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Hedging Spot Corn: An Examination of the Minneapolis Grain Exchange's Cash Settled Corn Contract

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Abstract

This research examines the potential basis behavior and hedging effectiveness for the Minneapolis Grain Exchange's (MGE) cash settled corn contract. MGE futures cash settle to the National Corn Index (NCI) calculated by Data Transmission Network (DTN). Focusing on seven regions in Illinois, the data suggest that NCI Futures offer potential advantages over the existing Chicago Board of Trade (CBOT) corn futures. In particular, nearby basis variability could be reduced by nearly one-half from 8.8 cents per bushel to 4.5 cents per bushel, and hedging effectiveness may incease from an average of 80% for the CBOT to 93% for the NCI.

Keywords: cash settlement, new contracts, basis behavior, corn futures

Introduction

The Minneapolis Grain Exchange (MGE) recently introduced a cash settled corn futures contract based on the National Corn Index (NCI). The NCI is calculated by Data Transmission Network (DTN) reflecting elevator bids for U.S. No. 2 yellow corn. The NCI contract offers an alternative hedging tool for producers and local elevators marketing and merchandising cash corn. The contract is designed to reflect first-handler or elevator-level pricing. Therefore, it may provide a more predictable and stable basis for producers and local elevators than the existing terminal-level corn futures contract. Likewise, the cash settled form of the contract may improve basis behavior over the current delivery-settled futures contracts. The objectives of this research are first to examine the NCI and the MGE futures in terms of construction, calculation, and settlement procedures. Second, potential basis behavior and hedging effectiveness are evaluated and compared to the existing Chicago Board of Trade (CBOT) corn futures contract. This study provides valuable information to the MGE and the trade in terms of expected basis levels, basis variability, minimum variance hedge ratios, and potential hedging effectiveness of the NCI futures contract.

Most academic research has looked favorably upon cash settled futures contracts in livestock markets (Schroeder and Mintert; Kimle and Hayenga; Ditsch and Leuthold) but concerns of manipulation and index reliability have been expressed (Kahl, Hudson, and Ward). Research concerning cash settled grain futures is scarce (Chaherli and Hauser). Therefore, the NCI provides a unique opportunity to examine the potential for a cash settled grain contract.

The first objective of the research is to examine and describe the contruction of the NCI. In order for cash settlement to be effective, the settlement procedure must be free of exploitation and accurately depict cash market prices (Peterson; Rich and Leuthold). The price index used for settlement must be a reliable indicator of the commercial value of the commodity (Garbade and Silber). This study examines the NCI to see how it meets these criteria. Then, the potential hedging effectiveness of the contract is determined.

The NCI's potential as a producer-level hedging tool is evaluated by calculating basis volatility, minimum variance hedge ratios, and hedging effectiveness. Here, we will follow traditional

regression approaches such as those used by Ditsch and Leuthold. The methodology focuses on hedging spot corn transactions over a relatively short horizon (one month). The cash markets examined are bids to Illinois producers as collected by the Illinois Department of Agriculture Market News. The cash data are available for seven different regions in Illinois, which are likely to have different basis patterns due to their unique geographical location. Since actual NCI futures price data is not yet available, the underlying cash index is used as a proxy for futures (Schroeder and Mintert; Kimle and Hayenga; Ditsch and Leuthold). Using these data sets, simulated basis levels and hedge ratios are estimated to provide a guide as to the contract's hedging potential for spot corn transactions in Illinois. The NCI results are compared to those from using the existing Chicago Board of Trade corn futures contract.

The NCI provides an interesting research opportunity because it is the first cash settled futures contract introduced for a major U.S. feed grain. Additionally, it represents a different risk transfer point in the grain marketing system than existing futures contracts. The results of the research are important as an informational guide to the MGE and potential users of the NCI for hedging spot corn transactions.

