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FUTURES MARKETS, FOOD IMPORTS AND FOOD SECURITY

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I. INTRODUCTION

The unprecedented volatility of major food and feed grain prices in the seventies created a major concern within the international community for "food security." The term food security itself evolved to a phrase which summarizes the myriad of issues surrounding both domestic (local) and international (global) food policies. Local dimensions of food security include self-sufficient production strategies, improved marketing facilities, food reserve schemes, and consumer subsidies. Global dimensions include international buffer stocks, compensatory financing schemes, and food-aid policies. These seemingly separate dimensions of food security issues are inextricably joined in individual country's decisions and policies concerning food imports or exports.

While instability in world food prices may have focused attention on security issues, an increasing awareness of questions of market efficiency within the broader policy context has also emerged. To the extent that improvements in market or marketing efficiency increase price stability, the links are clear. However, even perfectly efficient markets do not eliminate price variability. Thus, to the extent that a country continues to rely upon world markets for imports of food or feed grains, understanding these markets becomes of critical importance in effectively managing domestic "food security" programs.

With the exception of rice, the dominant food and feed grain markets in the world are commodity futures markets. Virtually all trade in these grains is priced by reference to these markets. Perhaps because they are located physically in developed countries (principally the U.S. and England), futures markets are not widely understood in less developed countries, even those that are significant grain importers.

Thus, the principal purpose of this paper is to describe the operation of futures markets generally and their role in the international movement of grain. The next section of the paper provides a description of a futures contract and of the mechanics of participating in futures markets. Following that, the broad classifications of futures traders are defined and their uses of the markets developed. Emphasis here is placed upon current forms of commercial, as distinct from speculative, uses of these markets. And, among commercial users, exporters' uses are highlighted.

Futures markets are used by the major grain export companies both to bid on import tenders or negotiations and to purchase temporarily the required, contracted commodity. Thus, understanding of these markets is linked directly to LDC's food importing strategies. The costs of these imports (and hence costs of all domestic programs linked to price policies) are reflected continuously in futures prices. Since futures contracts are traded more than a year ahead of their delivery time, planning of domestic food programs may be enhanced by careful observation and analysis of futures prices.

In addition however, futures markets may be of direct use to importing countries in managing the relatively shorter term price volatility that invariably alters actual from planned costs of imports (and, hence, costs a host of other programs). The final sections develop alternative purchase strategies available to LDCs using futures markets and evaluates their effects.

The links between an individual country's use of futures markets to procure food or feed imports and food security <u>per se</u> are indirect, at best. However, futures markets have been shown to be efficient market mechanisms for stabilizing, within the limits of the uncertainty of new market information, both intra and interseason prices. That is, futures markets lead to optimal within and between season allocations of commodity supplies. Thus, the effects of futures markets are linked directly to food security issues, especially as these concern optimal levels of stocks of commodities. These effects are discussed in the Appendix, however, since economically optimal stocks levels do not imply price stability. Prices remain variable reflecting differences between expectations and certainty about specific production and consumption levels. Even if the resulting price variability were politically acceptable, strategies designed to manage the effects of variability are important. Thus, the paper focuses upon use rather than effects of futures markets.

Finally, though importing strategies are the focus of the present paper, many importing countries are also exporters of primary agricultural products and metals and, since futures markets also exist for many of these products, exporting strategies using futures may also be of interest. Such strategies may be of direct concern if unpredictability of foreign exchange earnings, either in level or in seasonal flows, is a serious constraint on a country's ability to make import commitments on a timely basis. An analysis of these uses would be similar to those developed in Sections VII and VIII below and is not included here.

II. COMMODITY FUTURES MARKETS

A. Cash, Forward and Futures Markets

Grain marketing is accomplished through three interrelated marketing systems--cash markets, forward markets and futures markets. Cash markets are immediate delivery markets and represent transactions that simultaneously price and convey ownership of commodities. The most common cash market transaction is the point of first marketing of a grain, moving from the farm to a local elevator. A farmer, deciding to sell grain today, would deliver it to a local elevator, have it weighed and graded immediately, and receive a check on the same day. The price is a cash (sometimes called spot) market price. Prior to actually delivering the grain, the farmer does not know exactly what price he will receive. In the U.S., surveys (Helmuth, 1976; Heifner, et al, 1974) have indicated that the majority of grain moves from the farm to first merchant in cash market transactions.

Cash prices are location and quality specific. However, a published cash price quotation will represent normally the most common grade of the commodity (#2 yellow corn, #1 yellow soybeans). All cash merchants will maintain discount and premium schedules for grain that does not meet the standard grade specifications. These schedules can vary during a marketing season and do vary substantially between seasons. For example, in a year with a very wet corn harvest (high average moisture content in corn as it is being harvested), discounts on moisture greater than the standard 14 percent will be large. By contrast, corn harvested in drier conditions, such that most of the crop does not require drying before storage, will occasion minimal discounts on moisture deviations from 14 percent.

The second set of markets, forward markets, adds a time dimension to cash markets. Like a cash contract, a forward contract is location specific, quality specific, and amount specific. However, commodity ownership is not transferred on the date the contract is made; rather, a forward contract sets the actual transfer sometime in the future. Finally, a forward contract usually fixes the price. (Forward contracts may also be basis priced, a practice that will be discussed more fully later.) Buyer and seller agree today on what price will be paid for the commodity when it is delivered under the terms of the contract.

For example, a farmer in the U.S. who has decided to plant 75 acres of corn knows what his basic costs of production will be. He expects a yield of 115 bushels to the acre, but, to be conservative, he is planning on the basis of 100 bushels to the acre. He calls his local elevator to determine the price the elevator is bidding for corn to be delivered in the fall (October-November), at harvest. If the price covers his costs of production, he may decide today, while planting the corn, to sell it to the elevator for delivery in the fall. Thus, he might enter a forward contract with the elevator for 7,500 bushels of corn to be delivered in October, for which he will receive a fixed price today. The contract normally would include provisions for delivery either earlier or later than that agreed upon and for delivery of corn which does not meet other agreed upon specifications.

Forward contracts also are used extensively in the export of grains. In fact, virtually all export contracts are forward contracts--contracts made today for delivery of the actual commodity sometime in the future. They are used extensively by processors of agricultural commodities, for example flour millers and corn processors, to insure a continuous supply of the commodity to their processing facilities which typically do not have large on-site storage capacity. Since grains are produced only once during the year but are processed (consumed) continuously, forward contracts provide substitutes for storage capacity at the processing location. The grain is not actually moved from the farm or other location until it is needed for processing.

Forward contracts are not accompanied necessarily by performance bonds. That is, neither buyer nor seller is required to advance money to assure that he will honor the contract. Thus, as prices change over the period of the contract (from spring to fall in the farmer example above) either the buyer or the seller will have an incentive to default on the contract. In other words, the contract assumes value over its life.

Finally, forward contracts are relatively illiquid. A particular forward contract is quantity, quality and location specific. These conditions made it attractive to the original buyer and seller but they may not be attractive to any other potential buyer or seller. Thus, it is usually very difficult to trade a forward contract should market conditions change and the buyer, for example, no longer needs the contracted grain.

The third set of markets, futures markets, evolved in the mid-nineteenth century as a solution to both the liquidity and the default problems of forward contracts. The cost of the solution was standardization. Futures contracts are standardized forward contracts. That is, all corn futures contracts are identical in that they are obligations to make or take delivery of a fixed amount and quality of corn in a specified location at some point in the future. Potential delivery months are prespecified as is the time within the delivery month when actual delivery can be made. Summary contract specifications for corn, wheat and soybean futures contracts at the Chicago Board of Trade (CBT) are shown in Figures 1-3. The only item to be negotiated when buying or selling a futures contract is price.

Standardization of contract terms facilitates centralization of trading and, though cash grain markets remain regionally dispersed, futures trading is not. All futures contracts are traded on exchanges, according to the rules of the exchanges with regulatory oversight (in the U.S.) by the Commodity Futures Trading Commission (CFTC). All trades are by open outcry at the exchange--buyers and sellers offering their desired transactions to all assembled traders. Because all contract terms are prespecified, only price is being negotiated. The exchanges in the U.S. which trade grain futures are the Chicago Board of Trade (wheat, corn, oats, soybeans and soybean products), the Kansas City Board of Trade (wheat), the Minneapolis Grain Exchange (wheat, sunflower seeds). In England, the EC Grains Market trades corn and wheat, though prices there reflect the EEC's Common Agricultural Policy.

Figure 1.--Summary Specifications for the Wheat Futures Contract, Chicago Board of Trade*

Delivery months	July, September, December, March, and May
Trading unit	5,000 bushels
Price quotations and minimum fluctuation	Quoted in cents and quarters of a cent per bushel, with a minimum fluctuation of ¼ cent per bushel ($12.50 per contract)
Daily price movement limits	20 cents per bushel
Position limits	3 million bushels (CFTC limit) in any one future or in all futures combined
Par delivery grades	No. 2 Soft Red, No. 2 Hard Red Winter, No. 2 Dark Northern Spring, No. 1 Northern Spring, and substitutions at differentials established by the Exchange
Permitted substitutions on delivery	At a 1 cent premium: No. 1 Soft Red, No. 1 Hard Red Winter, No. 1 Dark Northern Spring. At a 1 cent discount: No. 3 Soft Red, No. 3 Hard Red Winter, No. 3 Dark Northern Spring and No. 2 Northern Spring (not to exceed 13.5% moisture)
Delivery	By registered warehouse receipts issued by warehouses approved by the Exchange in the Chicago Switching District or Toledo, Ohio Switching District. Deliveries from Toledo are made at a discount of 2 cents per bushel under contract price
Trading hours	9:30 a.m. to 1:15 p.m. Central Time

* Commodity Trading Manual, p. 140 and Rules and Regulations of the Board of Trade of the City of Chicago. The information here is meant to be representative; it is all subject to change.

Figure 2.--Summary Specifications for the Corn Futures Contract, Chicago Board of Trade*

Delivery months	December, March, May, July, and September
Trading unit	5,000 bushels
Price quotations and minimum fluctuation	Quoted in cents and quarters of a cent per bushel, with a minimum fluctuation of ¼ cent per bushel ($12.50 per contract)
Daily price movement limits	10 cents per bushel
Position limits	3 million bushels (CFTC limit) in any one future or in all futures combined
Par delivery grades	No. 2 Yellow corn
Permitted substitutions on delivery	At a ½ cent premium: No. 1 Yellow corn. At a 1½ cent discount: No. 3 Yellow corn (maximum 15½% moisture)
Delivery	By registered warehouse receipts issued against stocks in warehouses that have been declared regular by the Exchange, located in the Chicago Switching District, The Toledo, OH, Switching District, and the St. Louis, MO, Switching District (which includes East St. Louis, IL, and Alton, IL). Deliveries at Toledo and St. Louis are made at a discount of 4 cents per bushel under the (Chicago) contract price
Trading hours	9:30 a.m. to 1:15 p.m. Central Time

* *Commodity Trading Manual*, p. 147 and *Rules and Regulations of the Board of Trade of the City of Chicago*. The information here is meant to be representative; it is all subject to change.

Figure 3.--Summary Specifications for the Soybean Futures Contract, Chicago Board of Trade*

Delivery months	September, November, January, March, May, July, and August
Trading unit	5,000 bushels
Price quotations and minimum fluctuation	Quoted in cents and quarters of a cent per bushel, with a minimum fluctuation of ¼ cent per bushel ($12.50 per contract)
Daily price movement limits	30 cents per bushel
Position limits	3 million bushels (CFTC limit) in any one future or in all futures combined
Par delivery grade	No. 2 Yellow soybeans
Permitted substitutions on delivery	At a 3 cent premium: No. 1 Yellow soybeans At a 3 cent discount: No. 3 Yellow soybeans (maximum 14.5% moisture)
Delivery	By registered warehouse receipts issued by warehousemen against stocks in Chicago warehouses that have been declared regular by the Exchange
Trading hours	9:30 a.m. to 1:15 p.m. Central Time

* Commodity Trading Manual, p. 158 and Rules and Regulations of the Board of Trade of the City of Chicago. The information here is meant to be representative; it is all subject to change.

Unlike cash or forward contracts, futures contracts are rarely used to transfer actual ownership of commodities. The standardization of contract terms which facilitates market liquidity and price discovery discourages users of the physical commodity from accepting delivery. The standardized terms of futures contracts are rarely coincident with the precise needs of a commercial user as to timing, location or quantity. Thus, futures contracts are rarely held until delivery; instead, they are either replaced with contracts of more distant maturities (rolled over) or they are closed as the actual physical commodity is acquired (offset). Delivery on futures contracts occurs in less than 1 percent of the contracts traded. Thus, cash and forward markets remain as important links in the marketing system. They continue to be widely used to move the grain from producers to users. However, prices in these contracts are derived from those established on the grain futures markets, as will be considered below.

B. The Futures Exchange Clearinghouse and the Role of Margins

Two additional institutional features--margins and the clearinghouse--distinguish futures from forward contracts. All futures exchanges have a clearinghouse which checks all recorded trades to make sure that buyer and seller agree on price and on the number of contracts traded. In the unusual event that the two reported trades (i.e., the buyer's version and the seller's version) do not agree, the so-called out-trade is reported to both traders after the close of trading. The disputed items must be resolved before the opening of trading on the following day. If there are unresolvable differences, the two parties can take the dispute to an exchange arbitration committee. Finally, if there are too many out-trades unresolved before an opening, the market's open can (and has) been delayed to permit additional time to clear the records.

Assuming a trade "clears," then the clearinghouse becomes the third-party to each contract. That is, the individual buyer and seller now have obligations to take or make delivery with the clearinghouse, not with each other. The impersonalization of futures contracts through the third-party role of the clearinghouse serves to enhance market liquidity by facilitating market exit. For example, to fulfill contractual obligations, a buyer must either accept delivery of the actual commodity in the designated month <u>or</u> he must sell a like amount of contracts before the expiration of the contract. The latter transaction, called offset, makes the individual net even in the records of the exchange (having bought from and sold to the same "person"--the exchange--in equal amounts) and he would be out of the market. The buyer does not have to find the individual to whom he originally sold since his contract is not with that person. Thus, a futures contract is much more liquid than a forward contract.

Finally, in order to trade futures contracts, both buyer and seller must deposit a sum of money with the clearinghouse (or their broker who, in turn, is obligated to the clearinghouse) to guarantee performance on their contractual obligations. With these monies, so-called margin money, the clearinghouse marks all open futures positions to the market price at the close of trade every day. For example, suppose a September corn futures contract has been bought at $3.50 per bushel and by the close of trading September corn prices have risen to $3.60. The clearinghouse treats all positions as if they had been closed at the close of trade and transfers the gains to and losses from all traders into and out of their respective margin accounts. Thus, in the above example, $500 ($.10 X 5,000 bushels) actually will be transferred to the margin account of the purchaser. The money will have come from the account of someone who had sold corn. On a daily basis, the value of a futures contract is reset to zero as all gains and losses are paid.

The initial margin that must be deposited before an individual can trade is normally quite small relative to the value of the contract. Recently, the minimum initial margin on a soybean contract was $1,500. With soybeans trading at $6.50, a contract of soybeans was worth $32,500 or more than 20 times the margin deposit. While initial margins are small, the daily accounting of positions means that an individual with a losing position (e.g. the seller of corn at $3.50) may be required to deposit additional margin monies, maintenance margin, as his initial margin is depleted. And, if additional money is not deposited, his position will be closed out before the entire initial margin is depleted.

Initial margins can be set at very low levels in part because of maintenance margins (i.e., margin accounts are not allowed to be depleted) and in part because futures price changes are limited on a daily basis. For example, corn prices today can increase (decrease) by no more than $.10 from yesterday's closing prices. Thus, maximum daily losses are known in advance. Minimum margins are established generally so as to provide the clearinghouse with 3-5 days maximum loss protection, which enables firms adequate time to advance additional margin monies, if required. Price limits and margins can be changed overnight--should market conditions dictate.

Margins combined with daily marking of positions to the market reduce the risk of contract default to virtually zero. The clearinghouse, as third party to all transactions, establishes the principle of offset as a means of reversing a previous decision. Standardization of all contracts implies that only price is being determined. Because of their enhanced liquidity, small default risk and standardization, futures markets have become the primary point of price determination for all the grain markets.

III. TRADERS IN COMMODITY FUTURES MARKETS--SPECULATORS

Participants in commodity futures markets are classified into two groups--hedgers and speculators. The distinction has both legal (regulatory) and economic importance. From a regulatory viewpoint, hedgers are all those participants whose businesses involve some aspect of the production, marketing, or use of the underlying physical commodity. Included as hedgers would be farmers, grain elevators, merchants, processors, feeders and exporters. The economic implications of hedgers' transactions in futures markets can be evaluated properly only in terms of both their cash market and their futures market positions. Speculators, on the other hand, have no other commodity positions except futures positions. The economic implications of their futures trading are directly reflected in profits and losses on those positions. The regulatory significance of the distinction between hedgers and speculators is that the latter may control futures positions no larger than 3 million bushels (600 contracts) in any of the grain markets. The literature on futures markets distinguishes three kinds of speculators--position traders, spreaders, and scalpers.

