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Introduction

The lack of consistently acceptable convergence performance for Chicago Board of Trade (CBOT) corn, soybean, and wheat contracts since late 2005 has been widely discussed (e.g., Henriques, 2008).[1] Convergence performance is summarized in Figure 1, depicting delivery location basis levels on the first delivery date of each contract for the three commodities over January or March 2000 through March 2009. Extended periods of lack of convergence since late 2005 are obvious, although variable over time and by commodity. Performance has been consistently weakest in wheat, with futures prices at times exceeding delivery location cash prices by $1.00/bu., a level of disconnect between cash and futures not previously experienced in grain markets.

The economic damage associated with recent non-convergence problems is two-fold. First, the consistently large wedge between futures and cash prices during delivery is indicative of contracts that are out of balance, with a bias towards one side of the market. Hieronymus (1977, p. 340) warns, "When a contract is out of balance the disadvantaged side ceases trading and the contract disappears." Second, uncertainty in basis behavior has increased sharply as markets have bounced unpredictably between converging and not converging. This has led to marked declines in hedging effectiveness (Irwin et al., 2008). In a series of classic articles, Working (1953, 1954, 1960, and 1962) argued persuasively that commodity futures markets depend primarily on hedging for their existence. Consequently, the long-run viability of a futures market may be threatened if it does not provide an efficient hedging mechanism for producers, merchants, and processors. The history of other futures markets, such as Maine potatoes, with similar declines in hedging effectiveness is sobering (Paul, Kahl, and Tomek, 1981)

The purpose of this report is to evaluate causes of recent convergence problems in CBOT corn, soybean, and wheat futures contracts and potential solutions to address the problems. Our basic conclusion is that storage rate changes for corn and soybeans appear to have been sufficient to address problems is these two markets, but that a major change in the delivery terms of the wheat contract is needed in order to address the ongoing performance problems.

Spreads and Non-Convergence

There is not complete agreement as to the causes of poor convergence performance shown in Figure 1 or the relative contribution of potential causes.[2] In general, however, there appear to be two major factors contributing to the lack of convergence: 1) the tendency for

[1] While the CBOT is now part of the CME Group, Inc., the CBOT remains the self-regulatory organization that is approved by the Commodity Futures Trading Commission (CFTC) to list the corn, soybean, and wheat futures contracts for trading.

[2] See Appendix A of this report for an overview of the delivery process.

spreads in the futures market to reflect a relatively high percent of full carry and 2) structural issues related to the delivery process.[3] Large carry markets are thought to have contributed to poor convergence performance in all three markets, while structural issues appear to be largely confined to wheat.

Large carry markets contribute to lack of convergence by "uncoupling" cash and futures markets when futures prices are above cash prices. The delivery instrument for corn and soybeans is a shipping certificate, while the delivery instrument for wheat was a warehouse receipt until recently when it was changed to a shipping certificate (starting with the July 2008 contract). Those longs who receive certificates or receipts from shorts in the delivery process are not required to cancel those instruments for shipment. The instruments can be held indefinitely with the holder paying "storage" costs at the official rates specified by the CBOT in contract rules. The taker in delivery (the long) may choose to hold the delivery instrument rather than load out if the spread between the price of the expiring and next-to-expire futures contracts exceeds the cost of owning the delivery instrument. Therefore, as the magnitude of the nearby spread exceeds the full cost of carry for market participants with access to low-cost capital, those participants can (and do) stand for delivery but do not cancel delivery certificates or receipts for load out.

The lack of load out, then, means that deliveries do not result in cash commodity purchases by the taker that would contribute towards higher cash prices and better convergence. Alternatively, a smaller carry in the market and the absence of an "abnormal" return to certificate ownership would motivate participants with long positions to liquidate prior to delivery, putting downward pressure on nearby futures and contributing to better convergence.

Figure 2 shows the spread between prices for the expiring and next-to-expire contracts, expressed as a percent of full carry, on the first delivery date of each expiring corn, soybean, and wheat futures contract over January or March 2000 through March 2009. The percent of full carry is computed as:

$$C_t = \left[\frac{F2_t - F1_t}{S_t + I_t} \right] \times 100,$$

where $F1_t$ is the settlement price of the t^{th} expiring futures contract on the first delivery date for this contract, $F2_t$ is the settlement price of next-to-expire futures contract on the first delivery date of the t^{th} expiring futures contract, S_t is the CME contract storage rate per day times the number of days (n_t) between the first delivery date for the expiring and next-to-expire futures contracts, and I_t is interest opportunity cost, computed as the settlement price of the expiring futures contract on the first day of delivery $(F1_t)$ times the appropriately adjusted 3-month LIBOR interest rate $\left[I_t = F1_t \times (r_t / 365) \times n_t \right]$. Note that the scale for percent of full carry in

[3] Previous analyses of convergence performance in commodity futures markets mainly focused on structural factors (e.g., Paul, Kahl, and Tomek, 1981; Peck and Williams, 1991; Pirrong, Haddock and Kormendi, 1993).

Figure 2 is cut off at zero since large negative carry values (market inversions or "backwardations") distort comparisons.

The charts in Figure 2 reveal a similar pattern across the three commodities. There was a relatively brief period in 2000 and 2001 when spreads exceed 80% of fully carry and then spreads generally were capped near 80% of full carry through early 2005; but beginning in the last half of 2005 spreads routinely approached or exceeded 100% of full carry. As noted above, the relatively large carry created incentives takers of delivery (longs) to hold delivery instruments rather than canceling via load out. This general pattern is illustrated in Figure 3 for deliveries and Figure 4 for certificates or registered warehouse receipts. Note especially the decline in registered certificates for soybeans in late 2008 and corn in March 2009 that followed a drop in the carry below 80% in these two markets.

Figure 5 illustrates the relationship between the magnitude of the carry and the basis at delivery locations on the first delivery date of each expiring corn, soybean, and wheat futures contracts over January or March 2000 through March 2009.[4] The charts are constructed so that the zero line for basis on the left *y*-axis scale corresponds to 80% of full carry on the right *y*-axis scale. In addition, the scale for cost of carry (right *y*-axis) is cut off at -220%, since very large negative carry values in soybeans would again distort comparisons. Inspection of the charts shows a consistent pattern of poor convergence whenever the carry exceeds 80% and better performance when the carry is below 80%. Note that this pattern is evident not only during recent years but also in 2000-2001, when corn and wheat experienced another period of non-convergence, albeit at much smaller basis levels. Two other observations are particularly relevant regarding the most recent behavior of delivery location basis and carry. First, the recovery of corn basis levels in March 2009, soybean basis in January and March 2009, and wheat basis in September 2007, December 2007, and March 2008 tracks the decline in carry below 80%.[5] Second, the large carry in wheat since May 2008 continues to inhibit convergence.

The relationship between the percent of full cost of carry and delivery location basis levels is analyzed further in Table 1. Average basis levels above and below 80% of full carry are computed for the same sample period, January or March 2000 through March 2009, as shown in Figures 1-5. When interpreting the average basis levels it is important to keep in mind that delivery on grain futures contracts is not costless and is complicated by the existence of grade, location, and timing delivery "options" that have a demonstrated value to sellers of contracts (Hranaiova and Tomek, 2002). This implies that a zero basis is not necessarily expected during the delivery period of a contract. A more realistic approach is to think of a zone of convergence between cash and futures prices during delivery periods, with the bounds of convergence determined by the cost of participating in the delivery process. Direct costs of delivery are

[4] Cash prices for corn and soybeans are adjusted for location and grade differentials specified in contract rules. Settlement prices are used for futures. Basis is computed as cash price minus futures price. See Appendix B of this report for further details.

[5] At first glance, November 2008 in soybeans appears to be a major anomaly in the relationship. In fact, basis on the first day of delivery for this contract was likely distorted by an extremely large spike in barge rates due to a backup of unsold fertilizer in the supply chain. By the last day of the delivery period for the November 2008 soybean contract, basis narrowed to -13.25 cents per bushel.

estimated to be in the range of 6 to 8 cents per bushel. (i.e., barge load out, storage, and interest opportunity costs).

The averages in Table 1 lead to several important observations. First, the contrast between average basis above and below 80% of full carry is striking and provides strong evidence of the important role that carry plays in the physical delivery process.[6] Second, the level of the average basis when carry is above 80% is well above the direct costs of participating in delivery (6 to 8 cents) in all cases. Third, the difference between the averages is about the same for corn and soybeans and represents a weakening of the basis by about 15 to 20 cents. Fourth, the magnitude of the weakening of the basis is substantially higher in wheat compared to corn and soybeans. Fifth, it is interesting to note that there are several instances where the level of the average basis clearly exceeds the direct costs of participating in delivery even when carry is below 80% (Illinois River North and South of Peoria in soybeans, and St. Louis in wheat).

Figure 6 provides further perspective on the relationship between the percent of full cost of carry and delivery location basis levels. Whereas Figure 5 tracked the movement in the percent of full carry and basis over time, Figure 6 provides a scatter-plot of the relationship between the two variables irrespective of time. The *x*-axis for percent of full carry is cut off at -80% to once again avoid distortions due to large negative carry observations. The charts bring the relationship between carry and basis into even sharper relief. In particular, the thick black line in each of the charts is a simple model of the relationship where the basis is zero below 80% of full carry and then negative above 80% of full carry. While this model provides only a rough fit to the data and can clearly be improved upon, it nonetheless provides a useful frame of reference. The charts in Figure 6 also highlight the large magnitude of basis weakness, particularly in wheat, when the percent of full carry exceeds 80%.

As discussed in the introduction, another dimension of delivery performance is hedging effectiveness, which is directly related to the reliability of basis signals provided by the commodity futures market. The reliability of basis signals can be quantified by measuring the level of basis at some point before the delivery period and regressing this "initial" basis to the change in basis from that point forward through the delivery period. This approach was originally proposed by Working (1953) and has been used in several previous studies of the delivery performance of commodity futures markets (Peck and Williams, 1991; Williams, 2001; Hranaiova and Tomek, 2002**)**.

Perfect predictability of delivery location basis is illustrated in Figure 7. Note that when delivery location basis is perfectly predictable, the relationship between initial basis and the change in basis has a slope of -1 and the intercept is 0. In other words, if basis is -50 cents per bushel two months before expiration, the change in the basis over the subsequent two months should be +50 cents per bushel. Additionally, all points lie directly on the line, which implies the R^2 for the regression is 1 and that hedges over the interval are perfectly effective in eliminating basis risk. This also motivates the use of R^2 as an "index" of delivery location hedging effectiveness.

