CHAPTER 5.

BASIS CONVERGENCE AND HEDGING EFFECTIVENESS

Most commercial users of futures markets are concerned with the predictability of the convergence of cash and futures prices. Indeed, the subject of deliveries is important to them because deliveries are the mechanism forcing convergence at deliverable locations and by extension establishing predictable relations at many other locations. Of course, the difference between a particular cash price and the futures is the basis. Hence, a study of convergence is a study of basis behavior.

Basis behavior can be looked at from several perspectives. If, for example, in early October the local cash price of wheat is 20 cents per bushel under the December futures contract, it matters considerably to the return actually realized from holding hedged stocks whether the local cash price is 5 cents under or 5 cents over the expiring futures contract as of mid-December. That is, what matters is how well the change in the basis (measured against the December contract) from early October to mid-December matches the original basis. Put differently, what matters is how well the basis as of early October predicts the change in the basis.[1] Clearly, if the original basis predicts exactly the subsequent change, the basis risk is zero. This measure also has the advantage of taking into account the size of the initial basis, so that basis changes from 80 cents under can be compared easily with those from 20 cents under.

The same issue of basis predictability also arises in the setting of regulatory oversight and contract design. For example, an extreme positive basis is often taken as an indication of market congestion. Such a characterization of the basis presupposes a standard of comparison from earlier periods. It also requires that any movements in cash prices relative to an

[1] Holbrook Working (1953) emphasized the importance of the predictability of basis changes and proposed the tests used here.

expiring futures contract be examined against the size of the basis some weeks or months before. If, on the first of December, cash is 20 cents over the December futures price, the interpretation of that basis as indicating congestion is very different should the basis in early October have been 80 cents over rather than 15 cents over. The degree to which the early October basis predicts the change in the basis to early December is a method for making this standardization.

These examples also illustrate why calculation of the average basis pattern such as was done in the CBOT *Studies* is virtually meaningless, whenever the average is over many contract months and many years. With both positive and negative initial bases and both good and relatively poor convergence in any reasonable sample, the average basis path is likely to be close to zero and the relative convergence behavior not revealed. Nor does it help much to divide the sample between situations with an initial positive basis and an initial negative basis; these averages measure basis convergence from, say, 80 cents over, by the same criterion as from, say, 10 cents over. These difficulties explain why the CBOT's *Studies* found no statistically significant evidence of convergence in the prices they examined.

Thus, in the case of a deliverable location, the central hypothesis is whether the basis converges to 0 cents (or a similar predictable constant such as the load-out fee) by the expiration of each futures contract, that is, whether the current basis is an exact forecast of the subsequent change. However, the measurement of and, more specifically, the predictability of basis convergence are not straightforward. In the remainder of this chapter, the methodological issues are discussed in three applications of increasing complexity. The next section briefly discusses basis convergence for forward contracts and then studies the actual KCBOT wheat basis, which adds the complication of delivery timing inherent in futures contracts. The second section discusses the expected effects of multiple delivery locations and then analyzes the degree of basis convergence for each of the three CBOT markets.

For other than deliverable locations, the hypotheses about basis behavior are more varied. One hypothesis deals with the degree of basis convergence by the delivery month. The path of the basis over that period is important, too, because holders of stocks at non-deliverable locations must at some moment close out or roll forward their futures positions. As a result, they are subject to basis risk. In turn, any unpredictable movements in the basis reduces hedging effectiveness. Thus, a second hypothesis concerns the hedging effectiveness of the CBOT markets, specifically whether there has been a decline during recent years. This hypothesis is tested with data on weekly prices, from September 1966 through July 1989, for eight elevators in Illinois for corn and soybeans. The third section of this chapter presents those tests.

THE EFFECTS OF THE TIMING OPTION ON BASIS CONVERGENCE

The ability of a basis to forecast the subsequent change in basis would be perfect were there no ambiguity in the quoted cash price and no complexity due to the options in the three CBOT futures contracts to deliver any day within a month or to deliver at more than one location. Forward trading of lead at the London Metal Exchange (LME) permits no timing option for delivery on its contracts and only limited location variation. Thus, it provides the least complicated example to explain expected basis behavior. Every day the official ring session on the LME establishes a spot price and a price for a contract to deliver in 90 days. Although the value of that forward contract is not publicly quoted again, it is sometimes traded among the member firms privately, as it becomes successively a contract for delivery in 89 days, 88 days, and so on. On its final day, the expiring forward contract is effectively a spot contract. That is to say, at expiration of a forward contract, the basis is 0 pounds sterling. (The difference between the spot price and the new 90-day forward contract is another matter, of course.) Convergence is complete at expiration and the previous basis predicts exactly the change in the basis. Graphically, all points plotting the change in the basis over a 90-day interval against the previous basis fall on a line with a slope of -1.00. If, however, the cash price used were not the LME's own spot price, the exact relationship with the expiring forward contract would not be assured.

Futures contracts add first the complexity of an option in the timing of delivery, and, for most grains and soybeans, the difficulties of a spot quotation other than for the commodity in store. The Kansas City wheat contract illustrates well the effects of these difficulties. The cash market in Kansas City is relatively active, especially compared to Chicago. The KCBOT's *Grain Market Review* provides a number of cash quotations, including a high and low range for Ordinary Wheat, which has the protein content closest to that commonly delivered on futures contracts.[2] The low of the range appears to be the one more closely related to futures prices.

For this cash price series, the basis relative to the next futures contract was calculated as of the first business day of each month during which a contract expired. Its changes both to the first day of the delivery month and then to the next-to-last day of the month were also calculated.[3] Thus, for each of 91 wheat contract expirations from September 1972 through

[2] Recorded as a low and a high basis, these two quotations, when converted to flat prices, are closely related (but not identical) to the USDA's reported range of Kansas City prices for hard wheat.

[3] As in the earlier calculations of changes in spreads, the last day of trading is not used because the close is not simultaneous with other contracts.

September 1990, there are two pairs: the change in the basis from the first of the prior contract's expiration to the next-to-last trading day with the basis on that prior first day, and the basis change to the first of the month with that basis on the prior first day. These are plotted in Figure 5.1. The top panel plots the basis change to the first of the delivery month against the earlier quotation of the basis while the bottom panel plots the change to the end of the month against the same earlier basis.