A. Position Traders

Position trading is the most familiar form of speculation. It is trading done in the expectation of making a profit from price changes over time. The relevant time period may be as short as a day or two or as long as months. Position traders use both fundamental analyses of data on market supplies and demand and technical analyses of past price data (and sometimes other indicators of market activity) to determine their trading strategies. In recent years, position traders have accounted for an average of 20-30 percent of futures contracts open at the end of the day--the open interest--in each of the principal grain markets. They include both professional traders and the bulk of the so-called amateur traders. Also included are the professionally managed accounts and commodity mutual funds.

B. Spread Traders

The second form of speculation is spreading. Spread traders seek to profit from predicting changes in relative prices rather than price levels *per se*. Thus, a spread trader would buy one futures maturity and sell another simultaneously. Spreads may be established within one market or between two or more separate markets. An example of an intermarket spread in the corn market is buying December corn and selling March corn simultaneously in September. In this case, the trader would expect that the December price would gain on the March price before December. In addition he may have no opinion on which direction price levels will go. The most common intermarket spreads (or most frequently watched) are old crop/new crop spreads. For corn, the last old crop future is September while the first new crop future is December. For wheat, it is the May-July spread, and, for soybeans it is the July or August vs. the November future. The economic importance of these spreads will be discussed below in the price relationships section.

Intramarket spreads include those between two markets for the same commodity as well as for different commodities. For example, there are three active wheat futures markets--Chicago, Kansas City, and Minneapolis. A potential spread trade would be to buy Chicago July wheat and sell Kansas City July wheat in the expectation that Chicago wheat prices would increase relative to Kansas City prices. Increases or decreases in overall wheat price levels are immaterial to this position. The most common spread trade among markets for different commodities is between soybean futures and soybean product--meal and oil--futures. Buying soybean futures and selling soybean meal and soybean oil futures--called "putting on the crush"--would be done if the processing margin was expected to narrow. The reverse crush--sell beans and buy products--would be done if the margin was expected to widen. Other spread trades can be derived from production considerations. The relationship between new crop corn and soybean prices (December corn and November beans) is analyzed with a view to the relative incentive it reflects to plant corn and soybeans.

Only those spread trades that are between futures maturities for the same commodity are reflected in market statistics. In recent years, spreading among contracts for the same commodity has accounted for an average 5 to 20 percent of positions open at the end of the day in the grain markets.

C. Market-Makers

The third form of speculation on commodity futures markets has been given the name scalping. Fundamentally, scalpers are market-makers. They trade in large volumes during the daily trading session, but rarely do they carry open positions overnight. That is, only occasionally will they speculate on price changes over so short a period as a day. Their trading has been described by Working (1958, p. 186) as always standing "ready either to buy at 1/8 cent below the last price or to sell at 1/8 cent above it." Today, the 1/8 cent would be ¼ cent, reflecting the change in the minimum permitted price change. Scalpers' profits are derived from skillfully accommodating the flow of orders as they come to the market. Unlike market-makers on the stock market, scalpers are not assigned to any one market nor do they hold an "inventory" of public orders. Their income is derived solely from their trading.

The activity of scalpers is not measurable in the day's end open positions since they do not generally have open positions. Rather, their activity is reflected in the volume of trading during the day. Of course, the volume will also reflect the changes in positions of all other traders as well. Unfortunately, there is little data on the composition of traders in the daily volume. From what is available, it appears that approximately 90-95 percent of the volume is speculative (Rutledge, 1978) as opposed to hedging transactions and most of that is likely to be scalping.

D. Measures of Speculative Activity

The two measures of levels of activity on futures markets are volume and open interest. Both are measured from one side of the market only. That is, since every buyer must find a seller, to count both the buy and the sell transaction would be double counting. The volume of trading is the number of buy (or sell) contracts executed during the day (or any other fixed time). The open interest is always measured after the close of trading on a day and is the number of buy (or sell) contracts which remain open with the clearinghouse. Finally, since buyers are also denoted as long futures, and sellers are short futures, the composition is described for both the long open interest and the short open interest.

Given the various percentage participation numbers earlier, a comparison of the sizes of the different forms of speculation can be made. On Friday, October 24, 1980, the open interest in corn futures (CBT) was 144,895 contracts and the volume of trading was 37,115. The most recent complete categorization of the open interest in corn futures (Peck, 1981) showed position traders represented some 10 percent of both the long (buy) and the short (sell) open interest. Spreading accounted for approximately 15 percent of the open interest. Thus, on Friday, long speculation would have been some 14,490 contracts, short speculation would have been some 14,490 contracts, and spreading would have been 21,734. Finally, assuming 90 percent of the volume was speculation and that most of this was scalping, approximately 33,404 contracts were traded by scalpers. Thus, more than 50 percent of speculation in the corn futures market was scalping. And the smallest category of speculation was position trading--the category which is most often associated with the word speculation.

Finally, these data on volume and open interest are often used to calculate the average length of time a futures position is held open. Sometimes called the turnover, it is the open interest divided by the volume. From the corn data, the turnover on October 24 was 3.9 days. In recent years, the turnover rate in each of the principal grain futures markets has been averaging between three and five days. While the measure combines the activities of traders who hold no overnight positions with those that do (both hedging and speculative traders) it does provide an indication of the relatively short time horizons of all futures traders. In particular, if hedgers are assumed to have the longest planning horizons (dictated by the needs of their cash business), the majority of position traders and spreaders must be viewed as having very short planning horizons--measured more realistically in days rather than weeks or months.

IV. TRADERS IN COMMODITY FUTURES MARKETS--HEDGERS

Hedging is the use of futures contracts by commercial firms whose business involves the physical commodity as a temporary substitute for an intended cash market transaction. In recent years, hedging has accounted for 60-90 percent of the open interest on grain markets in the U.S. Hedging use of futures markets arises in three, very different circumstances. These have been identified as arbitrage hedging, operational hedging, and anticipatory hedging (Working, 1953a, b). Arbitrage hedging is the simultaneous purchase (sale) of the cash commodity and sale (purchase) of futures contracts and is most commonly associated with commodity storage. Operational hedging is the use of futures purchases or sales as temporary substitutes for actual purchases or sales primarily because futures markets are much more liquid than the relevant cash markets That is, they provide buying and selling convenience not available in cash markets. Finally, anticipatory hedging is the purchase or sale today of an anticipated commodity purchase or sale. In this case, futures markets are seen to provide an alternative, continuous market for pricing commodities, thus giving the hedger greater freedom in making business decisions.

Reduction in business risks is a motive often attributed to all hedging decisions. And as will be seen below, most hedging transactions do reduce risks as these relate to commodity price variability. However, risks must be variously defined to achieve a risk reduction effect in each of the above types of hedges. In addition, this motive, which numerous writers emphasize to the the exclusion of others, masks the real diversity among commercial users of markets. Indeed, in some circumstances, it leads to inappropriate formulations of the effectiveness of hedging transactions. Thus, risk reduction effects of hedging decisions will be considered in each of the examples, though emphasis will be placed on other motives.

A. Arbitrage Hedging

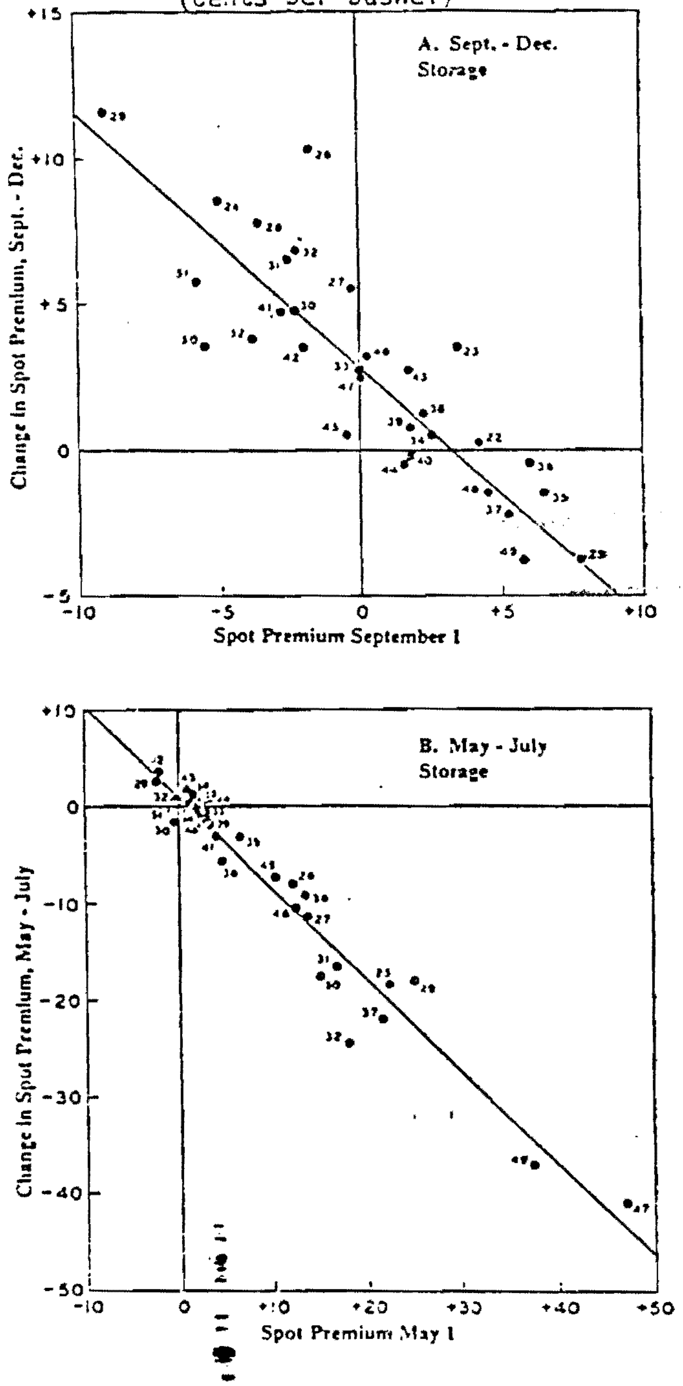
In the literature on futures markets, the most common example of a hedging transaction focuses on seasonal storage of an agricultural commodity. To simplify, consider an elevator located in Chicago which is a deliverable location on the CBT corn futures contract. In addition, assume that corn still moves to Chicago in significant quantity. On October 27, 1981 cash corn was trading in Chicago at $2.53¼ (technically, this was the to-arrive-in-30 days price in the Wall Street Journal). The closing price of the December corn futures contract on October 27 was $2.85¼. Thus, the elevator could purchase 5,000 bushels of cash corn, then hedge that purchase by simultaneously selling one contract of December corn futures. In this idealized hedging example, the elevator has now assured itself of a $.32 gross return to corn storage from the end of October until mid-December.

The hedged return is invariant to changes in prices. For example, suppose cash prices in Chicago decline to $2.00 by December. In December, the December future must also be priced at $2.00 since it is in delivery and delivery is in Chicago. That is, cash prices and futures prices must converge at the delivery location in the delivery month. If the elevator sells the cash corn in December and simultaneously lifts (buys back or offsets) his futures hedge, he will have made -$.53¼ on the cash purchase and sale ($2.00-$2.53¼) and +$.85¼ on the futures sale and purchase ($2.85¼-$2.00) for a gross return of $.32 per bushel. If on the other hand, prices rise to $3.50 by December, the cash side of the transaction earns $.96 $^{3}/_{4}$ per bushel ($3.50-$2.53¼) while the futures side earns -$.64 $^{3}/_{4}$ ($2.85¼-$3.50) for a gross return of the same $.32 per bushel.

The difference between the cash and the futures price at the time the corn was bought and stored is variously called the basis, the spot premium or discount, and carrying or inverse carrying charge. For example, in October, cash (spot) corn was $.32 under the December future, the spot discount was $.32 the basis was 32 under the December future, or the carrying charge was $.32. The basis in December was 0 and the returns to storage are simply the change in basis from October when the hedge was placed to December when the hedge was lifted. And, as the above example makes clear, today's basis is a reliable forecast of the returns to storage. The example was idealized as the hedger was in the delivery location and therefore could depend upon his cash and the December futures prices to converge in the delivery month.

Working has provided empirical evidence of the reliability of the current basis as a forecast of the return to storage (the change in basis) for a similar "idealized" situation in wheat--an elevator located in Kansas City hedging in Kansas City wheat futures. Figure 4 reproduces his evidence. On the horizontal axis of each graph is the basis (spot premium) for wheat

Figure 4.--Relations of Spot Premiums for Wheat at Kansas City on September 1 and May 1 to Gain or Loss from Subsequent Storage of Hedged Wheat, 1922-1952* **
(Cents per bushel)



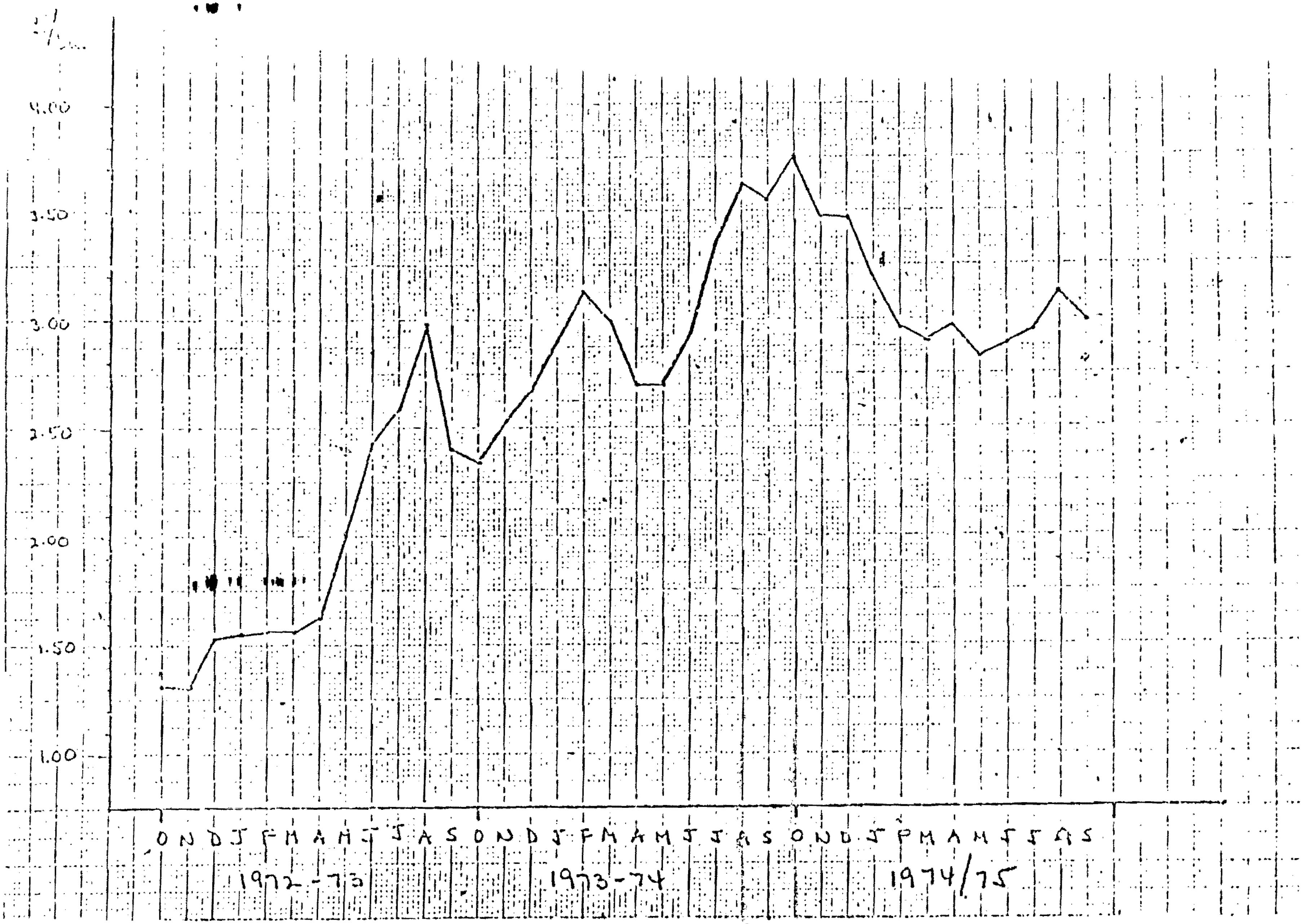
* Holbrook Working, "Hedging Reconsidered," in Anne E. Peck, editor, Readings in Futures Markets--Volume I: Selected Writings of Holbrook Working, Chicago Board of Trade, 1977, p. 128.

** Data compiled from Kansas City Grain Market Review; the spot premium used is that of the lowest quality No. 2 Hard Winter wheat, on track, taken in relation to the price of the Kansas City December (Section A) or July (Section B) future. The correlation coefficients and regression equations are: A,r=.839, y=-.861x+2.87; B,r=-.975, y=.946x+.980.

at Kansas City on a hypothetical hedging date (September 1 [top panel] and May 1 [bottom panel]). The vertical axis is the change in basis (spot premium) which is the return to storage over the indicated hedging period. As the plot and accompanying statistics indicate, the current wheat basis was a very reliable prediction of the returns to wheat storage. Like the corn example earlier, Working's analysis is for an ideal hedge. Cash prices and futures prices could be expected to converge in the delivery months since both are in the same location. The essence of an arbitrage hedge is the predictability of the basis over time and, in the delivery location, predictability is absolute.

