Crop Basis Patterns in the Presence of Spatial Competition and Government Intervention

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Crop Basis Patterns in the Presence of Spatial Competition and Government Intervention

This study analyzes the effect of the Loan Deficiency Payment (LDP) program, established under the Federal Agriculture Improvement Reform (FAIR) act of 1996, on corn and soybean basis pattern patterns in Missouri. Additionally, spatial competition is incorporated into the basis models. Using weekly corn and soybean basis pattern data from 1993 through 2001 for multiple locations in Missouri, and incorporating a variable for when the LDP is in effect, empirical models examining factors affecting corn and soybean basis pattern patterns are estimated. Results indicate that the presence of the LDP program has a significant economic impact on soybean basis. Furthermore, spatial competition strengthens corn basis.

Keywords: basis, LDP, government programs, spatial autocorrelation

Crop Basis Patterns in the Presence of Spatial Competition and Government Intervention

Basis, cash minus futures, provides agricultural producers, elevators, and agribusinesses with significant information on marketing strategies and local supply and demand. A strong basis indicates a different set of marketing strategies than a weak basis. A relatively strong basis indicates demand has increased relative to supply. Figure 1 is used to graphically depict basis terminology used for this study. Grain storage decisions depend on expected cash prices (Williams and Wright). Historical basis information provides crucial information in the forecasting of cash corn and soybean prices (Dhuyvetter and Kastens; Kastens, Jones, and Schroeder; Tomek). Changes in local supply-demand factors across locations, i.e., different basis levels across locations, can cause grain and oilseeds to flow to different markets. Thus, factors causing the basis to deviate from historical patterns could impact current and future marketing strategies, and not accounting for spatial competition among elevators may cause biased parameter estimates. Based on these concerns, the objective of this study is to analyze the impact of the implementation of the government supervised Loan Deficiency Program (LDP) and simultaneously account for spatial competition in analyzing corn and soybean basis patterns in Missouri.

Beginning in the fall of 1998 low corn and soybean prices triggered a government price support mechanism established under the 1996 Farm Bill. The LDP created minor marketing chaos for some producers. Initially producers did not understand how the LDP program functioned, and producers did not understand how grain marketing strategies might change with the LDP. As producers, researchers, and politicians began to understand the LDP program, more questions regarding the effectiveness and fairness of the program arose. One study by Babcock, Hayes, and Kaus analyzed claims that the LDP's are not consistent across state boundaries. Yet, no study has reported in depth on the impact of government intervention on temporal or spatial pricing patterns, i.e., basis patterns.

The 1996 Agriculture Market Transition Act gave farmers the choice of receiving a loan deficiency payment in lieu of placing their crop in storage under loan. The LDP is the loan price less the posted county price (PCP). Table 1 provides an example of how the LDP is determined for Lafayette county, Missouri. The PCP is based on a terminal or Gulf market price adjusted for a county loan differential. The PCP can be at, above, or below the local market price depending on how well the terminal or Gulf price, adjusted for the county loan differential, reflects local market conditions. Under previous farm programs, farmers forfeited the grain under loan to the Commodity Credit Corporation (CCC) when market prices are below the loan rate. The CCC could then hold the forfeited grain off the market creating a price floor at or near the loan price. The difference with the LDP is that producers no longer have an incentive to forfeit the grain and thus market prices are not supported by the loan rate.

The effect on basis from a change in the LDP would occur if the LDP would cause producers to market at times other than would normally occur. In this study basis is defined as cash minus nearly futures. Figure 2 provides a decision tree of potential changes in marketing strategies due to the LDP being in effect. The effect of this would be to change harvest basis levels compared to if the grain had been sold. The government determined loan rate is set to "theoretically" provide a fixed price support level. That is, county differentials are based on long-term price relationships between the county and USDA announced terminal market price. In theory, when cash prices are below the loan rate, the cash price plus LDP would equal the loan rate. However, two factors have caused alternative outcomes. First, the county differentials may not reflect the actual price spread. Second, the government would prefer not to take possession of grain so the county differential is changed periodically to increase the value of the county LDP – effectively causing the producer to take the LDP in lieu of the loan or cause the producer to redeem the loan at the PCP. For instance, the USDA listed market rates for April 3 and April 11, 2000, had accompanying notes regarding the differential. On April 3 the note stated, add 2 cents to the Gulf corn differential. On April 11, the note stated, add 4 cents to the Gulf corn differential (http://165.221.16.16/public/RATESPUB/default.htm).

The LDP alternative allows farmers to take the LDP up until 9 months following the beginning of harvest or until 9 months after the grain is placed under loan. This "decoupling" of marketing of grain from loan prices provided farmers the opportunity to seek profit maximization from both the loan program, in the form of an LDP, and in the cash market. In other words, the LDP program rewards producers for "picking the market top" (i.e., time of cash market sales) as well as "picking the market low" (i.e., time of taking LDP prior to or at cash market sale). If markets are efficient, there is no reason to expect producers could do this, but in reality this may be exactly what many producers try to do.

Despite claims that the LDP may have affected historical basis patterns, there has been little empirical research to substantiate or refute these claims. Visually reviewing basis data indicates that corn and soybean basis pattern levels since September 1998 are similar to historical basis levels (Figures 3 and 4). During most weeks of the 1998/1999 to 2001/2002 marketing year, corn and soybean basis patterns are below the historical average, but can all of the weaker basis be attributed to the LDP? Figures 3 and 4 are also used to graphically depict differences in corn and soybean basis by location. The degree to which a change in basis at one location impacts the basis level in another location is an indication of spatial competition. Thus, not accounting for spatial competition, i.e., spatial autocorrelation, could produce biased coefficient estimates.

If the CCC loan program no longer acts as a market price floor, then there is the possibility of a basis different than expected, based on a historical average. If the basis differs significantly from historical trends, then the PCP based on historical location differentials is likely to differ from local market prices. Figure 5 provides a graphical representation of basis changes overtime (temporal) and across locations (spatial) for two locations. The focus of this study is on both temporal (change in marketing strategies) and temporal (change in marketing location). To the extent that the PCP does not equal local price, a new opportunity for profit seeking exists. Furthermore, accounting for spatial competition among elevators allows for unbiased parameter estimates. With the passage of the 2002 Farm Bill, information on the impact of FAIR programs needs to be understood because many of these program are continued. Additionally, producers, agribusiness persons, and Extension marketing economists need to understand whether current farm policy is effecting the formulation of how cash grain prices are projected.

Empirical Model and Description of Data

Following the theoretical contributions of Working on commodity storage and basis, and extended by Stein and Telser, there have been considerable analyses of commodity basis behavior, e.g., Hauser, Garcia and Tumblin; Kahl and Curtis; Martin, Groenewegen, and Pidgeon; Tilley and Campbell; and Ward and Dasse. Other researchers have used historical basis patterns in evaluating grain marketing strategies, e.g., Kastens and Dhuyvetter. Most relevant, and somewhat difficult to cite, is that numerous producers, agribusinesses, and

University Extension outlook economists using local basis and futures price to forecast local cash prices.

