-.14	-12.9
S3 (IL)	.14	7.9	.21	15.5
S4 (IN)	.18	9.8	.17	11.0
S5 (OH)	.19	10.2		
S6 (SD)			-.05	-4.0
S7 (IA)	.04	4.3	.03	2.5
R^2	.59		.61	

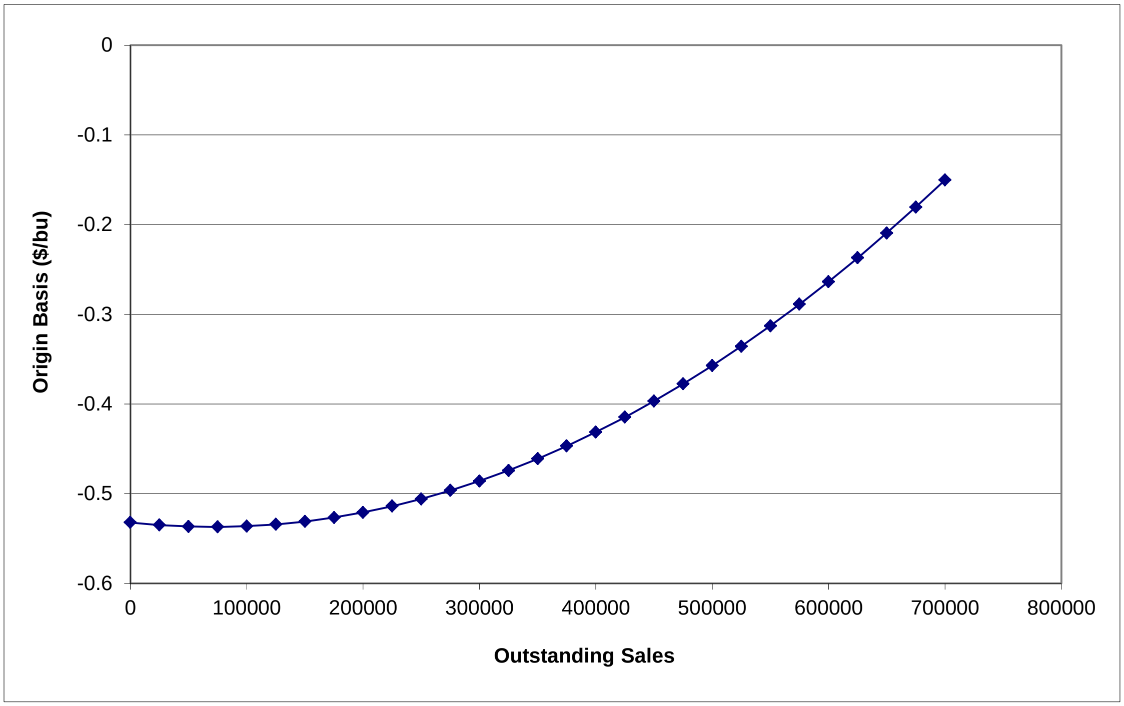
NS is not significant



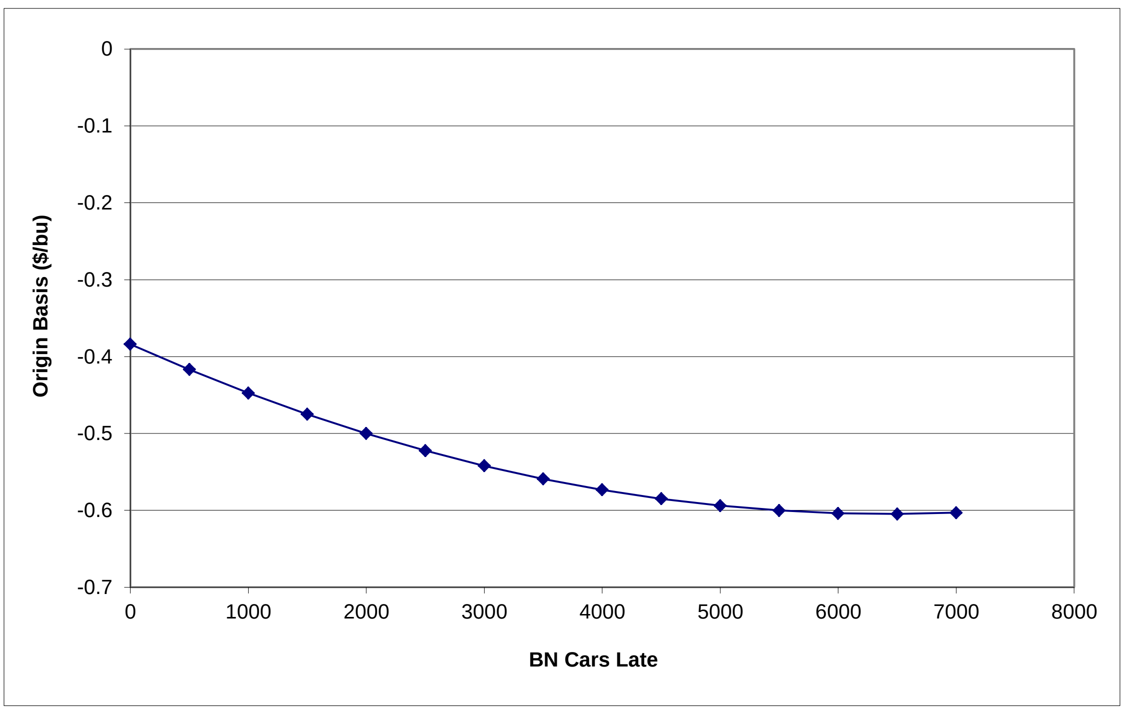
Appendix Figure B1.1. Soybeans: Sensitivity of Origin Basis to Changes in Shipping Cost.



Appendix Figure B1.2. Soybeans: Sensitivity of Origin Basis to Changes in Ocean Shipping Spread ($/mt).



Appendix Figure B1.3. Soybeans: Sensitivity of Origin Basis to Level of Outstanding Sales**.**



Appendix Figure B1.4. Soybeans: Sensitivity of Origin Basis to Level of BN Cars Late.