[6] Based on independent sample paired t-tests, the difference in the averages is statistically significant in all cases except St. Louis wheat.

Figure 8 shows the predictability of delivery location basis above and below 80% of full carry for corn, soybean, and wheat futures contracts over January or March 2000 through March 2009. The horizontal axis in each chart measures the level of the delivery location basis on the day after the preceding contract expires. The vertical axis measures the change in the delivery location basis from the day after the preceding contract expires to the first day of delivery. Observations for all delivery locations are pooled for each commodity, except St. Louis in soybeans, where deliveries almost never occur. September 2005 contracts are omitted for corn and soybeans due to the effects of hurricane Katrina. November 2008 contracts are also omitted for soybeans due to the distortion discussed in footnote #3. Also, observations for December and November contracts in corn and soybeans start on the first trading day of October, rather that the first day after preceding September contracts expire in order to avoid old/new crop cash price instabilities.

The regressions in Figure 8 indicate a marked decline in basis predictability for corn and soybeans when the percent of full carry exceeds 80%. In corn, the upper right regression line indicates the market performs reasonably well in terms of basis predictability when carry is less than 80%, as hedging effectiveness (R^2) is a respectable 77%. The lower left regression line shows a precipitous drop in hedging effectiveness to 21% when the carry exceeds 80%. The drop is not as large in soybeans, but it still declines from 66 to 39%. Note that the hedging effectiveness of corn and soybeans when the carry is below 80% compares favorably with measures reported in previous studies of convergence in commodity futures markets.[7]

Results for wheat differ sharply from those for corn and soybeans, in that basis predictability was poor at all times. Hedging effectiveness for wheat was only 27% when carry was less than 80% and declined to the very low figure of 7% when carry was above 80%. This effectively means that hedgers cannot predict delivery location basis behavior with any degree of reliability regardless of the level of carry. It also indicates an underlying structural problem in the wheat contract that predates recent issues associated with large carries.

In sum, the analysis in this section pinpoints an unusually large carry in nearby spreads as the main factor driving poor convergence performance of corn, soybean, and wheat futures contracts in recent years. The large carry led to a historically large wedge between futures and cash prices and substantial declines in hedging effectiveness. This raises the question of what caused the large jump in the carry for these markets starting in the second half of 2005.

Explaining the Large Carry

Factors identified as potentially responsible for the relatively long period of large carry generally fall in three categories: 1) CBOT maximum storage rates below actual commercial storage costs, allowing the spread to more easily move to full carry; 2) presence of large "long-only" index funds who tend to maintain positions in the nearby contract and roll in unison to the next contract, thereby contributing to a permanent increase in the spread; and 3) a significant

[7] Working (1953) studied Kansas City Board of Trade (KCBOT) wheat futures over 1922-1952 and reported an R^2 of 0.70. Williams (2001) reports an R^2 of 0.62 in a study of Coffee, Cocoa, and Sugar Exchange (CSCE) coffee futures over 1993-1997. Hranaiova and Tomek (2002) find that R^2 ranges between 0.65 and 0.79 for CBOT corn futures over 1989-1997.

increase in uncertainty about future commodity prices resulting in a large "risk premium" in the structure of futures prices that increases the price of deferred contracts relative to nearby contracts.

The first factor, low CBOT storage rates, has been accepted by a large segment of the grain industry as a major contributing factor. There is less agreement on the "right" level of storage rates needed to insure that convergence problems do not re-appear in the future. The CBOT conducted a storage cost survey of 47 firms in mid-2008, with the vast majority being interior country elevators. Survey results indicated that storage rates averaged approximately 4.3, 4.6, and 7.1 cents per bushel per month for corn, soybeans, and wheat, respectively.[8] Costs for corn and soybeans were near the storage rates on CBOT contracts at the time the survey was taken (4.5 cents per bushel), which makes it difficult to argue that the large carry in corn and soybeans was due to CBOT contract storage rates that were too low in relation to commercial storage rates. However, commercial storage rates were substantially higher for wheat in comparison to the CBOT contract rate at the time (also 4.5 cents per bushel). This supports the argument that low contract rates contributed to the large carry in wheat.

The second factor, the presence of large "long-only" index funds, is highly controversial. It is true that the large-scale entry of long-only index funds into the CBOT corn, soybean, and wheat futures contracts roughly coincides with the jump in the magnitude of the spreads that occurred in the last half of 2005 (Sanders, Irwin, and Merrin, 2008). Index funds enter market positions in the nearby contract and then roll to the next contract near the maturity of the nearby contract. Some argue that the concentrated rolling results in a recurring increase in the nearby spread. The evidence, however, does not support such a conclusion.

Table 2 summarizes the behavior of nearby spreads for corn, soybeans, and wheat during the first 13 business days of the calendar month prior to contract expiration.[9] The time window for the analysis is centered on days 5-9, the time period of the so-called "Goldman roll" when index funds tend to roll their positions from the nearby to the next deferred contract. Four periods are represented in each market. The first is March 1995 through November or December 2001, which represents a period with very little index fund trading. The second is January or March 2002 through November or December 2003, which is the time period when index fund trading first began to appear in earnest. The third is January or March 2004 through November or December 2005, which is the period of most rapid growth in index fund trading. The fourth is January or March 2006 through March 2009, which is the period with the largest index fund positions and also problems regarding non-convergence in CBOT corn, soybean, and wheat futures.

The averages in Table 2 reveal a consistent increase in the size of the spread to the next contract (expressed as a percent of full carry) during "Goldman roll" days 5 through 9. However, three observations are important. First, the spike in the magnitude of the spread either disappears

[8] We thank Fred Seamon of the CME for providing detailed information on the storage cost survey.

[9] August and September contracts in soybeans are excluded from the analysis because index funds typically do not trade in these relatively low volume contract months.

entirely or noticeably recedes during days 10 through 13, so rolling did not necessarily lead to a permanent increase in the magnitude of the spread. Second, the spike in the magnitude of the spread during the roll period was present long before convergence became an issue and before long-only index funds had a major presence in these markets. This is not surprising since the time window when index funds roll to the next contract is also the same time period when many other traders roll their positions. Third, spreads in the soybean market narrowed and even become negative in late 2008 even though long-only index funds were still present and rolling large positions forward.

We conclude that rolling of positions by long-only index funds is unlikely to explain the increase in the size of nearby spreads experienced since late 2005. The challenge, then, for those who argue that long-only index funds are responsible for convergence problems is to explain how the mere presence of index funds in corn, soybean, and wheat futures markets changed the pricing of deferred contracts relative to nearby contracts. The task is even more difficult when one considers the fact that index fund positions did not appear to change much after reaching a peak in 2006 (Sanders, Irwin, and Merrin, 2008), yet there was considerable variability in the magnitude of the spreads as a percent of full carry over time and across the three commodities (Figure 2).

The role of the third possible factor, a risk premium, has not been as widely-discussed as the first two factors. Pirrong (2008) develops a theoretical model where a positive shock to the variance of fundamental market uncertainty increases the precautionary demand for commodity stocks. This increased demand is then expressed in the market through an increase in spot prices, which leads to a decrease in consumption and an increase in production, and hence, an increase in stocks. In turn this leads to an increase in the expected price of storage, as reflected in an increase in the spread between near and deferred futures. The implication of this theory is that an additional term should be added to the conventional view of the determinants of spreads in futures contracts for storable commodities:[10]

Spread = Storage Cost + Interest Cost - Convenience Yield + Risk Premium.

An increase in the risk premium component of corn, soybean, and wheat spreads is consistent with the high level of market volatility experienced in recent years. Nonetheless, the existence of this additional risk premium component in spreads has not been documented by empirical testing.

Solutions

Proposed solutions to the lack of convergence, for the most part, address either the storage rate or the decoupling of the cash and futures markets during the delivery period. Proposals have been made and adopted to increase the maximum storage rate for the CBOT contracts based on the assumption that increased rates more accurately reflect commercial

[10] The first two terms on the right-hand side were included in the full cost of carry calculations presented earlier in this section. The third, convenience yield, is the operational benefit derived by inventory holders from holding stocks (Working, 1948, 1949).

storage costs. Increased CBOT storage rates reduce the likelihood that spreads will go to full carry, and therefore, eliminate the motivation for longs to receive and own certificates.

Proposals that directly address the decoupling of cash and futures markets include: 1) making the CBOT contracts cash settlement contracts and, by definition, forcing convergence at maturity, 2) making the delivery instrument a demand certificate by forcing the taker to cancel the certificate for load out and thereby re-establish the connection between cash and futures markets at delivery, and 3) limiting the number of shipping certificates that an individual firm can hold at any one point in time.[11]

For the corn and soybean markets, large carries began to disappear in very late 2008 and relatively smaller carries persisted into early March 2009 (Figure 2 and 5). As a result, convergence performance was very good for the January and March 2009 soybean contracts (and the November 2008 contract late in the delivery period) and the March 2009 corn contract (Figure 1). The reason for large carry markets giving way to smaller spreads is not known with certainty and it does not appear to be entirely explained by the increase in CBOT storage rates that began with the November 2008 soybean contract and the December 2008 corn contract. The absolute size of the spreads declined, not just the spreads as a percent of full carry, and the soybean market actually became inverted.

The return to smaller spreads tends to support the "risk premium" theory of the large spreads that emerged in 2005 through 2008. Regardless, it appears that the recent increase in maximum storage rates to 5 cents per bushel per month for corn and soybeans is sufficient to reflect actual commercial storage costs. However, there is a longer-term issue of whether some type of storage rate rule should be adopted for instances when there is convincing evidence of changing risk premiums in the price structure. Such rules, however, would be contingent on the development of acceptable methodology to identify and measure risk premiums. The attractiveness of this concept is illustrated by the recent experience with non-convergence. A quicker reaction to the jump in spreads in late 2005 surely would have mitigated the worst of the non-convergence problems in corn and soybeans.

It is important to point out that the recent situation in corn and soybeans contrasts with the period of non-convergence that emerged in 2000. The Illinois River Waterway Delivery System was introduced for the March 2000 corn and January 2000 soybean contracts and storage rates on January 1, 2000 were dropped from 4.5 to 3.0 cents per month for Illinois River shipping stations and from 4.5 to 3.6 cents per month for Chicago. Poor convergence was observed, particularly in corn, for the March through September 2000 contracts and the storage rate was raised back to 4.5 cents per month for all locations on October 31, 2001. This was an instance of non-convergence clearly being associated with CBOT storage rates at below market rates.