Data

The National Corn Index[1]

The Data Transmission Network (DTN) collects daily grain bids to producers posted by individual elevators on a national scale. The data are collected primarily through direct telephone calls to the elevator, although some bids are received via e-mail, fax, and internet. Bids falling outside of a designated range are flagged for confirmation. If the bid cannot be confirmed, it is not included in the day's data. The MGE points out that the bid process is largely self-auditing in the sense that DTN provides the individual elevator bids to DTN subscribers. Most DTN subscribers are producers and other agribusiness firms. So, to retain credibility with their customers, elevators are unlikely to report a bid to DTN at which they are unwilling to transact. In essence, it could prove very costly to an elevator's core business to provide DTN with anything other than their actual posted prices.

The National Corn Index (NCI) is the simple average price for all bids collected in the United States for U.S. No. 2 Yellow Corn. On a daily basis, DTN collects bids from an average of 1630 elevators (nearly 90% of all U.S. elevators). Elevators in seven states—Iowa, Illinois, Nebraska, Kansas, Minnesota, Indiana, and Ohio—represent 75% to 80% of the bids collected. The single largest owner of the corn bids (i.e., elevator ownership) comprises only 3.3% of those collected.

By all reasonable standards, DTN's NCI appears to meet the requirements for a "good" cash price. That is, it reflects commercial value and is not prone to manipulation (Peterson; Rich and Leuthold). So, the NCI is a valid candidate to underlie a cash-settled futures contract.

The MGE's Futures Contract

The Minneapolis Grain Exchange's National Corn Index Futures contract (NCI Futures) cash settles to a simple average of the last three daily NCI prices published during the contract month.

[1] The information in this section was drawn from the Minneapolis Grain Exchange's website (www.mgex.com) on March 21, 2002. The specific numbers reflect the MGE's audit of the DTN data collection process on April 23-25, April 30-May 2, and July 2-5, 2001.

The settlement price is rounded to the nearest quarter cent using standard rounding techniques. Cash settlement occurs on the business day following the last trading day of the month. A contract is listed for every calendar month. As an example, the March 2002 contract cash settles to a simple average of the daily NCI prices on the 26th, 27th, and 28th of March. Those prices were reported as 185.14, 186.85, and 183.76. So, the NCI futures cash settled on April 1st at a price of 185.25 cents per bushel. The NCI futures trade exclusively on the MGE's new electronic platform, MGExpress.

Illinois Spot Data

To evaluate the potential usefulness of the NCI Futures, cash transaction quotes are collected from an independent third party: the Illinois Department of Agriculture Market News. These data are from a daily survey of roughly 100 country elevators in Illinois over seven geographical regions (see Figure 1). The disparity between the geographical regions should provide uniquely different basis levels and potentially different basis behavior. For instance, the Northern and Little Egypt regions are aproximately 250 miles apart and can experience different local supply and demand conditions.

Data Collection

The Illinois spot data are available from June 1997 through December 2002. The analysis focuses on a monthly hedging horizon, resulting in 55 observations. Specifically, prices are drawn from the third to the last business day of each month. This corresponds to the first day of the three day averaging period for cash settlement of the NCI Futures. This is the day when the NCI futures should most closely converge with the underlying index before being influenced by the averaging process. CBOT corn futures prices are also collected on this day. The price levels reflect the nearest to maturity futures contract (without entering the delivery month), and price changes are calculated to reflect changes in the price of the nearby contract. Care is taken such that price changes are not impacted by contract roll-over.

Since the NCI Futures do not have a history, the underlying NCI must be used as a proxy for the cash settled futures contract. Clearly, the underlying NCI is not a futures price and does not reflect possible carrying charges, premia, or biases that may exist in actual futures prices. Nonetheless, using the underlying index as a proxy for the futures is common in this type of analysis (Schroeder and Mintert; Ditsch and Leuthold). Furthermore, the monthly delivery cycle and cash settlement feature of the futures should result in a predictable convergence of the NCI Futures and the underlying index (Kahl, Hudson, and Ward). Therefore, any bias this creates should be minimal. Figure 2 illustrates three of the time series utilized: the NCI, nearby CBOT corn futures, and cash prices from Western Illinois.

