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Factors Influencing Basis and the Speed of Basis Adjustment in Grain Markets

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Abstract

Basis for grains and other crops has widened in recent years. Many factors are attributable to basis changes. However, in the Mississippi Delta region basis levels rose sharply in 2007 and 2008. Comparatively, although basis levels for corn and soybeans did widen in the Midwestern region it was to a lesser extent. Much the same is true with regard to wheat when comparing the Delta region with that of Western Kansas.

Introduction

Few concepts in agricultural marketing are more important to decision makers than the concept of basis. By the same token, for the past few marketing seasons, few topics have been more frustrating for decision makers than the topic of basis.

Basis behavior summarizes the relationship between the cash market for a commodity and its associated futures market. Therein lies its significance to agricultural marketing. If futures instruments (or the cash forward contracts that rely on those instruments) are to be effective risk management tools, the relationship between cash and futures prices must be relatively consistent. Inconsistent basis implies an inconsistent relationship between cash and futures prices. When this is the case, the risk management benefit from taking a futures position to offset a cash market position is reduced.

The major frustration of producers over the last couple of years has related not so much to variability in basis but to the level of basis. From a historic perspective, basis on all grain

commodities has been very wide recently. As a result of this situation, extremely attractive pricing opportunities that appear to be available on the futures market are, in fact, not available at the local level. Basis for corn, soybeans and wheat has become more negative in recent years as compared to their five year average from 2002 to 2006. During August the difference between cash prices for corn at Helena, AR and the nearby corn futures contract reached -$0.55/bushel in 2007 and -$0.34/bushel in 2008, compared to a previous five year average of -$0.05/bushel. In Decatur, IL the October basis widened from an average of -$0.08/bushel to -$0.14/bushel in 2007 and -$0.22/bushel in 2008. Similar results were experienced for soybeans and wheat over the same time periods.

The persistently wide basis that has been observed in many markets since early 2007 raises concerns that markets – either cash, futures or both – may not be operating efficiently, either due to institutional deficiencies (e.g., lack of relevant information on supply and/or demand factors) or to the malfeasance of agents within the market. But, before reaching either of these conclusions, however, it is important to consider the components of basis and how those components may have been affected by the rather remarkable situation in commodity markets over the period of time during which this unusually wide basis has been observed. Therefore, the purpose of this research is to determine how harvest time basis for corn, soybeans and wheat have been impacted in this time of high commodity prices. Secondly, the speed at which futures prices adjusted to cash prices at various locations is quantified to determine if markets closer to par delivery points for these contracts adjusted more quickly than markets further away.

Background

The most obvious component of basis is transportation costs. Futures prices, at least theoretically, reflect the value of the underlying commodity at designated "par" delivery points. The cost of transporting the commodity from a given spot market to a par delivery point is, in general, a major component of basis. This fact alone suggests that recent basis should have been expected to be wider than historic averages. The boom in commodity prices has been accompanied by a boom in fuel prices. This has contributed to a substantial increase in transportation costs.

Basis in a local market is also influenced by the availability of storage space and transportation infrastructure (i.e., trucks, rail cars, or barges). Lack of storage space or of the transportation assets to move commodity quickly and smoothly through the supply chain creates a bottleneck that depresses further demand in the local market while not necessarily influencing the broader market forces reflected in futures prices. This issue has likely had at least some influence on grain basis levels in Delta regions over the few years as a dramatic shift in acreage to grain production has put stress on the state's storage and handling infrastructure.

Further, impacts to basis come from quality differences between the commodity available in a given spot market and the quality that is specified for par delivery in the futures contract will lead to changes in basis. Another factor to keep in mind in considering the recent behavior of basis is the overall level of commodity prices. Basis will be wider in periods of high prices because some of the normal costs of marketing will be higher as well. These would clearly include the cost of grain shrink (e.g., losses due to spoilage) as well as interest costs on capital tied up in inventory.