For wheat, poor convergence continued through the March 2009 contract (Figure 1), suggesting that if low maximum allowable storage rates were the cause of "full carry" markets, the increase in rates to 5 cents per month was not large enough. Beginning with the July 2009

[11] The CBOT proposed and the CFTC approved an amendment to rules for corn, soybean, and wheat contracts that limits any firm to holding a maximum of 600 shipping certificates for non-commercial purposes. The new rules went into effect on February 17, 2009.

contract, the maximum allowable storage rates will be increased to 8 cents per bushel per month for July 18th through December 17th. Based on the most recent CBOT survey of commercial storage rates, 8 cents appears to equal or exceed the actual cost of storage and as such is expected to reduce the incidence of full carry markets and may contribute to better convergence performance.

Issues with the wheat delivery process, however, are expected to persist and may contribute to on-going convergence performance problems. This structural problem was highlighted in the earlier analysis of basis predictability, where it was shown that hedging effectiveness was very poor even under "normal" carry conditions. The underlying issue is that historic delivery locations are no longer in the main commercial flow of wheat. It is important to recognize that such concerns about the CBOT wheat futures contract are not a recent phenomenon. Gray and Peck (1981) reviewed concerns about delivery specifications of the wheat contract that stretch all the way back to the 1920s. The fundamental problem is that changes in wheat production patterns, transportation logistics, and trade flows have left the contract with an increasingly narrow commercial flow of wheat to draw upon in the delivery process. Under these conditions, there is a constant potential for congestion in the delivery process and the attendant distortion of cash and futures prices (Paul, 1976; Hieronymus, 1977; Pirrong, 1993).

Figure 9 shows monthly corn, soybean, and wheat shipments (rail, barge, and vessel) from facilities regular for delivery over January 2000 through January 2009. Total shipments from corn and soybean delivery facilities averaged 22 and 14 million bushels per month, respectively. Monthly shipments of corn and soybeans from Illinois River delivery facilities were relatively large and dominated shipment totals, indicating that these locations were solidly in the commercial flow of corn and soybeans for the time period under study. However, there is a noticeable downtrend in the shipments, declining about 50% for both corn and soybeans (from about 30 to 15 million bushels per month for corn and from about 20 to 10 million bushels per month for soybeans). The lower level of shipments on the Illinois River in recent years still provides adequate commercial flows of corn and soybeans for the delivery process, particularly since the Mississippi River-Gulf market continues to be the major export market and prices for Illinois River markets are directly tied to Gulf prices by the cost of transportation. The trend does bear careful monitoring, particularly for soybeans. Finally, the continued low level of shipments from Chicago suggests this delivery location is not in the commercial flow. While its inclusion as a delivery market may do little harm, it is increasingly difficult to justify Chicago as a delivery market.

In contrast to corn and soybeans, Figure 9 shows that monthly shipments from facilities regular for wheat delivery remain alarmingly small, averaging a total of only 2.4 million bushels per month.[12] At the same time, Figure 10 shows that stocks of wheat at facilities regular for delivery, particularly at Toledo, have been consistently large, suggesting that wheat moves to

[12] All terminal elevators in Chicago are currently regular for delivery of wheat and only one relatively small terminal in Toledo (386,000 bushels of storage capacity) is not regular for delivery of wheat. This indicates that the low level of shipments from facilities regular for delivery of wheat in Chicago and Toledo cannot be attributed to partial coverage of facilities that ship wheat in these two locations.

Chicago and Toledo only because these locations are delivery markets and not to satisfy the demand for commercial shipments. The magnitude of wheat stocks that are consistently out of position is highlighted by the ratio of shipments from delivery facilities during the month to the magnitude of month-beginning stocks at those facilities. The ratio for wheat averages a paltry 10% compared to 230% for corn and 280% for soybeans. These data suggest that a major principle of locating delivery markets—a large commercial flow of the commodity—is violated in the case of wheat.

The CBOT has attempted to address this issue with the recent approval to add delivery locations for wheat in Northwest Ohio (shuttle trains) and at selected Ohio and Mississippi River barge shipping stations.[13] The devil is often in the details, and the critical details in this case are the pricing differentials for the new delivery locations relative to the par delivery points of Chicago and Toledo (Northwest Ohio: 20 cent discount; Ohio River: par; Mississippi River: 20 cent premium). Pricing differentials for the new delivery locations are characterized by the CBOT as "safety-valve" differentials in the sense that the new locations are expected to be used for delivery only under unusual market conditions.[14]

A related issue is the inherent difficulty of establishing pricing differentials for the heterogeneous market areas represented in the newly revised delivery locations for wheat. For instance, the cash price of soft red winter wheat in Memphis since 2004 has ranged from $0.75 above the price at Toledo to $1.50 below. The cash price in Cincinnati over the same time period has ranged from $0.40 above the price at Toledo to $1.00 below. The instability in pricing relationships reduces the usefulness of the additional locations in the delivery process.

Our view is that a major change in delivery terms is needed in order to address the underlying structural problems in the CBOT wheat contract. There is a relatively straightforward solution that does not require a shift to cash settlement or a change to a demand certificate system. Specifically, we propose the elimination of Chicago and Toledo as delivery points for the CBOT wheat contract and the establishment of a Mississippi River Waterway Delivery System. This contract would set Mississippi River Gulf (NOLA) as par delivery with other delivery locations being barge shipping facilities from the Illinois River to NOLA at differentials based on barge rates to NOLA. The delivery instrument would continue to be shipping certificates. An important benefit of the proposal is that it preserves the inherent advantages of physical delivery over cash settlement for storable commodities, which include prices that are based on actual market transactions rather than reported bid prices and prices that are based on homogeneous contract terms (Pirrong, Haddock, and Kormendi, 1993, pp. 39-45).

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[13] We thank Dave Lehman, Paul Peterson, and Fred Seamon of the CME for providing detailed information on the new wheat contract specifications.

[14] Standard arbitrage theory predicts that delivery for a commodity futures contract with multiple delivery locations will occur at the "cheapest-to-deliver" location, as this location will provide makers of delivery (shorts) the lowest cost alternative for sourcing the grain to satisfy delivery obligations. Pricing differentials are a key component in determining the cheapest-to-deliver location. When the differential for a location is set at a "safety-valve" level, the cash price for this location after adjustment for the differential will tend to be high enough relative to other locations that it is rarely economic to deliver at this location.

The proposed delivery system is similar to the current Illinois River Waterway Delivery System used for CBOT corn and soybean contracts. Despite recent convergence problems, we believe that the corn and soybean delivery system is basically sound because it is located squarely within substantial commercial flows of the commodities. As the data in Table 3 indicate, the proposed delivery system for CBOT wheat futures is well within the commercial flow of soft red winter, hard red winter, and hard spring wheat. Over the last five marketing years, an average of 206 million bushels of wheat was shipped through the Mississippi Gulf. This represented about 19% of all wheat exports from the U.S. By comparison, shipments of wheat from facilities regular for delivery in Chicago and Toledo averaged only 30 million bushels over the same period.

All three of the major classes of wheat (hard red winter, soft red winter, and hard red spring) have been deliverable on the CBOT contract, but the contract has been in effect a soft red winter wheat contract since it is prohibitively expensive to ship other classes of wheat from production areas to Chicago or Toledo. This is not expected to change under the recently revised delivery system since pricing differentials inhibit delivery in locations along the Mississippi River that are closer to supplies of other classes of wheat. Under the new delivery system proposed here, supplies of all three classes of wheat could potentially be available for delivery, with the market determining the cheapest to deliver in terms of location and class. Price differentials along the Mississippi River, like those along the Illinois River, are directly related to barge rates. The stability of these relationships should enhance the efficiency of the delivery process for wheat.

The proposed Mississippi River Waterway Delivery System not only has an ample commercial flow of wheat, but also contains numerous terminal elevators that could serve as regular facilities for delivery. In the proposed Mississippi River delivery area between the Illinois River and NOLA there are 77 terminal elevator facilities with 181 million bushels of total storage capacity, 10 million bushels of total barge shipping capacity per day, and ownership distributed among 23 different firms.[15] The largest four firms control 63 and 69% of total storage capacity and total barge shipping capacity, respectively, in the proposed Mississippi River delivery area. While this is a relatively high concentration of ownership in absolute terms it is substantially less than concentration in the current Illinois River delivery system for corn and soybeans. The largest four firms control 92 and 78% of total storage capacity and total barge shipping capacity, respectively, within the Illinois River Waterway Delivery System territories for corn, while the largest four firms control 92 and 81% of total storage capacity and total barge shipping capacity, respectively, for soybeans. Finally, concentration in the proposed Mississippi River delivery area is markedly lower than the historical concentration of ownership of delivery storage facilities for wheat in Chicago and Toledo, where four firms owned all of the storage space.

It is interesting to note that the CBOT actually traded a Gulf hard red winter wheat contract from April through December 1974. The contract specifications were unorthodox, with initial delivery at locations in Kansas and then rail delivery at either NOLA or Houston. Trading

[15] The source for these statistics is a database maintained by the USDA of elevator facilities registered with the Commodity Credit Corporation (CCC).

volume averaged about 400,000 contracts per month for the first three months of trading and then quickly faded to a few thousand contracts per month. It is not clear from the available historical record why the contract failed, but it is not hard to surmise that the delivery specifications may have been overly complicated. In addition, the fact that the Gulf contract was traded side-by-side with the existing wheat futures contract more than likely contributed to its demise. The 1974 Gulf contract had a high hurdle to overcome due to the liquidity advantages of the existing contract. Our proposal calls for termination of the current CBOT wheat contract as early as is prudent based on open interest, with delivery months under the new contract offered side-by-side until trading in delivery months under the old contract specification ceases.

Conclusions

Poor convergence performance of CBOT corn, soybean, and wheat futures contracts since late 2005 has been a major source of concern to market participants, regulators, and elected representatives at the state and national levels. After careful review of available evidence, it appears that recent storage rate changes for CBOT corn and soybean contracts were sufficient to address convergence problems is these two markets. The corn and soybean delivery system is functionally sound at the present time because it is located within substantial commercial flows of the commodities. Nonetheless, convergence performance for these two markets should continue to be closely monitored, particularly in light of the downward trend in corn and soybean shipments on the Illinois River.

