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REFLECTIONS OF HEDGING ON FUTURES MARKET ACTIVITY†

In recent years, futures markets have experienced remarkable growth both in the use of well-established markets and in the creation of new markets. In 1977, average month-end positions (total open contracts) in wheat, corn, and soybeans had grown by an average of 260 percent from their 1965 levels. Volume of contracts traded grew by 420 percent. The list of futures markets created over this period is equally impressive in its diversity and in its distinctly nonagricultural character. New contract markets for agricultural commodities include live cattle, pork bellies, frozen concentrated orange juice, and broilers. New contract markets for nonagricultural commodities include wood products (lumber and plywood), currencies (Canadian dollars, Deutsche marks, French francs, Japanese yen, Mexican pesos, British pounds, Swiss francs), interest rate futures (GNMA mortgages, 90-day Treasury Bills, Treasury Bonds), and precious metals (silver coins, gold bullion, gold coins, palladium, platinum).

In light of this growth, it is desirable to reexamine many long-held propositions about futures markets. Perhaps the most widely held and commonly accepted is that levels of activity on futures markets reflect commercial as distinct from speculative needs. In the absence of commercial use, futures markets have closed, and fundamental changes in a commodity's underlying productive pattern have caused fundamental changes in contract specifications.

The most persuasive evidence of the relationship between commercial use and total market activity has been the links between seasonal commercial needs, seasonal changes in commercial use of futures markets, and sympathetic seasonal changes in total market activity. These links demonstrate that speculation in futures markets responds to commercial use. H. Working (1960) extended the argument further in his construction of an index of speculative activity, measuring commercial use within a market as the total position of commercial buyers and sellers, not their net position.

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Direct testing of the relationship between commercial use and total market activity provides a useful starting point. Initial focus is upon the three major agricultural markets—wheat, corn, and soybeans—and seasonality in patterns of market use is examined to aid in interpreting the empirical relationships between total and commercial use.[1] Three other agricultural markets—Maine potatoes, live cattle, and pork bellies—and two financial markets—GNMA mortgages and 90-day Treasury Bills—are also examined. The latter three agricultural markets have production and marketing characteristics which differ significantly from the grains. The two financial markets are the oldest and most successful of the new markets, though data are limited because of their recency.

BACKGROUND

Evidence that patterns in the statistics of futures market use reflect the behavior of commercial and not speculative users began appearing in the 1930s. In the futures market statistics, commercial users are the hedgers. They comprise all those firms which trade futures contracts in conjunction with some operation—production, marketing, or processing—in the cash commodity business. G.W. Hoffman (1932a) presented evidence that the quarterly net positions of large hedgers in the corn futures market reflected visible supplies of corn over the period 1925-30. Net corn hedging was predominantly short and varied directly with stocks of corn. H.S. Irwin (1935) added evidence showing that total open interest in all wheat futures was a direct reflection of visible supplies of wheat over the period 1924-33. Although the data used by Hoffman and Irwin came from different markets, the results indicated that futures markets are hedging markets. Total open contracts on a futures market reflect hedging positions, and these in turn reflect variations in available supplies (here, stocks) of the underlying cash commodity. Hoffman (1941) and, much later, J.S. Schonberg (1956) presented complete analyses of stocks, open interest, and net hedging data from the wheat, corn, and soybean markets. Together, these have remained the only direct evidence on the generally accepted proposition that statistics of futures markets use reflect hedging needs.

Accepting the proposition does not mean, however, that all markets reflect the same patterns or that all the evidence is the observed seasonality in market use. R.W. Gray's (1961) analysis of the patterns of hedging and speculation on the three active wheat markets provides a different insight into the fundamental importance of hedging to futures markets. Kansas City and Minneapolis were much smaller futures markets in the 1920s and 1960s than Chicago. But they survived (and more recently have been thriving) by providing a specialized contract, one more closely attuned to commercial needs, and patterns in the use of the individual markets reflected these hedging needs. Gray (1961, p. 24) concludes, "Open interest on futures markets depends upon hedging. . . This tends to be true also of the aggregate of wheat futures contracts and hedging, but when the aggregate is divided into its components, the dependence of open

[1] Seasonality in market needs, which characterized the agricultural markets, is not expected necessarily in the nonagricultural markets and, as Gray's recent analysis (1979) suggests, no longer characterizes commercial needs in the major grain markets.

interest at particular markets upon hedging is seen to be somewhat more complicated, but still very close." Perhaps the strongest evidence of the reliance of futures markets on commercial use is provided by Working's description of the near demise of the Kansas City wheat futures market. In 1953, hard winter wheat was in very short supply, a significant premium relative to soft wheats developed. It became profitable to move soft wheats from the Chicago hinterlands to Kansas City and deliver them against expiring contracts which did not then specify delivery of only hard wheats. The Kansas City market thus became a soft wheat market, removing any preference hedgers had to use it for their hard wheat needs. Hedging left the Kansas City market and with it went the market. A new contract, calling for delivery of hard winter wheats only, was introduced for the 1954 crop year and hedging returned (Working, 1954).

While this is the most vivid illustration of the importance of commercial users to futures markets, other examples can be found in the more gradual process of contract development and revision. Unfortunately, much of the experience in contract development is within the research and development departments of commodity exchanges. R.L. Sandor's (1973) description of the development of the plywood market is an exception. Similarly, D.S. Miracle's (1972) account of the demise of the refrigerator egg contract is an account of fundamental changes in the production and marketing of eggs. Changed industry practice led ultimately to a new contract, calling for delivery of fresh eggs. And M.J. Powers (1967) discussed the series of changes in contract provisions that accompanied the introduction of futures trading in frozen pork bellies and sought to bring the contract into line with standard commercial practices.

EVIDENCE FROM THE WHEAT, CORN, AND SOYBEAN MARKETS

Taken together, the historical evidence is clear: futures markets reflect commercial needs. Prior research, however, has not examined directly the relationship between total market use and commercial activity. Total market activity is measured by total open interest, the sum of all open contracts on one side of the market. Commercial use is measured by the reported hedging data which are the positions of the large commercial firms.[2] Because hedgers normally have both long and short positions in futures, there are two potential measures of commercial use of the markets. The first, net hedging, measures the unbalanced demands of the commercial users, being the difference between long and short hedging. This is the most common measure and reflects the view that speculation provides the required offset to unbalanced hedging needs. The second, the sum of the reported long and short hedging, measures the total demands hedgers place on a market. This measure was suggested by Working (1960), on the grounds that separate speculative positions might be required to offset each hedging position, since rarely would long and short hedging positions enter the market simultaneously.

Measures of the degree of correspondence between commercial use and total

[2] Hedging is measured by the series "reported hedging" in the monthly position reports Hedge positions in the grain markets were reportable if they were greater than 200,000 bushels prior to June 1977 and greater than 500,000 bushels thereafter

open interest are presented in Table 1 for the three major agricultural markets corn, wheat, and soybeans. The available data span the postwar period through 1977/78, though the years included for each commodity vary slightly due to uneven market recovery after World War II. During most of this period, crop years 1947 through 1971,[3] prices of these commodities were heavily influenced by government loan programs and the accumulation of large stocks under government control. The degree of government involvement varied between years and among corn, wheat, and soybeans, but the entire period can nevertheless be described as one of controlled markets. The remaining six years, 1972 through 1977, were a period of relatively free markets. The large government stocks of corn and wheat were depleted in 1972. Export subsidies and other incentives were removed. The latter portion of this period includes the reinstitution of a grain-reserve program, but the period as a whole was one of relatively free markets.[4]

Statistics of average net and total hedging in Table 1 demonstrate the change in futures market use by hedgers after 1971. Prior to 1972, hedging was nearly always net short, though less so in the soybean market than in corn or wheat. Since 1972, total hedging has more than tripled, long hedging grew proportionately more than short hedging, and, hedging is now more nearly balanced on all three markets. Hedging in the corn market is now slightly long on average. In the early period, hedging was mostly short hedging; net hedging was, therefore, a good measure of total hedging; and net hedging correlated well with total open interest. Even there, however, total hedging provided a higher correlation and the increase varied inversely with the degree of balance between short and long positions. Wheat hedging prior to 1972 was the least unbalanced, net short 31.9 million bushels, and variation in net hedging explains 67.4 percent of the variation in open interest while variation in total hedging explains 80.4 percent. Soybean hedging averaged only 16.2 million bushels net short, and the respective correlations were 11.2 percent and 81.3 percent. These comparisons are reinforced by the experience in the post-1971 period. Here, the corn market is the most nearly balanced and the degree of correspondence between net hedging and open interest is zero. Total corn hedging is, however, highly correlated with open interest.