Methodology

Beyond the initial examination of the degree to which basis has recently shifted we explore the relationship of basis across various locations. This framework involves two challenging aspects with regard to the data. First time series data tend to be nonstationary and second because of this cointegration tests are used. This types of analysis commonly utilizes procedures outlined by Engle and Granger (1987) (see, Goodwin and Schroeder, 1991; Schroeder, 1997; Pendell and Schroeder, 2006). To test if each individual differenced price series of data is nonstationary, the augmented Dickey-Fuller unit root test is used:

(1) $\Delta Y_t = -\varphi Y_{t-1} + \sum_{i=1}^{k} \beta_1 \Delta Y_{t-i} + \varepsilon_t$,

where Y_t represents the price series, $\propto$ and β representing the intercept and slope coefficients, respectively, resulting from the regression and an error term, ε_t. From this the optimal lag length is determined using the Akaike information Criteria (AIC).

The test for cointegration involves conducting OLS on two price series of data:

(2) $Y_{1t} = a + bY_{2t} + e_t$

where, one series is the dependent variable, Y_{1t}, and the other series is the independent variable, Y_{2t}. The cointegration test, following equation (1) only substituting $\hat{e}_t$ for Y_t after calculating the estimated errors, $\hat{e}_t$, from the OLS coefficients, $\hat{a}$ and $\hat{b}$ (from Engle and Granger, 1987 as outlined in Enders, 2004).

Upon completion of the stationarity and cointegration tests, the speed of basis adjustment is quantified using vector autoregressive (VAR) models. When cointegration is present the VAR

models are estimated using an error correction model (ECM) to avoid model misspecification (Enders, 2004). The following ECM models are used:

$$(3)\quad \Delta B_{1t} = \alpha_1 + \alpha_{1B}\hat{e}_{1t-1} + \sum_{i=1}^{k} \alpha_{11}\Delta B_{1t-i} + \sum_{i=1}^{k} \alpha_{12}\Delta B_{2t-i} + v_{1t}\ ,$$

$$(4)\quad \Delta B_{2t} = \alpha_2 + \alpha_{2B}\hat{e}_{1t-1} + \sum_{i=1}^{k} \alpha_{21}\Delta B_{1t-i} + \sum_{i=1}^{k} \alpha_{22}\Delta B_{2t-i} + v_{2t}$$

where, the speed of adjustment coefficients are $\propto_{1B}$ and $\propto_{2B}$. If the absolute value of the speed of adjustment coefficients is close to one implies that the series adjust quickly and the series adjusts slowly as the coefficients approach zero.

Data

We use daily cash prices of corn soybeans and wheat published through the Agricultural Marketing Service of USDA with the Wednesday prices being used in this study (except when no Wednesday report was available and as such we used either the Tuesday or Thursday reported prices). When weekly data were missing we extrapolated the data using the reported prices before and after the missing data. Corn, soybean and wheat prices are used for two Mississippi locations, Greenville and Belzoni, and for St. Louis, Missouri. Corn and soybean prices for Decatur, Illinois and Helena, Arkansas are used. Lastly, wheat prices in Western Kansas (Dodge City) are used (see table 1 for the distance between these locations and figure 1 depicts these locations on a map for reference). Futures prices come from the daily closing prices of Chicago Board of Trade corn, soybean and wheat futures contracts.

Results

Basis patterns were examined for corn, soybeans and wheat at Greenville, Mississippi, Belzoni, Mississippi and St. Louis, Missouri. Basis patterns for corn and soybeans were examined for Decatur, Illinois and Helena, Arkansas. Wheat basis patterns in Dodge City, Kansas were also examined. For reporting purposes, the daily series was condensed into a quarterly series and is presented in tables 2 through 4. Table 2 shows corn basis for all locations, excluding W. Kansas. Comparing the third and fourth quarters of each year (approximately harvest in these regions) corn basis widened in both Mississippi locations by roughly 30 and 40 cents per bushel, respectively for Greenville (about the same as Helena, Arkansas) and Belzoni, as compared to 10 cents per bushel in Decatur, Illinois and 12 cents per bushel in St. Louis, Missouri. The level of basis widening across these same locations was similar to that of corn. For Greenville and Belzoni soybean basis widened about 40 and 50 cents per bushel, respectively (again Helena was comparable to Greenville). Decatur and St. Louis saw their soybean basis widen about 18 and 22 cents respectively.