The scatter diagram in the lower panel involving the basis change to the end of trading reveals there is a good forecast of basis change in the Kansas City basis. More precisely, the variable Previous basis "explains" 89 percent of the variation in the subsequent change in the basis, as can be seen in the R^2 given in the upper right of Table 5.1. Although the points do not fall exactly on a line parallel with the diagonal, they come very close to doing so; specifically the estimated slope is -0.88. The standard error of the regression, 6.00, is in units of cents per bushel, and represents the degree of basis risk.

Although when fitting a regression line one speaks of an "error term," the differences between the predicted change in the basis and the actual change in the basis from these regressions represent not measurement error but substantive economic factors. In particular, the cash price here is not as precise as in the forward market example. The premiums for protein may change or the spread between wheat in store and wheat on track may narrow. These protein premiums, elevating spreads, and transport rates may also have predictable seasonal components. In Table 5.1, the middle regressions allow for regular variability in these components by including a set of dummy variables for the four contract months after the new-crop July contract. The R^2 for the change in the basis to the next-to-last day of trading increases slightly to 0.91.

Although the inclusion of seasonal dummy variables does not change the conclusion about the degree of basis convergence involving the Kansas City wheat contract, measuring the change in basis only to the first of the delivery month does have a dramatic result, as shown in the upper panel of Figure 5.1. The points in the upper panel are more scattered than those in the lower panel and more off the anticipated line with its slope of -1.00. More precisely, as can be seen in the first column of Table 5.1, the estimated slope is -0.70, and the previous basis predicts only 72 percent of the variation in the change in the basis. Likewise, the standard error of the regression is greater, 8.74 cents rather than 6.00 cents per bushel, which represents some 46 percent more basis risk. If basis convergence were measured only to the first of the month, which is the common practice, the conclusion might well be drawn that the Kansas City wheat contract has a problem.

Thus, the principal conclusion of the example of Kansas City wheat

Figure 5.1 – The Relation Between the Previous Kansas City Wheat Basis and the Change in the Basis, September 1972–September 1990

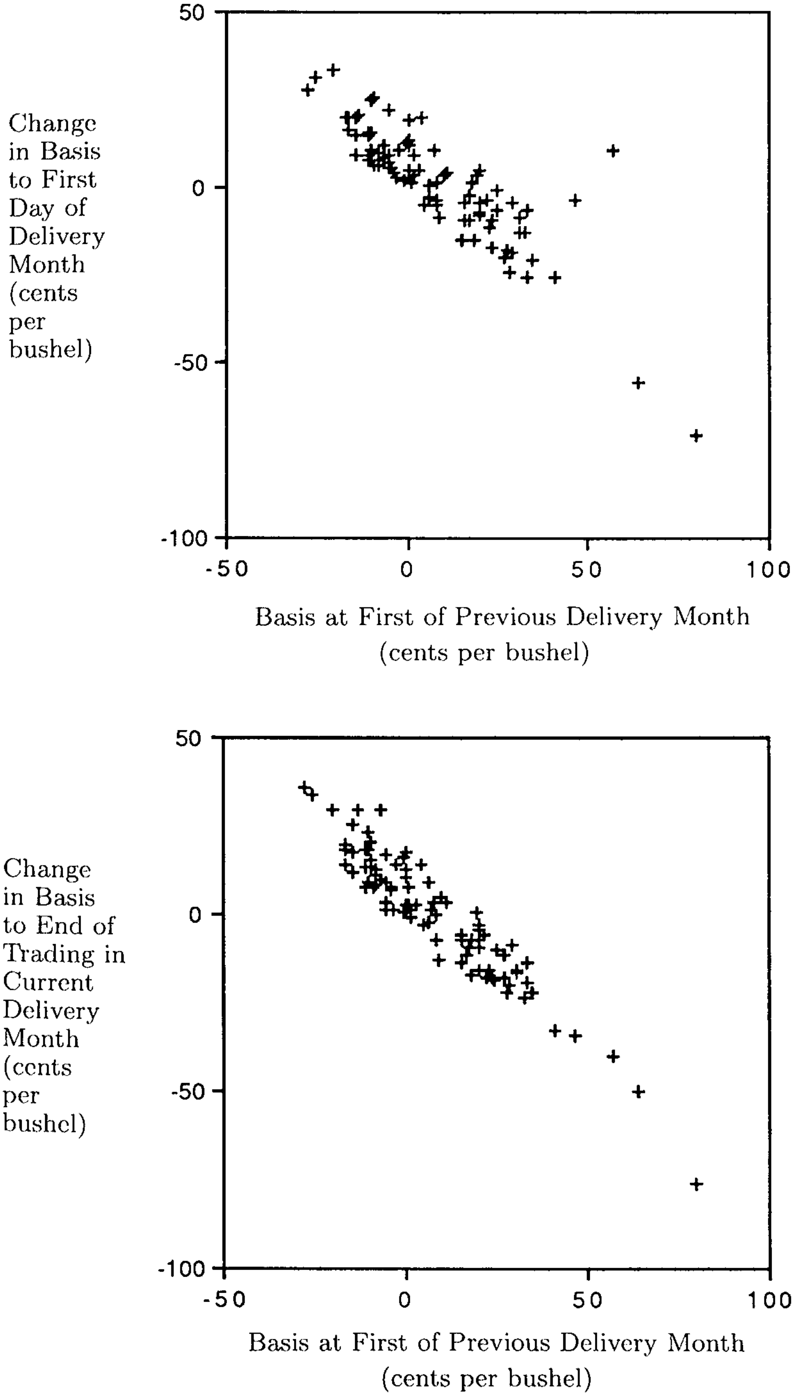


Table 5.1—Kansas City Wheat, Regressions Explaining the Change in the Basis, September 1972–September 1990*