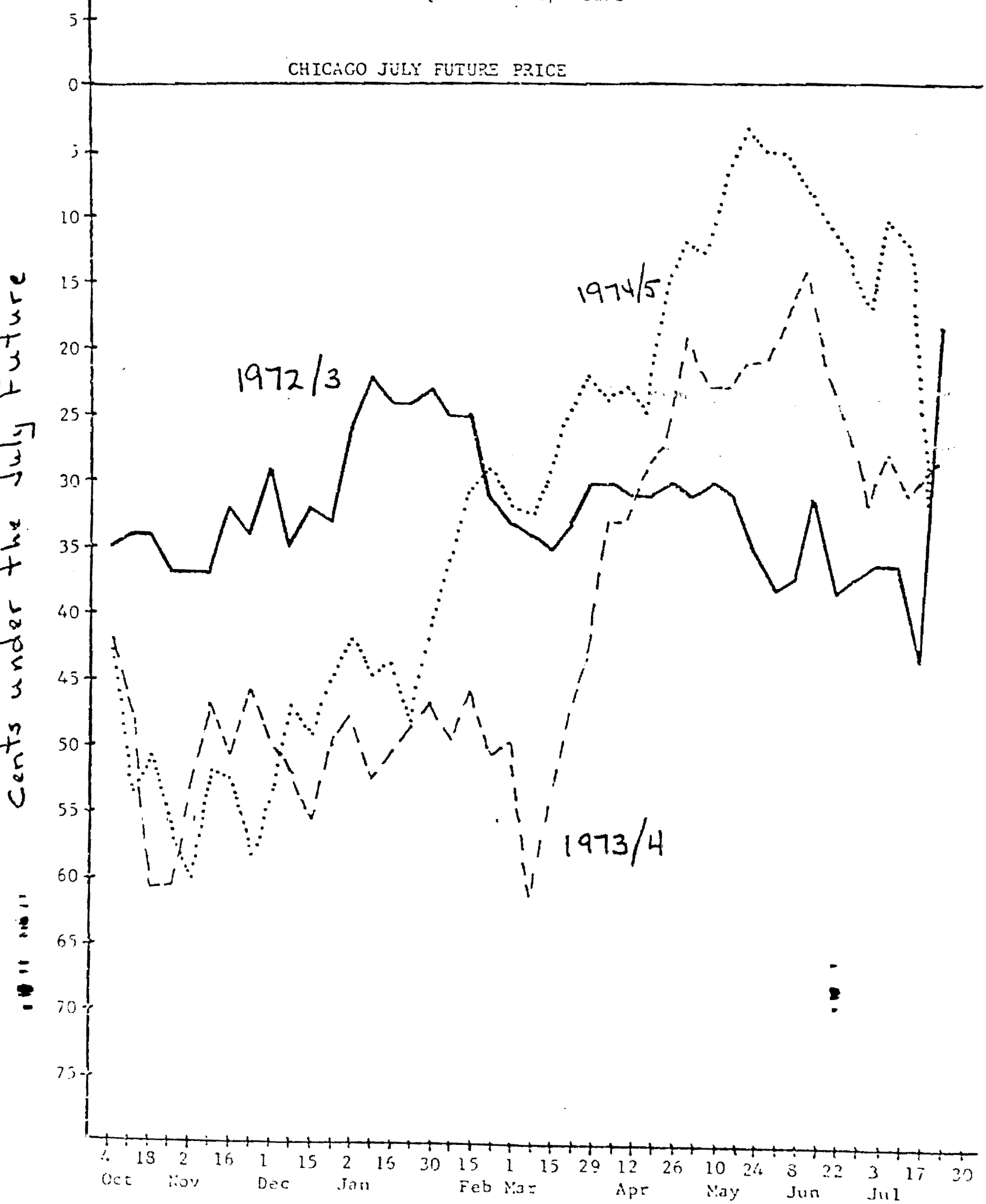
Clearly, not all (indeed, very few) grain elevators operate in this idealized environment. Grain does not move to Chicago in significant quantity. The operational question is then the predictability of the basis relative to the cash price over the relevant storage horizon. The former determines the returns to hedged storage while the latter determines that to unhedged storage. Figure 5 displays monthly cash corn prices over three crop years, 1972/73 through 1974/75. Prices changed dramatically over this period and unhedged storage of corn would have been both highly profitable and highly unprofitable at various points over this three-year period. Figure 6 presents basis prices of corn, that is, the cash price relative to a futures price (in this case, the July future) from an elevator located in Minnesota for the identical years. While the basis did not change identically in each year, it did change in a reasonably predictable way, with cash prices moving from about $0.50 under the July future in October to $0.20 under in July.

Figure 5.--Monthly Cash Prices of Corn, 1972/73-1974/75*



* Chicago Board of Trade Statistical Annuals.

Figure 6.--Weekly July Corn Basis at Stewartville, Minnesota During Three Crop Years*



* Adapted from Dahl [illegible]

Arbitrage hedging relies upon unequal changes in cash and futures prices, not upon parallel or equal changes in these prices. "The effectiveness of hedging, intelligently used in connection with commodity storage, depends on inequalities between the movement of spot and futures prices and on reasonable predictability of such inequalities" (Working, 1953b, p. 126). Finally, as Working's evidence showed, cash prices are not always below futures prices. That is, the relatively predictable returns to storage provided by hedged storage are not always positive. These relationships and the implied incentives for commodity storage will be discussed more fully in Section VI, Price Relationships.

B. Operational Hedging

The second form of hedging, operational hedging, typically involves buying futures (being long futures) and is common among grain processors and exporters. As Working (1953b, p. 131) described the operational hedging of flour mills that buy wheat and sell flour, wheat futures play two key roles:

> Under most circumstances in the United States the most accurate way for a miller to estimate the current market price of a particular quality of wheat is by reference to the latest futures quotation, adding to it or subtracting from it an appropriate price differential based on price relations observed in connection with recent sales of that quality of wheat.
>
> . . .if a large flour sale is to be matched immediately by purchase of an equivalent amount of wheat, the purchase must usually be of futures. This is so because the futures market is one in which 'bid' and 'asked' prices, even for large quantities, rarely differ by more than a small fraction of a cent per bushel. As much as 100,000 bushels of wheat can almost always be bought on the futures market, on a moment's notice, at a price not more than 1/8 or 1/4 cent per bushel above the last

> price at which a sale was made. To buy that amount of wheat in the spot market, a miller must choose between buying in driblets over days or weeks, as the wheat arrives from the country, or buying from an elevator operator who has the wheat in store, but who asks a price that includes his dealer's margin. And even if the purchase is to be made from an elevator, time may be needed for 'shopping' among several elevators, and a good deal of bargaining may have to be done to avoid paying an unnecessarily high price. So if wheat is purchased immediately to cover a large flour sale, the purchase is usually made in a futures market.

In sum, futures markets provide both a reliable pricing guide and a liquid market to absorb needed purchases. The buying and selling convenience provided by futures for operational hedging can be seen clearly in an exporter's use of futures. Suppose an importer has announced an import decision and is accepting bids on 100,000 bushels of corn to be shipped in four months. Other elements of the announcement will include quality specifications, possible port locations, and the like. The exporter, deciding to bid on this sale, will use futures in two ways. First, futures are used to formulate his bid. He will start with the price of the futures contract closest to the date of shipment. Then, he will add to or subtract from that price expected country basis relationships (from areas he expects to or has already purchased the actual commodity) and expected transportation costs to the designated port. Together these factors will determine the bid. If the futures price were $2.50, then a bid might be $2.70 or 20¢ over the designated future.

Suppose the bid of $2.70 is accepted. Then, the exporter will immediately buy futures (20 contracts) to cover the sale at approximately the $2.50 price from which the offer was originally made. These futures positions serve as a temporary substitute for the required purchase of the wheat to fulfill the contract. Having covered the sale quickly, the exporter can proceed to accumulate the actual commodity in places and times particularly suited to the sale, at prices that will net at the port less than the $.20 over he has committed. As the cash purchases are made, futures contracts will be sold, thereby canceling the earlier futures purchases (called lifting the hedge). In addition, the exporter might book his freight forward, if he does not have it already. Suppose freight from likely country accumulation points to the port is $.30 per bushel. In this case, the exporter will attempt to buy the cash grain at $.10 under the future and the change in price levels over the time between the export sale and the commodity purchase are irrelevant. Futures have provided both a pricing vehicle and a convenient, liquid market in which to purchase a temporary substitute for the required grain.

The use of futures markets has reduced significantly the business risks of an exporter. Without futures, the exporter's margin would have been as variable as cash prices between the time the contract was bid upon and the actual commodity was bought. With futures, the margin can be determined more nearly at the time of the bid on the sale. The actual margin will depend upon how well the relevant cash basis was anticipated. In the above example, the actual margin depends on whether or not grain could be purchased in country locations at more than 10¢ per bushel under the futures price. So again, knowledge of basis relationships is important.

C. Anticipatory Hedging

Finally, anticipatory hedging is the buying or selling of futures contracts in anticipation of a commodity purchase or sale. Most producer hedging, some processor hedging, and most potential importer hedging is anticipatory hedging. Farmers, for example, can sell in futures anytime during the year their intended output which will be available only at harvest. Futures markets provide a continuous pricing and sales opportunity for an otherwise discontinuous production process. Processing, on the other hand, is a continuous production operation. Typically, a processor will have relatively minimal on-site storage capacity. Thus, even if he wanted to, he could not buy at one time his annual grain requirements in the cash market. However, if the processor judged that prices were low, he could buy today his entire annual requirements of grain by buying futures.

Consider the position of a wheat processor, again located in Chicago, who knows he will need 100,000 bushels of wheat (equivalently, 20 futures contracts) in December and who has not sold the flour output forward. The time is January 1980. (Note, he no doubt has a series of monthly wheat requirements to consider, but for simplicity focus only on his December requirement.) Depending upon his view of the market and the course of prices over the next few months, he may wish to price those expected requirements now. In particular, if he thinks prices are going to increase significantly, he will want to buy now. Fundamentally, he has two ways to effect the speculative price judgment.

buying cash wheat today and storing it or buying futures today and the actual wheat in December.

The price data assembled in Table 1 show the current price situation as well as the course of relevant prices from January to December in 1980. On January 1, cash wheat traded at $4.35 per bushel while the December future closed at $4.90. If cash wheat is bought on January 1, storage charges of approximately 8.5 bushel/month ($.03 per month physical cost of storage and $.055/month interest charges with an average prime rate of 15.27 percent per year) will accrue for 11 months. The net cost of wheat will be $5.28½ for use in December. On the other hand, the processor could have bought December futures on January 1 at $4.90, held these until December 1 for a $0.05 profit, and bought cash wheat at (approximately) $4.95 giving a net cost of wheat of $4.90. Here, a portion of the total storage costs were paid in January in the $.55 differential between the cash and the December futures price, the December basis. It will never be greater than the total costs of actual storage and is frequently less than these costs even to the point of being negative. Thus, all physical storage costs cannot be avoided with a futures strategy; they are "paid," however, at the outset.

In addition, it should be noted that the above calculations of "net" procurement costs using the futures market are not quite net costs. Examination of the course of futures prices during the year shows there would have been significant margin calls to holding the futures. That

Table 1.--Wheat Prices in 1980*

Date	Cash price	Futures prices for indicated maturity		
		March	July	December
January 1	435	445	459½	490
March 1	433	433	451	477
July 1	425½		425½	457
December 1	495			495

* All prices are in U.S. cents per bushel. The cash price is a Chicago-equivalent price. It is the price of the expiring futures option.

is, prices declined from roughly January until July and these losses would have had to be paid on a daily basis. As it turned out, all of these losses were recovered in the second half of the year, but, the interest costs of those losses as well as the interest value of the subsequent gains should be included in the calculation of net gain.

In these anticipatory hedges, futures markets provided a decision-making alternative. However, the anticipatory hedge, unlike either arbitrage or operational hedging, requires the exercise of price-level judgment. That is, it is fundamentally a price-fixing decision. Prices look "good" today for the commodity that must eventually be bought or sold.

There is an important difference, however, between the cash market decision and a futures decision. Once a cash market decision is made, subsequent changes in prices (until the time the commodity is used) are only opportunity losses or gains. Typically they do not appear in the accounting of the firm's profits or losses. Futures decisions, on the other hand, involve margin monies and market losses (gains) are subtracted from (added to) the margin account daily. The losses in the futures position are real and highly visible. Anticipatory hedging is fundamentally speculative and the results of a decision are always highly visible.

Finally, anticipatory hedging can be viewed also as reducing risks because a price can be secured today for a purchase or sale that will not actually occur or be needed for weeks or months. The nature of this risk reduction will be considered in more detail in the analysis of importers' purchasing strategies. For the present, it is sufficient to note that the reduction in risks from an anticipatory hedge is not similar to that from either an arbitrage or an operational hedge. In both those cases, hedging secured (relatively, of course) a margin. Here, the risk reduction is not similarly measurable.

V. RELATIONSHIPS BETWEEN FUTURES PRICES AND THEIR IMPLICATIONS

In the foregoing hedging examples, the profitability of the hedging decisions depended upon the price of cash commodity relative to that of the futures contract. The elevator's position earned a return to storage, the exporter secured an export margin, and the processor evaluated the relative cost of owning (and storing) wheat versus that of owning futures contracts. In each example, the relevant price was the basis, that is, the difference between a futures price and a location-specific cash price. The basis is composed of two relations, the difference between cash prices in the user's location and those in the futures delivery location (equivalently, the nearby futures price) and the difference between futures prices for differing maturities. The former component is user specific and depends upon transportation rates and relative supplies and demands in the particular location. The latter, a price spread between futures contracts, is a market-determined price of storage and is described below. Two implications of these relationships are then considered, the stabilizing influences of futures markets and the forecast performance of futures prices.

A. The Theory of the Price of Storage

The relationship between two futures prices was first analyzed by Holbrook Working (1949). His theory, the theory of the price of storage, states that the difference between two simultaneously quoted prices for different delivery dates for any storable commodity (the so-called market price of storage) is directly related to stocks of the commodity which must be carried between the two dates. If supplies are large, the market price for storage will approximate the total costs of storage. In these circumstances, arbitrage hedgers can be assured of a return to storage which covers their costs, and thus will continue to store the surplus supplies. If, on the other hand, current supplies are relatively small, the market's price for storage will be less than the full costs of storage and will often be negative. In these circumstances, an arbitrage hedger will earn a return on hedged storage less than that required to cover his full costs. The market-determined disincentive for continued storage is the amount by which the market's price for storage, the difference between the two futures prices, falls below the full costs of storage. This amount is determined by levels of current supplies.

Thus, the prices for different futures delivery months are not independently determined prices. They can only be interpreted relative to each other. As an illustration, Table 2 contains the closing prices for corn, wheat and soybean futures on the Chicago Board of Trade on October 30, 1981. For all three commodities, futures contracts traded that called for delivery more than one year forward--December 1982 in corn and wheat and January 1982 for soybeans. The closing prices for each commodity are shown in the first column, identified by delivery month. The second column contains market prices for storage between successive delivery months. These have been calculated in per month terms to facilitate comparisons since the amount of time between the successive futures deliveries is not constant.

Consider first the corn price data. December delivery corn was $2.87½ per bushel. Corn was in very ample supply in October 1981--one

Table 2.--Futures Prices for Corn, Wheat and Soybeans, October 30, 1981 on the Chicago Board of Trade*

Corn			Wheat			Soybeans		
Delivery	Price	Price of storage	Delivery	Price	Price of storage	Delivery	Price	Price of storage
December	287½		December	439¼		November	651½	
March 1982	306¼	6¼	March 1982	464½	8 3/8	January 1982	671½	10
May	318½	6 1/8	May	474¼	4 7/8	March	694 3/4	11 5/8
July	326½	5	July	470	-2 1/8	May	714¼	9 3/4
September	332½	3	September	481½	5 3/4	July	729½	7 5/8
December	338½	2	December	498	5½	August	733	3½
						September	734	1
						November	740	3
						January 1982	756½	8¼

* Data from the Wall Street Journal. All prices are cents per bushel. The price of storage per-month is calculated as the difference between two successive futures prices divided by the number of months between delivery dates.

of the largest ever corn crops was being harvested and stocks of old crop corn (from the 1980 harvest) were also large. Most of this very abundant supply of corn had to be stored and the market therefore valued storage highly, paying \$.06¼ per bushel per month to store corn from December until March. The \$.06¼ represents the full cost--physical storage costs and interest costs--of corn storage from December to March. Physical storage costs (in terminal elevators) were about \$.03 per bushel per month and interest costs on the money used to purchase the corn were \$.034 per month (using the prevailing prime rate of 14 percent) for a total monthly storage cost of \$.064, very close to the market price for storage. In other words, an elevator that hedged corn which would be stored from December through March could earn a return to storage that would cover his costs.