With respect to wheat, third quarter basis levels in Mississippi widened more in 2007 and 2008 versus 2004 thru 2006 as compared to Western Kansas as well as St. Louis. Greenville wheat basis widened about $1.30 per bushel while Belzoni widened $1.35 per bushel. Western Kansas wheat basis did grow wider, by about 70 cents per bushel. St. Louis wheat basis was actually more comparable to the Mississippi locations with its wheat basis widening by about $1.25 per bushel. For ease of viewing the changes in basis are also reported in figures 2 through 3.

[insert speed of adjustment results here]

Conclusions

Many factors play a role in determining basis. This study has reported the basis patterns for various locations and has illustrated the degree to which basis grew abnormally wide in the Delta region of Mississippi and Arkansas for 2007 and 2008 with respect to corn and soybeans. Ironically, the trends appear to have reversed in 2009 as heavy rainfall damaged crops in the Delta region causing some scarcity of these commodities while this was not the case in Midwestern states.

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Table 1. Distance Between Various Locations Used in the Analysis (miles)

	Helena, AR	Decatur, IL	Dodge City, KS	Greenville, MS	Belzoni, MS
Decatur, IL	398				
Dodge City, KS	554	613			
Greenville, MS	58	453	584		
Belzoni, MS	93	470	632	47	
St. Louis, MO	308	109	524	365	389

Table 2. Quarterly Corn Basis Amounts At the Specified Locations ($/bu)

	Helena	Decatur	Greenville	Belzoni	St. Louis
Q1-2004	($0.06)	($0.02)	($0.10)	($0.17)	$0.07
Q2-2004	($0.05)	$0.02	($0.15)	($0.22)	$0.09
Q3-2004	($0.08)	$0.01	($0.10)	($0.17)	$0.06
Q4-2004	($0.01)	($0.08)	($0.17)	($0.24)	($0.04)
Q1-2005	($0.00)	($0.00)	($0.09)	($0.16)	$0.06
Q2-2005	$0.03	($0.03)	($0.09)	($0.16)	$0.08
Q3-2005	($0.13)	($0.08)	($0.20)	($0.29)	($0.12)
Q4-2005	$0.03	($0.05)	($0.20)	($0.28)	$0.01
Q1-2006	$0.00	($0.05)	($0.10)	($0.15)	$0.03
Q2-2006	($0.06)	($0.09)	($0.17)	($0.22)	$0.04
Q3-2006	($0.05)	($0.09)	($0.11)	($0.17)	($0.01)
Q4-2006	$0.03	($0.01)	($0.16)	($0.21)	$0.07
Q1-2007	($0.05)	($0.10)	($0.20)	($0.24)	$0.01
Q2-2007	($0.06)	($0.05)	($0.15)	($0.20)	$0.09
Q3-2007	($0.42)	($0.15)	($0.53)	($0.67)	($0.09)
Q4-2007	($0.07)	($0.05)	($0.22)	($0.40)	$0.08
Q1-2008	($0.15)	($0.13)	($0.33)	($0.51)	($0.01)
Q2-2008	($0.31)	($0.21)	($0.48)	($0.66)	($0.18)
Q3-2008	($0.36)	($0.22)	($0.54)	($0.72)	($0.21)
Q4-2008	($0.47)	($0.15)	($0.56)	($0.74)	($0.27)
Q1-2009	($0.15)	($0.02)	($0.47)	($0.65)	$0.07
Q2-2009	($0.12)	$0.02	($0.43)	($0.56)	$0.09
Q3-2009	($0.05)	$0.10	($0.22)	($0.34)	$0.14
Q4-2009	($0.19)	($0.35)	($0.14)	($0.22)	($0.10)