Recent and upcoming storage rate changes for CBOT wheat contracts are also expected to help improve performance of this contract. However, a major change in delivery terms is needed in order to address the underlying structural problems in the CBOT wheat contract. The underlying issue is that historic delivery locations are no longer in the main commercial flow of wheat. Recently approved additions to the delivery locations for wheat are unlikely to address the structural problem because new locations are viewed as “safety-valve” areas that will be used for delivery only when market conditions are unusual.

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Appendix A: Delivery Overview for CBOT Corn, Soybean, and Wheat Futures Contracts

The futures market trades standardized contracts with all terms clearly and strictly defined, except price. The defined futures market terms refer to the delivery territory, the deliverable grades, and period of delivery. Futures markets provide a means for price discovery, price risk transfer, and capital allocation. Since futures contracts have explicit expiration dates, positions in futures markets are temporary.

Commodity futures markets are primarily used by two types of traders, speculators and hedgers. The speculator is interested in profiting from price movements in the futures market, while the hedger is interested in managing price risk. The hedger holds a futures position opposite a cash position with the expectation that futures price movement will offset the price movement in the cash market. Hence, the need for the strong link between the cash price in the delivery territory and the futures price. When this link is functioning properly, there is no need for futures deliveries to serve cash merchandising needs as the long and short futures position holders will be indifferent to offset their positions rather than making and taking delivery.

A short would decide to make a delivery if the cash price plus costs for making delivery is less that the futures price. The long would stand for delivery if the cash price minus the cost of taking delivery is greater than the futures price. If deliveries are made, it is at the discretion of the short to initiate a delivery. The long, however, can force a delivery by refusing to offset his futures position at the expiration of the futures contract. The delivery process covers three days, Intention Day where the short makes his intention to delivery to the clearinghouse, Notice Day where the clearing house notifies the oldest outstanding long position holder with an invoice for delivery, and Delivery Day where the seller and the buyer exchange shipping certificates and money.

The delivery instrument for CBOT grains and oilseeds is the shipping certificate. Shipping certificates give the holder the right, but not the obligation to demand load-out of the designated commodity from the firm’s shipping station that issued the shipping certificate. The shipping certificate is the link between the futures market and the cash market.

Only firms approved by the Exchange as "regular for delivery" are allowed to issue shipping certificates. The regular firm is the source of all delivery instruments for their facilities or shipping stations. If a short position holder is not a regular firm, he/she must buy a delivery instrument from a regular firm, another holder of a delivery instrument, or have taken delivery on a previous long futures position. Only the short position holder that is also a regular firm has the ability to initiate an original delivery.

The firms regular for CBOT delivery have shipping stations within the delivery territory of the futures contract. They must meet certain exchange requirements for to be eligible for regularity such as a minimum net worth of $5 million. The firms regular for delivery issue shipping certificates based on the loading capabilities of the shipping stations registered. The futures contract rules specify the load-out procedures.

A long that has stopped a futures delivery, i.e., taken delivery, has several options as a shipping certificate holder. The firm or individual may continue to hold the shipping certificate as an asset and pay the storage charge, sell the shipping certificate to someone else at a negotiated price, sell a futures contract and re-tender the shipping certificate by making an intention for delivery on the futures market using the delivery process above, or cancel the certificate and demand load-out of physical commodity.

If a shipping certificate owner requests load-out, the owner surrenders the certificate to the exchange for cancellation. At the same time the owner provides the warehouseman/shipper with written loading orders that identify the conveyance that will take delivery of the grain and that specify the grade and estimated number of bushels to be loaded. It is the responsibility of the certificate owner to arrange for proper conveyance of the grain to be loaded out. The shipper orders the conveyance to the shipping station for actual placement for loading. The shipper must begin load out at the registered daily rate of loading for the shipping station within three business days following receipt of loading orders or within one business day of constructive placement, whichever occurs later. Final settlement charges are based on official weights and grades completing the delivery through load-out process linking the futures and cash markets.

Appendix B: Data Sources and Definitions

1. Futures prices from Barchart.
   http://www2.barchart.com/mktcom.asp?code=BSTK&section=grains
   The settlement price of the expiring futures contract is used to compute basis for delivery locations. The settlement price of the expiring futures contract and next deferred futures contracts are used to calculate the spreads used in the calculation of the cost of carry. The nearby-next deferred spread is calculated on the day after the previous contract expires and again on First Position Day (FPD) through Last Trading Day (LTD). On FPD the price limits to the futures contracts are removed. This day also is the First Intention Day where a short position holder may make his or her intention to deliver to the clearinghouse. Futures contract trading stops daily at 1:15 p.m. CST, except on holidays and on LTD when trading stops at noon CST.

2. Cash prices from the Agricultural Marketing Service of the U.S. Department of Agriculture for Chicago, Illinois River North of Peoria, Illinois River South of Peoria, Toledo, and St. Louis.
   http://www.ams.usda.gov/mnreports/nw_gr901.txt
   The USDA reports the range of spot bids at the specified location after 1:30 p.m. CST (closely after the close of the futures markets.) The data is generally available by 3:00 pm CST. Basis is calculated as the midrange of cash bids minus closing futures price minus futures premiums.
   a) Chicago corn, soybeans, and wheat are terminal elevator bids for spot delivery (within 15 days) of #2 yellow corn, #1 yellow soybeans, and #2 soft red winter wheat, respectively. No location differentials are applied to Chicago cash prices but 6 cents per bushel is deducted from all soybean cash prices whether in Chicago, on the Illinois River, or St. Louis for #1 yellow soybeasn to make them equivalent to futures based on the par deliverable quality of #2 yellow soybeans.
      http://www.ams.usda.gov/mnreports/gx_gr110.txt
   b) Illinois River barge terminals producer bids North of Peoria and South of Peoria are used to represent the Illinois River territories for delivery of #2 yellow corn and #1 yellow soybeans. The average location premium of the three Illinois River territories North of Peoria is 2.5 cents/bu. and is used as the futures premium for location to adjust cash prices to delivery equivalents. The futures premium for location is 3.5 cents/bu. for the Illinois River territory South of Peoria.
      http://www.ams.usda.gov/mnreports/gx_gr112.txt
   c) St. Louis soybean and wheat are terminal prices for spot delivery (within 15 days) of #1 yellow soybeans and #2 soft red winter wheat, respectively. For soybeans and wheat, 6 cents/bu. and 10 cents/bu., respectively, are subtracted from the cash prices to make them equivalent to futures. http://www.ams.usda.gov/mnreports/jc_gr111.txt

d) Toledo wheat is a terminal elevator bids for on-the-river spot delivery (within 15 days) of #2 soft red winter wheat. http://www.ams.usda.gov/mnreports/gx_gr111.txt

3. Delivery location and grade differentials from the Chicago Mercantile Exchange Group, Inc. (CME) Rulebook
   http://www.cmegroup.com/rulebook/CBOT/II/10/10.pdf
   Corn differentials: Chicago at par and the Northern Illinois River at 2.5 cents/bu. premium.
   http://www.cmegroup.com/rulebook/CBOT/II/11/11.pdf
   Soybean differentials: Chicago at par and the Northern Illinois River at 2.5 cents/bu. premium, the Southern Illinois River at 3.5 cents/bu. premium, St. Louis at 6 cents/bu. premium, and 6 cents/bu. premium for #1 yellow soybeans.
   http://www.cmegroup.com/rulebook/CBOT/II/14/14.pdf
   Wheat differentials: Chicago at par, Toledo at par, and St. Louis at 10 cents/bu. premium.

4. Storage and premium rates from the Chicago Mercantile Exchange Group, Inc. (CME) Rulebook
   http://www.cmegroup.com/rulebook/CBOT/II/10/10.pdf
   Corn rates: From 1/1/2000 through 10/31/2001 the storage rate was 10/100/ cent/bu./day for Chicago and 12/100 cent/bu./day for the Northern Illinois River. From 11/1/2001 through 10/31/2008 the storage rate was 15/100 cent/bu./day at all locations. From 11/1/2008 to present the storage rate is 16.5/100 cent/bu./day at all locations.
   http://www.cmegroup.com/rulebook/CBOT/II/11/11.pdf
   Soybean rates: From 1/1/2000 through 10/31/2001 the storage rate was 10/100/ cent/bu./day for Chicago and 12/100 cent/bu./day for the Northern and Southern Illinois River. From 11/1/2001 through 10/31/2008 the storage rate was 15/100 cent/bu./day at all locations. From 11/1/2008 to present the storage rate is 16.5/100 cent/bu./day at all locations.
   http://www.cmegroup.com/rulebook/CBOT/II/14/14.pdf
   Wheat rates: From 1/1/2000 through 6/30/2008 the storage rate was 15/100 cent/bu./day. From 7/1/2008 to present the storage rate is 16.5/100 cent/bu./day.

5. Interest rates from the British Bankers' Association (BBA): 3-month LIBOR
   http://www.bba.org.uk/bba/jsp/polopoly.jsp?d=141&a=15151
   LIBOR stands for the London Interbank Offered Rate and is the rate of interest at which banks borrow funds from each other, in marketable size, in the London interbank market. It is the most widely used "benchmark" or reference rate for short-term interest rates. It is compiled by the BBA in conjunction with Reuters and released to the market shortly after 11.00am London time each day.

6. Registrar Reports from the Chicago Mercantile Exchange Group, Inc. (CME)
   http://www.cmegroup.com/market-data/reports/registrar-reports.html
   a) Deliverable Commodities Under Registration http://www.cmegroup.com/market-data/reports/deliverable-commodities-under-registration.xls
      The DCUR report is posted as of 4:00 p.m. to show the number of shipping certificates or warehouse receipts by delivery firm, location, and shipping station/warehouse that have been registered by regular firms and are outstanding, i.e., being held by another party. The holders of the delivery instrument are paying the issuers of the shipping certificate or warehouse receipt at the daily rate of storage. The holder of a delivery instrument may sell a futures contract and make a delivery of the certificate/receipt. The holder also has the right to sell the delivery instrument to another individual through and off-exchange, negotiated transaction, including the issuer. If the issuer receives its own certificate/receipt it is removed from the DCUR report. If the certificate/receipt is canceled by the holder for load-out it is removed from the DCUR report.
   b) Daily Receipts and Shipment http://www.cmegroup.com/market-data/reports/daily-receipts-and-shipments.xls
      Report shows the daily bushels of grain received and shipped by delivery location at the close of business. Only regular facilities are required to report their receipts and shipments.
   c) Stocks of Grain-Updated Tuesday http://www.cmegroup.com/market-data/reports/stocks-of-grain-updated-tuesday.xls
      The SOG report is posted on Tuesday (second business day of the week) by 1:00 p.m. of the Deliverable Grades, Non-Deliverable Grades/Ungraded, and CCC Stocks by delivery location for the close of business on the previous Friday. Deliverable Grades of grain meet the exchange quality requirements for futures delivery, excluding CCC-owned grain but including all non-CCC deliverable grades regardless of whether receipted and/or registered. Non-Deliverable Grades/Ungraded is graded grain not meeting exchange quality requirements for futures delivery and ungraded grain, excluding CCC-owned grain. CCC Stocks are owned by the CCC and not deliverable. Non-deliverable classes or subclasses of grain (e.g. white wheat or white corn) are not included in any of the figures. Some regular firms may have throughput agreements and therefore no storage capacity. The storage capacity of shipping stations may also be limited. The report also shows the total storage capacity at regular firms by delivery location.