There has been numerous previous studies investigating factoring affecting grain and oilseed basis, e.g., Martin, Groenwegen, and Pidgeon; Tilley and Campbell; and Kahl and Curtis. Tilley and Campbell defined basis as the Gulf cash price less the Kansas City Board of Trade futures price adjusted for storage costs. Using weekly data, Tilley and Campbell regressed lagged basis, futures market liquidity, export commitments divided by free stocks, and contract month binary variables on basis. They estimated a partial adjustment model for both the expiration month and for greater than 4 weeks prior to contract expiration. The estimated coefficient for the lagged basis, in the greater than 4 weeks to expiration model, indicated that it took three weeks for the basis to make 90% of the full adjustment. Also, an increase in the export commitment to free stock ratio and market liquidity variables strengthened basis.

The empirical analysis used for this study builds on previous research by Tilley and Campbell to estimate the effect of spatial competition and government programs on corn and soybean basis patterns. A LDP adjusted cash price either below or above the loan rate is synonymous with the difference in the cash price and PCP. Producers are assumed to make rational management decisions and maximize profits; therefore, a producer may market the LDP independent of the cash to either satisfy cash flow needs or to take advantage of LDP adjusted prices above the loan rate. For the current study, factors affecting corn and soybean basis patterns are lagged basis, futures price, a proxy variable for the LDP, futures market liquidity, transportation costs, change in supply-demand factors, weeks prior to contract expiration, futures contract dummy variables, and location dummy variables. The nearby basis model specified for this study is:

$$
\begin{aligned}
(1)\qquad \text{Basis}_{\text{jit}} = {} & \alpha_0 + \alpha_1 \bullet \text{Basis}_{\text{jit}-1} + \alpha_2 \bullet \frac{\text{Posted County Price}_{\text{jit}}}{\text{Cash}_{\text{jit}}} + \text{a}_3 \bullet \text{Futures liquidity}_{\text{jt}} + \\
& \alpha_4 \bullet \text{Transportation cost}_{\text{t}} + \alpha_5 \bullet \Delta\text{Cash}_{\text{jit}} + \alpha_6 \bullet \text{Weeks to Expiration}_{\text{jt}} + \\
& \sum_{\text{C}=1}^{\text{C}=5_{j=corn} \text{ or } \text{C}=7_{j=soybean}} \alpha_{6+\text{C}_{\text{j}}} \bullet \text{Contract month}_{\text{jtC}} + \sum_{\text{i}=1}^{14} \alpha_{6+5_{j=corn} \text{ or } 7_{j=soybean}+\text{i}} \bullet \text{Location}_{\text{i}} + \varpi_{\text{jit}}
\end{aligned}
$$

This study uses weekly data between January 1993 and November 2001. Variable descriptions for equation (1) and summary statistics of selected variables are given in table 2. And, ϖ_{jit} is an *iid* normally distributed random error vector for the corn and soybean basis pattern models. Nearby basis is defined as the cash price minus the closing futures price for commodity *j* (*j* = corn and soybeans), in location *i* (i = Braymer, Cameron, Charleston, Chillicothe, Concordia, Corder, Hannibal, Jamesport, Kansas City (*default)*, Sikeston, St. Joseph, St. Louis, and Tarkio), during week *t* (t = 1, 2, . . ., 425). Cash prices are from DTN Farm Dayta. Futures prices, rolled forward on the first trading week of the contract expiration month, are from Commodity Research Bureau. Similarly, the futures market liquidity variable is computed from data obtained from Bridge. Posted County Price (PCP) data are obtained from CARD, Iowa State University.

Malick and Ward (p. 160) suggest a partial adjustment model is appropriate because "traders may not react to every market signal simply because longer-term hedging positions are adjusted in a consistent manner with forward pricing needs and not to interim market price changes". Lagged basis is included to capture the partial adjustment impact. The lagged basis coefficient is expected to be positive and lie in the unit interval.

The LDP and cash prices are simultaneously determined. Therefore, using the level of the LDP is not appropriate due to simultaneity. A proxy variable is used in place of the LDP. The ratio of PCP-to-cash price variable is included to determine whether the presence of the LDP affected basis when there is a LDP offered. Defined in this manner, when the PCP differs from the cash price the producer could receive a net cash price either above or below the loan rate. If the ratio is greater (less) than one, then a farmer could receive an adjusted cash price above (below) the loan rate, if the grain is marketed and the LDP taken simultaneously. There is expected to be no economic impact on basis from a change in the PCP-to-Cash price variable, because producers are assumed to market the LDP and cash jointly and consistent with historical selling patterns. However, it is worth noting that taking the harvest time LDP may have provided producers with short-term cash flow relief that allowed producers to store grain in anticipation of higher prices later in the marketing year. For this reason, separate corn and soybean basis pattern seasonal models are estimated following equation (1) with the addition of interaction terms to allow the coefficient of the PCP/Cash variable to vary by futures contract month.

A futures market liquidity variable is constructed as the ratio of futures volume to open interest. The variable is included in the basis models as a proxy for the ability of hedgers and speculators to enter or exit the market. Tilley and Campbell used a similar variable to explain factors affecting Hard Red Winter wheat basis variability. They found that prior to 4 weeks before contract expiration an increase in market liquidity strengthened basis, but during the 4 weeks before contract expiration an increase in market liquidity weakened basis. Because the current analysis does not include data during the contract expiration month a positive relationship with basis is hypothesized.

Transportation is included to capture spatial arbitrage opportunities represented by the difference in the location and futures market delivery location. The cash unleaded gas price is used as a proxy variable for transportation costs. Cash unleaded gas price data is from Commodity Research Bureau. An increase in transportation costs is expected to weaken basis.

The change in cash price is included as a proxy for factors such as production, stocks to use, export commitments, etc. Jiang and Hayenga evaluated alternative basis forecasting models for corn and soybean. They found transportation costs, production, and other demand factors affect basis. The change in cash price is computed as the cash price this week minus the cash price last week. Following convention an increase in the cash price change is expected to strengthen basis.

The weeks prior to expiration variable is included in the basis models to account for differences in current versus anticipated supply-demand factors in the cash and futures market equating nearer expiration. This variable is also capturing the cost of carry in the market. As the number of weeks prior to expiration increases, it is expected that basis will weaken.

Futures contract dummies are 0 or 1 binary variables (C = March, May, July, September, and December for j = corn; and C = January, March, May, July, August, September, and November for j = soybean). December is the default for corn and November is the default for soybean. Also, location dummy variables are included as a 0 or 1 binary variable. For both corn and soybean, Kansas City is chosen as the default location. Locations other than St. Louis and along the Mississippi River are expected to have a weaker basis relative to Kansas City.