Table 3. Quarterly Soybean Basis Amounts At the Specified Locations ($/bu)

	Helena	Decatur	Greenville	Belzoni	St. Louis
Q1-2004	$0.04	$0.08	$0.07	$0.02	$0.12
Q2-2004	$0.11	$0.11	($0.01)	($0.08)	$0.20
Q3-2004	($0.07)	$0.17	($0.13)	($0.20)	($0.01)
Q4-2004	$0.12	($0.00)	$0.03	($0.05)	$0.17
Q1-2005	$0.10	$0.02	$0.01	($0.08)	$0.17
Q2-2005	$0.02	$0.05	($0.09)	($0.18)	$0.08
Q3-2005	($0.09)	$0.05	($0.18)	($0.32)	($0.12)
Q4-2005	($0.03)	($0.07)	($0.24)	($0.39)	($0.06)
Q1-2006	$0.05	($0.08)	($0.01)	($0.16)	$0.01
Q2-2006	($0.01)	($0.10)	($0.15)	($0.30)	($0.02)
Q3-2006	($0.02)	($0.11)	($0.24)	($0.39)	($0.07)
Q4-2006	$0.14	($0.07)	($0.25)	($0.40)	$0.03
Q1-2007	($0.08)	($0.19)	($0.26)	($0.40)	($0.09)
Q2-2007	($0.30)	($0.23)	($0.47)	($0.62)	($0.24)
Q3-2007	($0.57)	($0.43)	($0.61)	($0.78)	($0.51)
Q4-2007	($0.19)	($0.26)	($0.34)	($0.53)	($0.11)
Q1-2008	($0.41)	($0.39)	($0.70)	($0.89)	($0.24)
Q2-2008	($0.52)	($0.11)	($0.93)	($1.10)	($0.19)
Q3-2008	($0.49)	$0.02	($0.54)	($0.76)	($0.22)
Q4-2008	($0.25)	($0.06)	($0.78)	($1.00)	($0.09)
Q1-2009	$0.11	$0.05	($0.14)	($0.36)	$0.21
Q2-2009	$0.10	$0.16	($0.21)	($0.43)	$0.19
Q3-2009	($0.56)	$0.28	($0.21)	($0.43)	$0.07
Q4-2009	($0.04)	($0.73)	($0.04)	($0.26)	$0.11

Table 4. Quarterly Wheat Basis Amounts At the Specified Locations ($/bu)

	W. Kansas	Greenville	Belzoni	St. Louis
Q1-2004	($0.21)	$0.09	($0.00)	$0.12
Q2-2004	($0.16)	($0.08)	($0.15)	$0.04
Q3-2004	($0.14)	($0.10)	($0.21)	$0.15
Q4-2004	$0.06	$0.17	$0.05	$0.42
Q1-2005	$0.01	$0.25	$0.13	$0.40
Q2-2005	($0.21)	$0.00	($0.08)	$0.12
Q3-2005	($0.13)	($0.33)	($0.46)	($0.21)
Q4-2005	$0.16	($0.37)	($0.52)	($0.15)
Q1-2006	$0.27	($0.10)	($0.25)	($0.05)
Q2-2006	$0.60	($0.47)	($0.55)	($0.23)
Q3-2006	$0.44	($0.54)	($0.66)	($0.46)
Q4-2006	($0.30)	($0.36)	($0.51)	($0.21)
Q1-2007	($0.25)	($0.45)	($0.58)	($0.35)
Q2-2007	($0.39)	($0.49)	($0.64)	($0.34)
Q3-2007	($0.87)	($0.80)	($0.96)	($0.65)
Q4-2007	($0.46)	($0.65)	($0.83)	($0.41)
Q1-2008	($0.25)	($0.74)	($0.93)	($1.25)
Q2-2008	($0.19)	($1.53)	($1.75)	($1.90)
Q3-2008	($0.46)	($2.41)	($2.63)	($2.14)
Q4-2008	($0.48)	($1.79)	($2.01)	($1.42)
Q1-2009	($0.30)	($1.43)	($1.65)	($1.02)
Q2-2009	($0.05)	($1.12)	($1.34)	($0.77)
Q3-2009	($0.47)	($1.49)	($1.71)	($1.50)
Q4-2009	($0.86)	($1.10)	($1.32)	($1.68)