While these relationships are consistent with Working's hypothesis on the appropriate measure of commercial use, they cannot be interpreted as establishing a causative relationship between hedging and open interest. Basic market identities lie behind the relationships estimated here, and an appropriately defined measure of total speculation would do as well as total hedging in explaining open interest. Other evidence must be sought to determine causality. Examination of seasonal variation in hedging needs provides some clues.

PATTERNS OF SEASONAL USE

Seasonal patterns have been estimated for visible supplies, total open interest, and net hedging positions for the 1947 through 1971 period (Charts 1, 2, 3).

[3] Crop years are designated by the year of the harvest.

[4] See Gray (1976) for a description of the changes in grain markets and marketing which began with the 1972/73 crop year.

TABLE 1.—THE RELATIONSHIP BETWEEN HEDGING AND TOTAL OPEN INTEREST ON WHEAT, CORN, AND SOYBEAN FUTURES MARKETS*

Commodity and period	Average net hedging (*million bushels*)	Average total hedging[b] (*million bushels*)	Degree of correspondence between total open interest and:[a] Net hedging positions (*percent*)	Total hedging positions (*percent*)
Wheat[c]				
1947/48-1971/72	-31.9	87.7	67.4	80.6
1972/73-1977/78	-15.1	344.5	47.7	92.3
Corn				
1948/49-1971/72	-31.4	104.6	46.7	93.0
1972/73-1977/78	7.5	565.7	0.1	93.0
Soybeans				
1951/52-1971/72	-16.2	85.9	11.2	81.3
1972/73-1977/78	-8.3	298.3	42.4	62.3

*Based on data from Commodity Futures Trading Commission, "Commitments of Traders," monthly, and United States Department of Agriculture, C.E.A., "Annual Summary of Commodity Futures Statistics," annually.

[a]Squared correlation coefficients.

[b]Sum of long and short reported hedging.

[c]Chicago, Kansas City, and Minneapolis combined.

Wheat stocks peak after harvest and begin building slightly before the following harvest, seeming to put the wheat seasonal one month out of phase (Chart 1). The difference is more apparent than real, however, since the wheat crop has the longest harvest period of the three crops, and the designated harvest point (June 30) is thus less representative. The significant differences among the three seasonals are the size of the average stocks and the variability of stocks over the seasons. Both are affected by the choice of visible supplies as a measure of stocks in commercial positions.[5]

In terms of total production, the corn crop is by far the largest, wheat is a poor second, and soybeans are an even poorer third. However, a large percentage of the corn crop never enters commercial supply channels since it is fed on or near the farm where it was grown. By contrast, virtually all of the wheat and soybean crops is sold into commercial channels. But, the three commodities also differ in the portion of the commercial supply that is included in "visibles." Most wheat and the corn that does enter commercial channels moves from farms to merchants and thence to mills, processors, or exporters, so that a sampling of elevator supplies captures much of the total commercial movement. A significant percentage of the soybean crop, however, moves directly from farms to processors and never appears

[5] Visible supply measures stocks of grain in commercial hands. It excludes farm stocks and stocks held by processors.

TABLE 2.—THE RELATIONSHIP BETWEEN HEDGING AND TOTAL OPEN INTEREST ON POTATO, LIVE CATTLE, PORK BELLY, GNMA, AND T-BILL FUTURES MARKETS*

Commodity and years (*percent*)	Average net hedging (1,000 *contracts*)	Average total hedging[b] (1,000 *contracts*)	Percent of the variation in total open interest explained by:[a] Net hedging positions	Sum of the hedging positions (*percent*)
Maine potatoes				
1952/53-1974/75	-2.2	3.4	61.8	63.0
Live cattle				
1972-1977	-13.5	19.3	81.2	88.4
Pork bellies				
1971-1977	-0.5	1.3	1.7	42.2
GNMA certificates				
July 1978-June 1979	-1.5	37.7	14.5	93.8
90-Day Treasury Bills				
July 1978-June 1979	-0.9	13.2	25.4	71.2

*Based on data from Commodity Futures Trading Commission, "Commitments of Traders," monthly, and United States Department of Agriculture, C.E.A., "Annual Summary of Commodity Futures Statistics," annually.

[a]Squared correlation coefficients.

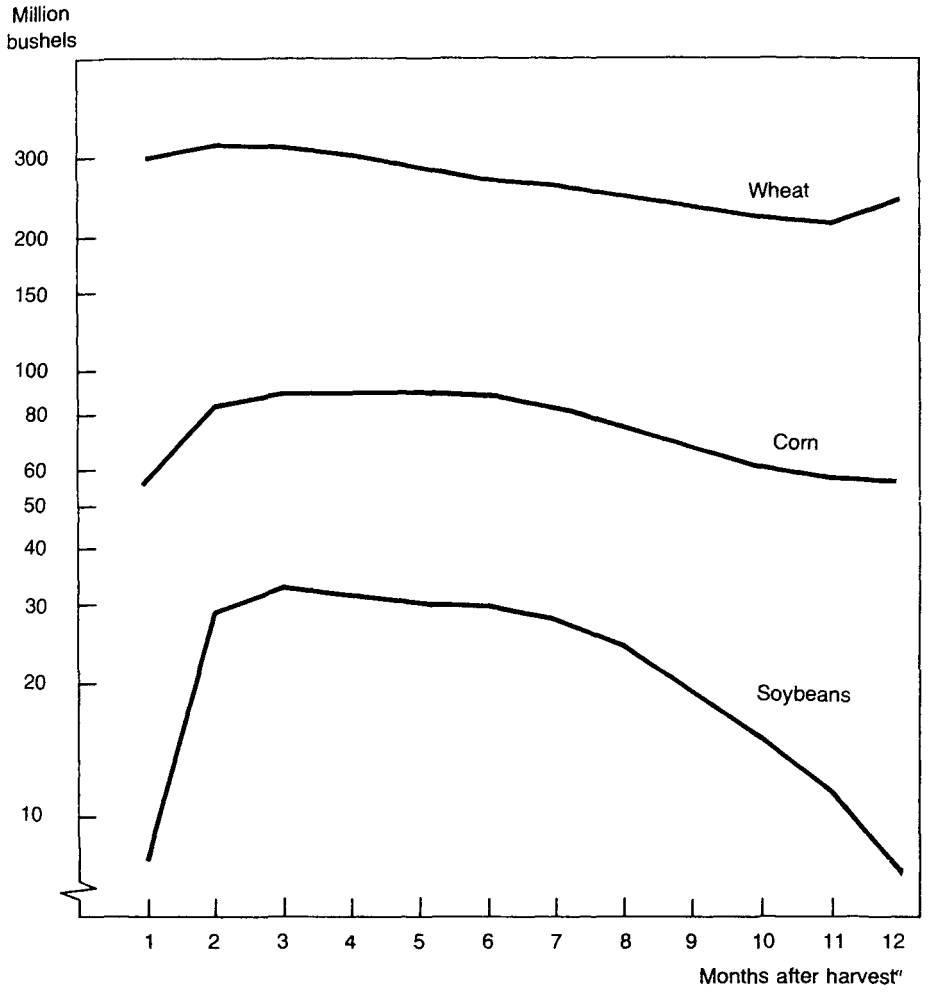
[b]Sum of long and short reported hedging.

in the visible supply.[6] Thus, visible supplies of soybeans are small on average (smaller than would be expected judging by crop size), and percentage changes in them are large.