Econometric Issues

For each of the thirteen locations which basis data is computed, the Dickey-Fuller test for the presence of a unit is rejected. Thus, models are estimated in levels. Local crop markets may be spatially correlated because of the transportability of grains and oilseeds. Thus, failure to account for spatially correlated errors yields biased parameter estimates. To ascertain whether spatial autocorrelation might be a concern a Geary ratio is computed for both corn and soybean data. The Geary ratio is computed as,

$$\text{(2)} \qquad Geary\ Ratio_t = \frac{[(n-1)\sum_{i=1}^{i=n}\sum_{k=1}^{k=n} c_{ik}(Basis_{jit} - Basis_{jkt})^2]}{[2\ (\sum_{i=1}^{i=n}\sum_{k=1}^{k=n} c_{ik})\sum_{i=1}^{i=n}(Basis_{jit} - \overline{Basis}_{jt})^2]}$$

Where matrix **C** is composed of 0 or l c_{ik} elements where $c_{ik} = 1$ when location *i*, *k* are neighbors in the corn and soybean marketing flow, and 0 otherwise, and *n* is the number of locations ($n = 14$). $Basis_{jit}$ is as previously defined, and $\overline{Basis}_{jt}$ is the average basis during week *t* for crop *j*. The standard procedure for testing the statistical significance of the Geary ratio is by permutating all combinations of the thirteen locations as neighbors. However, because elevators are not always competitors in grain marketing, i.e., grain flows southeast down the Mississippi river, and a time-series dataset is used, statistical significance is gauged by computing a Geary ratio for each time period, computing the average and standard deviation over the entire period, and assessing statistical significance using a z test. The computed Geary ratios are 0.874 for corn basis and 0.849 for soybean basis.[1] A z-test of the null-hypothesis of the Geary ratio equal to unity lead to a rejection of the null-hypothesis for both the corn and soybean basis data. To account for spatial correlation, equation 1 is slightly modified for estimation.

[1] A Geary ratio less than unity indicates similar clustering, a ratio equal to unity indicates no pattern, and a ratio greater than one indicates dissimilar clustering.

(3) $$\text{Basis}_{\text{jit}} = \Gamma_{ji}\sum_{k=1}^{k=14}\Phi_{ik}\,Basis_{jikt} + \alpha_0 + \alpha_1 \bullet \text{Basis}_{\text{jit}-1} + \alpha_2 \bullet \frac{\text{Posted County Price}_{\text{jit}}}{\text{Cash}_{\text{jit}}} + \alpha_3 \bullet \text{Futures liquidity}_{\text{jt}} + \alpha_4 \bullet \text{Transportation cost}_{\text{t}} + \alpha_5 \bullet \Delta\text{Cash}_{\text{jit}} + \alpha_6 \bullet \text{Weeks to Expiration}_{\text{jt}} + \sum_{\text{C}=1}^{\text{C}=5_{j=corn}\text{ or C}=7_{j=soybean}}\alpha_{6+\text{C}_{\text{j}}} \bullet \text{Contract month}_{\text{jtC}} + \sum_{\text{i}=1}^{13}\alpha_{6+5_{j=corn}\text{ or }7_{j=soybean}+\text{i}} \bullet \text{Location}_{\text{i}} + \varpi_{\text{jit}}$$

where, $\Phi_{ik} = c_{ik} / \sum_{k=1}^{k=14} c_{ik}$. The spatial autocorrelation coefficient (Γ) is allowed to vary by commodity and across location. Because data are pooled for estimation of factors affecting corn and soybean basis patterns, a separate model is estimated that allows the spatial autocorrelation to vary by location. It may be that some elevators, i.e., locations, are more competitive than others.

Data are pooled by crop and data transformed for cross-sectional heteroskedasticity and time-series autocorrelation. Following Kmenta, heteroskedasticity is corrected for by estimating equation (3) for each location separately using ordinary least squares (OLS). For simplicity, B_{jit} refers to the dependent variable, X_{jit} refers to explanatory variables, ϖ_{jit} refers to the error term. Where subscripts are as previously defined. Using the error terms (ϖ_{jit}), a separate error variance (λ_{ji}^2) for each location is computed as:

(4) $$\lambda_{ji}^{2} = \sum_{t=1}^{425}\varpi_{jit}^{2} / 425$$

Then the λ_{ji} are used to transform the dependent (B) and independent variables (X):

(5) $$B^*_{jit} = B_{jit} / \lambda_{ji} \qquad X^*_{jit} = X_{jit} / \lambda_{ji} \ .$$

Data transformed following (5) are corrected for serial correlation by first performing OLS using the transformed data from (5) and then using the errors (ϖ^*_{jit}) to estimate ρ_{ji} as:

(6) $$\hat{\rho}_{ji} = \frac{\sum_{t=1}^{425} \varpi^*_{jit} \cdot \varpi^*_{jit-1}}{\sum_{t=1}^{425} (\varpi^*_{jit})^2}$$

The $\hat{\rho}_{ji}$ are used to transform data from (5) as follows:

$$B^{**}_{ji1} = \sqrt{1-\hat{\rho}_{ij}^{\,2}} \cdot B^*_{ji1}, \qquad B^{**}_{jit} = B^*_{jit} - \hat{\rho}_{ij} B^*_{jit-1}, \qquad \text{for } t = 2,3,\ldots 425;$$

(7) $$X^{**}_{ji1} = \sqrt{1-\hat{\rho}_{ij}^{\,2}} \cdot X^*_{ji1}, \qquad X^{**}_{jit} = X^*_{jit} - \hat{\rho}_{ij} X^*_{jit-1}, \qquad \text{for } t = 2,3,\ldots 425.$$

The autocorrelation value (*rho*) is allowed to vary across location for both the corn and soybean basis pattern equation. For the corn basis models the *rho* value varied from –0.064 to 0.011, and for the soybean basis models the *rho* value varied from 0.208 to 0.460. Corn and soybean basis pattern models are estimated using the POOL command in Shazam 9.0 with the DN and FULL options employed and NCROSS=13 specified.

Results

Results of the corn and soybean basis pattern models estimated following the specification outlined in equation 3 are reported in table 3. The explanatory variables explained 99% of the variability in corn basis and 97% of the variability in soybean basis. Most of the explanatory variables are statistically significant and of the expected sign Because the number of observations is particularly large differentiating economic significance from statistical significance is important.

As expected, lagged basis is positive and is within the unit interval for both the corn and soybean basis pattern models. The partial adjustment factor can be computed by subtracting the lagged basis coefficient estimate from one. Thus, the partial adjustment factors for corn and soybean basis patterns are 0.02 and 0.19, respectively. A partial adjustment value closer to one indicates a more immediate adjustment. For this study, a long-run impact to a shock in one of the explanatory variables would have an impact of 50 times (one divided by 0.02) and 5.6 (one divided by 0.19) times the reported coefficient estimate for the corn and soybean basis pattern models, respectively.