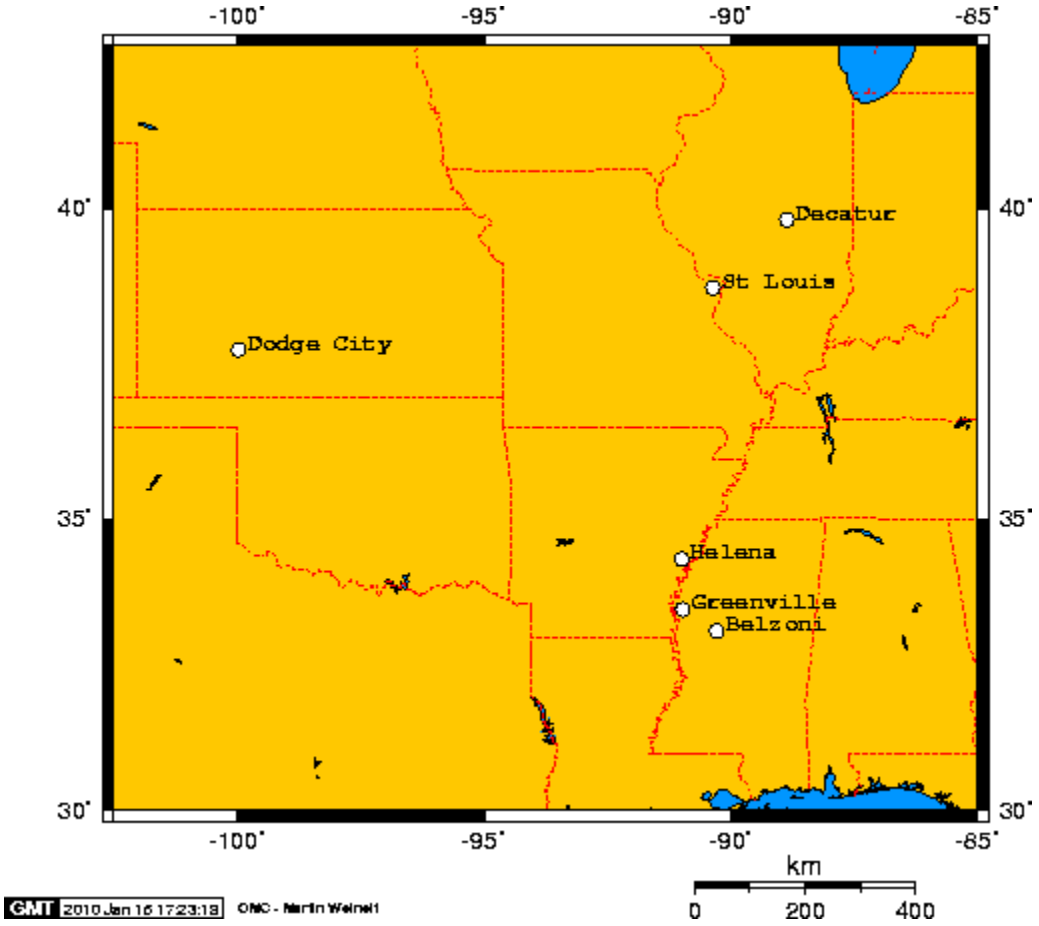

Figure 1. Map of Locations Used in the Analysis