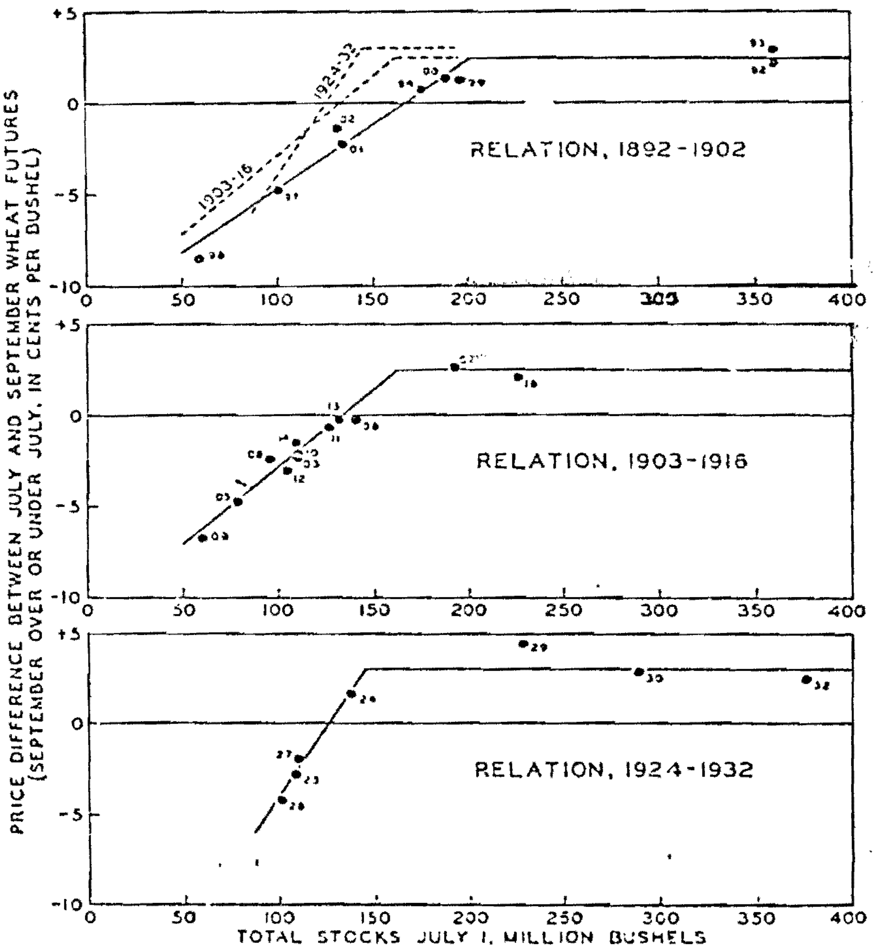
Similarly, wheat and soybeans were also in abundant supply in October. The higher market prices for current storage of wheat and beans--\$.08 3/8 and \$.10 per bushel per month--reflect the same physical storage cost of \$.03 per month but higher interest costs. Wheat priced at \$4.39¼ is \$.05 1/8 per month. On soybeans at \$6.51½, it is \$.076 per month. Thus, full carrying costs for wheat and soybeans are \$.08 1/8 and \$.106, which is very close to the market prices for their storage. When market prices for storage are positive, they are called carrying charges (or contango in British markets). When they are negative, they are called inverse carrying charges (or backwardation in British markets).

Storage returns reflecting nearly full storage costs continue through the March delivery in wheat, the May delivery in corn, and the May delivery in soybeans, roughly eight to nine months from the respective harvest dates (June, October and September). Then storage returns begin to decline, reflecting less market value for continued storage. In this somewhat anomalous year of relatively large supplies of all three grains, only in the wheat market do storage returns actually become negative. However, the data show clearly a marked decline in the prices of storage over time and the implied returns to hedged storage. With smaller stocks anticipated at the end of the crop year, the returns from continued storage are lower and, in one case here, they are negative.

Negative storage returns, inverse carrying charges, occur commonly in grain markets--reflecting seasonal, temporary shortages of grain. Unlike a carrying charge which can be no larger than the full costs of storage, inverse carrying charges are unbounded. The degree of inverse reflects the extent and significance of current shortage. Working summarized the relationship between carrying and inverse carrying charges and stocks of a commodity in the supply of storage curve. The empirical relationship is almost always estimated using year-end stocks of the commodity and the relevant price difference, that between the last old crop future and the first new crop future. Even in a year of relatively small production, stocks immediately after the harvest are normally plentiful and the markets nearly always reflect full carrying costs during this period. Significant variation in year-end stocks is common, however, and permits a clear view of the underlying relationships.

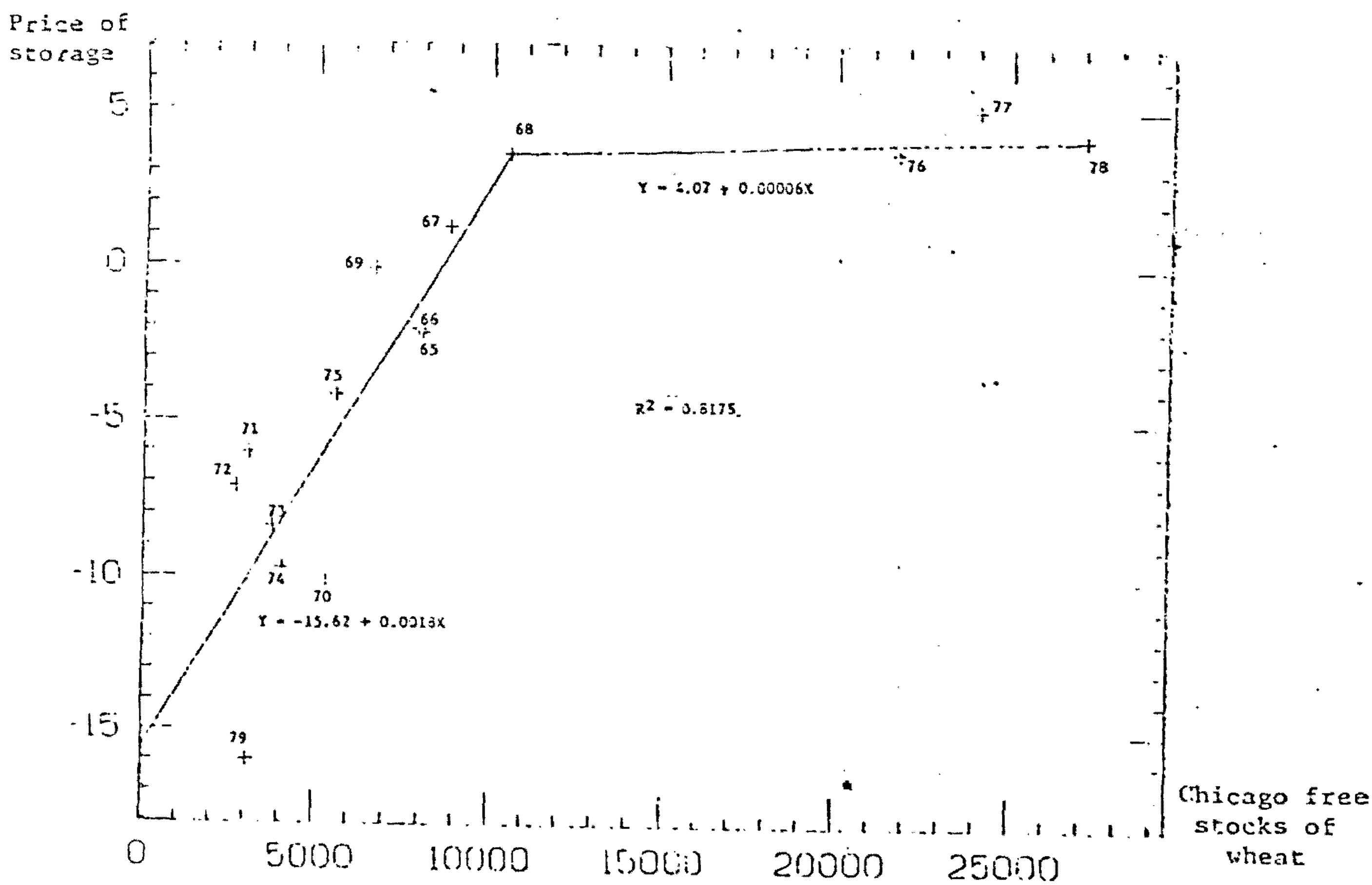
Working's original supply of storage curve used data from the wheat market for the years 1892-1932 and is shown in Figure 7. A supply of storage curve using more recent data from the wheat market is shown in Figure 8. As these diagrams show, inverse (negative) carrying charges are quite common between the old crop and the new crop future, indeed more

Figure 7.--Relation of Wheat Stocks to the "Carrying Charge" in Chicago Wheat Futures*



* Holbrock Working, "Hedging Reconsidered," in Anne E. Peck, editor, Readings in Futures Markets--Volume I: Selected Writings of Holbrock Working, Chicago Board of Trade, 1977, p. 134.

Figure 8.--Price of Storage, July-March, and Chicago Stocks on March 15, 1965-79*



* Roger W. Gray and Anne E. Peck, "The Chicago Wheat Futures Market: Recent Problems in Historical Perspective," Food Research Institute Studies, XVIII, 1, 1981.

common than carrying charges. The extent of the inversion is clearly related to stocks levels, the smaller the stocks level the more negative is the return to continued storage, thus urging any unneeded (for processing or direct consumption) stocks onto the market. At "adequate" stock levels, the relationship becomes horizontal, representing full costs of storage.

The processor's hedging decision (described in Section IV. C, above) can be used to show the implications of these relationships for purchasing decisions. There, the processor felt that prices were "right" in January, though the wheat was not needed until December. In purchasing cash wheat, he would have incurred total physical storage charges of $.085 per bushel per month or $.935 per bushel over the 11-month holding period. On the other hand, the carrying charge in the futures market was only $0.55 ($4.90 December future minus $4.35 cash wheat), which is significantly less than the total carrying costs. Thus, the purchase of futures was the cheaper alternative.

More generally, the theory of the price of storage shows that futures purchase strategies will never be more costly than the purchase and store alternative. They can be significantly less costly, depending upon the extent of carrying or inverse carrying charges in the market over the life of the hedge.

B. The Demand for Grain for Storage

The supply of storage curves (Figures 7 and 8) reveal that the amount of grain stored between crop years in the U.S. is variable and is determined by the market incentive to storage. Private firms, comprised of merchants, country and commercial elevators, and farmers are willing to store large amounts of grain between crop years if there is a return to that storage. As the return declines, so too does the amount of stored grain.

Futures markets facilitate private storers' decisions by providing a market-determined price for storage. If these stocks are hedged in the market, the quoted price of storage--the difference in price between futures contracts--is a reliable guide to the expected returns from storage (see, e.g., Figure 4). There appears to be no limit to the amount of grain these firms are willing to carry between crop years if the market is providing full carrying costs (interest, insurance, and warehousing fees). Other writers (Brennan, 1958; Weymar, 1968) have argued that eventually the horizontal portion of the supply of storage curve must turn up as the amount of storage approaches capacity.

Even with this qualification, however, the private trade is clearly price responsive in their storage decisions. It is worth noting that the wheat carryouts of 1892 and 1893 in Working's chart, Figure 7, represented more than one-half of average annual wheat production in that period. Translated to current levels, this would represent 30 million tons of wheat alone in the U.S. Current grain storage capacity in the U.S. is more than 17 billion bushels, well in excess of the annual production of all grains including soybeans.

The relationships shown in Figures 7 and 8 have been interpreted traditionally as supply curves for storage. They relate the price of storage to how much space merchants are willing to devote to the storage of the specific commodity. But they can also be viewed as demand curves, relating the demand for the commodity to be put into storage to the price of that storage. If the terminology is somewhat ambiguous, it can perhaps be understood in the institutional context in which the storage function is provided.

The owners of warehouse space, seeking to maximize earnings from the space, do so by purchasing the grain that they place into storage and simultaneously selling it in futures contracts. Thus empty warehouse space (a supply of binspace) implies a demand for the grain (to place in storage). The binspace would be priced the same, or nearly so, for any grain, since the warehouseman would be indifferent whether he earns a return through the storage of one grain or another; in this sense the price of storage for oats is the same as that for soybeans. But when the focus is shifted to the commodity, the price of storage must include interest on the value of the grain, and hence the price of storage of soybeans needs to be much higher than that for oats in order to induce storage. In other words, translating the supply of storage as it is traditionally known to a demand for the commodity to put into storage is simply to view the storage operators as providing a service. In producing their output, a commodity stored to a subsequent period, the warehousemen have an input demand, a demand for the commodity in the current period, which must compete with other current period demands for the commodity.

This implies there are at least three sources of demand for U.S. grains--consumption (direct and/or feed), exports and storage. Further, the presence of extensively used futures markets, providing predictable returns to storage, imparts a characteristic shape to the demand for grain to put into storage. When prices for nearby wheat deliveries are lower than prices for later deliveries, there is an observed greater willingness to store wheat; and vice versa for the opposite price relationship. And these price spreads reflect the abundance or shortage of existing supplies--positive "carrying charges" in the event of abundance, negative in the event of shortage.

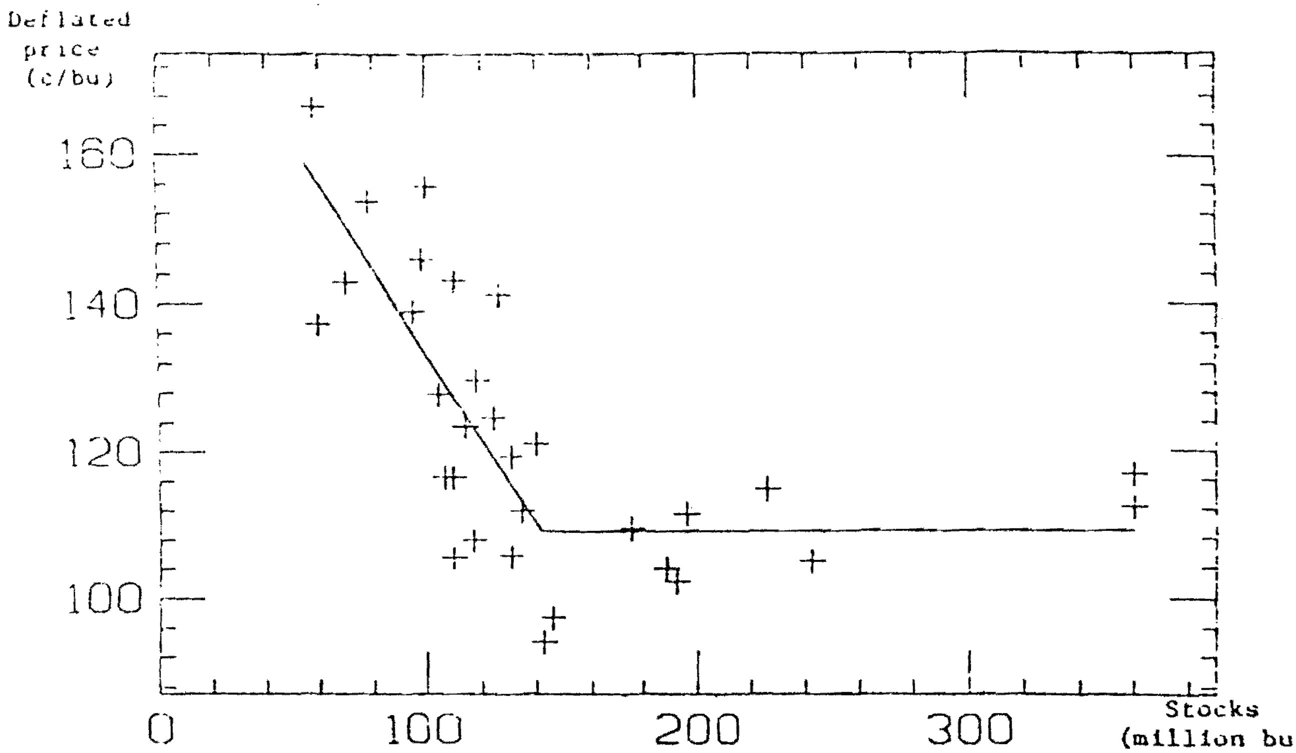
Why does it make sense, from a commercial profit standpoint, to store more of that which is abundant and to store less of that which is scarce? It can only make sense on the assumption that abundant supplies will become less abundant and scarce supplies will become less scarce as time passes--that there will be a return to some normal or average level of supplies. True surpluses and deficits are, by their very nature, deviations from normal. The most likely size of the next crop is its expected value, the mean (adjusted for trend) of past harvests.

The notion that a return to normal is implicit in the futures price spreads suggests that the so-called supply of storage curves may be readily transformed into an annual, demand for stocks relationship. Normal supply and demand is associated with normal, or average prices. Relative abundance is thus associated with below average prices while scarcity means higher than average prices. Finally, abundance and scarcity are measured by year-end stocks. The relationship between price levels and privately held stocks is shown in Figure 9 for the period of Working's original estimates of storage relationships. Prices have been deflated by the wholesale price index to allow the perception of "normality" to adjust with changes in overall economic conditions, and the years of World War I have been deleted because the futures markets were inoperative.