Varying patterns of seasonal supplies of the three commodities are reflected directly in commercial use (Chart 2). Net hedging of wheat and corn were more unbalanced than net hedging in soybeans, and wheat and soybean hedging showed greater seasonal variation: 51.5 million bushels for wheat, 50.4 million bushels for soybeans, and 40.4 million bushels for corn. The degree of hedging balance in the corn market during this period is surprising. The portion of the corn crop which was commercially processed was trivial compared with wheat, and soybeans and exports of corn were a relatively small part of available supply. Thus the corn market might be expected to have relatively fewer long hedgers to offset

[6] Mill stocks of wheat represent a sample of millers who report positions quarterly to the Millers National Federation. Processor stocks of soybeans are available monthly from the Census Bureau and are reported in the Chicago Board of Trade *Statistical Annual*. In the 1971 crop year, visible supplies of wheat averaged 23.1 percent of total off-farm stocks, and mill stocks averaged 10.2 percent. Visible supplies of soybeans averaged 13.5 percent of off-farm stocks, and processor stocks averaged 39.6 percent.

CHART 1.—MONTHLY AVERAGE VISIBLE SUPPLY OF WHEAT, CORN, AND SOYBEANS, PRE-1972*



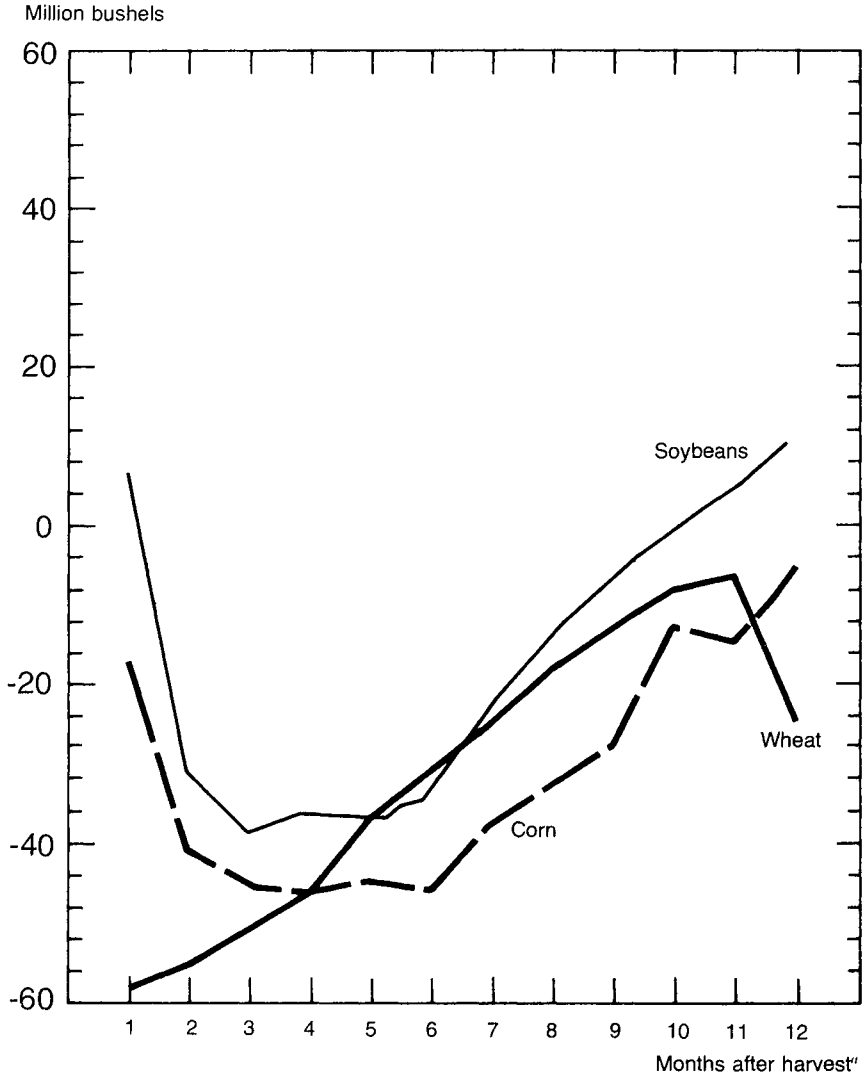
*Source: Appendix Table 1.

"One month after harvest was defined as July 30 for wheat, October 30 for corn, and September 30 for soybeans.

the short hedgers. Examining the data by subperiods within the 24-year period more nearly confirms this expectation. From 1948 to 1963, long hedging in corn averaged only 40 percent of short hedging, and on average hedging was 22.5 million bushels net short. Over the following eight years, long hedges averaged 62 percent of short hedges. Exports of corn, which had averaged only 140 million bushels in the decade of the 1950s, more than trebled to 506 million bushels in the 1960s.

Open interest for all three commodities peaks shortly after harvest, more or less in conjunction with the peaks in visible supplies and net hedging (Chart 3). It declines steadily over the season to a minimum shortly before the subsequent

CHART 2.—AVERAGE MONTHLY NET HEDGING IN WHEAT, CORN, AND SOYBEAN FUTURES MARKETS, PRE-1972*

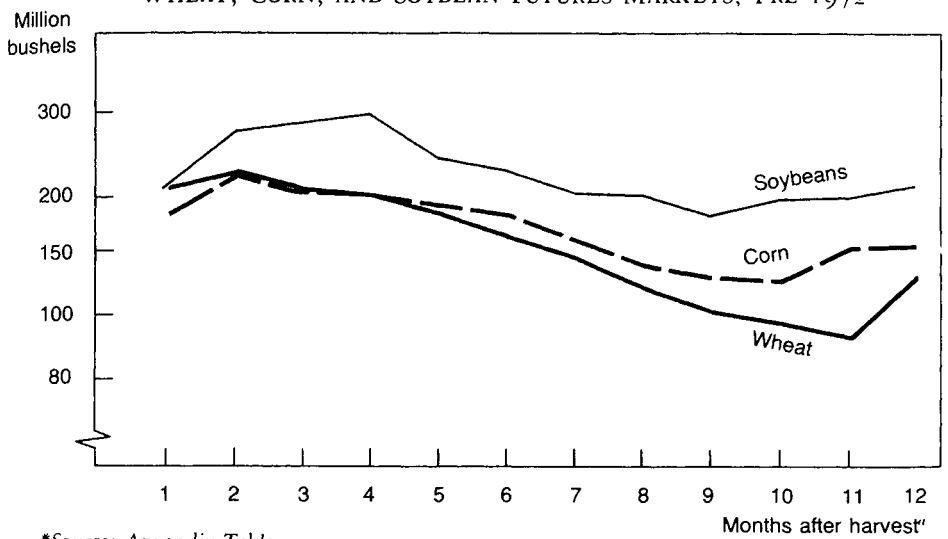


*Source: Appendix Table 1.

"One month after harvest was defined as July for wheat, October 30 for corn, and September 30 for soybeans.

year's harvest, again in consonance with the seasonal decrease in net short hedging and visible supplies. The most interesting anomaly is the relative size of the open interest on the soybean market. Hedging was most nearly balanced in this market and average stock levels did not approach those of the wheat market even when allowance was made for stocks held by processors. To the extent that markets reflect commercial use, one would expect a larger open interest on the larger market. However, government loan programs were more important market

CHART 3.—MONTHLY AVERGE TOTAL OPEN INTEREST IN WHEAT, CORN, AND SOYBEAN FUTURES MARKETS, PRE-1972*



*Source: Appendix Table 1.

"One month after harvest was defined as July 30 for wheat, October 30 for corn, and September 30 for soybeans.