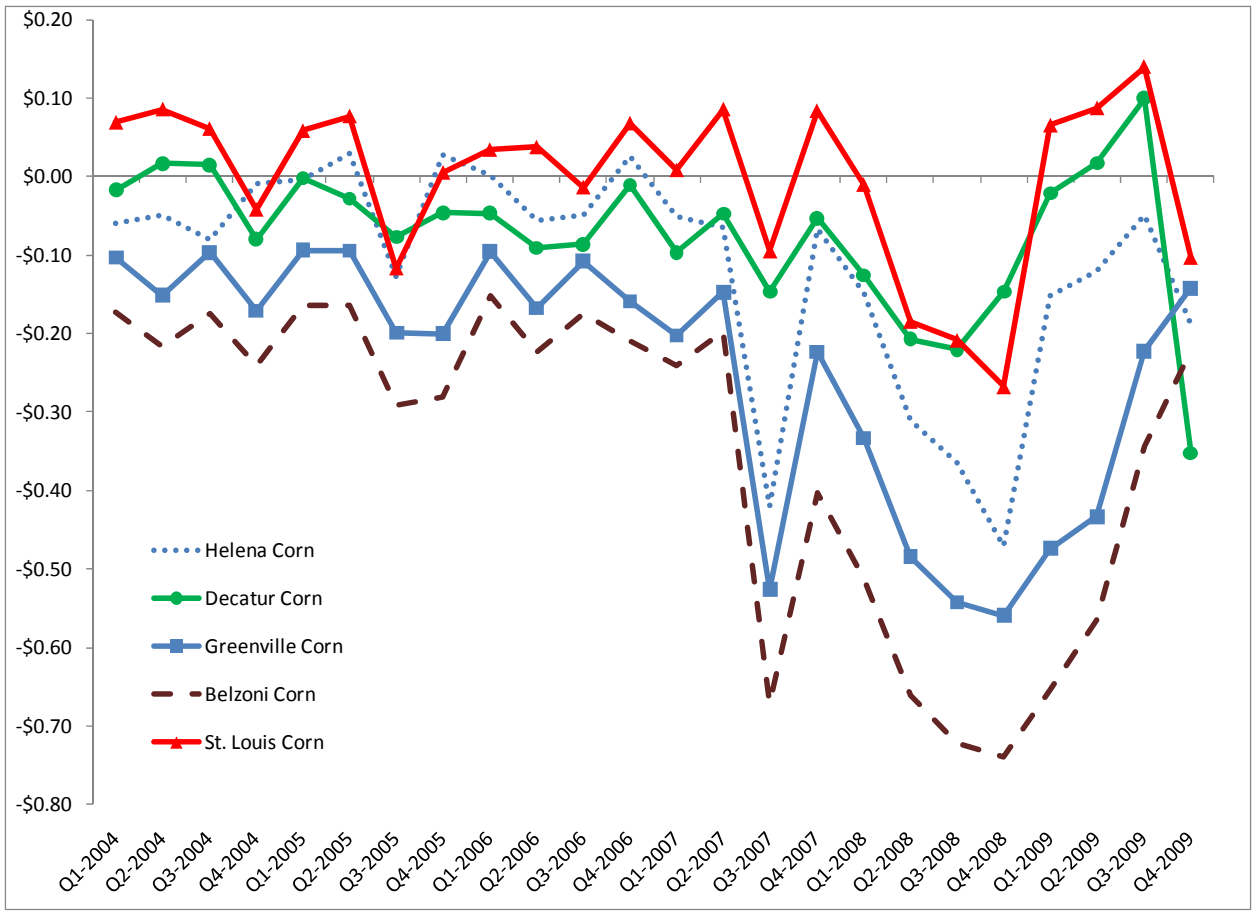

Figure 2. Corn Basis Changes, Quarterly, for Various Locations