The curve estimated in Figure 9 is based on historical data. However, the period embraced by Figure 9 is the most recent extended period during which there was no government participation in wheat pricing in the United States. Hence these data provide the best available picture of the private market's demand for stocks. A current period demand for stocks curve should be shifted to the right significantly. The shift is a direct reflection of growth in the wheat market. In the earlier period, working stocks (stocks that are carried in the absence of an incentive to store, including those in transit) were between 140 and 170 million bushels. Today, working stocks are at least double that level, a consequence of larger crops and an increased proportion of commercial movement of the crop.

The importance of the demand for storage curve is in its shape. With low prices, a large proportion of the crop will be put into private storage rather than consumed or exported. With high prices, much less will be stored at the end of the crop year and previously accumulated stocks will be released. Thus, total demand for wheat (or any storable commodity) will be very price inelastic at low prices and much more elastic at higher prices.

Figure 9. ...e Demand for Wheat for Storage, 1893-1929*



* Anne E. Peck and Roger W. Gray, "Grain Reserves: Some Unresolved Issues," Food Policy, 1980. The demand curve estimated for these data was:

$$Y = 191.0 - 91.62\,(D1) - 0.58\,X + 0.62\,(D1 * X) \qquad R^2 = 0.6316$$
$$(16.68)\quad(-4.86)\quad(-5.70)\quad(5.28)$$

where Y is deflated price, X is stocks and D1 is binary variable with a value of 1 when stocks are greater than 145.7 and 0 elsewhere. The slope of the horizontal segment (-0.58 + 0.62) is not significantly different from zero and has been so drawn, taking into account the means of the data used in its estimate, Put another way, current demand for both exports and domestic use must compete with the demand for storage and, at low prices, most of the surplus will be stored rather than exported or consumed directly.

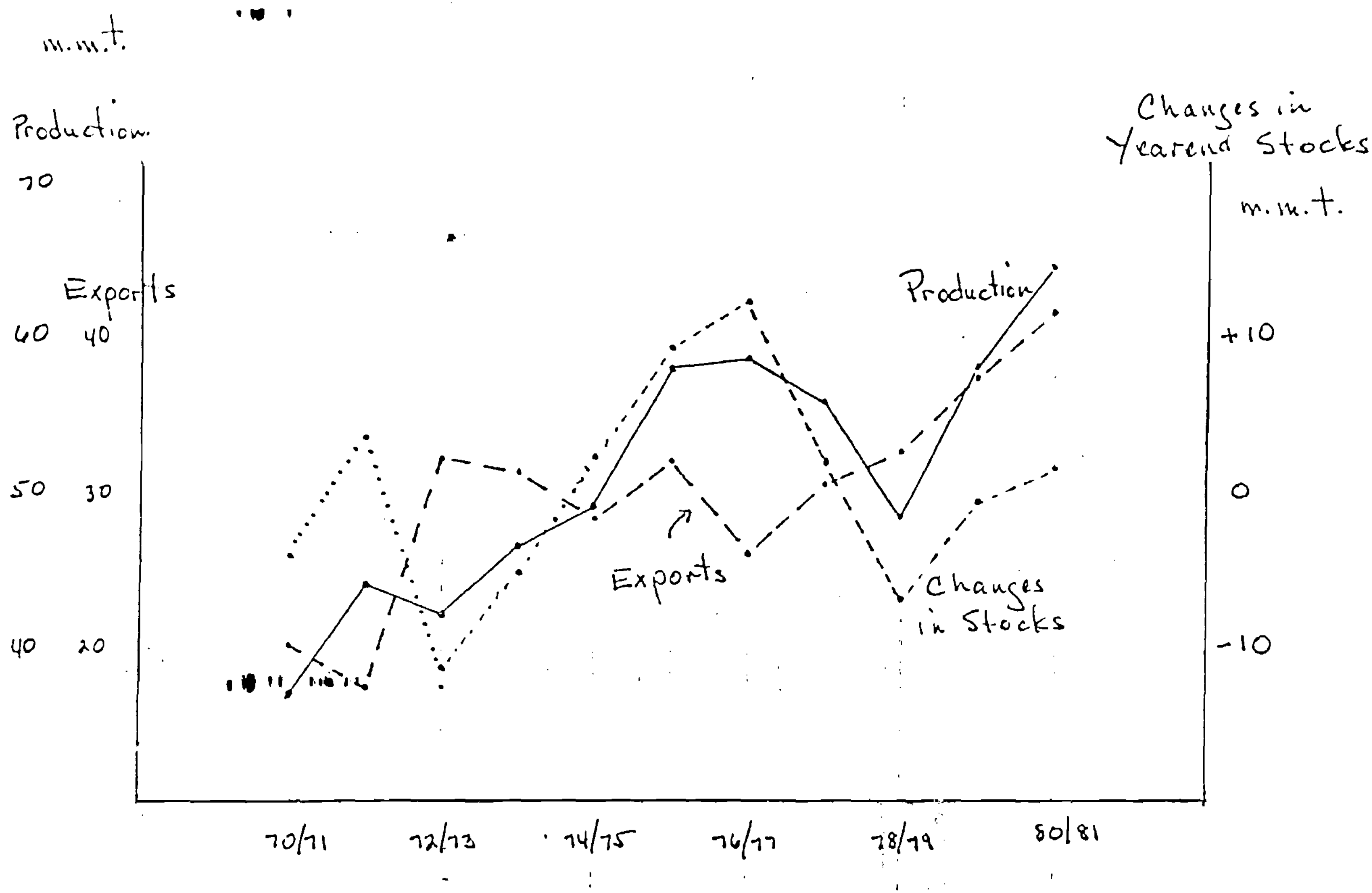
C. Market Stabilization: Storage Versus Exports

The potential, stabilizing influence of private storage is clear. Variability in U.S. production is not exported onto the world market. Rather, these fluctuations are largely absorbed by variations in annual stocks levels. The extent to which the U.S. exported its production instability in the wheat market was first examined by Working (1928, 1930). Using data from 1866/67-1929/30, he concluded that approximately one-half of the production variations in the U.S. wheat crop were absorbed in the export market and that the other half were absorbed domestically--in adjustments in year-end stocks. By contrast, the other major wheat exporters during that period exported virtually all of their production variability, with stock changes accounting for only a small part of that variation.

Data from the four major wheat exporters and two major corn exporters from the decade of the seventies provide a current view of the relative responsiveness of markets in these countries. The two markets are considered sequentially. Figures 10 through 13 present the basic data--production, exports and changes in year-end stocks--for the U.S., Canada, Argentina and Australia, countries that together account for well over three-quarters of world wheat exports. The visual contrast is striking.

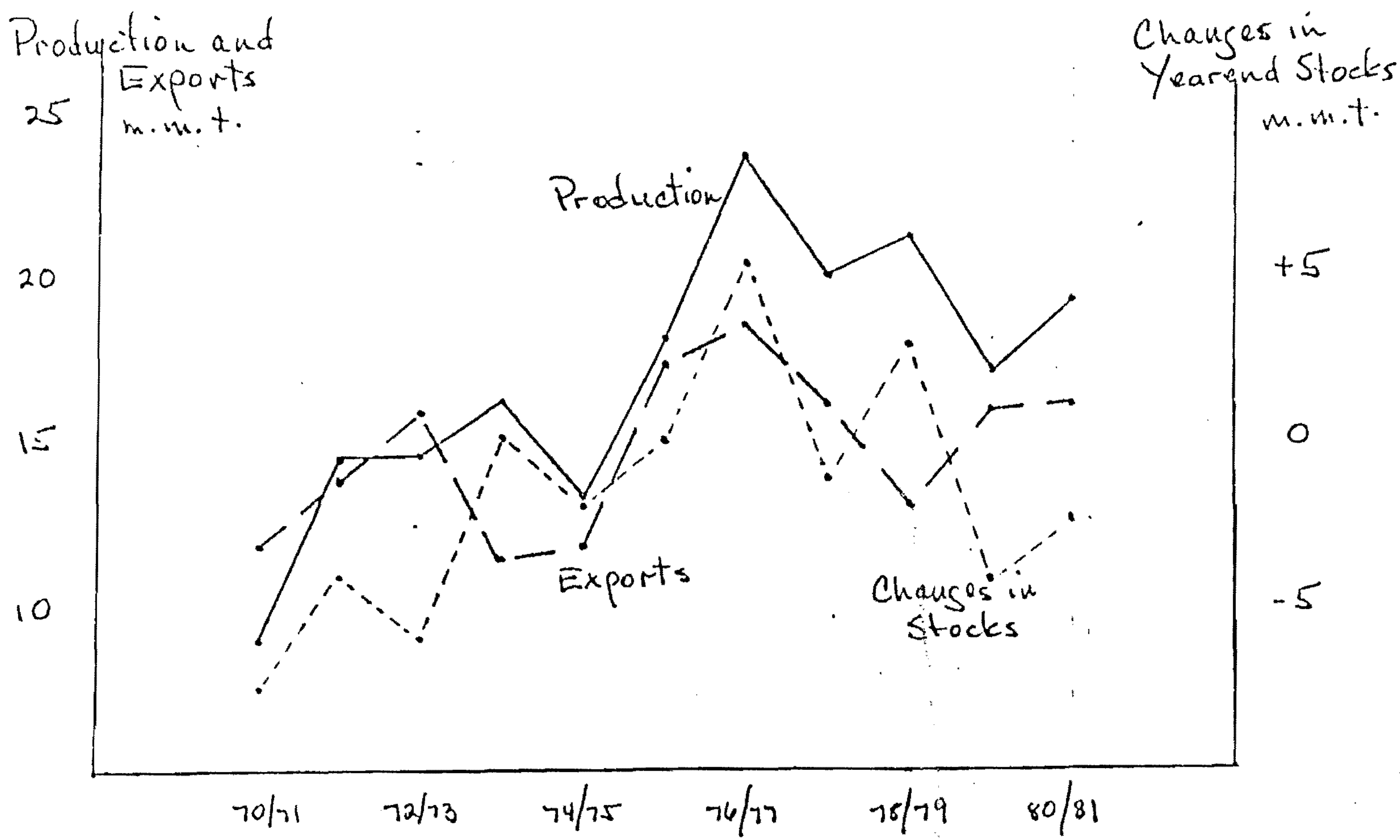
Very obvious trends exist in the production and export data for wheat

Figure 10.-- Annual Production, Exports and Changes in Year-end Stocks of Wheat, U.S., 1970/71-1980/81*



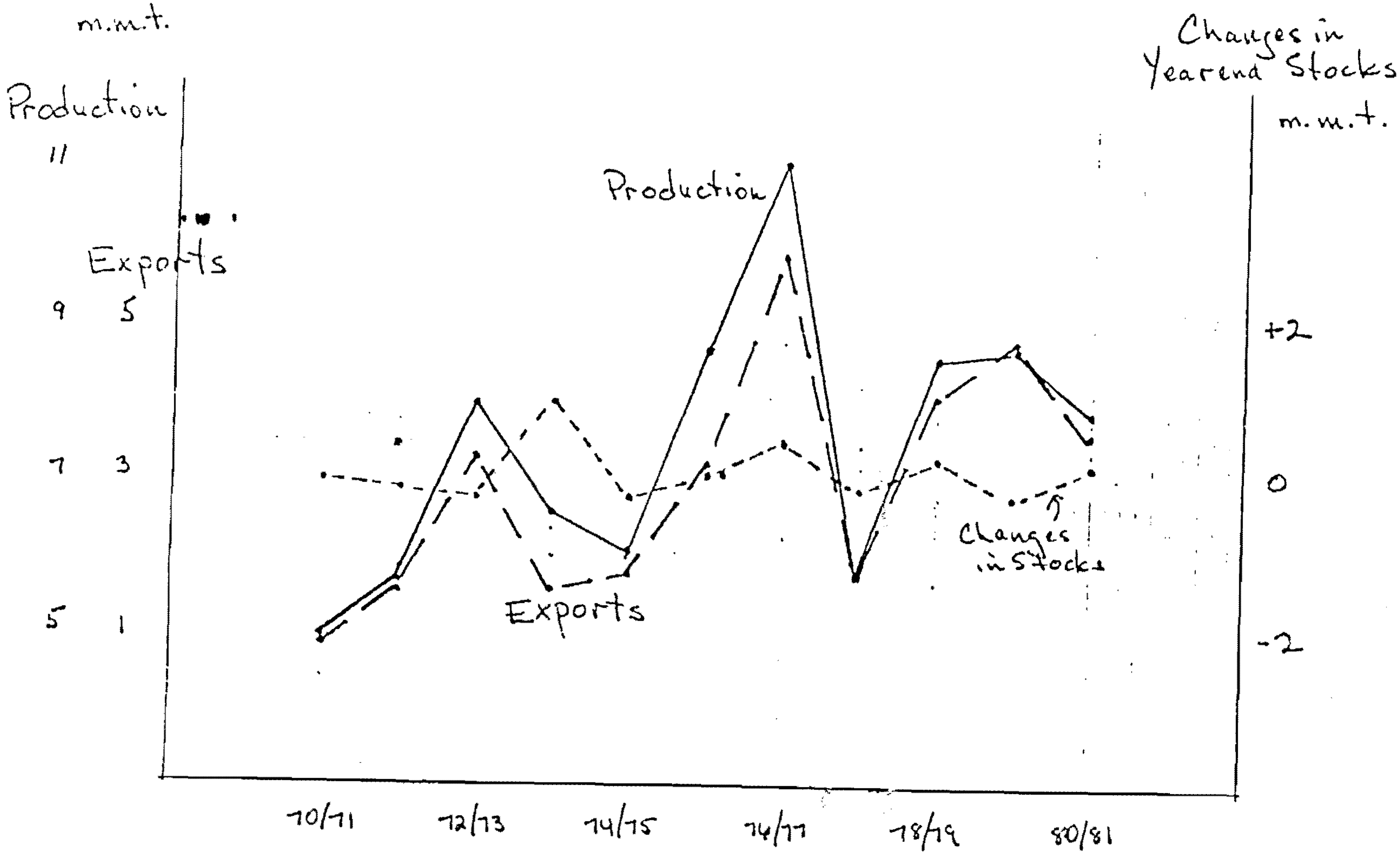
* Data from International Wheat Council.

Figure 11.--Annual Production, Exports and Changes in Year-end Stocks of Wheat, Canada, 1970/71-1980/81*



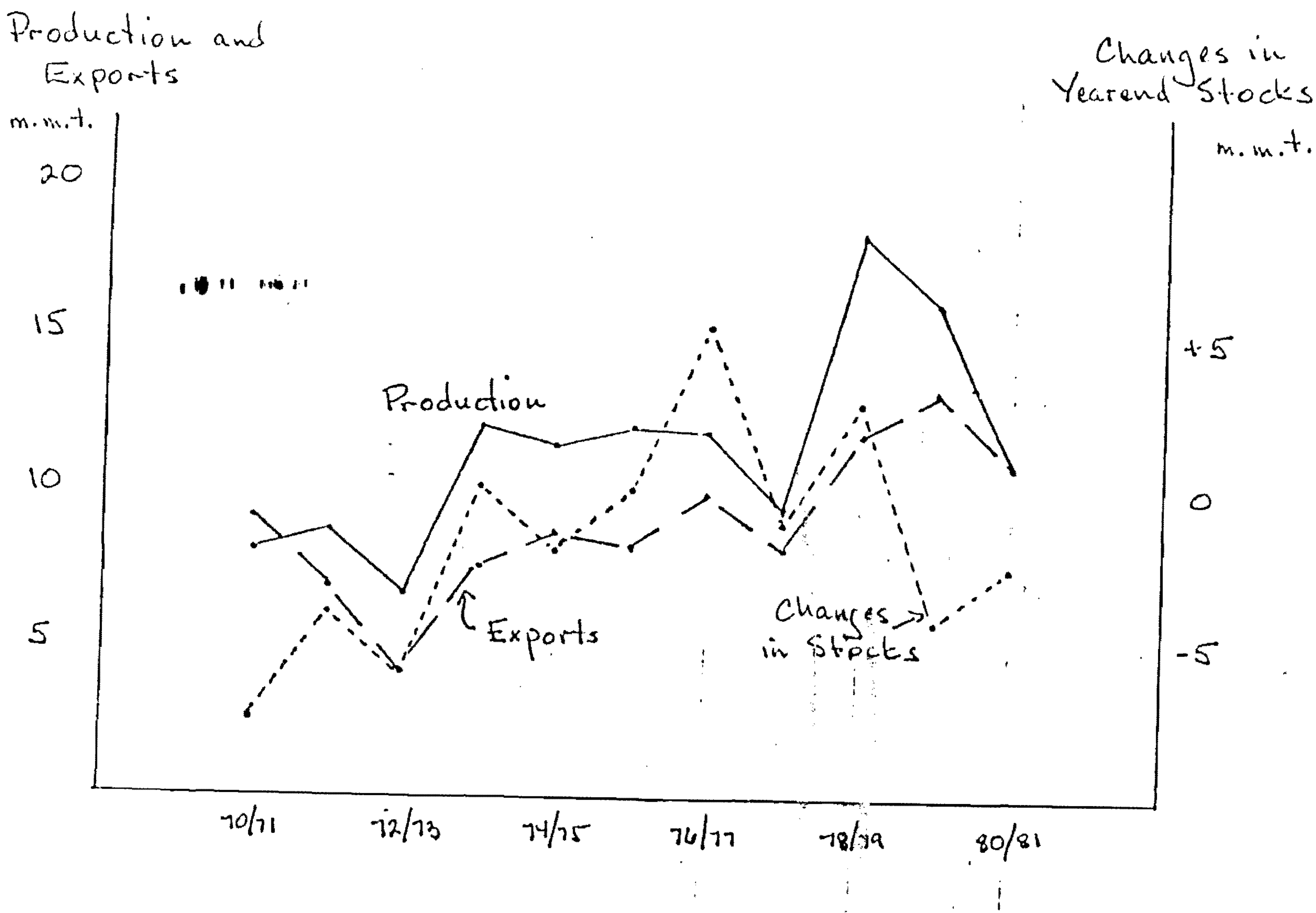
* Data from International Wheat Council

Figure 12.--Production, Exports and Changes in Year-end Stocks of Wheat, Argentina, 1970/71-1980/81*



* Data from International Wheat Council.