The spatial competition coefficient is statistically significant only for corn. A one unit increase in the spatial competition variable strengthened corn basis by \$0.004/bushel. Most locations in Missouri are corn deficit regions and soybean surplus regions. Thus, it is not surprising that the regional competition for corn is greater than for soybean since. The \$0.004/bushel value, after accounting for the long-run multiplier effect, is \$0.20/bushel. For corn, the spatial autocorrelation variable ranged from 1.33 to 5.34, so the maximum impact on corn basis would be \$0.80/bushel between the minimum and maximum value, which corresponds to the narrowest

and widest corn basis. This value represents over 50% of the difference between the weakest and strongest corn basis for the data set.

Results presented in table 5 follow from equation 3 with the exception that the spatial competition coefficient is allowed to vary by location. Only for the corn basis model are the spatial competition variables statistically significant, and all spatial competition coefficients are statistically significant at 5% level and higher. The size of the spatial competition coefficient varies only slightly by location. There is no discernable difference based on location, e.g., river, terminal, or regional clusters.

The PCP-to-cash price ratio variable for only the soybean basis pattern models is statistically significant. A one percentage point increase in the PCP-to-cash price ratio decreases soybean basis by -$0.03/bushel. In the long-run this would amount to a -$0.15/bushel narrower soybean basis. A one-standard deviation increase in the PCP-to cash price ratio decrease soybean basis by -$0.33/bushel in the short-run. This impact is economically significant, and rather large. This variable tended to vary little within a marketing year but more across marketing years. Thus, the impact within the marketing year may not be as large as reported here. However, there appears to be evidence that for soybean basis patterns the presence of the loan deficiency program has significantly weakened basis in Missouri.[2]

A second model was estimated that allows the PCP-to-cash price ratio to vary by contract month (table 5). This model was specified to capture potential seasonal differences within the marketing year. Only for the November, January, May, July, and August soybean futures contract periods are the variables statistically significant. For the November, January, May, and July contract months the impact of a one percentage point increase in the PCP-to-cash price ratio on soybean basis is negative. This result suggests that soybean producers may be changing their expected marketing pattern, given prices, by taking the LDP nearer harvest and selling off production. The impact tends to increase in absolute value from November to July. However,

[2] This result may differ by region as the relative importance of different crops may cause the size of the impact to differ.

for the August contract the PCP-to-cash price ratio is positive. This reflects a period in which for some locations harvest has begun before the next marketing year so the PCP reflects new crop prices, but basis reflects old-crop values.

In both the corn and soybean basis pattern models, the futures market liquidity variable is statistically different from zero at the 1% level. The impact is positive, which is consistent with previous findings by Tilley and Campbell. The magnitude of the coefficients suggests that deviations from the average liquidity value would be marginally economically significant, however, most of the variability of these variables occurs across contract months and not within the contract month. Thus, it is concluded that the liquidity variable is not economically significant.

A one dollar increase in unleaded gasoline futures price (proxy variable for transportation costs) weakens corn basis and soybean basis by -\$0.017/bushel and -\$0.079/bushel, respectively. Both coefficients were statistically significant at the 1% level. Because the long-run impact multipliers differ for corn and soybean basis, the long-run impact from an one unit change in transportation costs would be similar. This result is consistent with basis theory, and the impact is economically significant. This result also acts to support the notion of spatial competition because the economic significance of this variable indicates arbitrage occurs.

A one dollar increase in the change in corn (soybean) cash price lead to a \$0.99/bushel (\$0.92/bushel) strengthening corn (soybean) basis. This result was as expected. The average change in cash price was very small. Thus, the between week change in cash price would have a very small impact on basis levels. Also, an interpretation on this result is that basis strengthens (weakens) as cash price increases (decreases). This is consistent with observed basis patterns.

A one week increase in the number of weeks prior to expiration was not statistically significant for either corn or soybean basis. This result was not as expected. The theory of basis suggests that cash and futures converge, i.e., basis strengthens, as the futures contract approaches expiration.[3] This unexpected result may be due to rolling forward of the futures contract the month prior to contract expiration. Typically, most of the cash and futures price convergence occurs during the expiration month. Furthermore, Tilley and Campbell found factors affecting wheat basis patterns to differ significantly between the contract expiration month and beyond one month prior to contract expiration.

Contract dummy variables varied in magnitude and statistical significance. Larger coefficients occurred in months further after harvest (i.e., default contract). Location dummy variables also varied in magnitude; however, locations further from the default location (Kansas City) and further away from river terminals are larger in absolute value. This results is as expected. This is consistent with the difference in transportation costs of markets further from terminal and river markets.

Conclusions

Many commercial elevator operators and agricultural producers rely on basis for crop marketing decisions. Understanding seasonal and historical basis patterns is beneficial because basis patterns are more predictable than either cash or futures prices. Therefore, understanding factors affecting crop basis patterns has a tremendous impact on furthering agribusiness and producer

[3] Basis theory suggests that the actual supply and demand at time *t* weeks prior to expiration and expected supply and demand at expiration equal as expiration approaches.

marketing strategies. Numerous studies have analyzed crop basis patterns, however, no previous study has incorporated a spatial competition variable to account for regional competition between elevators, and no previous study has attempted to capture the impact of government intervention on crop basis. This research analyzed both spatial competition and government intervention in modeling factors affecting corn and soybean basis patterns in Missouri.

A spatial competition variable accounted for regional competition among grain/oilseed elevators. The results from this analysis indicate that only corn basis patterns in Missouri are impacted by spatial competition. This result is consistent with intuition as Missouri is a corn deficit state and a soybean surplus state. Two conclusions lead from the incorporation of a spatial competition variable. First, previous research analyzing crop basis patterns and not accounting for spatial competition yielded biased parameter estimates. Second, more research is needed to assess the changes in spatial competition within regions, across regions, over time, and for different commodities. Understanding drivers of structural change will help to make better assessments of future structural changes.

This study analyzed the effect of the LDP program, established under the Federal Agriculture Improvement Reform (FAIR) act of 1996, on corn and soybean basis pattern. Using weekly Missouri corn and soybean basis data between 1993 through 2001, and incorporating the LDP when in effect during the 1998 through 2001 period, empirical models of factors affecting corn and soybean basis patterns are estimated. An increase in the LDP is found to have a negative, and economically significant, impact on soybean basis. Furthermore, the impact of the presence of the LDP differed within the marketing year. The implication of this result is that, for forecasts using historical soybean basis, it may be necessary to adjust the forecast to account for changes in basis levels due to the presence of the LDP, which continues under the 2002 farm bill.