Methodology and Results

Basis Variability

The basis is calculated as the cash price, CP_t minus the futures price, FP_t. The summary statistics are presented in Table 1. In the top panel of Table 1, the NCI is the assumed futures price. In the bottom panel, the futures price is the nearby CBOT corn futures. For example, the Western Illinois basis using the CBOT futures (lower panel, Table 1) has a mean of -21.97 cents per bushel with a standard deviation of 8.76 cents per bushel. This is in contrast to the NCI basis for Western Illinois (upper panel, Table 1), which has a mean of 3.72 and standard deviation of 4.71.

The NCI basis is more stable than the CBOT basis with a standard deviation nearly one-half the size (4.71 versus 8.76 cents per bushel) and a smaller range (22.72 versus 33.75 cents per bushel). The Western Illinois bases are illustrated in Figure 2. The figure suggests that the two basis share some similar time series patterns, but the NCI basis is generally more stable.[2]

The relative stability of the NCI basis could be partially due to temporal differences. That is, hedges placed in the NCI are always a few days from expiration; whereas, the CBOT hedges may be as much as 8 weeks from expiration. For instance, at the end of May, the nearby CBOT futures is the July contract, and it is four weeks until first notice day. At the end of September, the nearby CBOT futures is the December contract, and it is eight weeks until expiration. This temporal difference may bias the results toward the NCI contract. One could argue that this is simply an advantage of the NCI's contract design—monthly expiration cycle and cash settlement. However, it is important to consider the temporal differences to make a fair comparison.

To adjust for the temporal factor, we compare relative basis variability only at the end of calendar months where the nearby CBOT contracts are about to enter delivery (month-end February, April, June, August, and November). For instance, at the end of February, the CBOT nearby basis is calculated versus the expring March contract. This limits our number of monthly observations to 23. The results (not shown) do not change dramatically from those presented in Table 1. The standard deviation of the NCI basis is 4.29 cents per bushel, and it is 7.13 cents per bushel for nearby CBOT futures. So, the difference in basis standard deviations is smaller by 1.21 cents per bushel versus that of the full sample, but the general conclusions are not altered.

Hedging Effectiveness

The second step in evaluating NCI futures is to look at potential hedging effectiveness. Hedging effectiveness has traditionally been examined with the following first difference regression model (Leuthold, Junkus, and Cordier).

$$\Delta CP_t = \alpha + \beta \Delta FP_t + e_t \qquad (1)$$

Where, ΔCP_t is the change in the cash price being hedged over interval t, and ΔFP_t is the change in the futures price over interval t, and e_t is a random error term or residual basis risk. The β is the minimum variance hedge ratio and the α measures systematic trends in the basis. The R-squared from estimating Equation 1 is a measure of hedging effectiveness or risk reduction associated with applying the minimum variance hedge ratio.

In this research, the measurement interval is monthly, and the ΔFP_t is represented by changes in the NCI and nearby CBOT corn futures. The ΔCP_t is the change in the Illinois spot or cash price for a given region. The estimated β is the *ex post* minimum variance hedge ratio, and the estimated α captures any systematic trends in the basis over the sample period. The R-squared is a measure of the in-sample hedging effectiveness, and it is analagous to using the simple

[2] The CBOT altered the delivery terms of their corn futures contract in the year 2000 from negotiable warehouse receipts to shipping certificates at Illinois River points. It is unclear how this may impact the future performance of the contracts.

correlation coefficent as suggested by Ederington. The higher the R-squared, the greater the correlation among cash and futures; thus, the lower the residual basis risk. In this research we use price changes (cents per bushel) to facilitate practicioners intuitive interpretation and to reflect the cash-flow nature of the hedging process (Shafer).