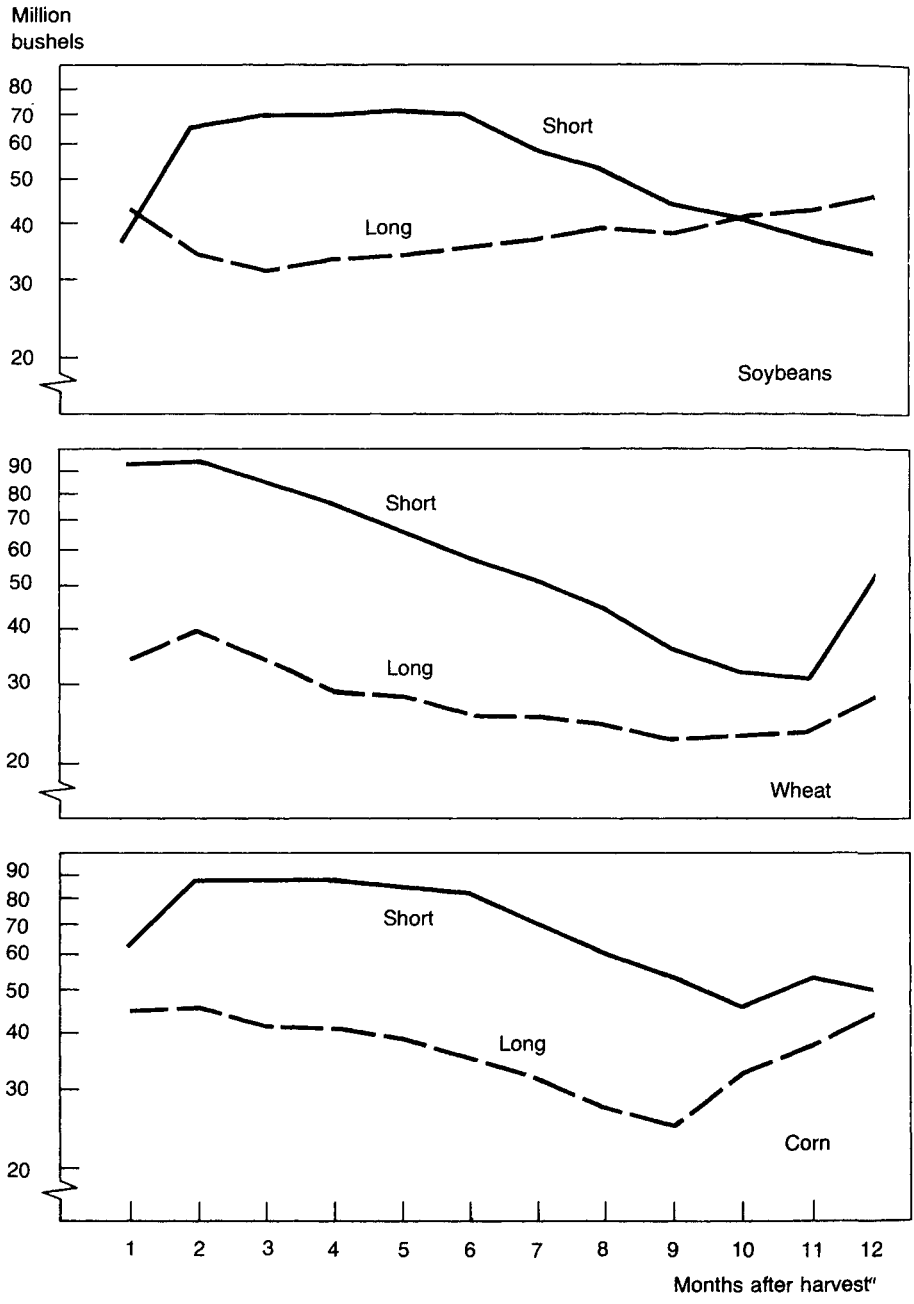
influences for both wheat and corn than for soybeans.[7] As a consequence, there was greater uncertainty in the soybean market, and a larger percentage of commercial activities was hedged. The relative balance in hedging needs in the soybean market masks this greater reliance on hedging.

The consonance among the three indicators of market activity—visible supply, net hedging, and total open interest—is evidence which suggests that futures markets depend upon commercial use. Important differences among the three markets in basic marketing patterns and in the extent to which government support programs were influenced are reflected in these comparisons. But, that total market activity responds seasonally in hedging needs is clear evidence of the dependence of futures markets upon hedging. If markets responded to speculative demands, market activity would peak at times of greater uncertainty, typically the period prior to harvest when total supplies are uncertain.

While these analyses help untangle causality, they do not aid in determining whether net or total hedging is the better measure of hedging demand. The seasonal changes in long and short hedging are shown in Chart 4. Long hedging in corn and wheat begins to increase three months before harvest and peaks within two months after harvest. For the remainder of the year, months two through nine, it decreases, changing in consonance with changes in short hedging. The patterns in soybean hedging are markedly different. Long hedging is lowest three months after harvest and rises steadily until the next harvest. Over nearly the

[7] The loan programs established floor prices for all three commodities. The more influential the program, the more it provides a "hedge" for producers as well as merchants of the crop.

CHART 4.—MONTHLY AVERAGE HEDGING IN WHEAT, CORN, AND SOYBEAN FUTURES, PRE-1972



*Source: Appendix Table 1.

"One month after harvest was defined as July for wheat, October 30 for corn, and September 30 for soybeans.

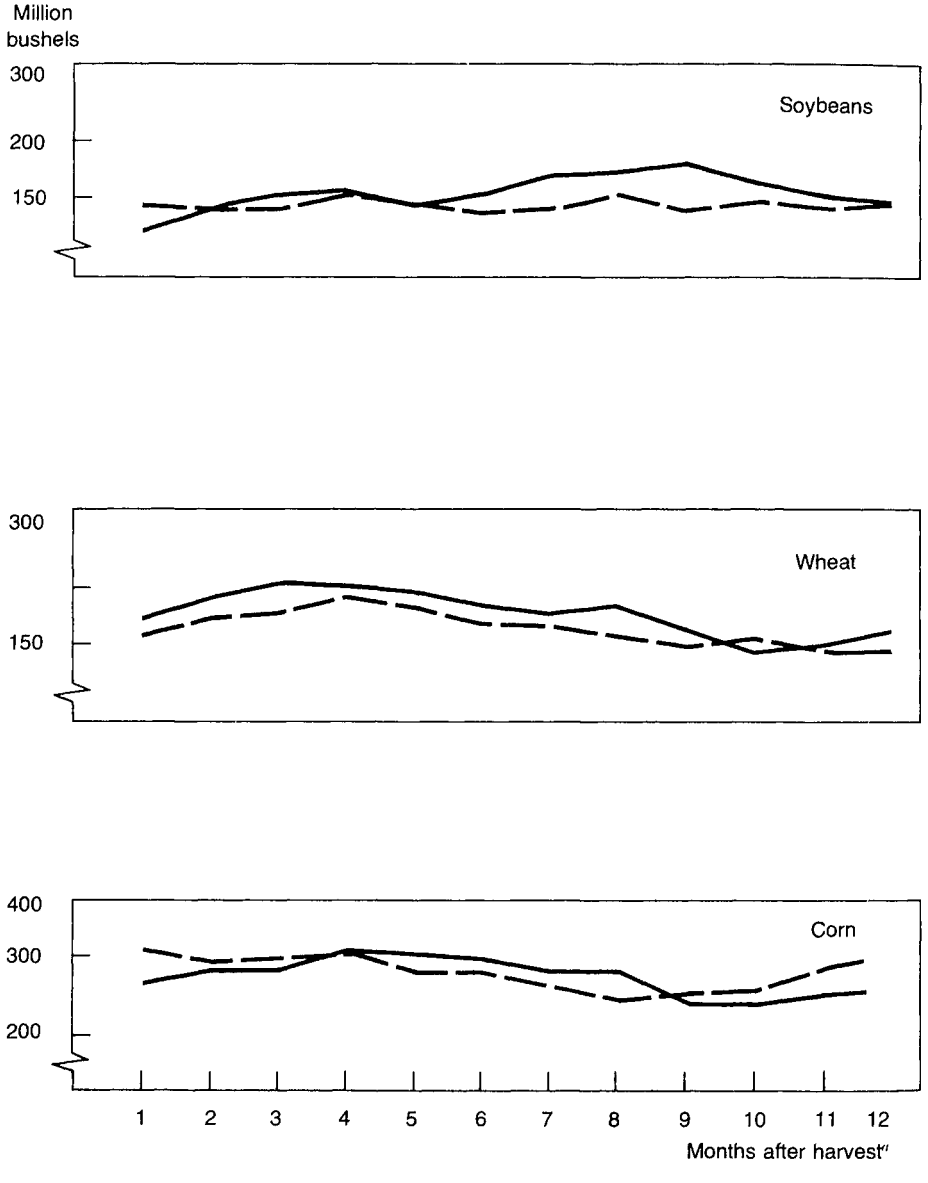
entire year, long and short soybean hedging changes in opposite directions. Thus, while soybean hedgers are more nearly offsetting in the levels of their buying and selling, their seasonal needs are quite different. Direct offset of short with long hedging is less likely, and total hedging demand provides a markedly superior explanation of total open interest.