Limitations of this research are that this analysis is conducted only for Missouri, proxy variables are developed for several variables because a consistent time-series data set for several of the variables was not obtainable, and only weekly data was used as opposed to daily data. Yet, this research can be used by agribusinesses and crop producers to better understand drivers of change in crop basis patterns.

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Table 1. Determination of Loan Deficiency Payment for Lafayette County Missouri

		PCP Below Loan Rate	PCP Above Loan Rate
A.	Gulf price	$2.16	$2.46
B.	Gulf differential	$0.46	$0.46
C.	Posted county price based on Gulf cash price (A ! B)	$1.70	$2.00
D.	Kansas City price	$1.88	$2.36
E.	Kansas City differential	$0.22	$0.22
F.	Posted county price based on K.C. cash price (D ! E)	$1.66	$2.14
G.	Posted County Price (maximum of line C and F)	$1.70	$2.14
H.	County Loan Rate	$1.87	$1.87
I.	Loan Deficiency Payment (LDP) rate (H - G, where H - G > 0 for LDP to be available)	$0.17	$0.00

note: PCP refers to Posted County Price

Table 2. Description of Variables and Summary Statistics of Data used in Estimation of Weekly Basis Equations for Corn and Soybean (5,525 observations)

Variable	Description	Avg	S.D.
j	Commodity, where *j* = corn, soybean		
i	Location, where i = Braymer, Cameron, Charleston, Chillicothe, Concordia, Corder, Hannibal, Jamesport, Kansas City, Sikeston, St. Joe, St. Louis, and Tarkio.		
t	Weeks between January 1993 and December, 2001, t = 1, . . ., 425		
Cash_{jit}	Local cash price of commodity *j* in town *i* during week *t*.		
	Corn ($/bu)	$2.399	$0.709
	Soybean ($/bu)	$5.847	$1.169
Nearby Futures_{jt}	Nearby futures price for commodity *j*, rolled forward on the first week of the contract expiration month, during week *t*.		
	Corn ($/bu)	$2.543	$0.586
	Soybean ($/bu)	$6.035	$1.121
Basis_{jit}	Local cash price of commodity *j* in town *i* during week (Cash_{jit}) minus nearby futures of commodity *j* during week *t* (Nearby Futures_{jt}).		
	Corn ($/bu)	-$0.143	$0.215
	Soybean ($/bu)	-$0.188	$0.255
Lagged Basis_{jit}	Lagged one week local cash price of commodity *j* minus lagged one week nearby futures of commodity *j* in town *i* during week *t*.	n/a	n/a
	Corn ($/bu)		
	Soybean ($/bu)		
PCP_{jit} / Cash Price_{jit}	Government determined Posted County Price (PCP), for commodity *j*, for the county town *i* is located divided by Cash_{jit} .		
	Corn ($/bu)	82.9%	17.1%
	Soybean ($/bu)	87.9%	11.6%
Futures Liquidity_{jt}	Trading volume for commodity *j* during week *t* divided by open interest for commodity *j* during week *t*.	16.7%	6.7%
	Corn (%)	30.4%	9.9%
	Soybean (%)		
Transportation costs_t	Cash unleaded gas price during week *t*. A proxy variable for the costs of transporting grain and oilseeds between locations, down the Mississippi river, or terminal elevator locations ($/gal).	$0.596	$0.153

Table 2. Description of Variables and Summary Statistics of Data used in Estimation of Weekly Basis Equations for Corn and Soybean (5,525 observations)

Variable	Description	Avg	S.D.
$Cash_{jit}$-$Cassh_{jit-1}$	Local cash price of commodity *j* in town *i* during week *t* minus Local cash price of commodity *j* in town *i* during week *t*-1.		
	Corn ($/bu)	-$0.001	$0.108
	Soybean ($/bu)	-$0.003	$0.180
Weeks to Expiration	Number of weeks prior to futures contract month expiration (note, the nearby futures contract is rolled forward to the next deferred month on the first week of the expiration month).	n/a	n/a
Contract $Dummy_{jtC}$	0 or 1 binary variables differentiating the different contract months of commodity *j* (C = 1,2,...5 for j = corn; default = December & C = 1,2,...7 for j = soybean; default = November)	n/a	n/a
Location $Dummy_{jit}$	0 or 1 binary variables differentiating location of cash price quote (*i* = 1, 2, . . . 13; default = Kansas City)	n/a	n/a

Table 3. Pooled Regression Results for Factors Affecting Missouri Corn and soybean basis pattern, Dependent Variable is Basis ($/bushel).

Corn			Soybean		
Variable	Coefficient	p-value	Variable	Coefficient	p-value
Spatial auto.	0.0042**	0.011	Spatial auto.	0.0004	0.1354
Lagged basis	0.9797***	<0.001	Lagged basis	0.8079***	<0.001
PCP/Cash	-0.0018	0.179	PCP/Cash	-0.0299***	<0.001
Liquidity	-0.1792***	<0.001	Liquidity	-0.1474***	<0.001
Transportation	-0.0168**	0.094	Transportation	-0.0788***	<0.001
Cash price change	0.9929***	<0.001	Cash price change	0.9190***	<0.001
Expiration	0.0007	0.183	Expiration	0.0005	0.686
Contract Dummies (*default* = December)			Contract Dummies (*default* = November)		
March	-0.0119***	0.006	January	0.0320***	0.001
May	-0.0055	0.249	March	0.0265**	0.011
July	0.0064	0.183	May	0.0294***	0.006
September	0.0387***	<0.001	July	0.0907***	<0.001
			August	0.0897***	<0.001
			September	0.0391***	<0.001
Location Dummy (*default* = Kansas City)			Location Dummy (*default* = Kansas City)		
Braymer	-0.0043***	<0.001	Braymer	-0.0643***	<0.001
Cameron	-0.0041***	<0.001	Cameron	-0.0673***	<0.001
Charleston	-0.0030**	0.013	Charleston	0.0110**	0.017
Chillicothe	-0.0009	0.448	Chillicothe	-0.0640***	<0.001
Concordia	-0.0024***	0.001	Concordia	-0.0522***	<0.001
Corder	-0.0019***	0.003	Corder	-0.0410***	<0.001
Hannibal	-0.0006	0.374	Hannibal	-0.0076***	0.010
Jamesport	-0.0038***	<0.001	Jamesport	-0.0610***	<0.001
Sikeston	-0.0006	0.455	Sikeston	-0.0059**	0.039
St. Joe	-0.0009*	0.060	St. Joe	-0.0208***	<0.001
St. Louis	-0.0003	0.811	St. Louis	0.0066*	0.078
Tarkio	-0.0045***	<0.001	Tarkio	-0.0564***	<0.001
Intercept	0.0227**	0.018	Intercept	0.0663***	<0.001
R-squared	0.9927		R-squared	0.9685	
Mean of Dep. Variable ($/bu.)	-0.1432		Mean of Dep. Variable ($/bu.)	-0.1883	
No. of Obs.	5525		No. of Obs.	5525	

Note: Single, double, and triple asterisks denote coefficients significantly from zero at the 0.10, 0.05, and 0.01 level, respectively. The reported p-value is a two-tail test. Thirteen locations and 425 time periods are pooled.