Figure 13.--Annual Production, Exports and Changes in Year-end Stocks of Wheat, Australia, 1970/71-1980/81*



* Data from International Wheat Council.

in the U.S. But there is little correlation between deviations in these series from their respective trends. In the U.S., however, there is a clear relationship between changes in annual carryout stocks and production levels (again, deviations from trend). Changes in U.S. stocks are on average zero over this period, though there were significant annual changes during the decade. The U.S. pattern is most sharply constrasted by the Argentina data, Figure 12. There, stock changes are approximately zero every year and virtually all the variations in production are matched by variations in exports. Canada (11) and Australia (13) fall between the U.S.-Argentina extremes. Both stocks and exports appear to vary sympathetically with production.

The contrasting behavior of wheat exports and stock changes among these countries is summarized by the averages reported in Table 3. For each country the 11-year (1970/71-1980/81 crop years) period has been partitioned into years of above average production and years of below average production, where average is measured by a simple linear trend. For these two groups of years, export deviations (from their trends) and stock changes were recorded and all three series were averaged to obtain the numbers in the table.

For the U.S., years of increased production averaged 3.1 mmt greater than trend values. Exports in these years actually declined by 2.6 mmt and stocks increased an average of 5.1 mmt from the previous year. Similarly, in years of decreased U.S. production, exports actually increased on average while stocks absorbed both changes. Exports absorbed none of

Table 3.--Comparative Responsiveness of Export Levels and Year-end Stocks to Increases and Decreases in Domestic Production of Wheat in the Four Major Exporting Countries, 1970/71 to 1980/81*
(million metric tons)

Country years of:	Average deviation from trend values: Production	Exports	Average change in year-end stocks
U.S.			
Increased production	3.1	-2.6	5.1
Decreased production	-3.0	1.8	-5.7
Canada			
Increased production	1.7	0.2	-0.3
Decreased production	-2.9	-0.3	-4.1
Argentina			
Increased production	1.3	1.0	0.0
Decreased production	-1.0	-1.0	0.0
Australia			
Increased production	2.1	0.5	1.1
Decreased production	-1.7	-0.4	-2.0

* Based on data from the International Wheat Council, Annual.

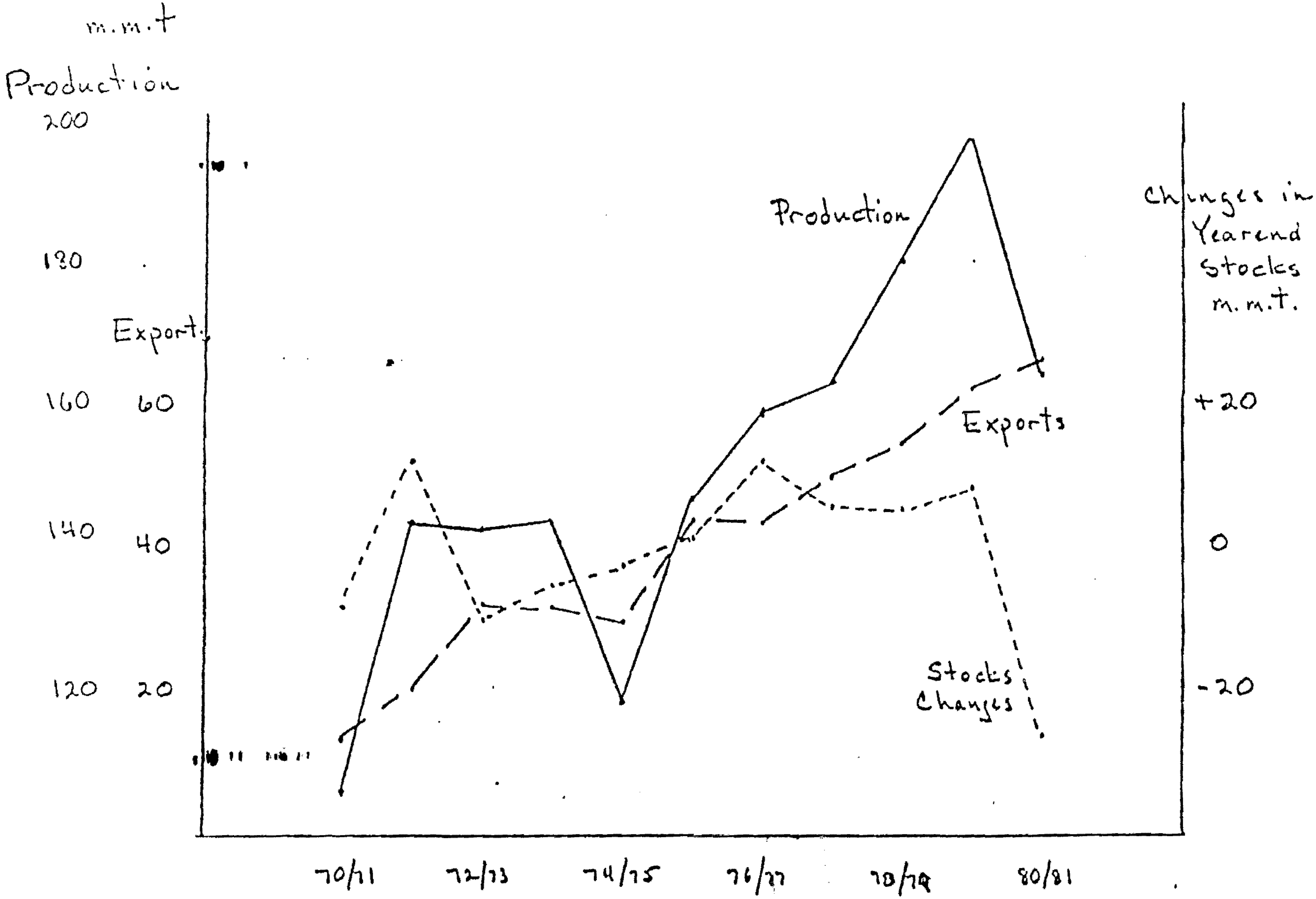
the production fluctuations and actually changed in opposite directions.

Argentina shows the sharpest contrast with the U.S. figures. Virtually all of the average decreases and increases in production were absorbed by exports and none appear in stock changes. For Canada, 11 percent of production variations are absorbed by exports while in Australia, the figure is 24 percent. Of production increases in Canada and Australia, some 18 and 52 percent, respectively, are absorbed in stock increases. Production decreases are accompanied by 141 and 118 percent stock decreases. However, in both cases, stock increases (decreases) are understated (overstated) since stock levels declined significantly over this period. Stocks in Canada declined from 27.5 mmt at the beginning of the decade (carryin to 1970/71) to a 8.0 mmt carryout from the 1980/81 crop year. In Australia, stocks declined from 7.2 mmt to 0.8 mmt. The present analysis has not taken these changes into account.

Finally, these calculations ignore changes in domestic consumption. Clearly, there were some, but the extent probably relates to the amount of wheat used as livestock feed, rather than to that used directly for human consumption. Direct consumption in these countries tends to be very price inelastic compared to that for feed demand. A more complete analysis would look at this question more closely. However, data from the corn market, examined next, are suggestive of the greater responsiveness of domestic consumption (food and feed use) when direct (albeit feed) demand is important.

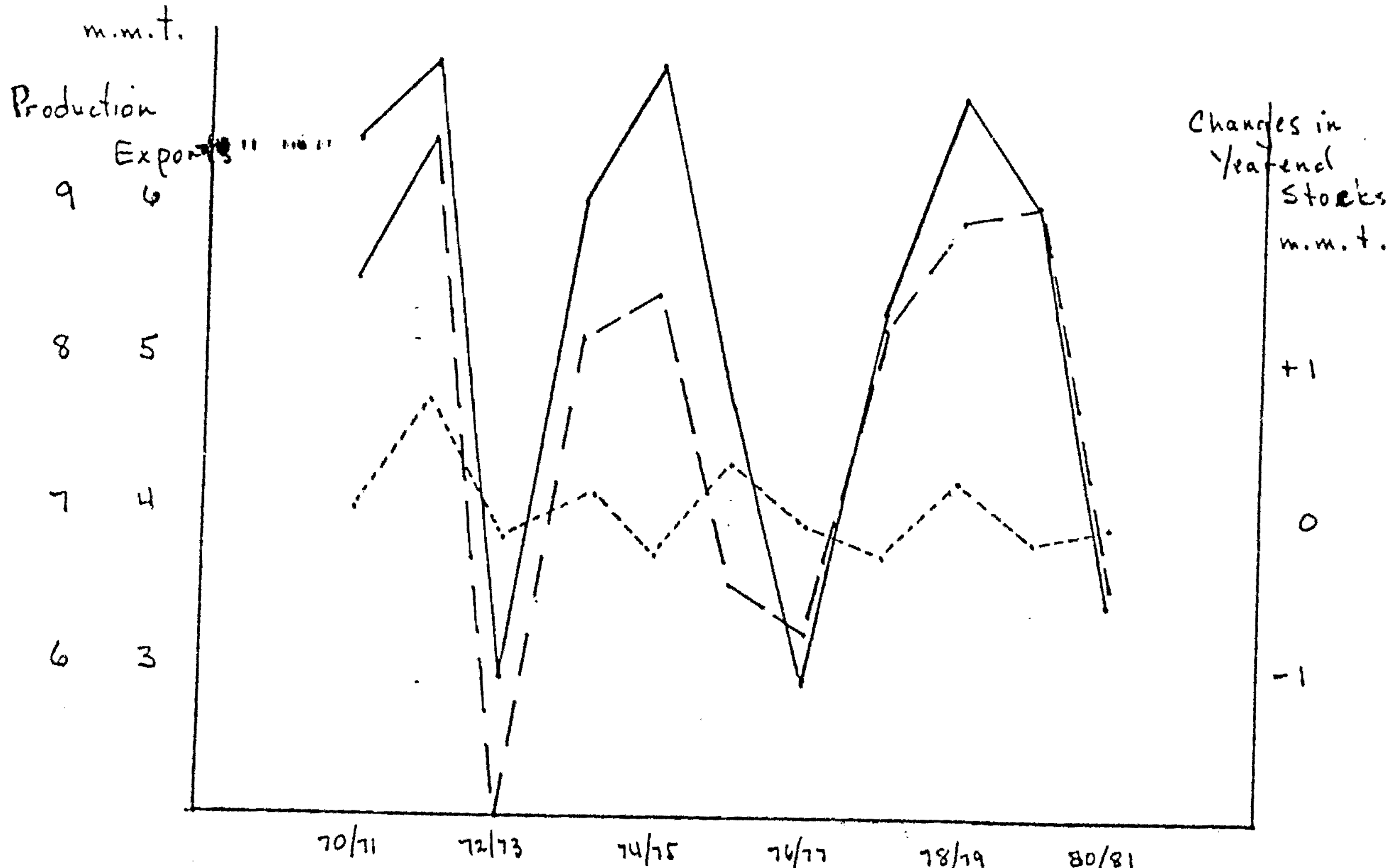
Figures 14 and 15 present the production, export and stock change

Figure 14.--Annual Production, Exports and Changes in Year-end Stocks of Corn, U.S., 1970/71-1980/81*



* Data from U.S. Department of Agriculture, Foreign Agricultural Service.

Figure 15.--Annual Production, Exports and Changes in Year-end Stocks of Corn, Argentina, 1970/71-1980/81*



* Data from U.S. Department of Agriculture, Foreign Agricultural Service.

data for corn from the two leading exporters, the U.S. and Argentina. Averages, derived from these data, are in Table 4. Again, the contrast in export flows from the two countries is striking. Stock changes absorb almost none of the production variability in Argentina while accounting for about half that in the U.S.

For the U.S., the averages in Table 4 indirectly show the importance of adjustments in the domestic feeding sector. In years of increased production, exports and stock changes account for about one-half of the excess production. In years of decreases, about three-quarters of the adjustment is in these two sectors. The remainder must be in the feed economy.

The contrasts in marketing performance among the major grain exporters are striking. The U.S. is the least destabilizing influence in the world market and is the only exporter with active grain futures markets. All of the contrast cannot, of course, be attributed to the greater responsiveness of stocks induced by futures markets. Some of the contrast must be attributed to government policies and to those of marketing boards prevalent in the other major exporters. However, combined with Working's evidence from the earlier period--a period during which such interventions were not significant--the present evidence is stronger. If permitted to do so, private traders will accumulate and decumulate stocks in a way that will stabilize commodity markets. Their responsiveness is even more impressive in the presence of futures markets.

Table 4.--Comparative Responsiveness of Export Levels and Year-end Stocks to Increases and Decreases in Domestic Production of Corn in the Two Major Exporting Countries, 1970/71 to 1980/81*

(million metric tons)

Country years of:	Average deviation from trend values		Average change in year-end stocks
	Production	Exports	
U.S.			
Increased production	10.3	0.9	3.4
Decreased production	-9.4	-1.0	-6.4
Argentina			
Increased production	1.2	1.0	0.1
Decreased production	-1.5	-1.2	-0.1

* Based on data from U.S. Department of Agriculture, Foreign Agricultural Service.

D. Futures Prices as Forecasts of Expected Future Prices

A second implication of the theory of the price of storage is that futures prices are not forecasts of expected future prices any more than is today's cash price. The simultaneously quoted prices--cash and futures--must be interpreted as reflecting one basic price level and a series of prices for storage over several time periods. Each price is not independently determined and cannot be viewed as a forecast of expected future events.

Stated differently, futures prices represent forecasts of no change in prices. The price data in Table 2 (p. 39) can be used to illustrate the argument. Suppose the prices reported there were those observed on December 1, 1981. The December corn price ($2.87½) is effectively a cash price since the contract will be deliverable soon. Meanwhile, the price of corn for March delivery is $3.06½. Should this be interpreted as a forecast that corn prices will increase by nearly $.19? Consider purchasing corn, storing it and placing a hedge. Today's expected value of the corn in March is $2.87½ minus the costs of $.19 for storing it for three months (at $.064 per month) plus the return of $.19 from hedging. That is, the expected value of the corn held until March is $2.87½, today's price.

Market information is reflected equally in all prices, cash and futures. There is no additional information in a futures price that is not in today's cash price. And, emerging new information serves to effect all prices roughly equal since these prices are connected by the current value of continued storage. Any differential effect only reflects the effects the new information might have on stocks levels and thus on the value storage.

Data from the soybean market illustrate the argument. The carryout of 59.6 million bushels from the 1972/73 crop year was the smallest during the decade, whereas in 1975/76, the carryout of 244.9 million bushels was the largest of the decade. In May 1973, nearby soybean futures (July maturity, effectively a cash price) rose from $6.93¼ per bushel on May 1 to $10.58 at month's end, a change of $3.64 3/4. Meanwhile, prices of the November future (the first truly new crop future) over the same period changed only $1.62 rising from $4.69 to $6.31. Prices representing both crop years (the May 1973 delivery and the November 1974 delivery) rose, but those in the current year rose significantly more. Stocks levels were already expected to be small and the unexpected increase in current demand served to make them even smaller, thereby increasing the inverse carrying charge.

By contrast, in May 1976, July soybean futures rose from $4.89¼ to $5.79 and November futures from $5.06½ to $5.91½, changes of $.89 3/4 and $.85 per bushel, respectively. In May, carryout stocks were expected to be large and carrying charges prevailed. This time, the unexpected increase in demand, which resulted in higher prices, could be easily accommodated by the large stocks. Stocks were still expected to be large and the new information in May influenced both price levels nearly equally.