	To first of month	To end of trading
Simple regressions		
Constant	7.25	6.68
	(7.32)	(9.85)
Previous basis	−0.70	−0.88
	(−14.97)	(−27.53)
R^2	0.72	0.89
Regression standard error	8.74	6.00
Regressions with seasonal shifters		
Constant	−0.25	2.28
	(−0.12)	(1.51)
September	4.83	4.03
	(1.77)	(2.03)
December	11.45	7.02
	(3.98)	(3.38)
March	9.24	4.36
	(3.40)	(2.22)
May	10.11	5.05
	(3.84)	(2.65)
Previous basis	−0.65	−0.84
	(−13.57)	(−24.31)
R^2	0.78	0.91
Regression standard error	7.90	5.71
Regressions with seasonal shifters and delivery timing		
Constant	7.56	3.81
	(2.53)	(1.65)
September	5.77	4.21
	(2.22)	(2.11)
December	11.47	7.03
	(4.24)	(3.38)
March	9.06	4.33
	(3.55)	(2.20)
May	8.10	4.66
	(3.18)	(2.38)
Previous basis	−0.74	−0.86
	(−14.06)	(−21.07)
Delivery timing	−13.17	−2.58
	(−3.45)	(−0.88)
R^2	0.81	0.91
Regression standard error	7.44	5.71

*The basis, in cents per bushel, is the low of the range provided by the Kansas City *Grain Market Review.* Figures in parentheses are t-statistics.

is that the issue of timing within the delivery month itself is central to any study of price convergence. An indirect indication of the influence of the pattern of deliveries within the month is the greater importance (as measured by the increase in R^2) in the regressions listed in Table 5.1 of the seasonal dummy variables, because these are associated with the frequency of price inversions. A more direct test is provided by including in the regressions the variable Delivery timing, which is the timing proportion variable defined and analyzed in Chapter 4. When Delivery timing has a low value, deliveries are late in the month. If convergence is also late, so that the change in the basis to the first of the month is not as large as forecast by the previous basis, the coefficient on Delivery timing should be negative and statistically significant. This is precisely what happens, as can be seen in the regressions reported at the bottom of Table 5.1. By contrast, the variable Delivery timing adds no explanatory power in the regressions that involve the change in the basis to much later in the month as shown in the comparative results in the lower right-hand column in Table 5.1.

BASIS CONVERGENCE FOR THE CBOT CONTRACTS

In addition to timing and possible changes in the economic content of the cash price, analyses of basis convergence of CBOT contracts must account for the variation in location of deliveries described in Chapter 4. Over the period during which both Toledo and Chicago have been deliverable, cash prices in any one location should not be expected to converge to the futures price in all months. If Toledo is the principal delivery location during a particular month, cash prices in Chicago may differ significantly from the futures price. Similarly, the Toledo cash price should be expected to move more independently of the futures price whenever the futures contract is effectively a Chicago delivery contract. The lack of convergence of a particular basis in any particular month, therefore, need not indicate a problem with the contract, but the natural workings of a contract with more than one delivery point.

Consequently, the location of actual deliveries should be an important factor in explaining the change in the basis, whether the Chicago basis or the Toledo basis. Should deliveries be predominantly in Toledo, one would expect the Chicago basis to have narrowed less, if previously over the futures, or to have gone from under to over, if previously under. Two measures of possible location effects are available, the actual proportion of deliveries in Toledo and the cash price difference between Chicago and Toledo. The proportion is the preferred measure because it reflects the effects of the relative price incentives throughout the delivery month, at least in theory. Evidence in the preceding chapter showed, however, that this theoretical expectation is not met by the actual delivery data. Therefore, a second measure, the observed price difference, is also used in later analyses to evaluate more precisely the effects of multiple delivery on basis convergence. Specifically, the difference in cash prices between Chicago and Toledo on the first of the delivery month is included with the previous basis to explain the change in basis. This Chicago premium should be positively related to the change in the Chicago basis and negatively related to the change in Toledo.

To examine basis convergence at the CBOT's deliverable locations, the cash price series to be used was first identified. The results reported here all come from analyses using the USDA quotations in Chicago and Toledo. Whenever a range was reported the midpoint was calculated. These quotations are not ideal for tests of basis convergence because they are processors' bid prices. Nevertheless, they are the prices that are routinely examined whenever there are regulatory or market performance concerns. In addition, analyses not reported here made use of a number of other measures of value in Chicago and Toledo with no important changes in the conclusions.[4]

The results of the statistical estimates are in Table 5.2. For each of the three commodities, Table 5.2 is organized to make possible comparisons when Toledo was and was not a deliverable location in addition to Chicago. For each of the two eras is shown the coefficients and R^2 of a regression relating the change in the basis to the previous basis and the variable Percentage (delivered) in Toledo (if relevant). Although not reported, the regressions also included a set of seasonal dummies and constant, identical to those in Table 5.1.

The figure for each commodity presents the scatter of points that would correspond to a simple regression for that commodity. Each figure, such as Figure 5.2 for wheat, shows the relations using Chicago cash prices. (Comparable figures for Toledo cash prices look much the same.) In each, the top panel plots the relationship for the change in the basis to the first of the delivery month and the bottom panel the change in the basis to the next-to-last trading day. The data for the figures cover the Toledo era, including the more recent cropyears, which have the empty square rather than cross markings.

Inspection and comparison of these tables and figures suggest six conclusions, the first four of which pertain to the operation of a contract with two deliverable locations. First, there appears to be less predictable basis convergence in Chicago during the Toledo era, even accounting for the

[4] For Chicago, alternative wheat, corn, and soybean prices were constructed from the USDA's Gulf quotations and prevailing barge rates which were provided by the Consolidated Grain and Barge Company. For corn, a "best bid" series for Chicago was provided by CPC International. Finally, the Andersons provided Toledo bid prices for all three commodities for a substantial period of time.