The results of estimating Equation (1) are presented in Table 2, where the upper panel are the NCI results and the lower panel are the CBOT results. Looking at the CBOT results (lower panel), the estimated hedge ratios are generally less than 1.00, but none of them are statistically different from unity (two-tailed t-test, 5% level). The R-squared, or hedging effectivness, ranges from 75% in Northern Illinois and the Little Egypt region to a high of 86% in South Central Illinois.

Turning to the NCI results (upper panel), the estimated hedge ratios tend to be larger than unity with those in South Central, Western, and West Southwest statistically greater than 1.00 (two-tailed t-test, 5% level). Hedging effectiveness, R-squared, ranges from a low of 90% for Northern Illinois to a high of 95% for the North Central and Wabash regions.

Comparing the NCI and CBOT results, two observations are made. First, the hedge ratios for the NCI are consistently greater than those of the CBOT.[3] However, in only three cases are any of the estimated ratios different from 1.00. So, the naive equal and opposite hedging strategy or bushel-for-bushel, may be just as effective *ex ante* as using the estimated hedge ratios (Collins). Second, hedging effectiveness as measured by the R-squared is notably greater for the NCI than the CBOT across all seven regions. For instance, in the Northern and Wabash regions, the difference in R-squared's is 15%. The largest difference in hedging effectiveness occurs in the Little Egypt region (difference of 16%) and the smallest difference in hedging effectiveness is in the South Central region (difference of 8%).

Again, to adjust for temporal differences in the CBOT contracts, the hedging effectiveness regressions are also estimated using only those months just prior to a CBOT contract expiration (February, April, June, August, and November). Using this limited sample (22 observations), the average hedging effectiveness is 95% for the NCI and 75% for nearby CBOT futures. Clearly, the conclusions presented in Table 2 are not altered, so, the full results are not shown.

Evaluating the Results

To meaningfully interpret the above results, two questions should be addressed. First, are they statistically significant? Second, are they economically significant? To address the first question, the basis variances for the NCI and CBOT are tested for equality at each location using a standard F-test. For each location, the null hypothesis of equal basis variance is rejected at the 1% level. Therefore, the basis variability for the NCI is statistically lower than that of the CBOT futures.

[3] The mean ΔFP_t for NCI Futures and CBOT corn futures are -0.94 and -4.25, respectively. The standard deviation of the ΔFP_t for the NCI Futures and CBOT corn futures are 13.05 and 13.82, respectively. Neither the mean (pair-wise t-test, 5% level) or the standard deviations (F-test, 5% level) are statistically different. Therefore, the presented regression results are not likely caused by a difference in variance of the independent variables.

The second question is much more difficult to address, since there are many economic issues involved in a hedging program other than basis variability. The average basis standard deviation across the seven Illinois locations is 4.5 cents per bushel with the NCI and 8.8 cents per bushel with nearby CBOT futures.[4] Grain merchandising is a notoriously low margin business with return on sales estimates for country elevators ranging from 0.75% (Ginder) to 1.6% (Robert Morris Associates). If we assume an average corn price of $2.25, then this would imply a profit margin ranging from 1.7 to 3.6 cents per bushel. With this small of a margin, it would seem that reducing basis varibility by 4.3 cents per bushel or nearly one-half would be economically important. Similarly, one would expect that a 10% to 15% increase in hedging effectiveness is of economic importance. However, this benefit must be carefully weighed against the true costs of using a new futures contract such as liquidity and other transaction costs (Pennings and Meulenberg).

Conclusions

The NCI, as calculated by DTN, accurately reflects commercial corn prics (U.S. No. 2, yellow) at the country or first-handler level. Furthermore, the construction of the index using over 1600 daily elevator bids and the self-auditing process makes manipulation of the NCI improbable. Therefore, it is a "good" candidate for a cash settled futures contract.