The earlier correlation results also reflected marked changes in these markets in the 1972-77 period. In 1971, month-end open interest averaged 149.5 million bushels of wheat, 261.8 million bushels of corn, and 290.8 million bushels of soybeans. By 1977, these figures were 335.4, 590.2, and 497.3 million bushels, respectively. Commercial use of futures markets grew more than proportionately. Short hedging of corn, which was averaging 47 percent of total open interest in the pre-1972 period, averaged 62 percent of the open market interest in the period 1972-77. Simultaneously, long hedging grew from 24 to 62 percent of the open interest. In the soybean market, long hedging grew from 21 to 42 percent of the open interest while short hedging grew from 30 to 42 percent of the open interest. Long hedging in the wheat market grew from 23 to 61 percent of the open interest and short hedging from 45 to 65 percent.

Examination of open interest, hedging, and stocks data from this period also reveals significant changes from the earlier seasonal patterns and at first glance suggests that hedging and commercial needs became less important in explaining market behavior in the 1972-77 period. These patterns are not shown graphically, but the comparative statistical results are in the Appendix table. Seasonal fluctuations in stocks are significantly larger both absolutely and relatively. With a clear increase in seasonal variability in stocks of these grains and hence in hedging needs, the previous arguments lead to an expectation of similar changes in the seasonals in open interest and net hedging as well. Neither net hedging nor open interest shows corresponding increases in seasonality. In contrast with the pre-1972 results, each regression from the 1972-77 period has at most one or two statistically significant seasonal coefficients, even though a variable has been included to account for the annual average changes in levels of activity. In the recent period, hedging has become more nearly balanced in all the markets with little significant deviation from overall balance. While the earlier figures on market growth showed that all hedging had become much greater in relation to the total market, these results show clearly the effects of the more than proportionate growth in long hedging relative to short hedging.

Export data from the recent period confirm the growth in long hedgers' need of futures markets. From 1966 to 1971, exports of wheat averaged 47.6 percent of total annual disposition; from 1972 to 1977, they averaged 59.2 percent. Corn exports grew even more dramatically averaging only 12.8 percent of disposition from 1966 to 1971 and 26.0 percent from 1972 to 1977. Soybean exports grew from 32.4 percent to 38.9 percent of disposition. Thus, the radical changes in the distribution of open interest and net hedging coincided with significant changes in the marketing of these crops. The largest export growth was in the corn market, and commercial users are now net long on average. The absence of regular seasonal variation in the open interests of these three commodities reflects the changed, now nonseasonal, net demands of hedgers.

CHART 5.—MONTHLY AVERAGE HEDGING IN WHEAT, CORN, AND SOYBEAN FUTURES, 1972-78*



*Source: Appendix Table 1.

"One month after harvest was defined as July for wheat, October 30 for corn, and September 30 for soybeans.

To examine more closely these changes in net hedging, the seasonals for separate long and short hedging were estimated and are presented in Chart 5. In the 1972-77 period, the increase in balance and level are clearly apparent. Monthly changes in long and short wheat hedging are again mostly offsetting with increases in short hedging coming with increases in long hedging. Soybean hedging, however, has changed in the post-1971 period. No longer is there much of a seasonal in either long or short hedging, and almost none of the seasonal coefficients in either is significant. And, with the absence of clearly opposite changes in long and short hedging, the correlation coefficient for net hedging in this period (42.4) is much higher than in the previous period (11.2). The balanced hedging needs are more likely to be offsetting. The most significant differences in results from the earlier period are in the corn market. Though the seasonals from the 1972-77 period are much less statistically significant, there is an increased tendency for monthly changes in the separate hedging amounts to be in opposite directions. Thus, though balanced nearly as much as in the soybean market, net corn hedging is uncorrelated with total open interest and the total hedging demand is highly correlated.

Taken together, these analyses reaffirm the fundamental importance of hedging to futures markets and dependence of total activity upon hedging needs. The results also lend support to the Working definition of an appropriate measure of hedger demands upon a market. Net hedging is not the most useful view of the demands commercial users make on a market. Speculation is needed to offset both long hedging and short hedging. Only coincidentally are long and short hedgers sufficiently alike in date and amount to be offsetting, although increased balance increases the probability of such correspondence and differences in seasonal needs between long and short hedgers decreases this probability. The appropriate measure of minimum required speculation must at least begin with total hedging demand.

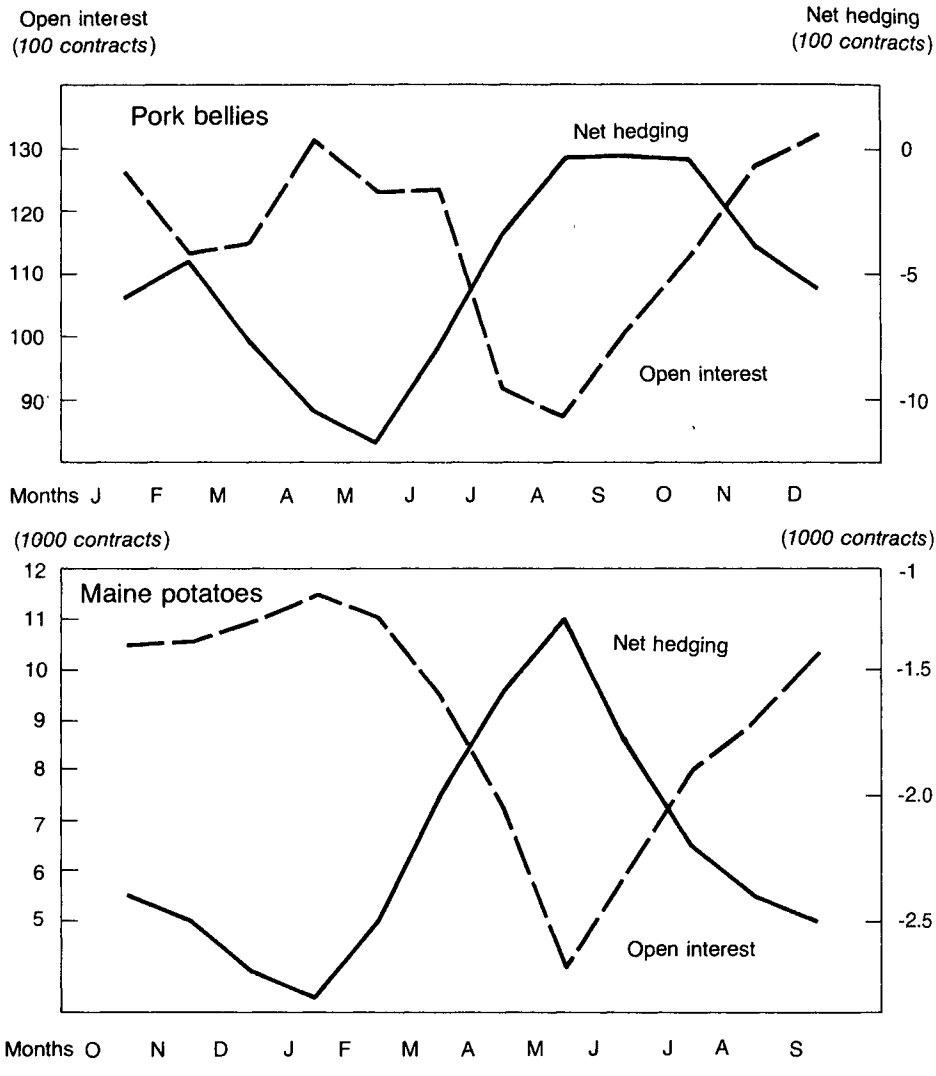
EVIDENCE FROM FIVE OTHER FUTURES MARKETS