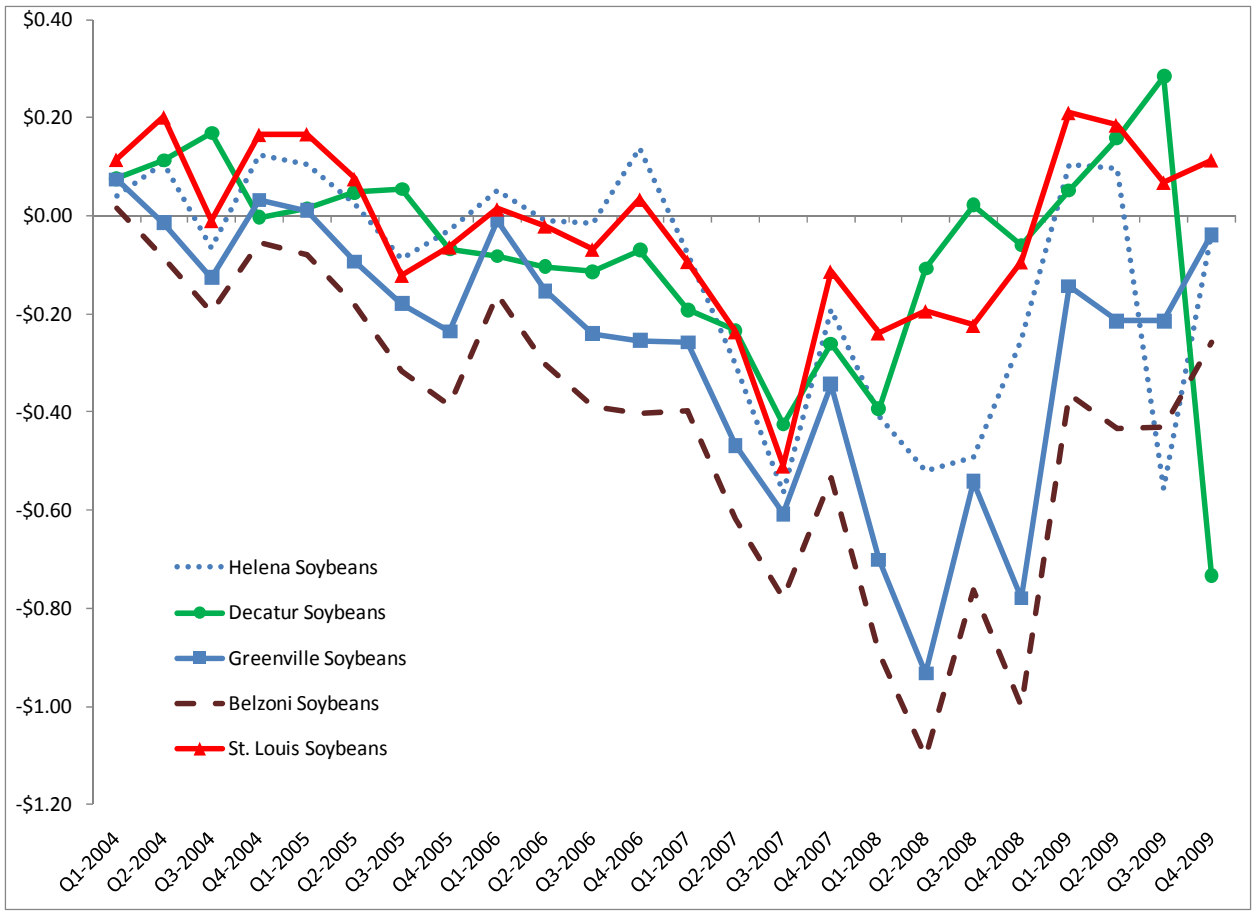

Figure 3. Soybean Basis Changes, Quarterly, for Various Locations