The MGE's NCI Futures contract is evaluated in terms of basis variability and hedging effectiveness for seven locations in Illinois. Using past values of the NCI as a proxy for futures prices, it is found that the NCI Futures may provide a better hedging tool than current CBOT corn futures in terms of lower basis variability and increased hedging effectiveness. The average basis variability across the seven regions is 4.5 cents per bushel for the NCI versus 8.8 cents per bushel for the CBOT futures. Similarly, the hedging effectiveness (R-squared) across the seven regions averages 0.80 for nearby CBOT futures versus 0.93 for the NCI. So, the residual basis variability is reduced by 49% and hedging effectiveness increases by 0.13 (or 16%) when hedges are placed in the NCI as oppossed to the existing CBOT contract.

Although a successful NCI Futures contract may offer substantial benefits to country-level grain merchants, the probability of success still remains low. The NCI Futures face strong tradition and liquidity hurdles in oppossing the encumbent CBOT corn futures. However, if critical liquidity can be achieved, then the NCI Futures may prove to be a valuable hedging tool.

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[4] The basis is also examined in terms of log-relative percents, where the basis, $\ln(CP_t/FP_t)$, represents a percent of the futures price (see Garcia and Sanders). The average standard deviation of the NCI basis across the seven regions is 2.3%, and the average CBOT basis variability is 5.1%. Using percentages does not change the presented results.

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Table 1. Basis Summary Statistics, Illinois Locations, Cents per Bushel, June 1997 – December 2001.

				NCI			
	Northern	N. Central	S. Central	Western	West Southwest	Little Egypt	Wabash
Mean	0.41	8.56	9.92	3.72	7.82	14.52	13.32
St. Dev.	4.94	4.10	3.93	4.71	4.50	5.27	4.19
Max.	9.11	17.61	18.46	14.66	17.11	22.57	20.66
Min.	-14.27	-2.06	1.15	-8.06	-4.82	-3.32	2.18
Range	23.48	19.67	17.31	22.72	21.93	25.89	18.48
				CBOT			
	Northern	N. Central	S. Central	Western	West Southwest	Little Egypt	Wabash
Mean	-25.29	-17.13	-15.77	-21.97	-17.88	-11.18	-12.37
St. Dev.	8.98	8.91	7.39	8.76	8.66	9.95	8.72
Max.	-12.00	-2.00	-0.50	-8.25	-3.00	11.50	9.50
Min.	-44.50	-36.50	-34.00	-42.00	-39.00	-38.50	-35.00
Range	32.50	34.50	33.50	33.75	36.00	50.00	44.50

Table 2. Hedging Effectiveness Regressions, $\Delta CP_t = \alpha + \beta \Delta FP_t + e_t$, June 1997 – December 2001.

				NCI			
	Northern	N. Central	S. Central	Western	West Southwest	Little Egypt	Wabash
Hedge Ratio, β	1.06	1.05	1.09*	1.08*	1.12*	1.09	1.07
St. Error	(0.048)	(0.035)	(0.039)	(0.040)	(0.039)	(0.047)	(0.034)
R-sqrd.	0.90	0.95	0.94	0.93	0.94	0.91	0.95
				CBOT			
	Northern	N. Central	S. Central	Western	West Southwest	Little Egypt	Wabash
Hedge Ratio, β	0.91	0.92	0.98	0.94	0.98	0.94	0.93
St. Error	(0.073)	(0.062)	(0.056)	(0.067)	(0.066)	(0.074)	(0.064)
R-sqrd.	0.75	0.81	0.86	0.79	0.81	0.75	0.80

*Statistically different from 1.00 at the 5% level using a two-tailed t-test.

Figure 1. Illinois Cash Price Regions.