7. Delivery Reports from CME
   http://www.cmegroup.com/market-data/reports/cbot-delivery-reports.html
   a) Delivery Detail Report for Grains identifies the date of delivery by facility: http://www.cmegroup.com/delivery_reports/IssuesAndStopsLocationDetailReport.pdf

Facility Report for Grains identifies the date of delivery by facility and grade: http://www.cmegroup.com/delivery_reports/IssuesAndStopsFacilityDetailReport.pdf

b) Month to Date Report for Grains and Financials provides the total daily deliveries and cumulative monthly deliveries: http://www.cmegroup.com/delivery_reports/IssuesAndStopsMTDReport.pdf

8. Wheat Inspected and or Weighed for Export by Class, Region and Port Area http://www.ams.usda.gov/mnreports/wa_gr156.txt

Table 1. Average Delivery Location Basis on the First Day of Delivery for CBOT Corn, Soybean, and Wheat Futures when Nearby Spreads are Below and Above 80% of Full Carry, January or March 2000 - March 2009 Contracts

Commodity/ Delivery Location	Average Delivery Location Basis: Below 80% of Full Carry	Average Delivery Location Basis: Above 80% of Full Carry	Difference
		---cents/bu.---	
Corn			
Chicago	-1.2	-14.3	-13.1
Illinois River North of Peoria	-4.2	-20.8	-16.7
Soybeans			
Chicago	-9.7	-25.8	-16.1
Illinois River North of Peoria	-17.7	-35.9	-18.2
Illinois River South of Peoria	-18.9	-33.1	-14.2
St. Louis	-9.7	-19.5	-9.9
Wheat			
Chicago	-8.2	-32.6	-24.4
Toledo	-4.3	-41.8	-37.6
St. Louis	-22.2	-38.8	-16.6

Notes: Cash prices for corn and soybeans are adjusted for location and grade differentials specified in contract rules. Settlement prices are used for futures. Basis is computed as cash price minus futures price.

Table 2. Average Nearby Spreads for CBOT Corn, Soybean, and Wheat Futures during the Roll Window of Long-Only Index Funds, March 1995 - March 2009 Contracts

	Average Nearby Spread during Roll Window		
Commodity/Contracts	**Days 1-4**	**Days 5-9**	**Days 10-13**
		---% of full carry---	
Corn			
March 1995 - December 2001	20.1	22.4	18.0
March 2002 - December 2003	37.4	41.9	36.8
March 2004 - December 2005	61.4	70.3	67.9
March 2006 - March 2009	90.4	92.8	90.5
Soybeans			
March 1995 - November 2001	21.1	21.3	15.6
January 2002 - November 2003	-33.5	-26.1	-32.3
January 2004 - November 2005	30.4	35.8	28.0
January 2006 - March 2009	85.4	86.8	81.7
Wheat			
March 1995 - December 2001	40.1	51.0	48.1
March 2002 - December 2003	43.2	54.8	46.4
March 2004 - December 2005	78.7	83.7	77.9
March 2006 - March 2009	104.5	106.4	100.0

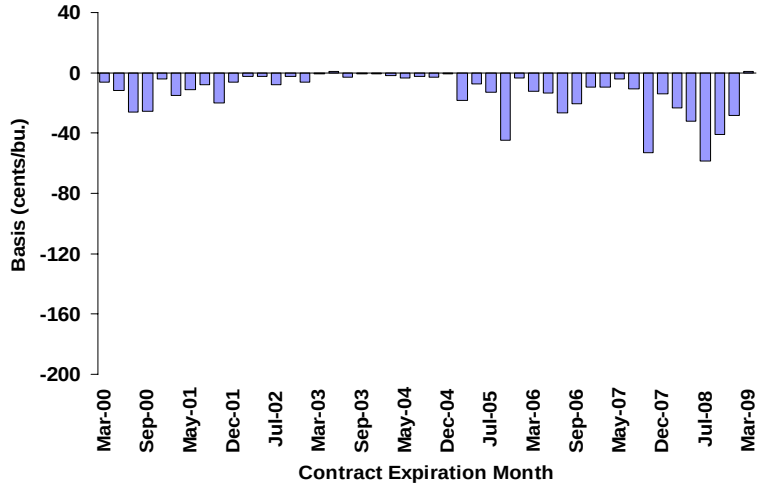
Notes: The event window for each contract is the first 13 business days of the calendar month prior to contract expiration. The time window is centered on days 5-9, the time period of the so-called "Goldman roll" where index funds tend to roll their positions from the nearby to the next deferred contract.

Table 3. Shipments of Wheat Through the Mississippi Gulf and U.S. Exports of Wheat, 2003/04 - 2007/08 Marketing Years

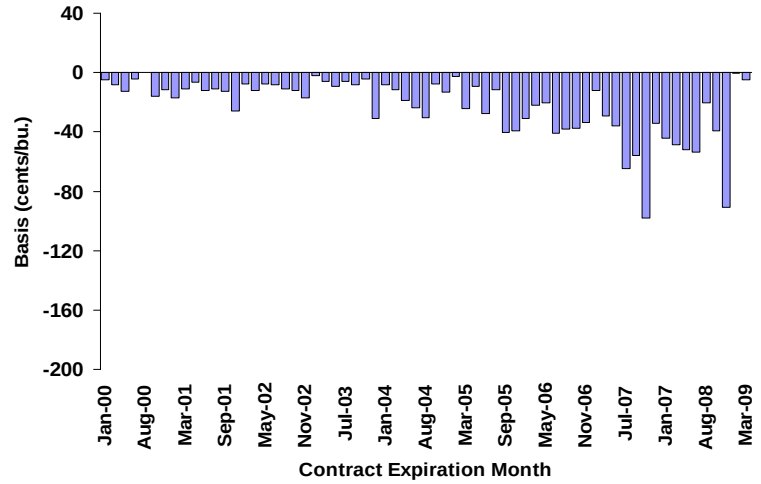
Marketing Year	Class of Wheat: Hard Red Winter	Soft Red Winter	Hard Red Spring	Hard and Soft White	Durum	Total
Panel A. Gulf-Mississippi River Shipments (mil. bu.)						
2003/04	58.5	114.1	73.7	0.8	9.9	256.9
2004/05	65.0	105.8	60.0	0.9	8.3	240.0
2005/06	54.8	52.5	36.9	0.0	6.0	150.1
2006/07	46.4	90.7	27.1	0.0	3.7	167.8
2007/08	46.7	130.1	35.0	0.0	5.5	217.4
Average	54.3	98.6	46.5	0.3	6.7	206.4
Panel B. U.S. Exports (mil. bu.)						
2003/04	510	138	272	192	46	1,158
2004/05	389	122	315	208	31	1,065
2005/06	428	76	280	174	45	1,003
2006/07	280	145	248	196	40	909
2007/08	538	209	305	170	42	1,264
Average	429.0	138.0	284.0	188.0	40.8	1,080
Panel C. Shipments/Exports (%)						
2003/04	11.5	82.7	27.1	0.4	21.5	22.2
2004/05	16.7	86.7	19.0	0.4	26.8	22.5
2005/06	12.8	69.0	13.2	0.0	13.3	15.0
2006/07	16.6	62.5	10.9	0.0	9.2	18.5
2007/08	8.7	62.3	11.5	0.0	13.2	17.2
Average	13.2	72.7	16.3	0.2	16.8	19.1

Notes: The source for the Gulf-Mississippi River shipments data is the Agricultural Marketing Service of the U.S. Department of Agriculture (monthly report WA_GR106). The source for the U.S. exports data is the Economic Research Service of the U.S. Department of Agriculture (annual report Wheat Year in Review (Domestic)/WHS-2008).