Table 5.2—The Changing Degree of Predictability in the Basis at the End of Delivery Months*

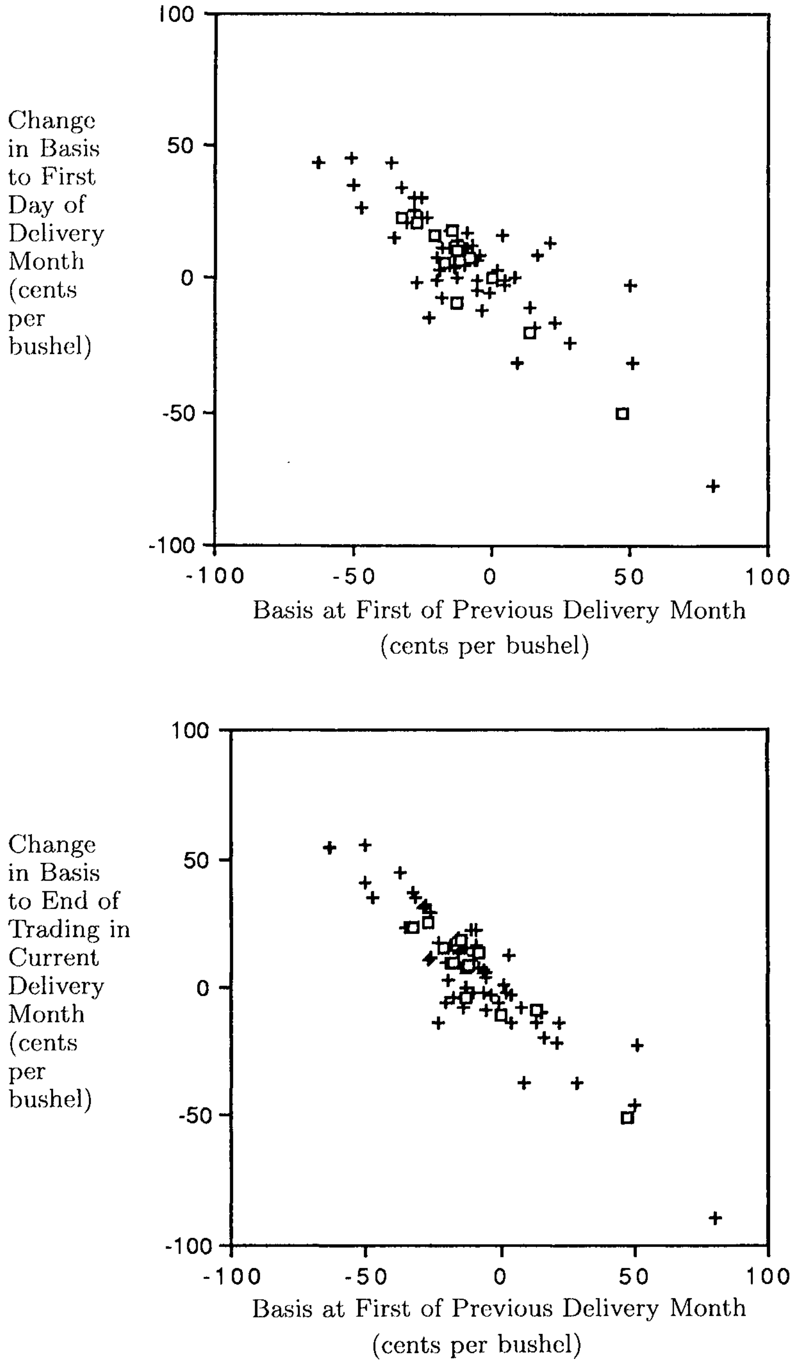
	Pre-Toledo era	Toledo era	
	Chicago	Chicago	Toledo
Wheat			
Previous basis	−1.03	−0.88	−0.80
	(−11.35)	(−15.04)	(−15.38)
Percentage in Toledo		8.01	4.06
		(1.70)	(0.98)
R^2	0.86	0.85	0.86
Regression standard error	2.94	9.90	8.62
Corn			
Previous basis	−1.23	−0.90	−0.87
	(−14.75)	(−17.86)	(−14.40)
Percentage in Toledo		−1.50	1.46
		(−0.37)	(0.33)
R^2	0.87	0.87	0.83
Regression standard error	3.69	6.02	6.61
Soybeans			
Previous basis	−0.82	−0.72	−0.82
	(−18.71)	(−11.54)	(−13.71)
Percentage in Toledo		11.97	14.83
		(2.39)	(3.11)
R^2	0.84	0.79	0.87
Regression standard error	8.36	8.70	8.29

*The basis is derived from the U.S. Department of Agriculture's series for cash prices in Chicago and Toledo, taken variously from the Chicago Board of Trade *Statistical Annuals*, USDA's weekly *Grain Market News*, and the Minneapolis *Daily Market Record.* Regression standard errors are in cents per bushel. All regressions include a constant and intercept shifters for the various delivery months. Figures in parentheses are t-statistics.

proportion delivered each month in Toledo. That is to say, the R^2's in the regressions are the same or lower in this period, and more important, the standard errors are higher. For example, for soybeans the R^2 in Table 5.2 of the regression for the change on the basis to the end of the month is 0.79 in the Toledo era versus 0.84 in the pre-Toledo era.[5] The increase in

[5] It is particularly important that these comparisons were made with the change in basis to the end of the month because it is not affected as much by the timing of deliveries within the delivery month.

Figure 5.2 The Relation Between the Previous Chicago Wheat Basis and the Change in the Basis



+ December 1976–September 1987 □ November 1987–September 1989

Figure 5.3—The Relation Between the Previous Chicago Corn Basis and the Change in the Basis