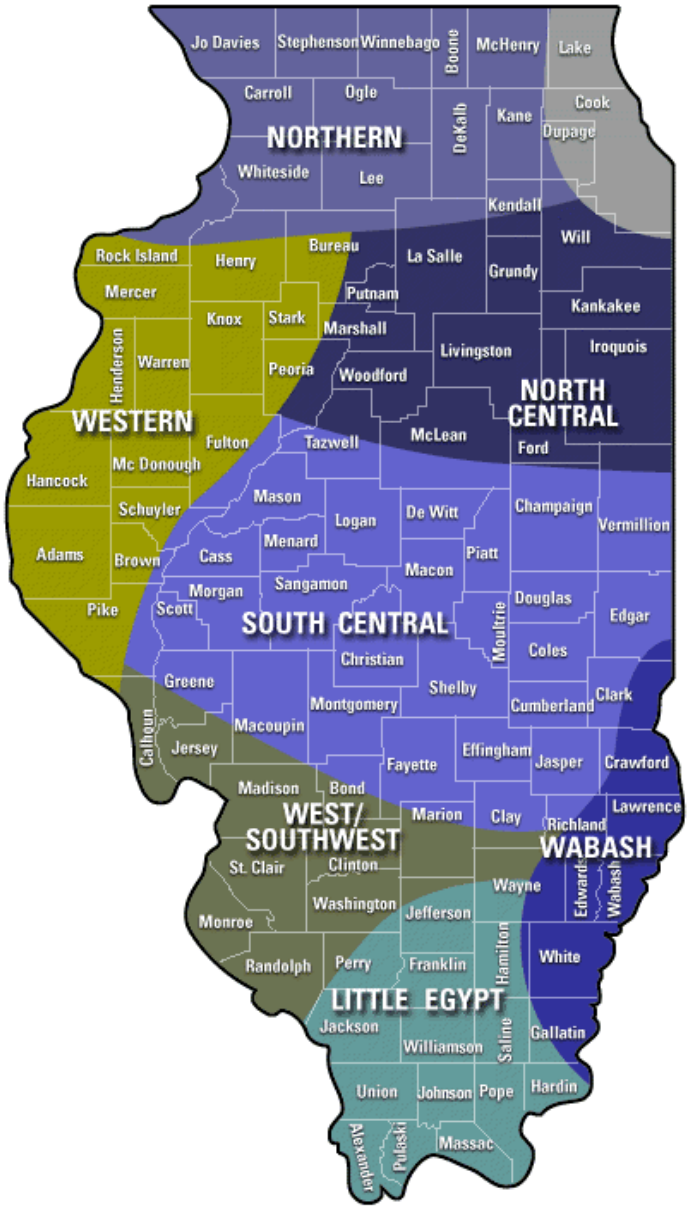

Figure 2. Corn Price Levels, June 1997 – December 2001.