Panel A. Corn, Illinois River North of Peoria



Panel B. Soybeans, Illinois River North of Peoria



Panel C. Wheat, Toledo

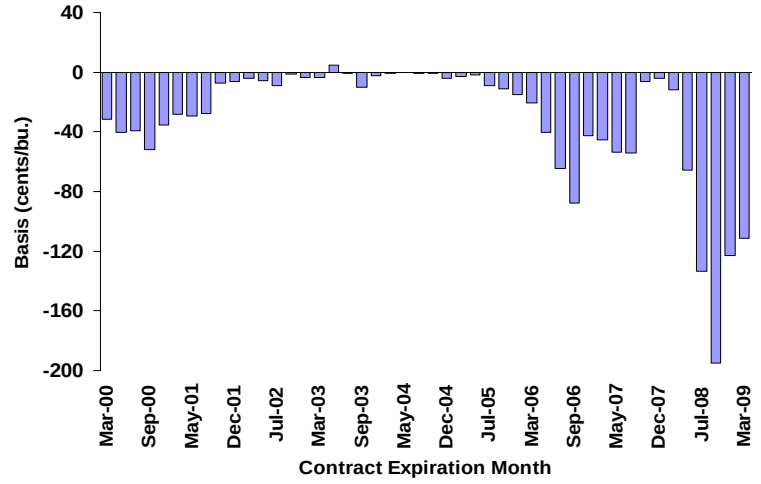
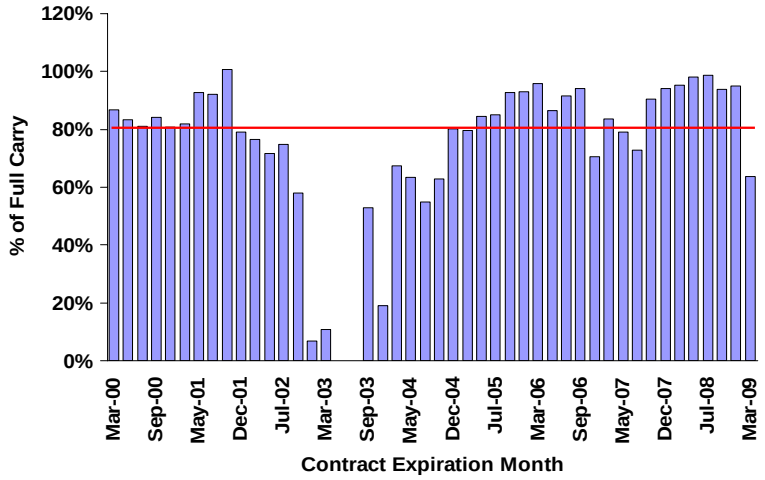
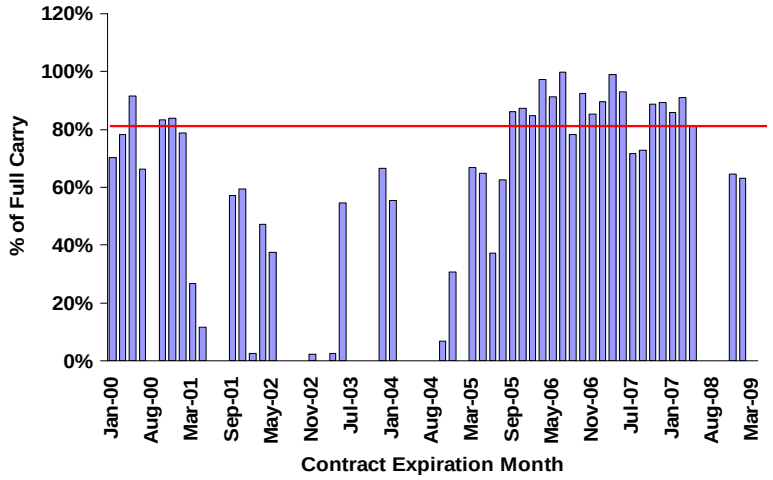


Figure 1. Basis (futures minus cash) on the First Day of Delivery at Selected Delivery Locations for CBOT Corn, Soybean, and Wheat Futures, January or March 2000 - March 2009 Contracts

Panel A. Corn



Panel B. Soybeans



Panel C. Wheat

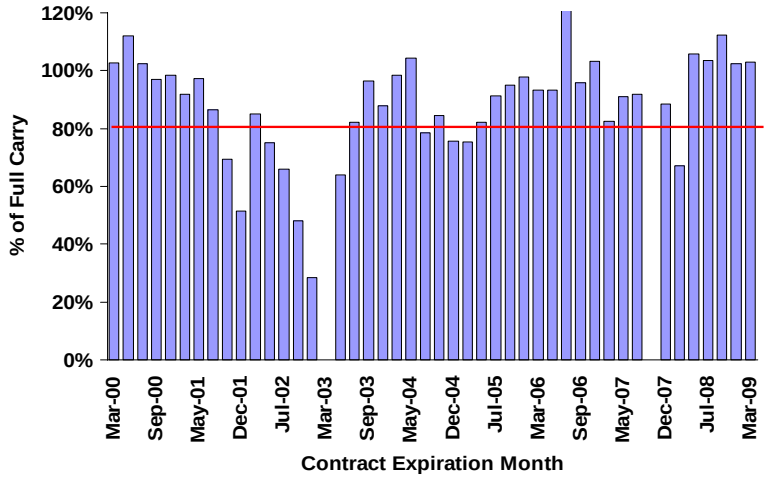
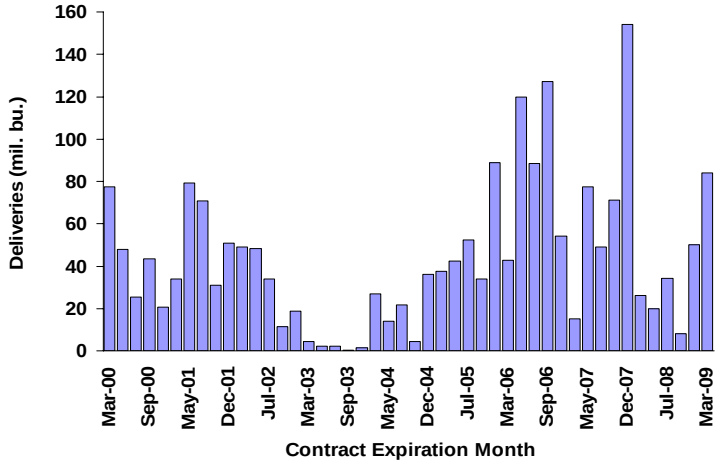
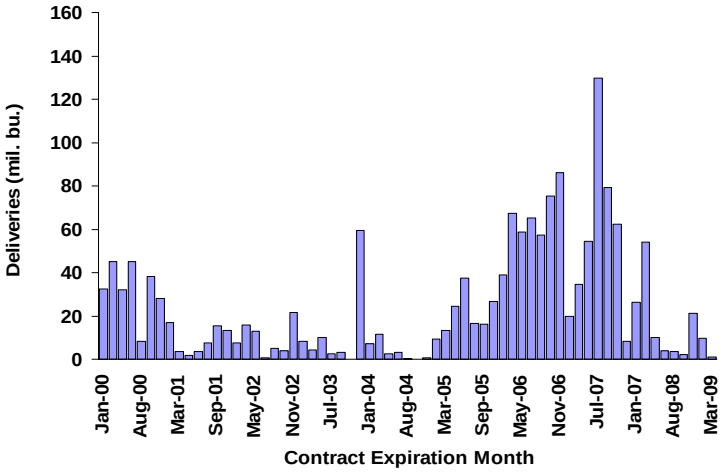


Figure 2. Spread (percent of full carry) on the First Day of Delivery between Prices of the Expiring and Next-to-Expire Contracts for CBOT Corn, Soybean, and Wheat Futures, January or March 2000 - March 2009 Contracts

Panel A. Corn



Panel B. Soybeans



Panel C. Wheat

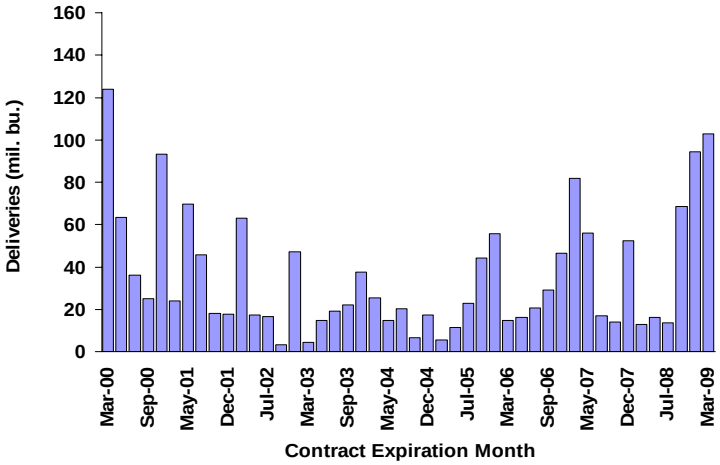
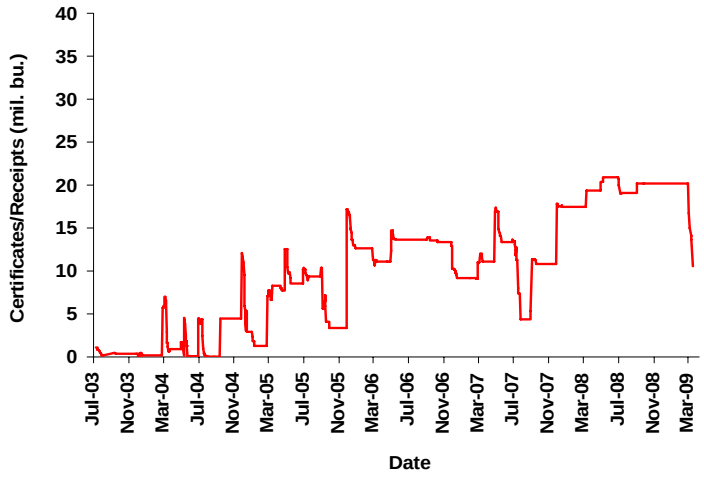
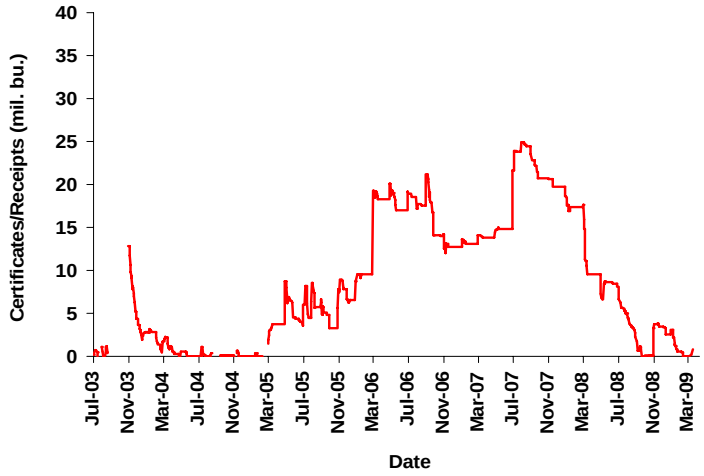


Figure 3. Total Deliveries for CBOT Corn, Soybean, and Wheat Futures, January or March 2000 - March 2009 Contracts