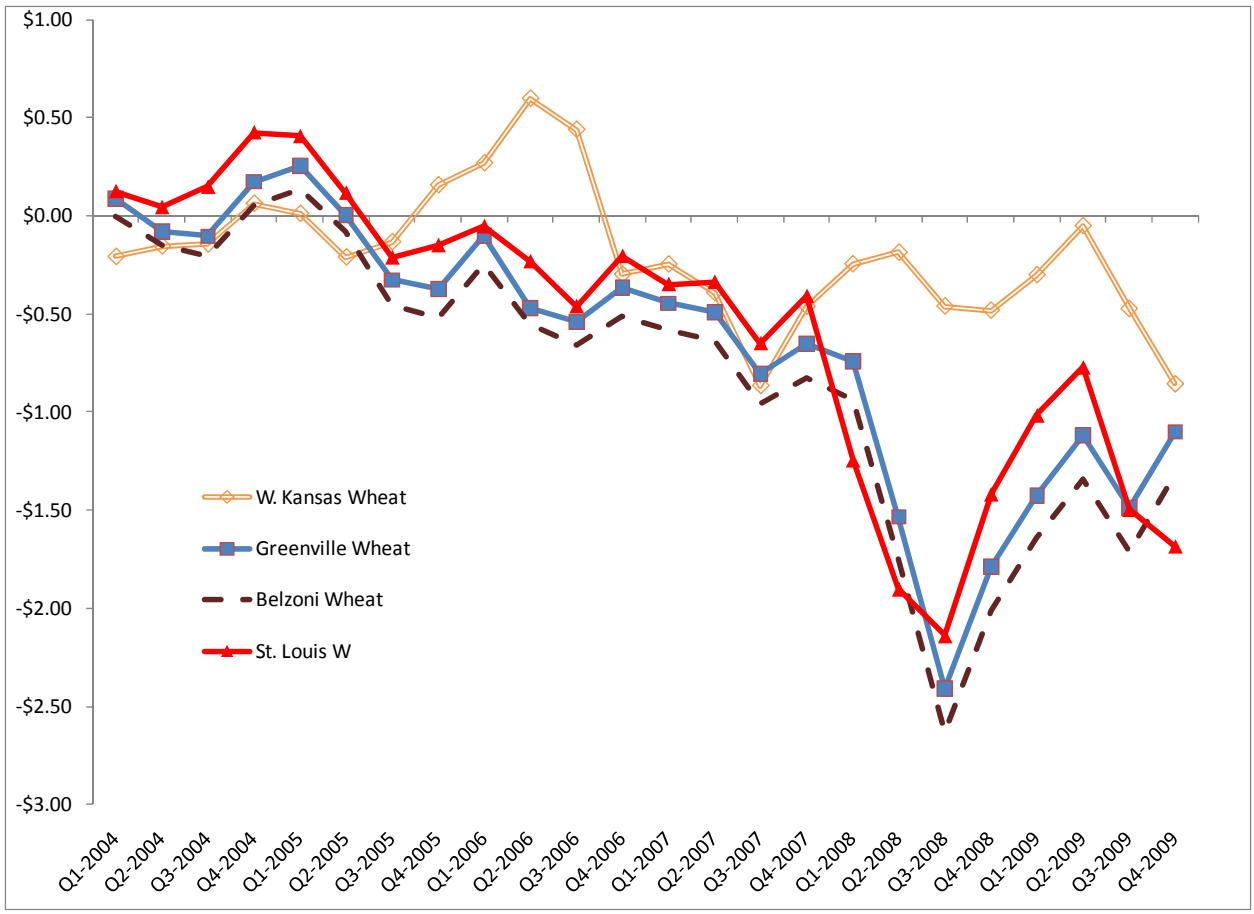

Figure 4. Wheat Basis Changes, Quarterly, for Various Locations