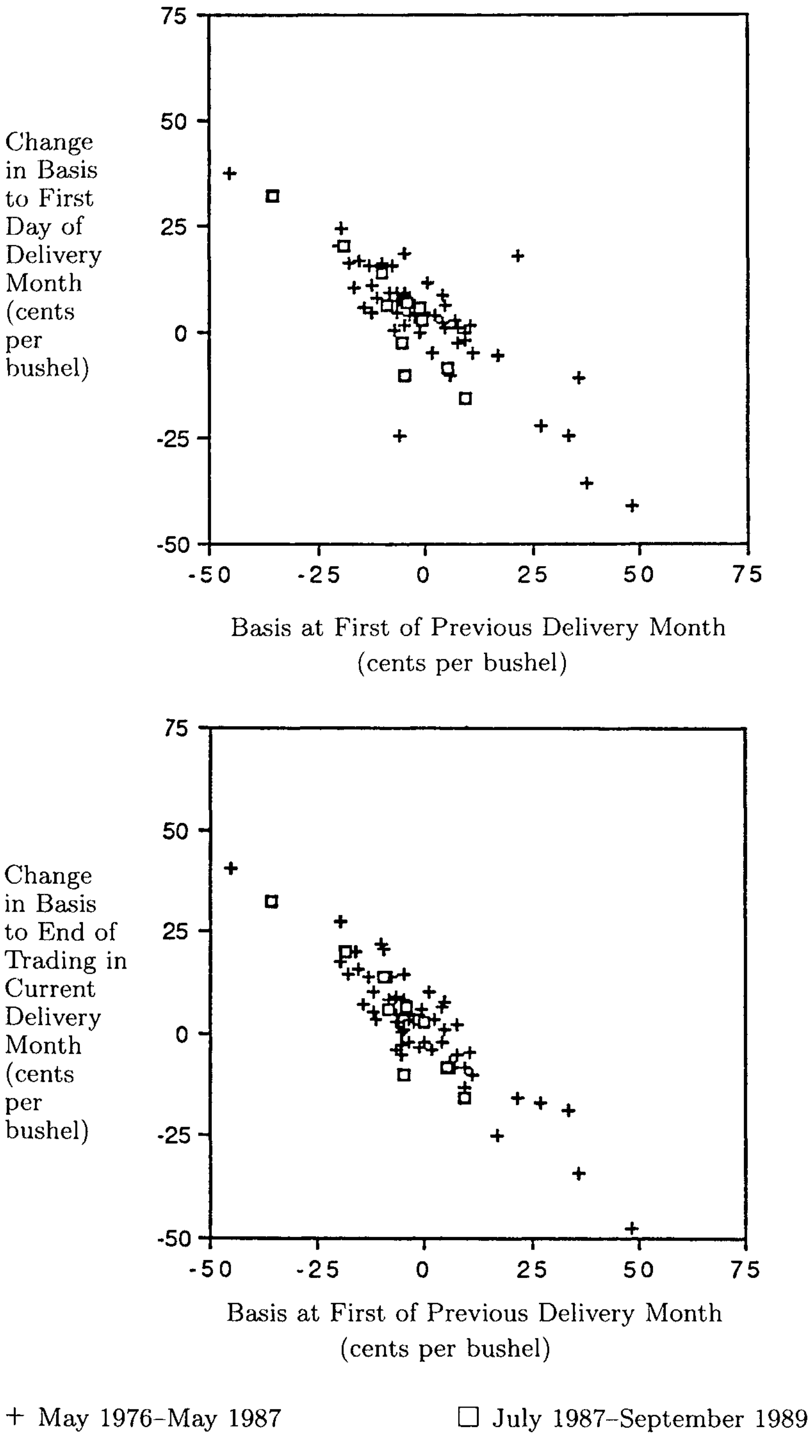
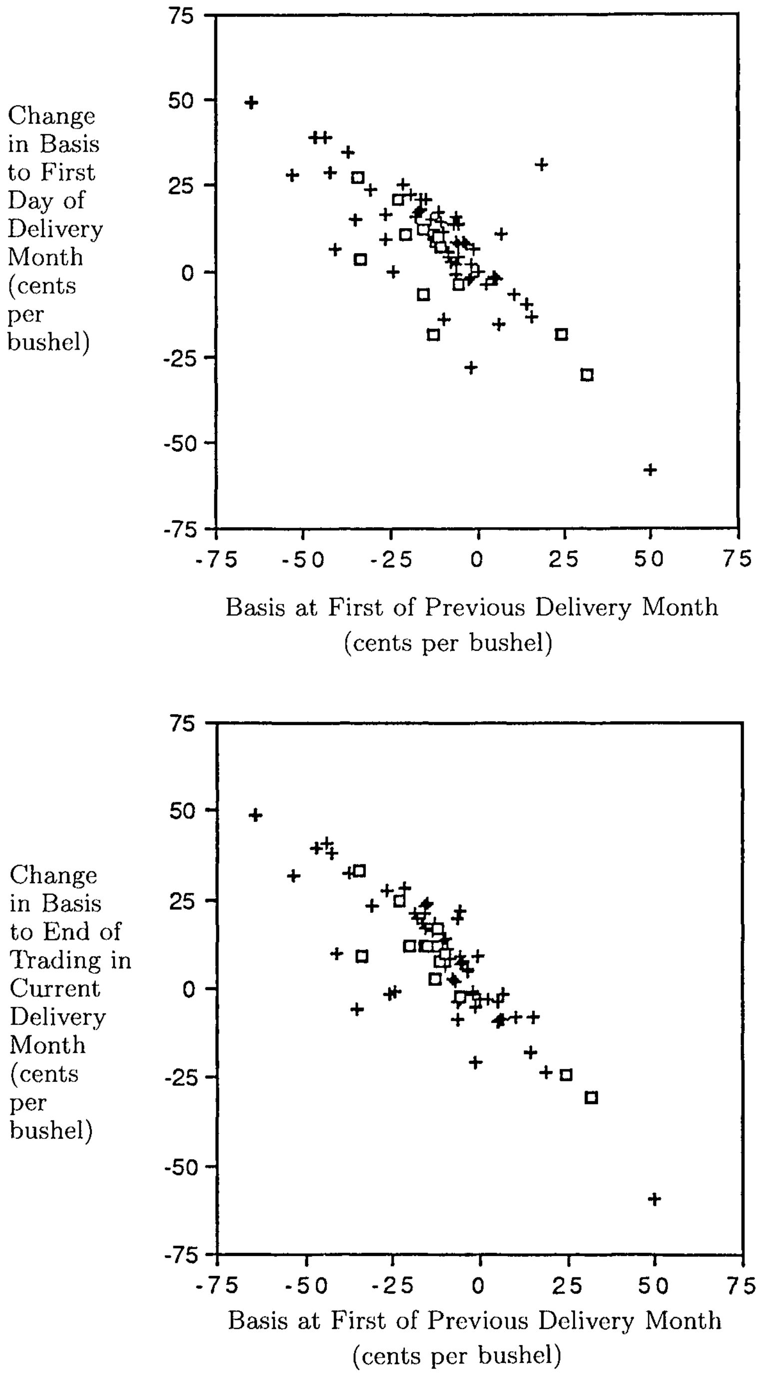


Figure 5.4—The Relation Between the Previous Chicago Soybeans Basis and the Change in the Basis



+ November 1979–September 1987 □ November 1987–September 1989 the standard error of the regression from 8.36 cents to 9.02 cents, although small, tells the same story. And although the pre-Toledo era for corn includes the turbulent years 1972–74, the standard error of 6.02 cents in the Toledo era is substantially larger than 3.69 cents.