Even though the information content of a futures price is no different from that of a cash price, the question for market users remains whether these prices are reliable indicators of futures prices. Two measures of reliability are of concern--biasedness and goodness-of-fit. Analyses of bias in futures prices of a wide range of commodities generally have concluded that, for active markets, futures prices may be regarded as unbiased (e.g., Gray, 1960 and 1962; Tomek and Gray, 1970). Further, Tomek and Gray have shown that, for storable commodities, futures prices are also reasonably reliable guides. The implications of this evidence will be considered in more detail in assessing the potential costs and benefits of various futures strategies for importing countries.

VI. REGULATION OF COMMODITY FUTURES MARKETS

Activity on individual futures markets in the U.S. is regulated by the separate exchanges and by an independent, federal regulatory agency, the Commodity Futures Trading Commission (CFTC). In the U.K., the Bank of England performs a regulatory oversight role. Much of the daily regulation of markets--price limits, margins, trading practices--rests primarily with the exchanges, though the CFTC maintains an active oversight role. The CFTC monitors large traders closely in an effort to prevent manipulations, maintains adjudication processes for customer complaints, certifies and regulates individuals who control or advise public accounts, and the like. For purposes here, the regulations which are of greatest importance are the price limits, the establishment of margins, and position limits.

The price limits establish the maximum amount a futures price may change relative to the previous day's closing price. Currently, limits in corn futures prices are 10¢ per bushel, on wheat are 20¢ per bushel and on soybeans are 30¢ per bushel. For example, if today's closing price of the December corn future is $2.50, then tomorrow's closing price must be between $2.60 and $2.40, plus or minus 10¢ from $2.50. In addition, if there are two successive days of limit price changes in the same direction, the limits are automatically increased 50 percent. As noted earlier, the purpose of limiting daily price changes is to help insure contract integrity. They define the maximum amount by which margin monies will be depleted in a day and, simultaneously, permit individuals nearly 24 hours to arrange for additional (maintenance) margin funds if needed.

Price limits are important to the individual trader for two reasons. First, limits can and do change if market conditions change. That is, in addition to the automatic increase after two days, the limits may be changed overnight by the exchange (technically, by the clearinghouse of the exchange). Thus, a trader may have an otherwise unexpected call for additional margin funds. Secondly, limited price changes mean a trader can get "locked into" a position. When prices increase or decrease to the daily limit, trading ceases. An individual can neither enter a new position nor get out of a current position. While so-called lock-limit markets are not frequent, they occur when major new information comes into the market--just at a time when an individual would be reevaluating his position.

The second regulatory tool, margins, are important to a trader for virtually the same reasons as price limits. Minimum margin levels can be changed overnight. Often this is done in conjunction with changes in the daily price limits.

The third regulatory tool, position limits, are of only limited interest to commercial users of futures markets. Position limits are applied only speculators--in the grains, an individual speculator may control no more than 3 million bushels of any individual commodity in futures positions. (These position limits are under review by the CFTC and may be raised.) However, all traders with large (greater than 1 million bushels) positions in futures are required to report these positions to the CFTC.

Finally, though there are no specific regulations, participation of the international community directly in U.S. futures markets is an issue of continuing concern to the CFTC. The primary concern is one of the agency's ability to enforce regulations when the trader is not subject to "normal" judicial remedies. Two well-known examples serve to illustrate the concern. In investigating a potential manipulation of the coffee futures market, the CFTC was unable to obtain information on large foreign traders' cash market positions. Similarly, in monitoring the silver market in 1979/80, regulators were unable to obtain information about large positions traded through a Swiss bank. In general, foreign participation on U.S. markets is not discouraged. There may, however, be some additional guidelines forthcoming from the CFTC.

VII. CHANGING COMMERCIAL USES OF FUTURES MARKETS IN THE 1970s

The 1972/73 crop year fundamentally altered world grain markets. The prior two decades had seen the U.S. established as the principal residual supplier of food and feed grains to the rest of the world. This position was a direct result of surpluses created by domestic price support programs. The ever-increasing government ownership of grains, especially wheat, in the early years of the loan program spawned several surplus disposal programs as well as fundamental revisions in the loan program. Support prices were significantly lowered. Flexibility requirements (acreage diversion and set-asides) were introduced and continually adjusted in an effort to bring current production and consumption into balance. On the disposal side, direct export subsidies were introduced as were indirect subsidy programs like PL-480 to help export the accumulated surpluses.

The 1972/73 crop year was but a continuation of these policies. The large purchase of grain by the USSR through private channels created only minimal price effects. Average annual prices of wheat within the U.S. increased from $1.34 in the 1971/72 crop year to only $1.76 per bushel in the 1972/73 crop year. The increase in corn prices was somewhat larger, from $1.08 to $1.57 per bushel. While the quantum leap in exports implied by the USSR purchases took the market by surprise, the surprise was quickly absorbed as the U.S. government viewed them as a means to reduce further their ownership of grains, continuing the disposal policies of the 1960s.

Indeed, the purchases were announced in late July and early August b : the export subsidy scheme continued in effect until late September.

In 1973, events conspired to alter market fundamentals from surplus to scarcity. Stocks levels were moderate entering the 1973/74 crop year. Prices were somewhat above historic averages within the U.S. Some land continued to be forcibly idled under the various program provisions. Soviet purchases were only moderate. However, the dollar had been significantly declining in international markets all during 1973 so that the moderate price increases within the U.S. were not transmitted to major purchasers. Finally, fears of production shortfalls in the 1973 crops started significant price increases. These increases fueled what, in retrospect, can be described as excessive speculation or panic buying by many of the normal, relatively affluent importers of U.S. grains. In the face of historically high prices (even when currency changes are accounted for), stocks levels in both the EEC and Japan actually increased over the 1973/74 crop year.

By the end of the 1973/74 crop year, government-owned stocks in the U.S. were depleted. Prices were left to balance market supplies and demands for the remainder of the decade--though with sporadic government interventions. These were on the one hand more episodic, e.g., export embargoes, than previously and therefore contributed to price instability. However, a farmer-owned reserve program was also created which probably has contributed to price stability. Its release prices have been established at levels well above entry prices and--most importantly--ownership reverts to farmers at the release price. Thus, it is unlikely that its sale into the market will be as nonprice responsive as was that of the government-owned stocks earlier.

Changes in the fundamentals of the grain markets which brought a decade of more variable prices also bought significant changes in the futures markets. Among these, declining levels of speculation and increasing levels of commercial use are of particular interest because they seem, at first glance, counter to expectations.

A. Futures Speculation in 1973

Speculation on commodity futures markets is often alleged to influence commodity prices unduly. Such allegations are most common in periods of unusually high or unusually low prices. The first period of major grain price increases, 1973, was no exception. Among others, Cooper and Lawrence (1975) attributed part of the "blame" for the unprecedented high and variable prices on speculation in futures.

Speculators' net futures positions in the Chicago wheat market at the end of each month from March through December 1973 are shown in Table 5. As these data clearly show, speculators were on average net short, i.e., sellers of futures contracts, during this period. Prices rose from a low of \$1.97½ per bushel on March 27 to a high of \$5.78 on December 12 (basis the December future). Thus, speculators on futures markets neither caused nor benefitted from the price increase. Moreover, as the following data show, speculation in futures markets has been declining relative to commercial firm's use of the markets.

Table 5.--Net Speculation in Chicago Wheat Futures, 1972*
(mil. bu.)

Date	Net position of futures speculators
March 31	-2.5
April 30	-4.8
May 31	+3.1
June 30	-16.1
July 31	+4.3
August 31	+2.2
September 30	+5.4
October 31	-23.6
November 30	-12.4
December 31	-3.6

* Roger W. Gray, "The Emergence of Short Speculation," International Futures Trading Seminar Proceedings, VI, 1979, Chicago Board of Trade. Net speculation is computed simply as the obverse of the net reported hedging. Minus sign indicates net short position.

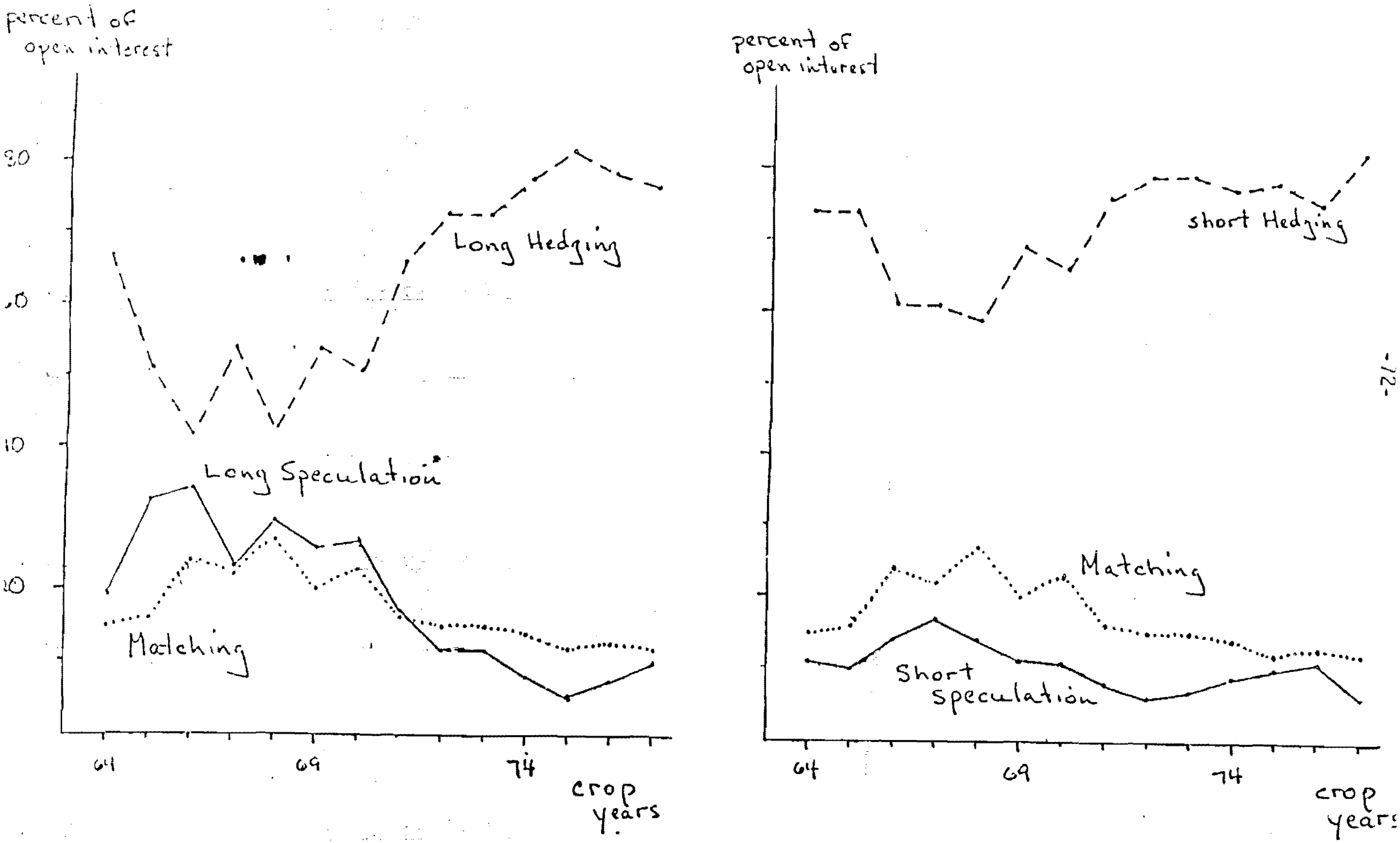
B. Increases in Export Hedging

With the volatility of all prices, agricultural as well as financial, one might expect much of the growth in commodity trading to be accounted for by speculative interests. Absolute levels of speculation did increase in the grain markets. These increases were dwarfed, however, by increases in commercial firms' use of the markets. Figures 16-18 exhibit these trends in use of the corn, wheat, and soybean futures markets over the period 1964-1977. The observations are crop-year averages of monthly positions and 1964 is the 1964/65 crop year. The data have been expressed as percentages of the total open interest to provide a clearer picture of relative changes in market composition.

Two fundamental changes in these markets' composition are evident in these figures. First, both long and short hedging have increased more than the open increases in the open interest over this period. Second, the proportionate increase in long hedging has been significantly greater than that in short hedging. These changes imply simultaneous decreases in speculation as a percentage of the open interest. Matching positions, which measure spread trading, remained fairly constant. These are relative changes. With total open interest increasing some 260 percent, a decrease in long speculation from 30 percent to 10 percent of the open interest in the corn market still implies a growth in absolute levels of speculation. However, it remains true that commercial needs have grown much faster than speculative participation.

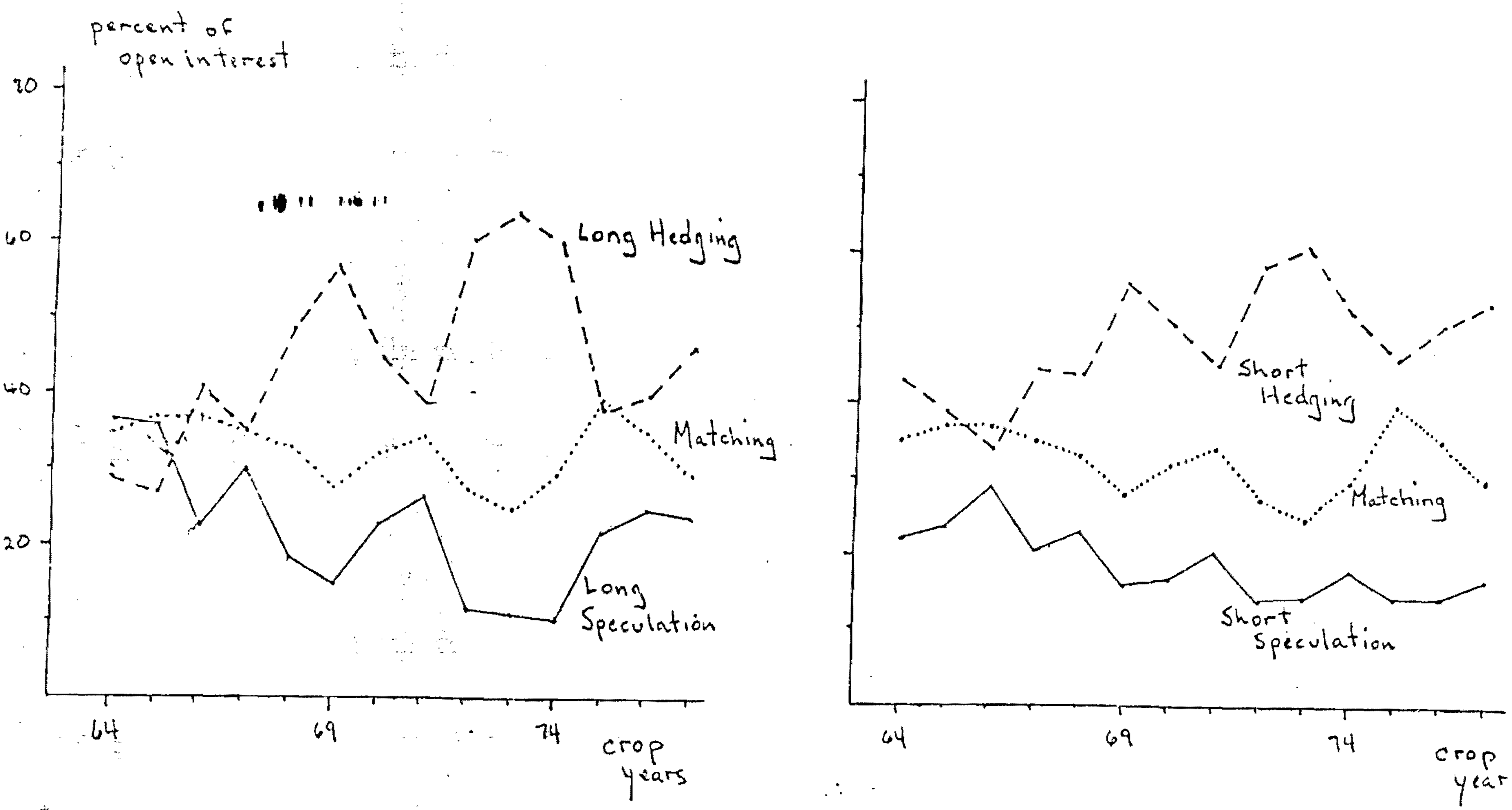
The growth of and increasing balance in hedgers' use of these future

Figure 16.--Trends in Hedging and Speculation in the Corn Futures Market, 1964-1977*