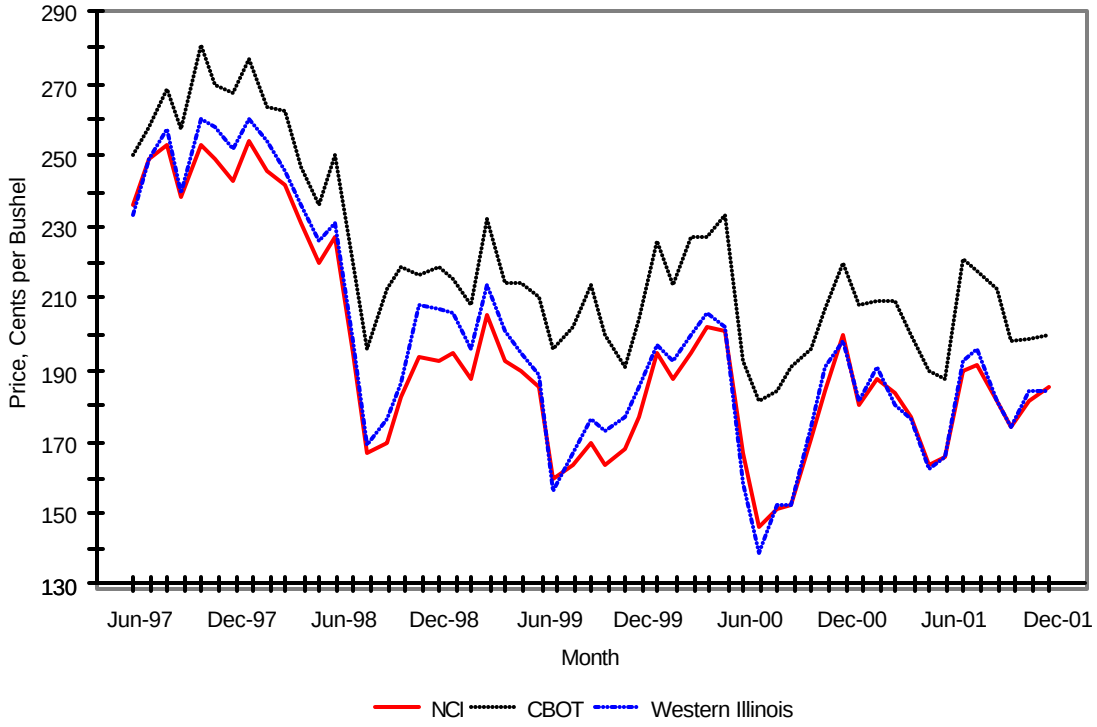
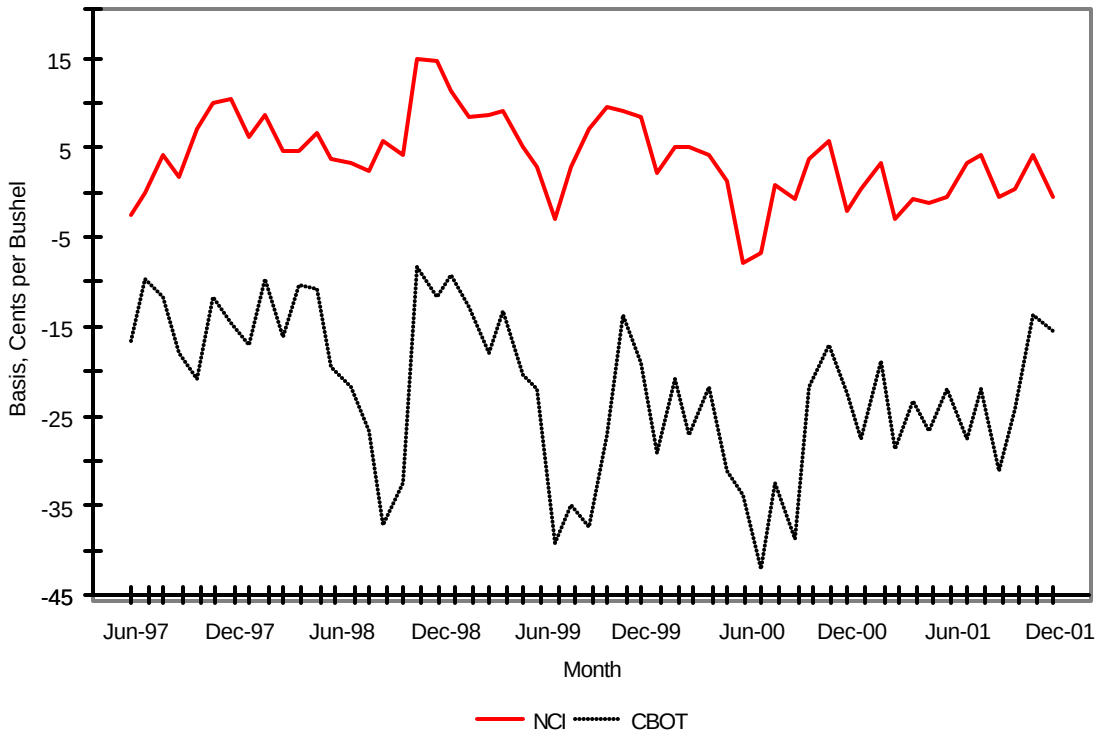
Figure 3. Western Illinois Nearby Contract Basis (cash price minus futures price), June 1997 – December 2001.