Panel A. Corn



Panel B. Soybeans



Panel C. Wheat

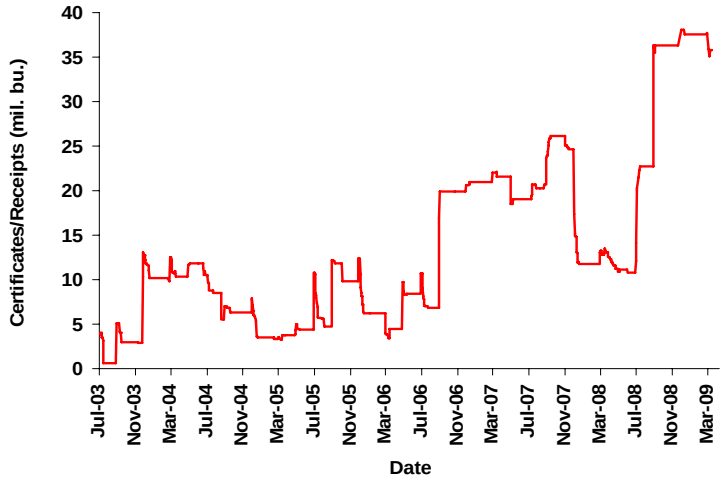
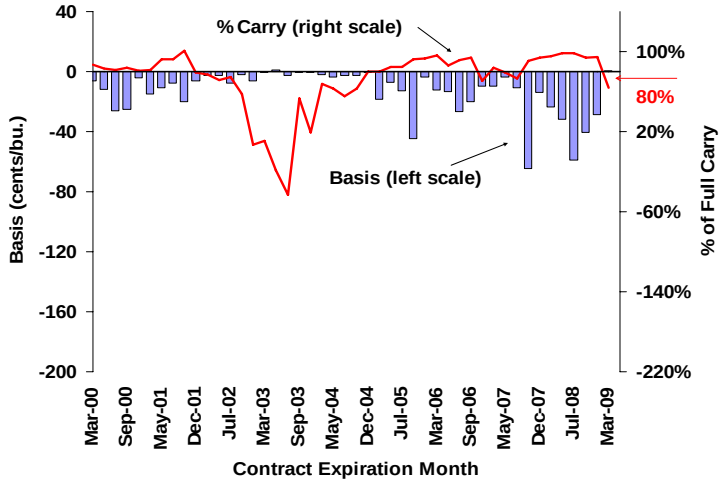
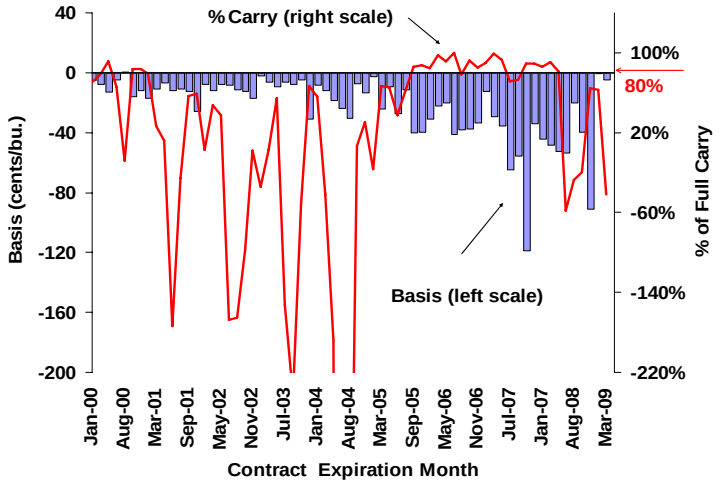


Figure 4. Daily Total of Registered Shipping Certificates or Warehouse Receipts for CBOT Corn, Soybean, and Wheat Futures, July 1, 2003 - March 16, 2009

Panel A. Corn, Illinois River North of Peoria



Panel B. Soybeans, Illinois River North of Peoria



Panel C. Wheat, Toledo

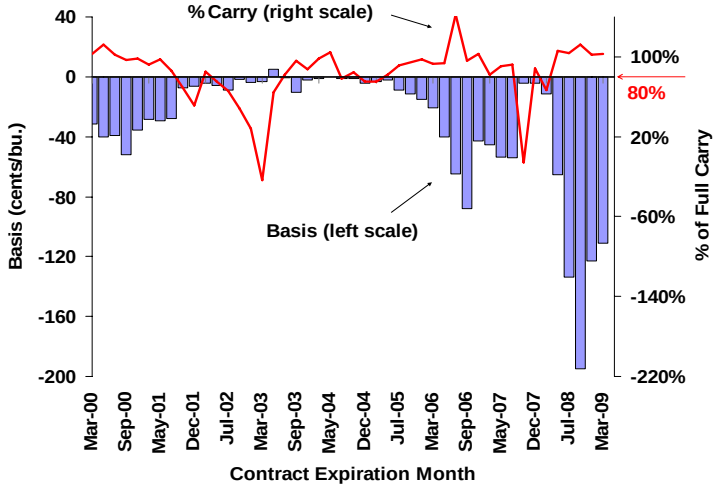
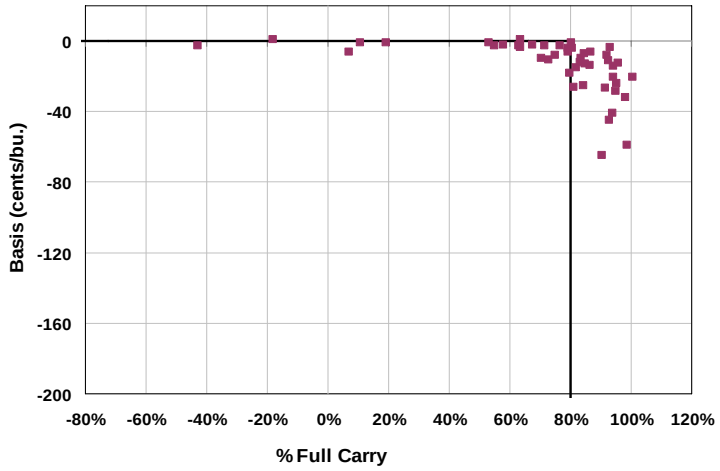
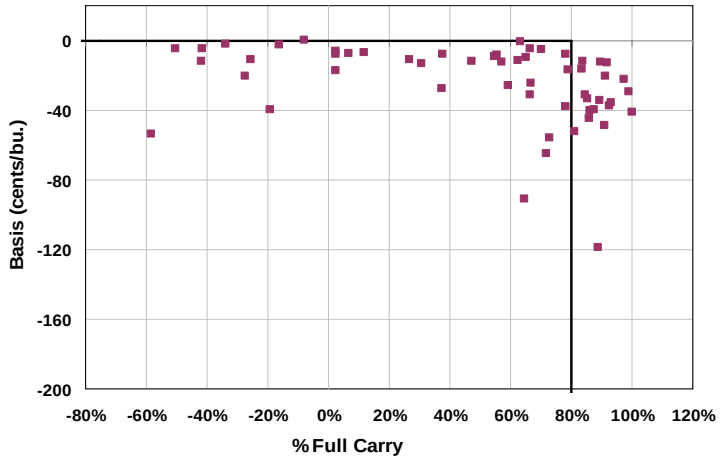


Figure 5. Basis and Percent of Full Carry on the First Day of Delivery at Selected Delivery Locations for CBOT Corn, Soybean, and Wheat Futures, January or March 2000 - March 2009 Contracts

Panel A. Corn, Illinois River North of Peoria



Panel B. Soybeans, Illinois River North of Peoria



Panel C. Wheat, Toledo

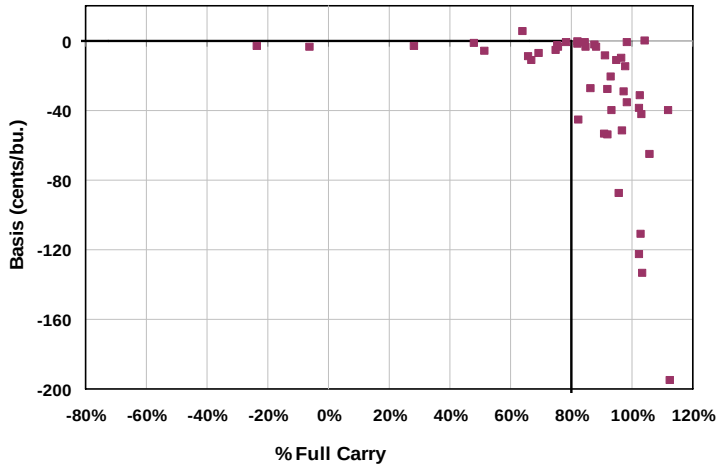


Figure 6. Basis versus Percent of Full Carry on the First Day of Delivery at Selected Delivery Locations for CBOT Corn, Soybean, and Wheat Futures, January or March 2000 - March 2009 Contracts

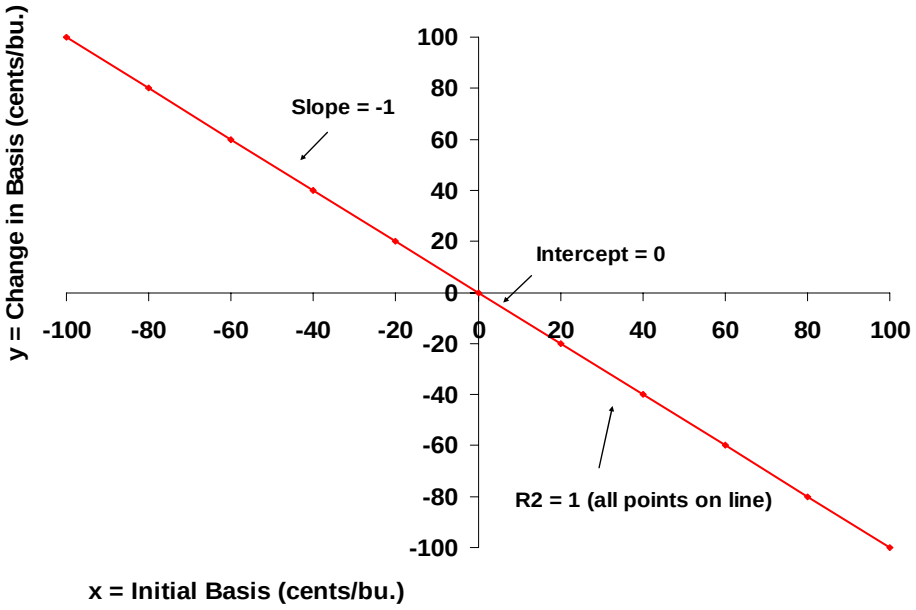
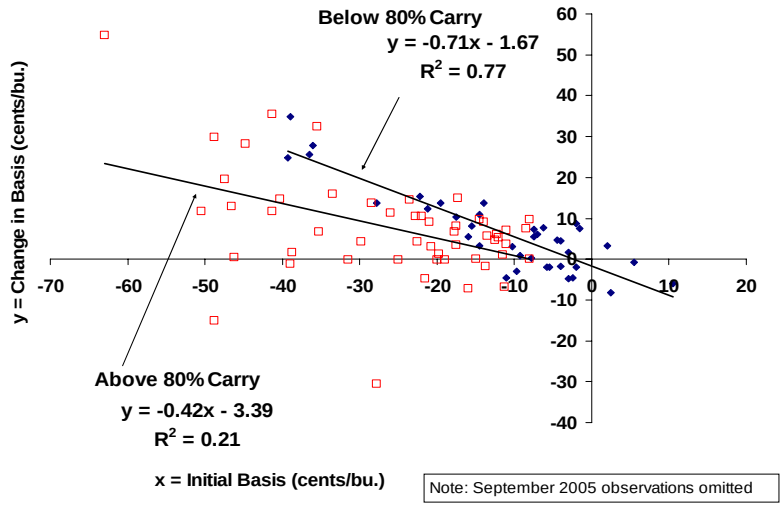
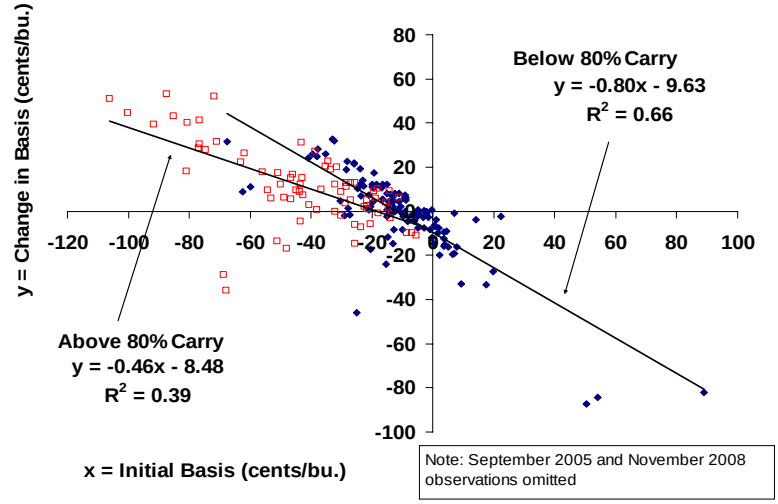