Examination of the relationship between market activity and commercial use is extended to five other futures commodities: Maine potatoes, live cattle, pork bellies, 90-day Treasury Bills (T-Bills), and Government National Mortgage Association Certificates (GNMA's). Futures markets for the three agricultural commodities are the oldest for products with production and marketing patterns substantially different from the grains. T-Bills and GNMA futures are the oldest of the financial futures and are most likely to reflect settled patterns of use.

The Maine potato futures market has delivery months in the storage season when potatoes from the fall harvest are available from storage. However, trading in these contracts is continuous through the year, including the period prior to harvest when there are no potatoes in stock.[8] Pork bellies and live cattle, on the other hand, are produced continuously and pork bellies are storable. Futures trading in government-secured T-Bills and GNMA mortgages began in the mid-1970s though positions in these markets were not reported monthly until July 1978.

[8] See Gray (1972) and W.G. Tomek and Gray (1970) for an analysis of the pricing role of these futures as well as a more detailed description of potato marketing patterns.

CHART 6.—MONTHLY AVERAGE NET HEDGING AND TOTAL OPEN INTEREST IN PORK BELLY AND MAINE POTATO FUTURES*



*Source: Appendix Table 1.

The relationship between commercial use and total market activity on each of these markets is shown in Table 2. Total hedging demand is again the much superior measure overall and the increase in correlation is most marked when hedging is most nearly balanced. With the exception of the pork belly market, these correlations are similar to those found earlier for the grain markets. Hedging use is most unbalanced in the Maine potato and the live cattle futures markets. Over the periods observed here, long hedging averaged 8 percent of total open interest on both the potato and cattle markets, respectively. Short hedging averaged 34 percent of the open interest on the potato market and 40 percent on the cattle market. With relatively unimportant long hedging components, hedging demand is represented nearly as well by net as by total hedging. Hedging in the pork belly markets tends to be balanced, but small. Long hedging was 3 percent of the open interest on average and short hedging 8 percent.

The data for these three commodities were analyzed for the presence of seasonal patterns in hedging use.[9] The results for Maine potatoes and pork bellies are shown in Chart 6. Reported hedging in the live cattle market represents primarily meat packers and livestock slaughterhouse operators[10] and showed little evidence of seasonality. The open interest also showed no evidence of seasonality. Both the potato and the pork belly markets reflect evidence of significant seasonality in their levels of activity which are direct reflections of net hedging (Chart 6). This is perhaps most surprising in the pork belly market, where hedging is such a small percentage of total market use. Net short hedging reaches maximal levels twice during the year, in May and January, with May being the largest. This seasonal reflects inventory movement, just as in the grain markets. Pork bellies begin to move into storage in the fall. Stocks are gradually accumulated until the following spring (May), when the current hog slaughter can no longer satisfy consumption needs and the accumulated stocks are drawn down. Within this overall seasonal pattern, there tends to be a secondary seasonal with some reduction of stocks between December and February. Total open interest continues to reflect hedging needs even though they form such a small component of the total market.[11]

Maine potatoes are also storable and a seasonal is expected. However, the pattern is different from that of the grain markets. Hedging, basically all short hedging, is at a minimum in May, the end of the storage season. From May through January hedging grows increasingly net short, but most of the seasonal increase in short hedging occurs during the growing season, May through October, not over the storage period. In fact, short hedging increases most rapidly in June and July, and more than one-half of the entire increase occurs in these two months. Total open interest changes similarly over the season, peaking in January and reaching its low in May. The sporadic surveys of ownership of

[9] See Appendix Table 1.

[10] The May 1969 survey of the open interest in live cattle futures showed that producer hedging was also important with 6,006 contracts on the short side and 7,669 contracts on the long side. However, with reporting requirements set at 25 contracts and 1,160 traders involved, most of these positions would not appear in the reported hedging positions.

[11] T.A. Hieronymus (1981) has pointed out that stocks of pork bellies are among the most highly hedged. The real difficulty is that stocks of pork bellies are not large.

positions in potato futures show that most of the hedging is done by grower-dealers, the reverse of findings of similar surveys of the grain markets where producers are not significant participants. Thus, the seasonal increase in short hedging is hedging of stocks that are still in the ground. Though the pattern is different, hedging use does reflect commercial needs and total market activity reflects hedging use.

The most commercially balanced of the five markets examined here are the financial markets, and the correlation between total hedging and total market activity was high. The T-Bill market appears to be more balanced but slightly less well used by commercials than is the GNMA market. For the twelve-month period, July 1978 through June 1979, reported long hedging in T-Bills averaged 6,152 contracts, an average of 12 percent of open interest. Short hedging was nearly balanced, averaging 7,041 contracts or 13 percent of the open interest. In the GNMA market, reported hedging was also nearly balanced, averaging 18,084 contracts on the long side and 19,637 contracts on the short side, or 31 and 33 percent of open interest, respectively. These data are, however, somewhat misleading, a result of reporting requirements which, while similar in number of contracts (25), are dissimilar when applied by contract size. GNMA futures are traded in contracts of $100,000, and T-Bill futures are contracts of $1,000,000. Thus, a reportable position in GNMA's is one-tenth that of one in T-Bills.

A November 1977 survey (Hobson, 1978) of the entire open interest confirms that the difference in reporting requirements account for most of the apparent differences between these markets. In the 1977 survey, long hedging in T-Bill futures accounted for 41 percent of the open interest, and short hedging accounted for 34 percent. The figures from the GNMA market are similar, with long hedging 43 percent of the open interest and short hedging 41 percent. The lower correlation coefficients found in the T-Bill market are a reflection of the less representative character of the reported hedging data, not of a poorer relationship between hedging and total levels of market activity.

SUMMARY AND CONCLUSIONS

The analyses have explored the relationships between commercial use and total market participation in futures markets for both agricultural and nonagricultural products. Seasonality of commercial use of the three largest agricultural markets is dictated by seasonality in commercial stocks of these annually produced, continuously consumed commodities. Total market use was shown to reflect this seasonality. Since 1972, seasonality in commercial needs has virtually disappeared. While stock accumulations remain seasonal, the tremendous growth in exports and hence in commercial long hedging has offset the storage-related, short hedging needs. However, total market use is still dependent upon hedging needs, as measured by total hedging, with hedging explaining an average of 80 percent of the variation in total open interest.

Analyses of five other futures markets reaffirms the importance of commercial use in determining total levels of market activity. The Maine potato market, dominated by grower-dealer hedging, reflects these needs in a significant,

nonstorage-season increase in short hedging and, consequently, in total market use. The pork belly market is the least commercial of the markets examined here, and yet total levels of market activity clearly reflect the underlying seasonal needs of commercial users. Hedging in the live cattle market is largely nonseasonal, though highly correlated with total open interest.

The results from the two financial markets are similar to those from the agricultural markets. Commercial users of these markets are equally significant portions of total users on both markets. Commercial use is nearly balanced as in recent grain markets. Total market activity is also highly correlated with commercial use.