Table 4. Pooled Regression Results for Factors Affecting Missouri Corn and Soybean Basis Patterns, Where Spatial Correlation Variable is Allowed to Vary Across Location, Dependent Variable is $/bushel.

Corn			Soybean		
Variable	Coefficient	p-value	Variable	Coefficient	p-value
Spatial Correlation			Spatial Correlation		
Braymer	0.0068***	0.002	Braymer	0.0027	0.407
Cameron	0.0065***	0.001	Cameron	0.0024	0.496
Charleston	0.0055**	0.022	Charleston	0.0038	0.465
Chillicothe	0.0077***	0.003	Chillicothe	0.0015	0.648
Concordia	0.0068***	<0.001	Concordia	0.0029	0.404
Corder	0.0052***	0.001	Corder	0.0012	0.694
Hannibal	0.0071***	0.008	Hannibal	0.0035	0.394
Jamesport	0.0066***	0.001	Jamesport	0.0028	0.465
Kansas City	0.0066***	0.001	Kansas City	0.0019	0.588
Sikeston	0.0051***	0.007	Sikeston	0.0007	0.851
St. Joe	0.0074***	0.001	St. Joe	0.0021	0.549
St. Louis	0.0046**	0.039	St. Louis	0.0023	0.615
Tarkio	0.0079***	0.001	Tarkio	0.0026	0.461
Lagged basis	0.9776***	<0.001	Lagged basis	0.8073***	<0.001
PCP/Cash	-0.0020	0.147	PCP/Cash	-0.0288***	0.003
Liquidity	-0.1762***	<0.001	Liquidity	-0.1469***	<0.001
Transportation	-0.0181*	0.073	Transportation	-0.0790***	<0.001
Cash price change	0.9917***	<0.001	Cash price change	0.9186***	<0.001
Expiration	0.0006	0.205	Expiration	0.0005	0.655
Contract Dummies (*default* = December)			Contract Dummies (*default* = November)		
March	-0.0114***	0.008	January	0.0320***	0.001
May	-0.0053	0.268	March	0.0261***	0.007
July	0.0063	0.193	May	0.0289***	0.003
September	0.0387***	<0.001	July	0.0899***	<0.001
			August	0.0893***	<0.001
			September	0.0388***	<0.001

Table 4 (continued). Pooled Regression Results for Factors Affecting Missouri Corn and Soybean Basis Patterns, Where Spatial Correlation Variable is Allowed to Vary Across Location, Dependent Variable is $/bushel.

Corn			Soybean		
Variable	Coefficient	p-value	Variable	Coefficient	p-value
Location Dummy (*default* = Kansas City)			Location Dummy (*default* = Kansas City)		
Braymer	-0.0049***	<0.001	Braymer	-0.0689***	<0.001
Cameron	-0.0040***	<0.001	Cameron	-0.0696***	<0.001
Charleston	-0.0049**	0.013	Charleston	0.0001	0.996
Chillicothe	-0.0035	0.448	Chillicothe	-0.0616***	<0.001
Concordia	-0.0034***	0.001	Concordia	-0.0574***	<0.001
Corder	-0.0025***	0.003	Corder	-0.0369***	<0.001
Hannibal	0.0029	0.374	Hannibal	-0.0168	0.256
Jamesport	-0.0053***	<0.001	Jamesport	-0.0663***	<0.001
Sikeston	0.0031	0.455	Sikeston	0.0013	0.928
St. Joe	-0.0028*	0.060	St. Joe	-0.0221**	0.020
St. Louis	0.0052	0.811	St. Louis	0.0313	0.104
Tarkio	-0.0081***	<0.001	Tarkio	-0.0609***	<0.001
Intercept	0.0173	0.018**	Intercept	0.0570**	0.032
R-squared	0.9922		R-squared	0.9687	
Mean of Dep. Variable ($/bu.)	-0.1432		Mean of Dep. Variable ($/bu.)	-0.1883	
No. of Obs.	5525		No. of Obs.	5525	

Note: Single, double, and triple asterisks denote coefficients significantly from zero at the 0.10, 0.05, and 0.01 level, respectively. The reported p-value is a two-tail test. Thirteen locations and 425 time periods are pooled.

Table 5. Pooled Regression Results for Factors Affecting Missouri Corn and Soybean Basis Patterns, Where LDP Proxy Variable is Allowed to Vary Across Months, Dependent Variable is $/bushel.

Corn			Soybean		
Variable	Coefficient	p-value	Variable	Coefficient	p-value
Spatial auto.	0.0041**	0.015	Spatial auto.	0.0018	0.6126
Lagged basis	0.9787***	<0.001	Lagged basis	0.8072***	<0.001
PCP/Cash			PCP/Cash		
December	-0.0018	0.512	November	-0.0611***	<0.001
March	-0.0037	0.210	January	-0.0435**	0.022
May	-0.0040	0.263	March	-0.0254	0.169
July	-0.0016	0.515	May	-0.0862***	<0.001
September	0.0029	0.484	July	-0.1142***	<0.001
			August	0.1249***	<0.001
			September	0.0120	0.446
Liquidity	-0.1804***	<0.001	Liquidity	-0.1327***	<0.001
Transportation	-0.0165	0.102	Transportation	-0.0727***	0.001
Cash price change	0.9928***	<0.001	Cash price change	0.9199***	<0.001
Expiration	0.0007	0.180	Expiration	0.0005	0.676
Contract Dummies (*default* = December)			Contract Dummies (*default* = November)		
March	-0.0096*	0.055	January	0.0223	0.165
May	-0.0020	0.725	March	0.0057	0.717
July	0.0099*	0.079	May	0.0420***	0.009
September	0.0408***	<0.001	July	0.1152***	<0.001
			August	-0.0146	0.450
			September	0.0019	0.896

Table 5 (continued). Pooled Regression Results for Factors Affecting Missouri Corn and Soybean Basis Patterns, Where LDP Proxy Variable is Allowed to Vary Across Months, Dependent Variable is \$/bushel.