Second, the change in the Toledo basis to the end of the month is more predictable, as measured by the R^2, and the discrepancy at the end of the month less variable, as measured by the standard error, than the change in the Chicago basis for wheat and soybeans, while for corn the evidence is weak in the other direction. For example, for soybeans the R^2 for the regression involving the seasonal shifters is 0.85 for Toledo and 0.78 for Chicago. These relative R^2's suggest for wheat and soybeans either that Toledo, not Chicago, is the more relevant cash market from the perspective of the futures contract or that the USDA cash quotations for Chicago are less representative of market values than those for Toledo.

The third pattern is evidence of systematic effects in the nature of the USDA quotations. The variable Percentage (of deliveries) in Toledo has the expected positive sign in explaining the change to the end of the month in the Chicago wheat and soybean basis. The same variable, however, has a positive effect rather than the expected negative effect in explaining the changes in the Toledo basis. (It has no measurable effect on corn.) The implication is that a component of the USDA's quotations for wheat and soybeans, which are processors' bids, is related to the factors that lead to delivery in Toledo.

The effect of Toledo as a possible delivery location on the behavior of Chicago prices can perhaps be seen more directly in Table 5.3. The data behind this table measure the change in the basis only to the first of the month. A comparison of the first two columns would suggest a marked deterioration in basis convergence, more so than seen in Table 5.2. For example, the R^2 for corn declined from 0.86 to 0.66. But much of this apparent decline can be attributed to the natural workings of a contract with a month-long delivery window with more than one delivery location. Adding the Chicago premium over Toledo, which should indicate where deliveries are most likely and hence to which cash price the futures is most closely related, and the variable Delivery Timing to the regression, shows most of the deterioration in convergence is precisely the effect of these embedded. This evidence with prices is stronger than with the deliveries themselves and works in the anticipated direction: When the Chicago premium is large, the Chicago basis is more over (or less under) the futures than otherwise, and when the deliveries are late the basis convergence is less. Thus, the fourth conclusion is that study of basis convergence must allow for the effects of location and timing of deliveries, although when convergence is measured to the next-to-last trading day, only the effects of the location needed be included. In this instance, they explain a large part of the apparent decline in basis convergence at Chicago.

The fifth conclusion may be so obvious as to be overlooked. Although the performance by era, location, and commodity are different, the previous basis is always a significant explanatory factor. Just as it should account for location and timing, any discussion of whether cash and futures prices have converged should account for the magnitude of the original basis. The CBOT's *Studies* amount to a regression specification with a dummy variable for whether or not the previous basis was positive and several weekly shifters in the context of explaining changes in the basis. It should not be surprising that this specification had so little explanatory power. It should also be clear that any conclusions about basis convergence derived from such a specification are dubious, because of the problems resulting from omitting the most important explanatory variable, the previous basis.

Sixth and finally is the answer to the question whether the two most recent cropyears have behaved differently, or more precisely, whether the predictability of basis changes has decreased. The empty boxes are the observations for 1987/88–1988/89 in Figures 5.2, 5.3, and 5.4 allow a visual test of this question. (A more formal statistical test for structural change yields the same answer.) This period is indistinguishable from the earlier years in the era of Toledo deliveries. The impression of later and more problematic convergence in the last two cropyears may be explained by the clustering of the points for the most recent period toward the lower right of the figures. (The clustering is even more pronounced when 1985/86 and 1986/87 are added to the definition of the most recent period.) Disproportionately, the last few years have been characterized by markets with inverse carrying charges late in the cropyear. When the basis is positive, convergence should be expected to be later in the month than when the cash price is under the futures price.

BASIS BEHAVIOR AT NON-DELIVERABLE LOCATIONS

The previous section was concerned with basis behavior at official delivery locations. Most users of futures markets, however, are commercial firms at other locations. This section examines basis behavior and hedging effectiveness at some of them.

The evidence could begin with a study of the previous basis forecasting the change in the basis at each of these locations, but it would mainly serve to reiterate the points made earlier. The available data suggest a slightly different approach. These data are series of weekly (Thursday) corn and soybean prices at eight different elevators in Illinois, as well as weekly USDA quotations for Chicago, Toledo, and the Gulf. They cover, for most of the elevators, September 1966 through July 1989.[6]

[6] These data have also been used by Thompson, Hauser, and Eales (1990.)

Table 5.3—The Changing Degree of Predictability in the Chicago Basis at the First of Delivery Months*

	Pre-Toledo era	Toledo era	
Wheat			
Previous basis	−0.90	−0.63	−0.73
	(−12.50)	(−11.10)	(−10.54)
Chicago premium			0.47
			(3.50)
Delivery timing			−15.86
			(−1.80)
R^2	0.89	0.78	0.83
Regression standard error	2.34	9.92	8.99
Corn			
Previous basis	−0.90	−0.69	−0.79
	(−12.36)	(−9.84)	(−12.60)
Chicago premium			0.83
			6.16
Delivery timing			−12.32
			(−2.60)
R^2	0.86	0.66	0.81
Regression standard error	3.21	8.38	6.43
Soybeans			
Previous basis	−0.75	−0.62	−0.69
	(−17.78)	(−8.08)	(−9.84)
Chicago premium			0.77
			(5.21)
Delivery timing			−20.50
			(−2.38)
R^2	0.83	0.65	0.77
Regression standard error	8.05	10.72	8.85

*The basis is derived from the U.S. Department of Agriculture's series for cash prices in Chicago and Toledo, taken variously from the Chicago Board of Trade *Statistical Annuals*, USDA's weekly *Grain Market News*, and the Minneapolis *Daily Market Record*. Regression standard errors are in cents per bushel. All regressions include a constant and intercept shifters for the various delivery months. Figures in parentheses are t-statistics.