Figure 7. Hypothetical Example of Perfect Predictability of Delivery Location Basis

Panel A. Corn



Panel B. Soybeans



Panel C. Wheat

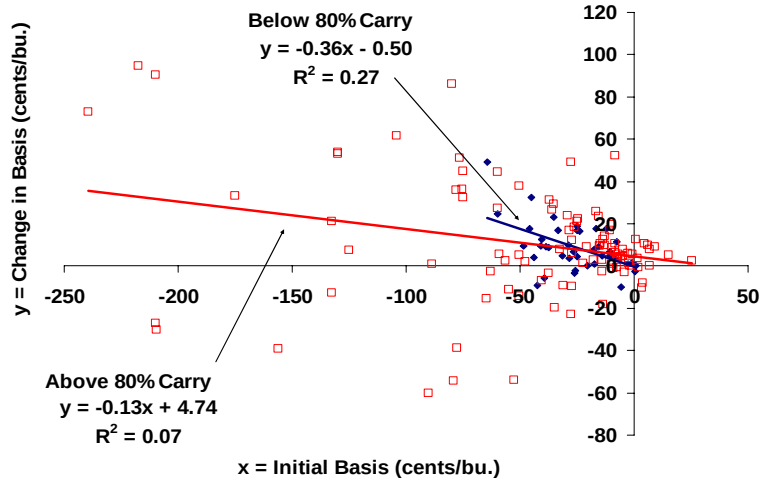
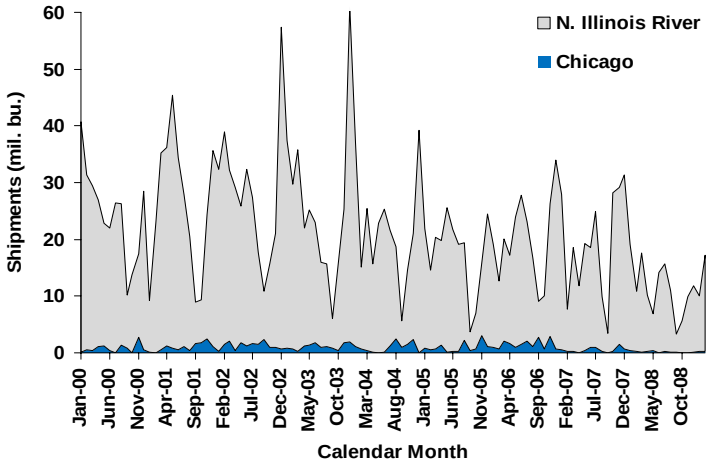
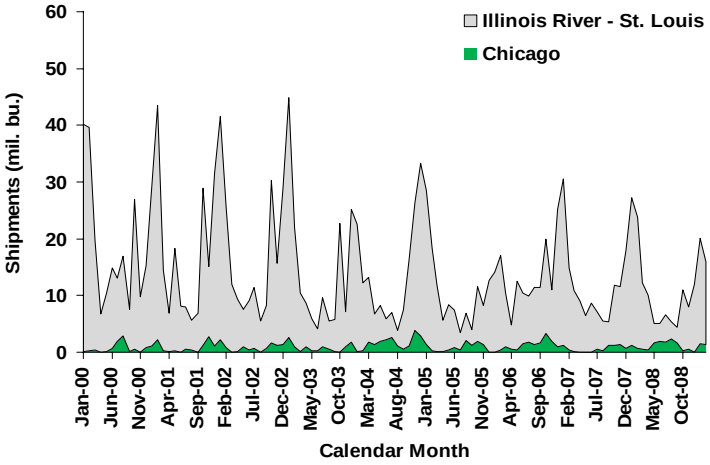


Figure 8. Predictability of Basis Change to First Day of Delivery (all delivery locations pooled except St. Louis for soybeans) for CBOT Corn, Soybean, and Wheat Futures, January or March 2000 - March 2009 Contracts

Panel A. Corn



Panel B. Soybeans



Panel C. Wheat

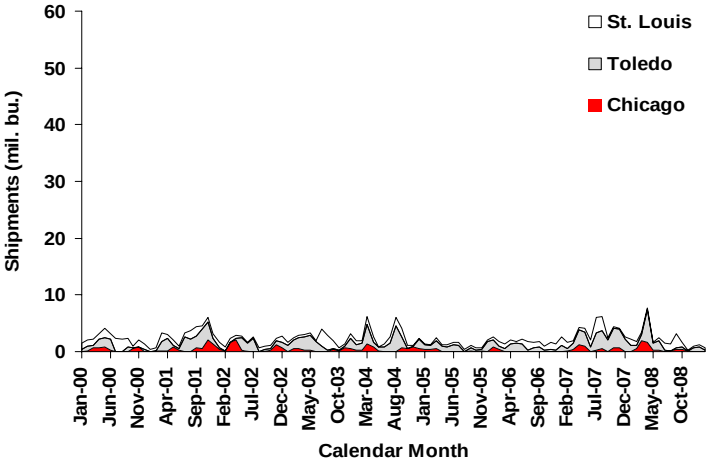
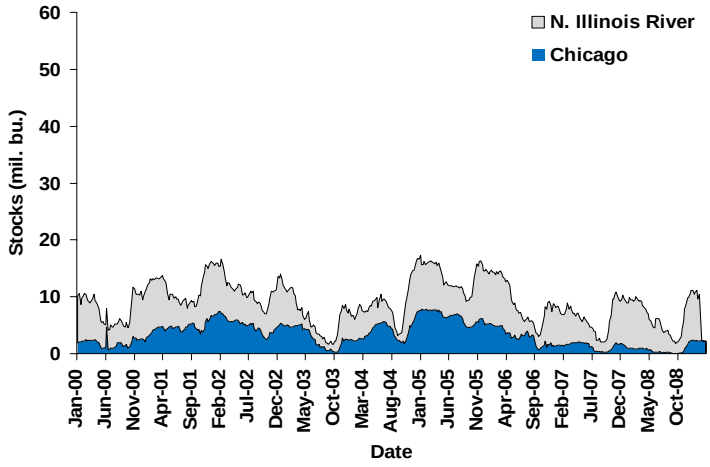
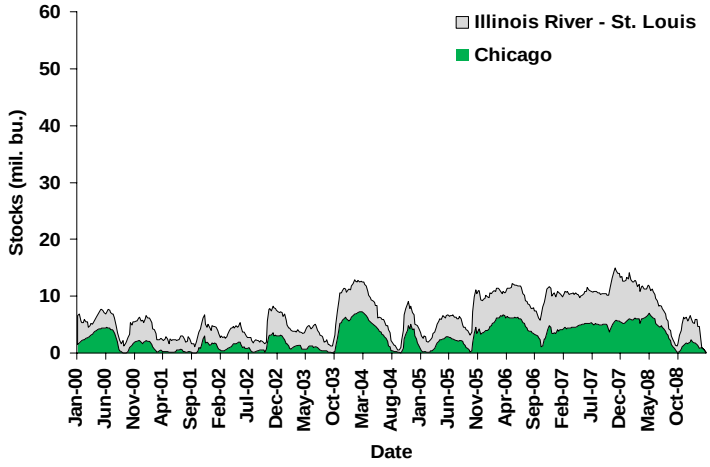


Figure 9. Monthly Shipments of Corn, Soybeans, and Wheat from Facilities Regular for CBOT Delivery, January 2000 - February 2009

Panel A. Corn



Panel B. Soybeans



Panel C. Wheat

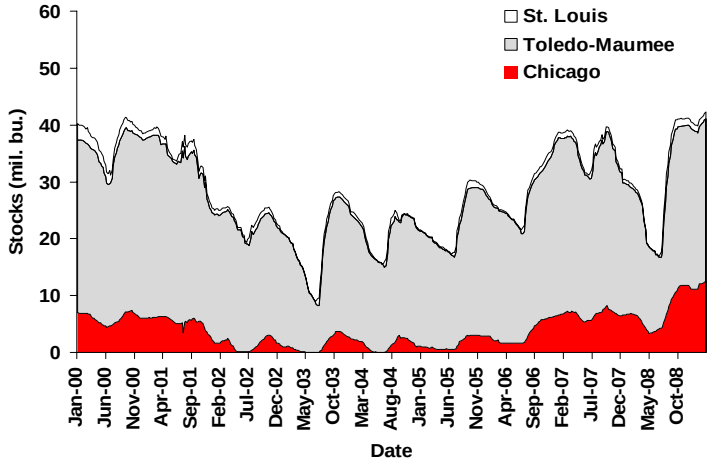


Figure 10. Weekly Stocks of Corn, Soybeans, and Wheat at Facilities Regular for CBOT Delivery, January 7, 2000 - February 27, 2009