Corn			Soybean		
Variable	Coefficient	p-value	Variable	Coefficient	p-value
Location Dummy (*default* = Kansas City)			Location Dummy (*default* = Kansas City)		
Braymer	-0.0045***	<0.001	Braymer	-0.0640***	<0.001
Cameron	-0.0044***	<0.001	Cameron	-0.0669***	<0.001
Charleston	-0.0032***	0.009	Charleston	0.0111	0.996
Chillicothe	-0.0009	0.436	Chillicothe	-0.0637***	<0.001
Concordia	-0.0025***	<0.001	Concordia	-0.0519***	<0.001
Corder	-0.0021***	0.002	Corder	-0.0407***	<0.001
Hannibal	-0.0068	0.331	Hannibal	-0.0073	0.256
Jamesport	-0.0041***	<0.001	Jamesport	-0.0608***	<0.001
Sikeston	-0.0067	0.397	Sikeston	0.0055	0.928
St. Joe	-0.0009**	0.049	St. Joe	-0.0206**	0.020
St. Louis	0.0003	0.817	St. Louis	-0.0680	0.104
Tarkio	-0.0047***	<0.001	Tarkio	-0.0564***	<0.001
Intercept	0.0207**	0.036	Intercept	0.0681***	0.006
R-squared	0.9924		R-squared	0.9688	
Mean of Dep. Variable (\$/bu.)	-0.1432		Mean of Dep. Variable (\$/bu.)	-0.1883	
No. of Obs.	5525		No. of Obs.	5525	

Note: Single, double, and triple asterisks denote coefficients significantly from zero at the 0.10, 0.05, and 0.01 level, respectively. The reported p-value is a two-tail test. Thirteen locations and 425 time periods are pooled.

Figure 1. Basis (Cash minus Futures) Terminology

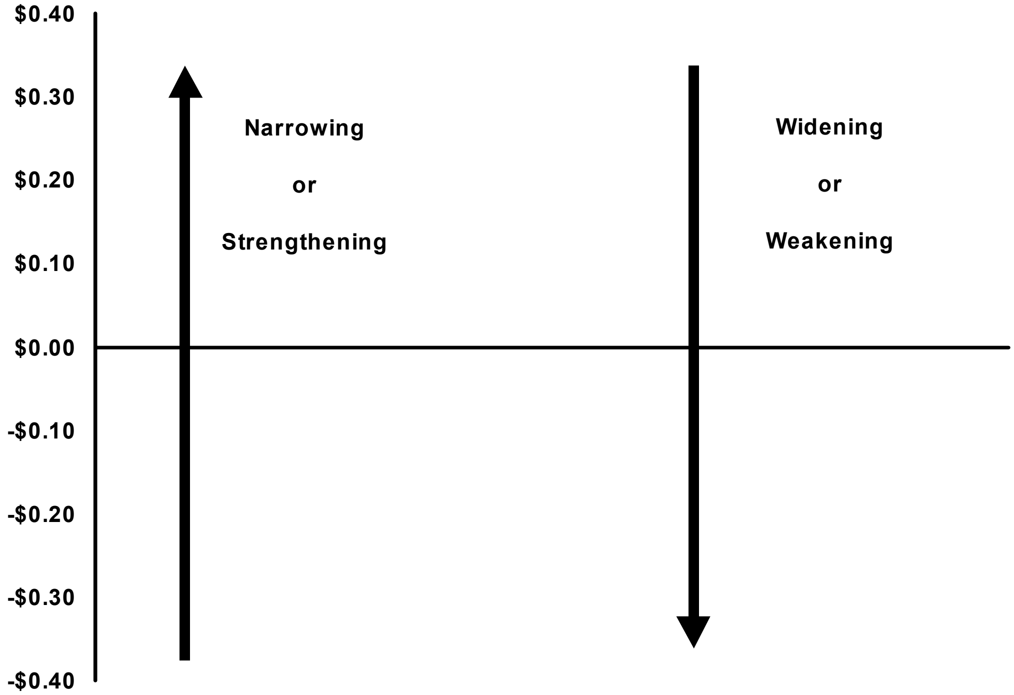

Figure 2. Farmers Marketing Decision Tree with LDP and how it Affects Cash Price Relative to Traditional Marketing Strategies.

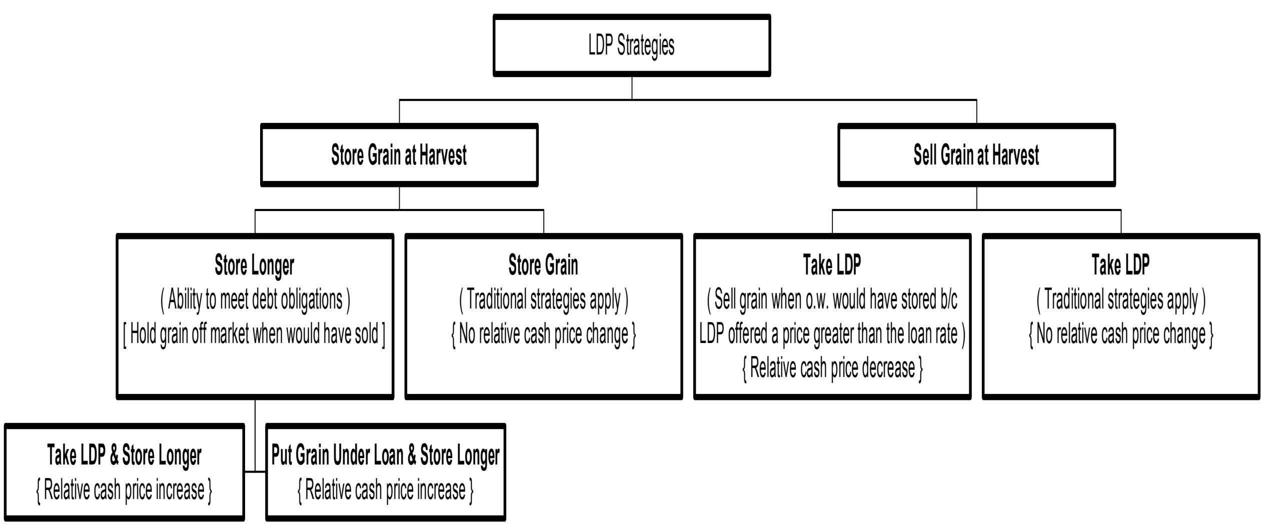

Figure 3. Nearby Weekly Corn Basis for Braymer and Kansas City, Missouri, January 1993 through November 2001.