A conventional measure of hedging effectiveness is the (squared) correlation coefficient between changes in the cash price and changes in the futures price. Presumably, the more closely the cash and futures prices change together, the more useful the futures contract is at reducing the risk of price changes. Put another way, the lower the correlation, the greater the basis risk. A simple correlation has a number of defects as a measure of hedging effectiveness—not least because the theory was developed for deliverable locations and the application is to other places—but many, including the CBOT's *Studies*, use it because of its simplicity.[7]

Thus, this long series of cash prices at the 11 locations permit tests of changes in hedging effectiveness. More specifically, they have been broken into (sometimes overlapping) segments, each covering the 12 Thursdays before the first delivery day of a futures contract.[8] The correlation of the changes week to week in the cash price with the relevant futures is computed. Except for the overlap when the contracts are closer than twelve weeks, this exercise corresponds to perpetually rolling forward a hedge just before the first notice day and recording contract by contract the resulting hedging effectiveness for each period. It creates a time series of correlation coefficients, which are shown in the upper panel of Figure 5.5 for the soybean prices from an elevator in Macoupin County, which is southwest of Springfield, Illinois.

The series of correlation coefficients, such as in the upper panel of Figure 5.5, still contain much information. Table 5.4 compresses the information to more manageable amounts. It gives the average of the correlations involving just the March contracts (that is, those computed every year for the 12 weeks before March 1) and the July contracts (that is, those computed every year for the 12 weeks before July 1). The number of correlations is up to 46, depending on the elevator.[9] The March and July contracts do not have substantively different averages for any of the 11 locations. Both have higher averages than the last old-crop or first new-crop contracts, where the occasional year of steep price inversion disconnects the cash price from the new-crop futures prices.[10]

Table 5.4 arranges the average correlations to compare the eras with

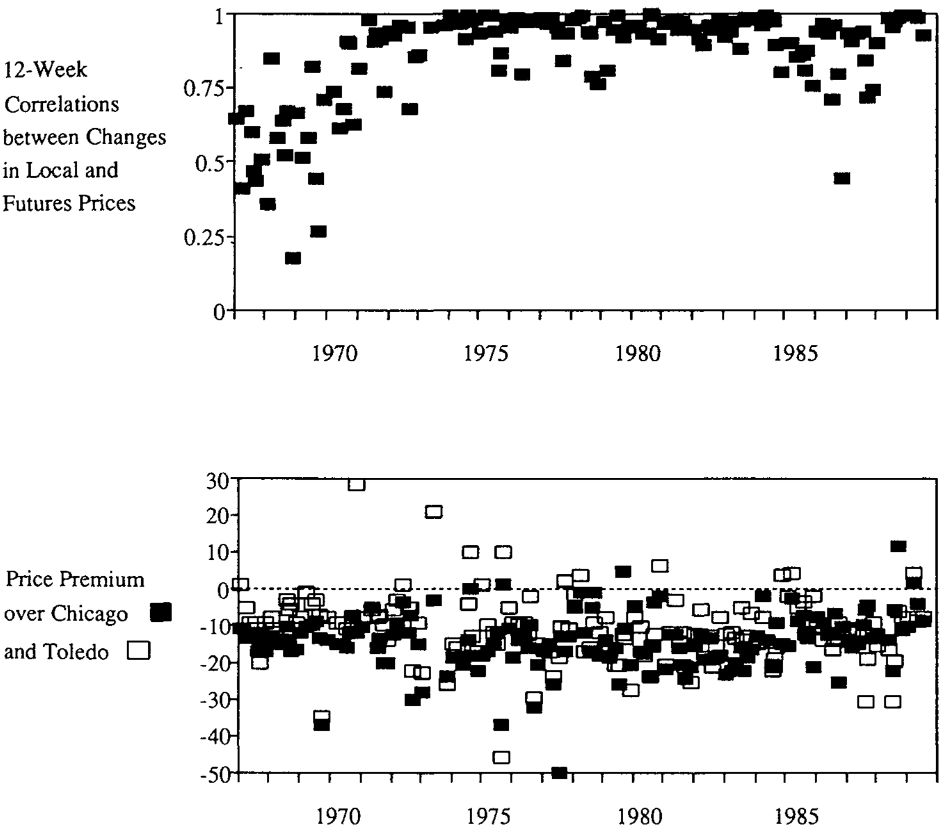
[7] Kahl (1983) shows how many definitions of hedge ratios rely on the simple correlation.

[8] If fewer than 11 prices were recorded over the 12-week intervals, say, because of holidays, the correlation was not computed. These instances are not random—they come disproportionately from 1973 and 1974 and similar periods of inversion.

[9] Correlations, of course, cannot be above 1.00; the occasional low correlation pulls the average down. The median may be a better indication of the typical correlation, but the conclusions are the same.

[10] Measured 12-week correlations are inversely related to the basis prevailing at the start of the period, as would be expected. An implication of this relationship,

Figure 5.5—Hedging Effectiveness of the Chicago Board of Trade Soybean Contract for a Country Elevator in Macoupin County, Illinois



and without Toledo delivery. For corn, some of the 11 locations have an apparent increase in hedging effectiveness and others slightly less. (None is markedly different from Chicago itself.) For all elevator locations, the hedging effectiveness of the soybean contract appears to have been higher in the Toledo era than during 1966/67–1978/79. The soybean series of the elevator in Macoupin County in Figure 5.5 is typical in this respect. As can be seen in that figure, the performance during 1987/88–1988/89 seems barely different, although there is a small decline around 1985–87, as is true for other elevators' soybean prices. This decline may explain why concern arose over the hedging effectiveness of the soybean contract. From

however, is that a study of hedging effectiveness, like one of basis convergence, should standardize for the degree of price inversion.