Futures markets are commercial markets. Their levels of activity reflect the needs of commercial firms. Commercial needs are most appropriately measured by examining their total rather than their net effect, the view suggested by Working's earlier efforts to measure total speculation relative to that minimally required to service hedging needs. A balance between long and short hedging does not imply that speculation is unnecessary, though hedger offset is more likely when large portions of the open interest are accounted for by hedging. The much higher correlation between total hedging and total open interest underscores the importance of speculation in providing a market for hedgers with conflicting needs as to timing and duration of market positions.

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APPENDIX TABLE 1.—REGRESSION MODELS OF SEASONAL PATTERNS IN NET HEDGING, TOTAL OPEN INTEREST, AND VISIBLE SUPPLIES FOR A SELECTION OF COMMODITY FUTURES MARKETS

Dependent variable		Mean	Regression coefficients[a]												
			Seasonal shifters											Annual average	R^2
			S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11		
								All Wheat[b]							
Long hedging															
	I	27.9	6.1	11.0	6.1	1.3	-0.0	-2.5	-2.8	-3.6	-5.7	-5.3	-4.7	1.0	0.84
			5.7	*10.1*	*5.6*	*1.2*	-0.0	*-2.3*	-2.6	*-3.3*	-5.2	*-4.9*	*-4.3*	34.9	
	II	164.7	-6.1	8.2	13.7	26.6	17.8	3.8	2.0	-7.2	-15.4	-8.9	-18.1	1.0	0.66
			-0.6	0.8	*1.4*	2.7	*1.8*	0.4	0.2	-0.7	*-1.6*	-0.9	*-1.8*	9.7	
Short hedging															
	I	59.8	33.2	35.0	25.8	16.3	5.6	-2.8	-9.0	-15.5	-23.5	-28.0	-29.2	1.0	0.89
			14.7	*15.5*	*11.4*	7.2	2.5	*-1.2*	-4.0	-6.9	*-10.4*	*-12.4*	*-12.9*	34.9	
	II	179.8	-7.0	11.9	28.1	25.7	19.2	6.2	-1.5	6.2	-14.6	-32.6	-27.7	1.0	0.88
			-0.8	*1.3*	*3.1*	2.8	2.1	0.7	-0.2	0.7	*-1.6*	-3.6	-3.0	19.4	
Net hedging															
	I	-31.9	-27.0	-24.0	-19.7	-15.0	-5.7	0.2	6.2	12.0	17.9	22.7	24.5	1.0	0.82
			-11.1	-9.9	-8.1	-6.2	-2.3	*0.1*	2.6	4.9	7.4	9.3	*10.1*	27.2	
	II	-15.1	0.9	-3.8	-14.3	0.9	-1.4	-2.4	3.5	-13.4	-0.8	23.8	9.7	1.0	0.58
			0.1	-0.4	*-1.4*	*0.1*	*-0.1*	-0.2	0.3	*-1.3*	*-0.1*	2.3	*1.0*	8.4	
Open interest															
	I	126.5	26.2	35.4	27.1	22.7	14.0	2.5	-6.2	-17.2	-26.4	-30.4	-34.9	1.0	0.89
			7.9	*10.6*	*8.1*	*6.8*	*4.2*	*0.7*	*-1.9*	*-5.1*	*-7.9*	*-9.1*	*-10.4*	*41.1*	
	II	273.7	-19.0	-6.9	17.5	34.6	21.4	11.7	4.8	7.7	-13.8	-23.2	-22.5	1.0	0.89
			-1.8	*-0.7*	*1.7*	*3.4*	*2.1*	*1.1*	0.5	0.7	*-1.3*	*-2.3*	*-2.2*	20.6	

Appendix Table 1.—Continued

Dependent variable		Mean	Regression coefficients: Seasonal shifters S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	Annual average	R^2
							All Wheat (continued)								
Visible supplies															
	I	268.5	31.5	50.5	49.8	35.9	17.0	2.0	-7.7	-21.3	-32.2	-45.1	-54.5	1.0	0.98
			9.5	*15.2*	*15.0*	*10.8*	*5.1*	0.6	*-2.3*	*-6.4*	*-9.7*	*-13.6*	*-16.4*	*107.5*	
	II	275.7	38.7	83.9	94.2	81.4	43.8	11.1	-15.3	-38.0	-60.6	-85.1	-110.9	1.0	0.95
			3.3	*7.1*	*7.9*	*6.9*	*3.7*	*0.9*	*-1.3*	*-3.2*	*-5.1*	*-7.2*	*-9.2*	*27.9*	
							Corn[c]								
Long hedging															
	I	36.6	8.0	8.7	4.3	3.8	1.7	-1.7	-5.3	-9.6	-11.9	-4.6	0.6	1.0	0.94
			4.6	*5.0*	*2.5*	*2.1*	*1.0*	*-1.0*	*-3.0*	*-5.5*	*-6.8*	*-2.6*	*0.4*	*63.1*	
	II	286.6	32.8	15.3	16.6	25.2	-3.8	-2.3	-20.6	-38.2	-28.9	-25.0	4.0	1.0	0.76
			2.2	*1.0*	*1.1*	*1.7*	*-0.3*	*-0.2*	*-1.4*	*-2.6*	*-2.0*	*-1.7*	*0.3*	*12.9*	
Short hedging															
	I	68.0	-6.0	18.8	18.6	19.0	15.6	13.4	1.4	-8.0	-15.3	-22.6	-15.7	1.0	0.77
			-1.1	*3.4*	*3.4*	*3.5*	*2.8*	*2.4*	*0.3*	*-1.5*	*-2.8*	*-4.0*	*-2.8*	*28.8*	
	II	279.1	-12.3	6.1	8.9	36.8	31.4	23.1	7.7	6.0	-32.3	-35.4	-23.3	1.0	0.77
			-0.8	*0.4*	*0.5*	*2.3*	*1.9*	*1.4*	*0.5*	*0.4*	*-2.0*	*-2.2*	*-1.4*	*13.2*	
Net hedging															
	I	-31.4	14.0	-10.0	-14.2	-15.2	-14.0	-15.1	-6.7	-1.6	3.4	18.0	16.3	1.0	0.42
			2.4	*-1.7*	*-2.5*	*-2.6*	*-2.4*	*-2.6*	*-1.2*	*-0.3*	*0.6*	*3.1*	*2.8*	*11.6*	
	II	7.5	45.2	9.2	7.7	-11.6	-35.2	-25.4	-28.4	-44.2	3.4	10.5	27.3	1.0	0.65
			2.9	*0.6*	*0.5*	*-0.7*	*-2.2*	*-1.6*	*-1.8*	*-2.8*	*0.2*	*0.7*	*1.7*	*8.6*	