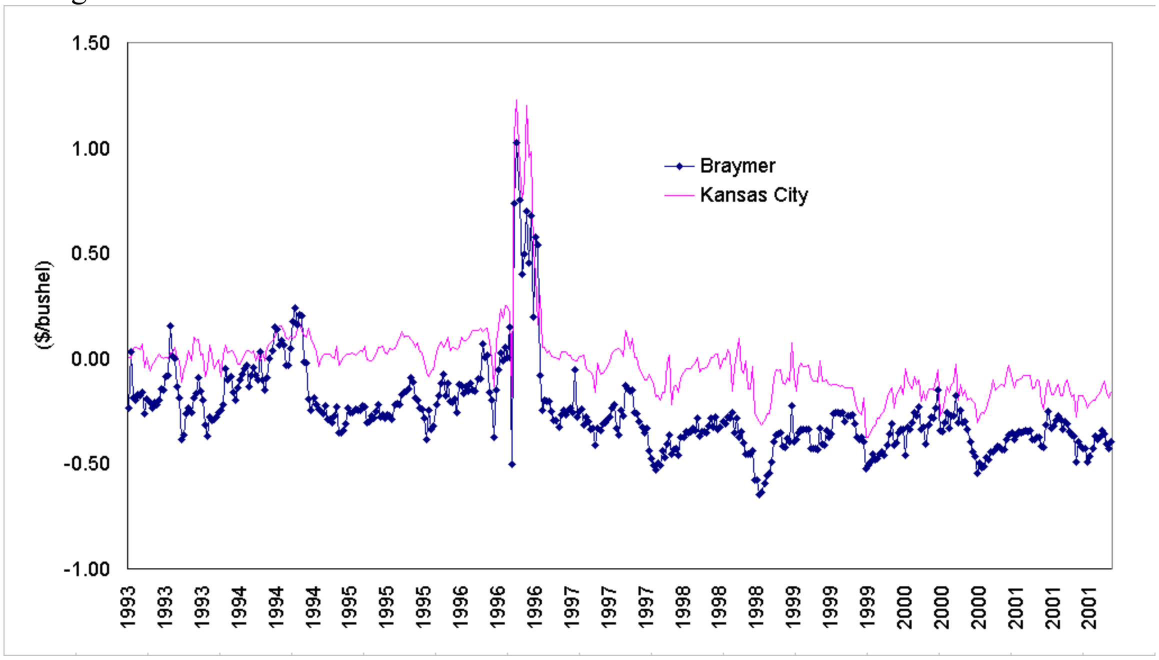

Figure 4. Nearby Weekly Soybean Basis for Braymer and Kansas City, Missouri, January 1993 through November 2001.

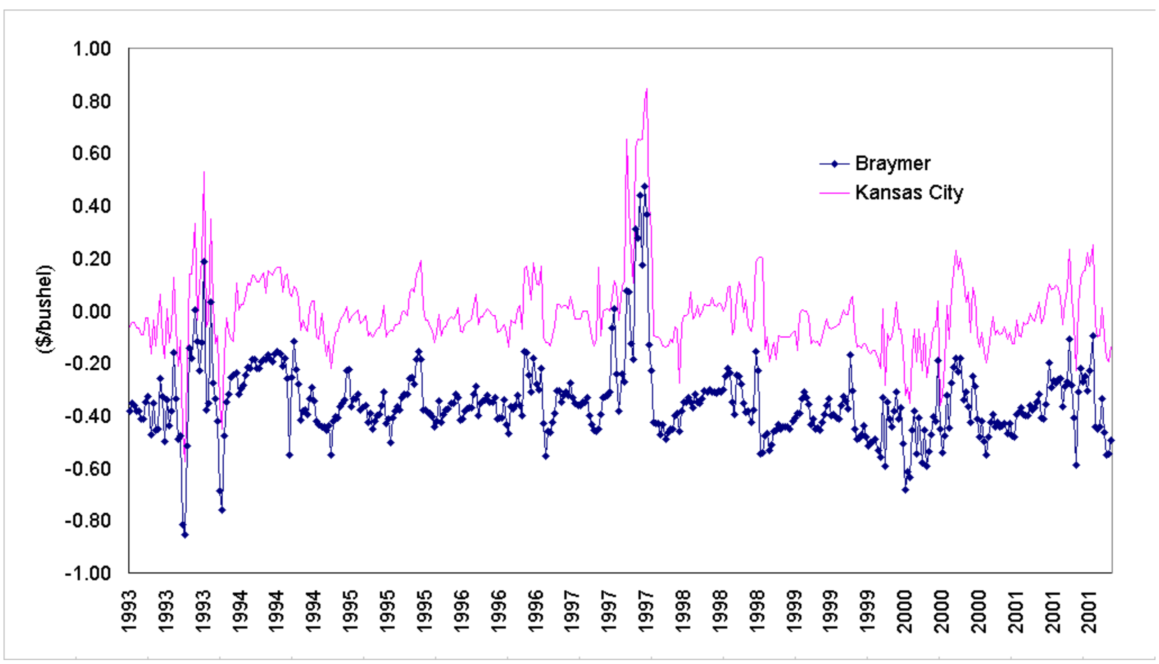

Figure 5. Spatial and Temporal Schematic of Basis.

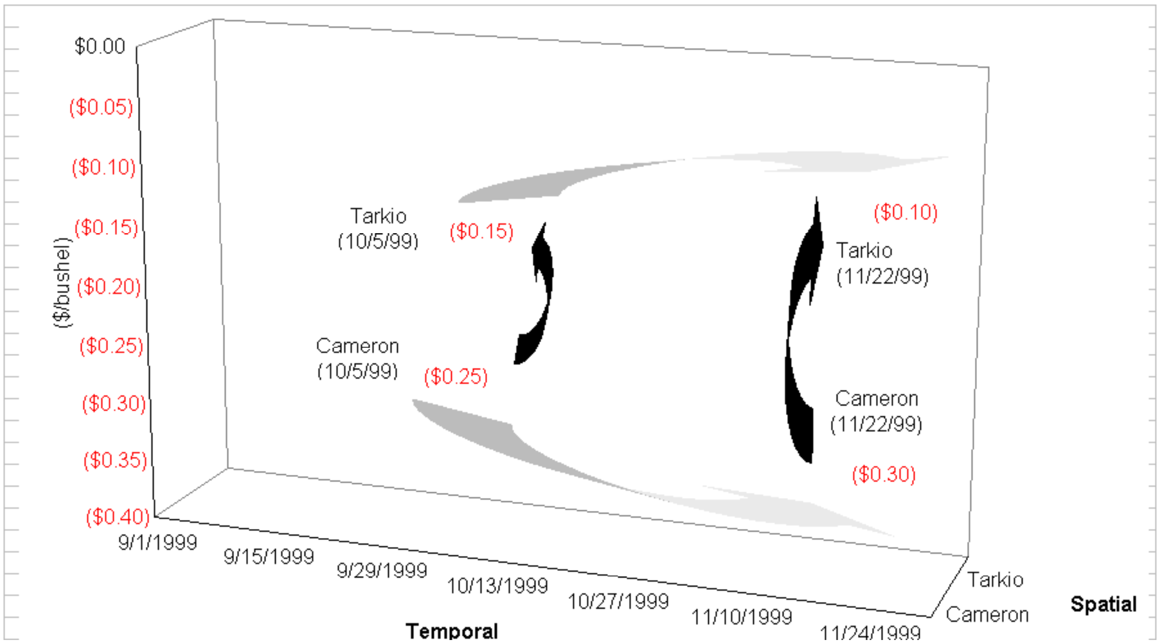

Figure 6. Spatial Representation of Locations Used for Basis Study