Table 5.4—Average Hedging Effectiveness*

	Corn		Soybeans	
	Pre-Toledo era	Toledo era	Pre-Toledo era	Toledo era
Illinois country elevators				
Whiteside County	0.79	0.79	0.85	0.89
Boone County	0.79	0.81	0.83	0.90
Knox County	0.84	0.80	0.82	0.89
Kankakee County	0.78	0.81	0.82	0.91
Champaign County	0.87	0.91	0.82	0.95
Macoupin County	0.78	0.84	0.85	0.92
Effingham County	0.69	0.83	0.80	0.92
St. Clair County	0.84	0.88	0.84	0.87
Terminal elevators				
Chicago	0.77	0.81	0.94	0.95
Toledo	0.79	0.88	0.88	0.95
Gulf	0.80	0.78	0.80	0.92

*Figures in the table are the average correlation of changes in weekly prices with the futures for the 12 weeks preceding the March and July contracts, in the years 1967–89. Futures prices are from Chicago Board of Trade *Statistical Annuals* or provided by the exchange; Illinois county elevators' prices were provided by the University of Illinois; and terminal elevators' prices are from the U.S. Department of Agriculture's weekly *Grain Market News*.

a longer perspective, one that includes the late 1960s and early 1970s, the hedging effectiveness of the soybean contract, as represented by the correlation coefficient, was above average.

The changes in measured hedging effectiveness of the soybean futures contract may be attributable to substantive changes in the wider market rather than the specifics of the contract. In the late 1970s and early 1980s strong export demand through the Gulf dominated the structure of prices. That is not to say that prices at the many interior points did not change week to week relative to Chicago or the Gulf, but rather that each location was firmly in the web of prices. This may explain why the correlations for the Macoupin County elevator and others were higher in the Toledo era, and from 1978 through 1983 in particular. In periods of less export activity, such as the late 1960s and late 1980s, or in periods with major government programs, local conditions are proportionately more important. Because each local price moves rather more independently, the measured hedging effectiveness of a futures contract with delivery at one or two locations is lower. But under such circumstances, the decline is not due to the design of the contract as much as changing patterns in the entire market.

A second problem is also apparent in using correlation coefficients as measures of hedging effectiveness. In Table 5.4 for corn and soybeans in Chicago, the average correlation is higher for the Toledo era. Yet the detailed study of basis convergence discussed in the previous section found the opposite. The implication is that correlation coefficients are not especially reliable indicators and that little should be read into small differences in them.

To determine whether changes of pattern in the entire market or the specifics of contract design are more to blame for declines of hedging effectiveness requires information about the whole spatial configuration of prices. This is the same information needed to determine, for example, that a single location's price is "out of line" (an allegation made in every manipulation case). Inspection of the prices themselves offers little evidence of their being out of line without comparison to the prevailing costs of transportation such as barge rates, which quite reasonably change continuously. The point at issue can be seen in the lower panel of Figure 5.5, which shows the difference in the Macoupin County elevator's soybean cash price from Chicago (or Toledo). The series is highly variable—there is some basis risk—but it is impossible to say that any one price is "wrong," without information on the direction of soybean shipments and on the cost of transportation.[11]

In sum, there is no pronounced evidence of a long-term decline of the hedging effectiveness of the corn and soybean contracts in the weeks prior to the delivery period. There is some evidence of a temporary decline in the period approximately 1985–87, but this decline is small compared to situations in the late 1960s or early 1970s. The results are also clear that the specific measure of hedging effectiveness is itself not sensitive enough to detect the changes caused by adding Toledo to the contract.

HEDGING EFFECTIVENESS AND MULTIPLE DELIVERY POINTS

A frequent proposal for reform of the three CBOT contracts is to add delivery points, the approach already adopted in adding Toledo. Such changes in the possible locations for delivery would not increase hedging effectiveness for all users of the contract. The effects would vary markedly by location.

Although no one is proposing adding a delivery location on the Pacific Coast, the potential effects on specific firms are most easily seen by considering such an extreme.[12] To describe such an extreme situation,

[11] In passing, it is worth noting in the lower panel of Figure 5.5 that this Illinois elevator's price in the Toledo era is not recognizably more in line with Chicago than with Toledo.

[12] The idea is not without precedent, however. Pacific Coast delivery points

imagine a commodity that is exported to Europe through Chicago and to Asia through Pacific Coast ports and that is grown everywhere in between. A futures contract might be designed to permit delivery at both locations (whether at par or at a discount is immaterial), or it might permit delivery at only one location. If multiple delivery is the choice, Chicago would be the delivery location in practice when prices there were lowest, as for example when export demand from Europe was low. Those elevators and processors in the interior near Chicago would find that their local prices would move closely to the Chicago price during this period; the futures contract would be an effective hedging mechanism for them. By contrast, those elevators nearer the Pacific Coast would find that changes in the futures price would be largely uncorrelated with movements in their own cash prices. Those elevators and processors in some middle region would sometimes be connected to Chicago and sometimes not. In contrast, in cropyears when export demand is relatively low through the Pacific, and prices there are lowest, the futures contract would be effectively one with Pacific Coast delivery. Those nearer the Pacific coast would find their prices highly correlated with the futures price during these periods whereas those near Chicago would find the contracts' hedging effectiveness low.

Compared to a single delivery point, the contract with either Chicago or the hypothetical Pacific Coast delivery is not universally preferred. Obviously, those near Chicago would prefer a contract restricted to Chicago delivery. Those near the Pacific Coast would prefer a contract with Pacific Coast delivery, although they might prefer a contract with both locations than one with just Chicago. Only those in the middle region might prefer the multiple location contract to any other configuration. More generally, any redesign of the contract terms would not mean an improvement in trading terms for all firms.

In the real world, the web of locational differences is much more complex, and, as analyses here have shown, it is extremely difficult to assess the effects of contract changes on specific basis patterns. The more closely linked by transport and commodity flows are the market locations being considered as additional delivery locations, the less pronounced will be the effects on basis convergence and hedging effectiveness as seen by firms in specific locations. But, even for locations so closely linked as Toledo and Chicago, analyses here demonstrated the addition of Toledo did affect the degree of basis convergence in Chicago. More generally, any additional options conferred by the futures contract, if they are at all valuable, will affect basis convergence and hedging effectiveness.

---

have been actively considered for the New York Cotton Exchange cotton contract.