Appendix Table 1.—Continued

Dependent variable		Mean	Regression coefficients: Seasonal shifters S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	Annual average	R^2
							Corn (continued)								
Open interest															
	I	133.7	6.1	25.6	17.2	15.1	10.0	6.0	-5.6	-16.2	-20.6	-21.5	-8.3	1.0	0.85
			0.8	*3.6*	*2.4*	*2.1*	*1.4*	*0.8*	-0.8	-2.2	-2.9	-3.0	*-1.1*	*38.0*	
	II	464.7	8.6	-0.3	-2.8	28.3	17.4	9.7	-6.1	2.6	-32.5	-23.6	-18.3	1.0	0.83
			0.4	-0.0	*-0.1*	*1.5*	0.9	0.5	-0.3	*0.1*	*-1.7*	*-1.2*	-0.9	*16.5*	
Visible supplies															
	I	74.2	-15.9	7.6	14.6	13.9	14.9	13.6	7.9	-0.4	-7.0	-14.4	-17.0	1.0	0.81
			-5.3	2.5	4.9	4.6	5.0	4.5	2.6	*-0.1*	-2.3	-4.8	-5.7	*31.7*	
	II	96.5	-1.0	31.0	36.3	37.4	30.7	24.5	8.9	-18.0	-28.6	-42.8	-44.9	1.0	0.87
			-0.2	5.4	6.3	6.5	5.4	4.3	*1.6*	*-3.1*	-5.0	-7.5	*-7.8*	*8.2*	
							Soybeans[d]								
Long hedging															
	I	32.7	6.0	-3.1	-6.1	-4.3	-3.8	-2.5	-1.9	1.2	-0.0	2.1	4.3	1.0	0.91
			2.8	*-1.5*	-2.9	-2.0	*-1.8*	*-1.2*	-0.9	0.6	-0.0	*1.0*	*2.0*	*48.1*	
	II	145.0	0.7	-2.4	-2.4	7.4	-0.5	-5.4	-2.8	7.7	-4.2	3.0	-2.7	1.0	0.56
			0.1	*-0.4*	-0.4	*1.1*	*-0.1*	-0.8	-0.4	*1.2*	-0.6	0.5	*-0.4*	*8.4*	
Short hedging															
	I	53.2	-16.9	11.9	16.3	15.2	16.5	15.1	4.0	-1.8	-10.0	-13.4	-17.0	1.0	0.82
			-4.9	*3.5*	*4.7*	*4.4*	*4.8*	*4.4*	*1.2*	-0.5	-2.9	-3.9	*-4.9*	*30.5*	
	II	153.3	-24.9	-11.0	-1.4	3.1	-9.5	-1.5	14.5	20.8	16.3	9.2	-1.5	1.0	0.58
			-1.7	-0.7	*-0.1*	0.2	-0.6	*-0.1*	*1.0*	*1.4*	*1.1*	0.6	*-0.1*	*8.6*	

Appendix Table 1.—Continued

Dependent variable		Mean	Regression coefficients: Seasonal shifters S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	Annual average	R^2
Soybeans (continued)															
Net hedging															
	I	-16.2	22.9	-15.1	-22.4	-19.5	-20.3	-17.6	-5.9	3.0	10.0	15.5	21.3	1.0	0.64
			5.3	*-3.5*	*-5.2*	*-4.5*	*-4.7*	*-4.1*	*-1.4*	*0.7*	*2.3*	*3.6*	*4.9*	*15.3*	
	II	-8.3	25.6	8.6	-1.0	4.3	9.0	-3.8	-17.4	-13.2	-20.5	-6.2	-1.2	1.0	0.46
			1.7	*0.6*	*-0.1*	*0.3*	*0.6*	*-0.2*	*-1.1*	*-0.9*	*1.3*	*-0.4*	*-0.1*	*6.5*	
Open interest															
	I	164.4	-9.5	22.6	29.3	35.5	7.4	1.3	-12.1	-13.0	-23.3	-15.5	-14.9	1.0	0.90
			-1.6	*3.8*	*5.0*	*6.0*	*1.3*	*0.2*	*-2.1*	*-2.2*	*-4.0*	*-2.6*	*-2.5*	*45.0*	
	II	369.1	-10.4	6.5	28.6	73.3	-30.5	-38.4	-15.6	-9.1	2.1	2.9	-8.2	1.0	0.89
			-0.6	*0.4*	*1.8*	*4.5*	*-1.9*	*-2.4*	*-1.0*	*-0.6*	*0.1*	*0.2*	*-0.5*	*21.0*	
Visible supplies															
	I	22.1	-14.1	6.3	10.4	9.0	8.1	7.5	5.7	2.2	-3.0	-7.0	-10.5	1.0	0.87
			-10.3	*4.6*	*7.6*	*6.6*	*6.0*	*5.5*	*4.2*	*1.6*	*-2.2*	*-5.1*	*-7.7*	*34.4*	
	II	34.6	-20.7	8.6	13.5	9.5	11.4	11.9	6.3	5.1	-2.3	-7.8	-14.4	1.0	0.79
			-6.7	*2.8*	*4.4*	*3.1*	*3.7*	*3.9*	*2.1*	*1.7*	*-0.7*	*-2.5*	*-4.7*	*6.8*	
Maine potatoes[c]															
Net hedging															
	I	-2.2	-0.2	-0.3	-0.4	-0.6	-0.3	0.2	0.6	0.9	0.5	-0.0	-0.1	1.0	0.55
			-0.6	*-1.3*	*-1.9*	*-2.4*	*-1.3*	*1.0*	*2.5*	*3.9*	*2.0*	*-0.1*	*-0.6*	*17.0*	
Open interest															
	I	-9.1	1.4	1.5	2.0	2.4	2.0	0.4	-1.8	-5.0	-3.1	-1.1	-0.2	1.0	0.77
			2.5	*2.8*	*3.5*	*4.2*	*3.5*	*0.7*	*-3.2*	*-8.9*	*-5.5*	*-1.9*	*-0.2*	*26.3*	

						Live cattle[f]								
Net hedging														
	I	-13.5	2.6	2.2	0.2	-2.3	-2.8	0.5	-1.8	-1.1	-0.1	1.7	-0.3	1.0	-0.86
			1.9	*1.6*	0.2	*-1.7*	-2.0	*0.4*	*-1.3*	-0.8	*-0.1*	*1.2*	0.2	20.8	
Open interest															
	I	38.9	-5.0	-2.9	-0.1	1.5	2.8	-1.9	0.7	-0.1	0.6	0.1	2.6	1.0	0.93
			-2.3	*-1.3*	*-0.1*	0.7	*1.3*	-0.9	*0.3*	*-0.1*	*0.3*	0.0	*1.2*	*30.3*	
						Pork bellies[g]								
Net hedging														
	I	-5.2	-0.7	0.6	-2.6	-5.2	-6.5	-2.9	1.8	4.7	4.9	4.7	1.5	1.0	0.65
			-0.5	*0.5*	*-1.9*	*-3.8*	*-4.8*	*-2.2*	*1.3*	*3.5*	*3.6*	*3.5*	*1.1*	*8.5*	
Open interest															
	I	115.5	10.2	-1.8	0.1	16.0	7.5	7.9	-23.3	-27.9	-14.7	-2.3	11.4	1.0	0.83
			1.5	*-0.3*	*0.1*	*2.3*	*1.1*	*1.1*	*-3.3*	*-4.0*	*-2.1*	*-0.3*	*1.6*	*19.2*	

*Based on data from U.S. Department of Agriculture, C.E.A., "Annual Summary of Commodity Futures Statistics," Statistical Bulletins, 1947/48-1971/72, Commodity Futures Trading Commission, "Commitments of Traders in Commodity Futures," monthly, 1972-1978, and Chicago Board of Trade, *Statistical Annuals*, various years.

"S1 through S11 are dummy variables whose numbers indicate months after harvest. They take on values of 1 in the specified month, -1 in the omitted (twelfth) month, and zero elsewhere. The shifter for the omitted month is the negative sum of the coefficients of all the included variables. The value of the overall constant is the mean of the dependent variable in this formulation. Since, however, a variable has been included to adjust the regression for changes in the annual average ("annual average" is each crop year's average value of the dependent variable), the value of the overall constant was uniformly zero and these terms are not reported here. Figures in italics are t-statistics.

[b]Futures positions are summed over the Chicago, Kansas City, and Minneapolis markets. Units are million bushels. Period I is July 30, 1947 through June 30, 1977, and period II is July 30, 1971 through June 30, 1978.

[f]Units are million bushels. Period I is October 30, 1948 through September 30, 1972 and period II is October 30, 1972 through September 30, 1978.

[d]Units are million bushels. Period I is September 30, 1951 through August 30, 1972 and period II is September 30, 1972 through August 30, 1978.

[e]Units are thousand contracts. The period is November 30, 1952 through October 30, 1975.

[f]Units are thousand contracts. The period is January 30, 1972 through December 30, 1978.

[g]Units are hundred contracts. The period is January 30, 1971 through December 30, 1978.