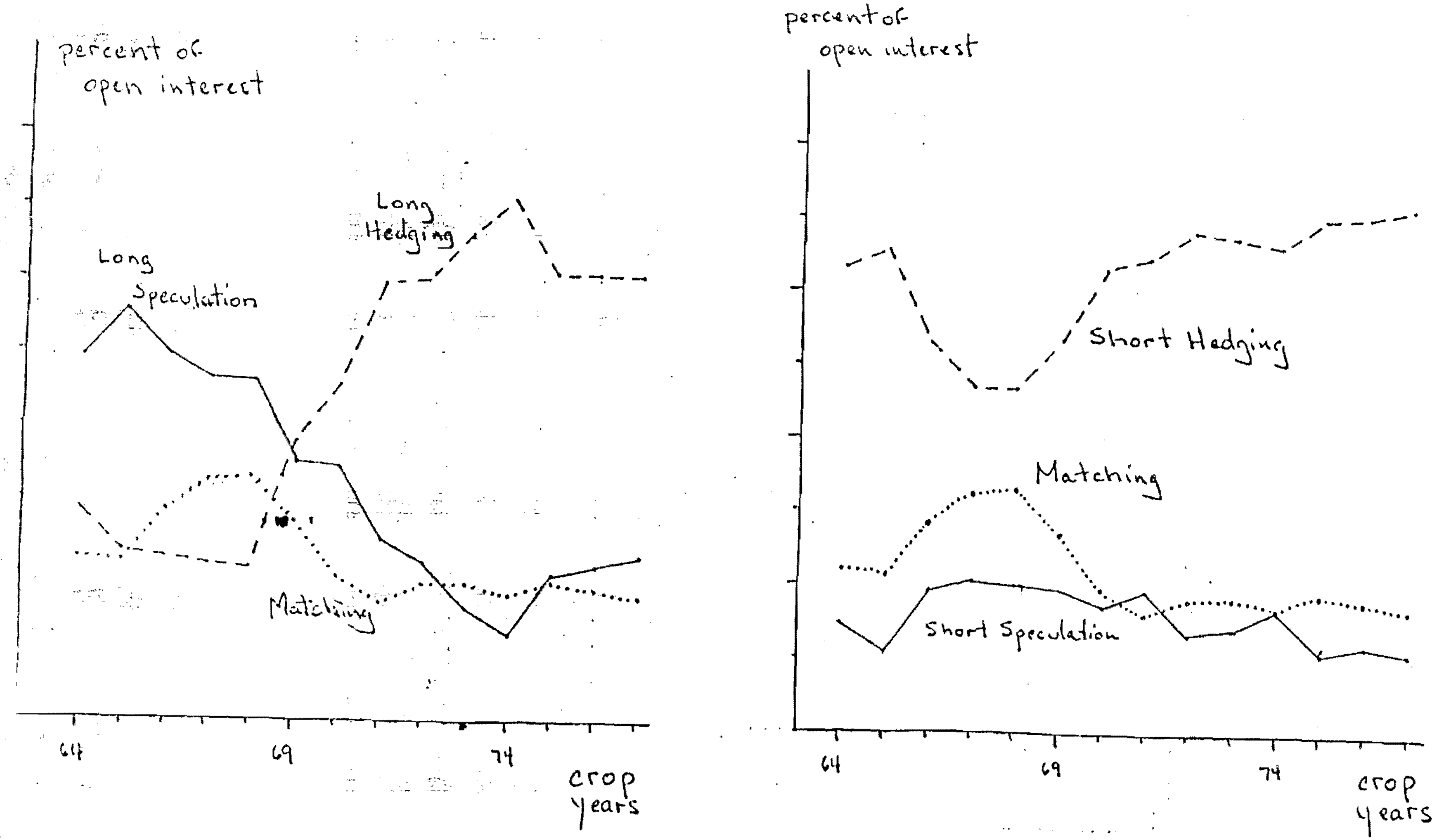
* Anne E. Peck, "The Adequacy of Speculation in the Wheat, Corn and Soybean Futures Markets," in Ray Goldberg, editor, Research in Domestic and International Agribusiness Management, Vol. II, 1981.

Figure 17.--Trends in Hedging and Speculation in the Soybean Futures Market, 1964-1977*



* Anne E. Peck, "The Adequacy of Speculation in the Wheat, Corn and Soybean Futures Markets," in Ray Goldberg, editor, Research in Domestic and International Agribusiness Management, Vol. II, 1981.

Figure 18.--Trends in Hedging and Speculation in Chicago Wheat Futures Market, 1964-1977*



* Anne E. Peck, "The Adequacy of Speculation in the Wheat, Corn and Soybean Futures Markets," in Ray Goldberg, editor, Research in Domestic and International Agribusiness Management, Vol. II, 1981.

markets reflects directly changes in the underlying cash markets. Exports have become much larger percentages of the total use of all three of these crops. Increased exports have lead to increased long hedging since exporters generally are purchasers of futures contracts as temporary substitutes for the purchase of the cash grain to be exported. In addition, increased exports mean more of the commodity is in commercial channels longer. Much of this movement will be accompanied by short hedging. In addition, the abrupt change from surplus to scarcity led to dramatic increases in commodity price variability. Thus, the incentive to hedge has increased markedly over this period, resulting in the growth in hedging seen in these figures.

VIII. IMPORT DECISIONS AND ALTERNATIVE FUTURES MARKET STRATEGIES

Most LDC import decisions are currently implemented through fixed-price contracts. In addition to prices, such contracts include quantity, quality and precise delivery specifications (e.g., FOB or CIF). They may be negotiated privately with individual export houses or marketing boards or they may be offered as tenders where all interested exporters are invited to bid on the contract. Under this method the actual contracting and the pricing decision are made simultaneously.

Fundamentally, futures markets could be used to separate these currently simultaneous decisions. In particular, the decision to price can easily be separated in time from the decisions about timing, quality, quantity, and transportation of required imports. Further, while roughly equivalent time horizons are available in futures as in forward contracts, futures can be used more readily to spread over time the pricing component of a sizable contract commitment.

As one alternative, importing countries could consider pricing at least a portion of their anticipated requirements before actual import contracts are negotiat.d. For example, exact quantities may not be known well in advance of the time they will be needed due to uncertainties about domestic production or financing arrangements. On the other hand, it seems quite likely that minimal requirements would be known, if on'y based upon previous years' experience. If, in addition, current prices are thought to be advantageous, these price levels could be .ssured (within the limits of variable transport and currency costs) through the purchase of futures in amounts approximating minimal anticipated quantities. When precise quantities are known and the actual imports are contracted, the futures purchases would then be offset (by sales of futures). In this use of futures only approximate import prices are secured. The actual price paid for delivery in the specific country will depend upon transportation rates and currency values at the time the import contract is offered.

As a second alternative, futures contracts could be used to spread out the time of pricing, for example, by buying fixed percentages of the total anticipated transaction each month. Import contracts are normally large and forward contracting with fixed prices requires pricing the entire contract on the same day. Unless the importing agency is particularly adept at contracting at or near market lows, the costs of this method of pricing could be significant in any particular year. By buying fixed percentages of the contract amount over a period of months (either in anticipation of the actual fixed price contract as above or after a basis-priced contract has been negotiated as discussed below), the importer is very likely to purchase at a market average price. Again, the average price level fixed in this way will only be approximate.

One fundamental concept involved in separating pricing from actual contracting is the role of the basis and basis-pricing. The next section describes basis pricing and how it is commonly used. Then several examples of alternative pricing methods are considered.

A. Basis Priced Contracts

In any so-called fixed or flat price import contract, the price bid can be separated into two parts, the relevant futures price (the price level) and a basis price which is the difference between the futures price and prices for the specified grade in the specified location. As such, the basis may include transportation costs (either CIF or FOB) and quality differentials if the quality to be contracted is different from the standard contract grade. Together, the futures price plus the basis price give the price level in the location of interest.

These two components of a flat price bid can and are frequently traded separately, permitting the buyer to establish the relative price and the absolute price at different times. This practice, known as basis-pricing or basis-fixing, is common among elevators and processors within the U.S. A contract which fixes the basis is identical in every respect--quantity, quality, time of shipment, etc.--to a priced contract except that the "price" agreed upon is the price relative to a futures contract. For example, if the buyer is using New Orleans as a loading point for May shipment, the "price" fixed in the contract might be FOB-New Orleans, $.20 over the May future. In addition, the contract would include a specification like "buyer's option" or "to be priced by the buyer" which entitles the buyer to price--establish the price level--at any time between the contracting date and the first of May (or other designated deadline). To complete the transaction, that is to fix the price, the buyer simply buys futures (in this case, May futures) at a time he decides is advantageous.

An exporter, using futures markets to price and to routinely hedge his contracts, is indifferent between a basis-priced and a flat-priced contract. In both cases, his job is the same--to have grain in New Orleans ready for loading on the specified date at a specified differential from the (May) future. If the contract is a flat price contract, the exporter hedges it by buying futures as a temporary substitute for the cash purchases. The futures purchase will establish the basis (the difference between the flat price in the contract and the futures price) against which he has to purchase grain and move it to New Orleans. The basis-fixed contract accomplishes the same thing--establishing a basis against which he must purchase and deliver the grain.

The final element of the transaction, buying futures contracts, prices the transaction and is accomplished in one of two ways. When the importer decides it is time to price the contract, he may instruct his broker to buy futures and have those recorded for the account of the exporter. Thus, while the purchase is initiated by the buyer, the futures contracts are recorded in the clearinghouse of the exchange as belonging to the exporting firm. A second alternative is for the importer to buy the futures contracts for his own account when he desires to price the contract. Then, on a prespecified date, the importer and exporter will exchange their futures positions for the cash commodity.

Either way, the futures transaction establishes the final price that the exporter is owed, the futures price plus the $.20 (in this case) basis. Examples of the transactions involved in a price-fixed contract versus a basis-fixed contract are shown in Table 6. The basic difference involves the timing of the purchase of futures, which in basis-fixing is initiated at the option of the buyer at a time when he thinks prices are right. In the meantime, quantity, quality and delivery times have been assured.

B. Alternative Purchase Strategies

Several import pricing strategies may be illustrated with the price data in Table 1, p. 34. To illustrate the importer's options, assume the importer knows in January 1980 his import requirements for January 1981 (one year away). The time horizons involved in this example are probably much longer than is common, but the strategies illustrated are equally applicable to much shorter time horizons. Also, assume the importer's basis is known and is constant (U.S. $0.50) during the year and foreign exchange rates are stable. Using these assumptions, six alternatives are discussed amd their results are shown in Table 7.

The importer, knowing his purchase requirements in January 1980, could simply wait until December and purchase wheat on the cash market and simultaneously arrange shipment. With one month required for shipping, the wheat would arrive in January 1981 as planned. In December, cash wheat prices are $4.95 per bushel. Combined with the known basis ($0.05), the importer's price of wheat is $5.45 as shown in the first column of Table 7

However, knowing his import requirements in advance gives the importer flexibility in contracting and pricing. Five alternatives are illustrated in Table 7. Since the imports are to be shipped in December, the relevant

Table 6.--Simple Mechanics of Price-fixing and Basis-fixing Forward Contracts of Corn for Export

Month	Price of May future	Transactions
Case 1: Price fix		
October	2.60	Forward contract corn, fixing price, for export in May. Price fixed at $.20 over May future. Exporter buys futures as temporary substitute for cash purchase.
November	2.40	Exporter buys corn even with the May future for April shipment, lifts his future hedge at $2.40, and books April barge transportation from country elevators to New Orleans at $.15 per bushel.
May	2.10	Importer pays $2.80. Exporter sold corn at $2.80, bought corn at $2.40, has a $.20 futures loss and costs of $.15, for a gross profit of $.05 per bushel.
Case 2: Basis fix--buyer to price		
October	2.60	Forward contract corn, fixing basis only, for export in May. Basis fixed at $.20 over the May future.
November	2.40	Exporter buys corn even with the May for shipment in April and books April transportation at $.15 per bushel to port. Sells May futures at $2.40 to hedge the cash purchase.
December	2.35	
January	2.25	Importer buys May futures for the account of the exporter, thereby fixing "cash" price at $2.25.
May	2.10	Importer pays $2.25 + $.20 = $2.45. Exporter bought corn at $2.40, has futures profit of $.15, costs of $.15 and sold corn at $2.45 for a gross profit of $.05 per bushel.

[continued on next page]

Table 6 (continued)

Month	Price of May future	Transactions
Case 3: Basis fix--exchange futures		
October	2.60	Forward contract corn, fixing basis only, for export in May. Basis fixed at $.20 over May future.
November	2.40	Exporter buys corn even with the May future for April shipment and books April transportation at $.15 per bushel to port. Sells May futures at $2.40 to hedge this purchase.
January	2.25	Importer decides to price contract, buys May futures at $2.25 for his own account.
May	2.10	Buyer and seller exchange futures positions for cash. Buyer pays $2.10 plus $.20 or $2.30, but has futures loss of $.15, so costs are $2.45. Seller sold corn at $2.30, has a futures profit of $.30, costs of $.15 and bought corn at $2.40 for a gross profit of $.05 per bushel.

Table 7.--Illustration of Six Alternative Purchase Strategies*

ures options	Cash	Fixed price forward contract	Futures price in January and contract in March	Averaging prices with futures[1]	Basis pricing in March and pricing in July	Rolling forward futures positio
			Results of futures transactions			
uary			4.90 (B)	4.90 (B)		4.45 (B
ch			4.77 (S)	4.77 (S)		4.33 (S 4.51 (B
y					4.57 (B)	4.25½(S 4.57 (B
ember					4.95 (S)	4.95 (S
			Results of total transaction			
tract month	December	March	March	March	March	March
cing month	December	March	January	January and March	July	January
. equivalent price	4.95	4.77	4.77	4.77	4.95	4.95
is	0.50	0.50	0.50	0.50	0.50	0.50
ures loss (+) or gain (-)	n.a.	n.a.	+0.13	0.06½[1]	-0.38	-0.00½
ort price	5.45	5.27	5.40	5.33½	5.07	5.44½

All price data are U.S. $ per bushel. In the futures transactions (B) indicates the buying price and (S) indi- es the selling price. In calculating the import price in the lower half of the table, futures losses (gains) a: wn with a plus (minus) sign since these add to (subtract from) total costs.

Only one-half of the total quantity is purchased in January futures. The $0.13 loss on this position averaged [illegible] results in an average futures loss of 0.06½.

(though not necessarily used) futures option is the December contract. Over 1980, the December futures price went from $4.90 in January to $4.77 in March to $4.57 in July, and, finally to $4.95 in December. One alternative to waiting until December to purchase is to forward contract, say in March, fixing price levels. The results of this strategy are shown in column 2. The cost of imported grain is $5.27. On the other hand, suppose the importer had decided that prices were attractive in January 1980 and he wanted to "assure" these prices. If he did not want or could not negotiate a forward contract in January, he could have priced the imports through futures and negotiated a fixed price contract later. The results are shown in column 3. The import price (U.S. $5.40) is the sum of the price obtained when the actual contract was negotiated in March (price plus basis) and any net losses or gains in the futures positions. Note that the price paid using this strategy is the price implied when the futures position was assumed in January ($4.90 + 0.50). This equivalence is a result of the assumption of a constant basis and will not hold in general.

Another strategy would combine the forward and futures pricing strategies above to enable the importer to average specific months' prices. One-half of the actual quantity could be purchased in January futures. In March, the entire contract would be negotiated with fixed prices and the futures positions would be closed. The import price is an average of those above and is shown in column 4.

A fourth alternative would be to forward contract only the basis price in March. In this way, all quantity, quality and transportation arrangements can be secured. And, in the present case, the basis fixed contract would specify the price as $0.50 over the December future. In principle, pricing could be done any time until December. Assume the pricing decision is made in July and December futures are purchased. These futures would then be exchanged with the exporter in December at the then prevailing market prices. As shown in column 5, the result of this strategy is an import price of $5.07.

Finally, it is important to realize that although the December future is the relevant reference price in this example, it is not necessary to do the actual pricing via futures positions in the December contract. For example, in January, the importer could have purchased March futures, rolled these forward in March to July futures, and, in July rolled these forward to December futures. At some point, the import contract would be basis priced again, for example, in March. The results of this strategy are shown in column 6. As with the futures pricing example the fundamental pricing decision was made in January (price now). Here, however, it was made with March rather than December futures. The resulting import price was $5.44½, similar to that available when the imports were priced with the December option. Choosing this strategy depends upon a view of the relationships among the futures options prices and their likely direction of change. In the example, this strategy cost $0.04½ more because the differentials widened due to rising interest rates. The strategy also illustrates that futures contracts with maturities coinciding with the precise dates of expected shipment do not have to be available for futures markets to provide an effective pricing mechanism.

There are a variety of caveats to this simple illustration. The basis has been assumed constant. Basis relationships are not constant. They change dramatically as the availability of transportation and relative supplies of the commodity in various locations change. Currency considerations can be very important; indeed, they may dominate price expectations.

Most important, however, all of these decisions are equally speculative. Knowing that grain must be procured at some point implies that a speculative decision must be made. Whether it is made by default, waiting for the shipment date and buying cash wheat, or whether it is made with forward contracts with or without futures positions, the fundamental decision is the same and is equally speculative. Whenever the grain is purchased, the importer is saying that prices are acceptable now. Futures positions simply provide additional ways in which that decision can be made.

C. Potential Costs and Benefits of Using Futures Markets

To the extent that importing countries are unfamiliar with the operation of futures markets, there are likely to be significant gains in purchasing effectiveness through increased knowledge about these markets. The bids importers receive are derived from the relevant futures quotation and the actual contract will enter the futures market in the normal course of exporter's operational hedging. The exporter's bid is no more than the sum of a futures price and a location specific basis price calculation.

Given a fixed price bid from an exporter, the importer can calculate the exporter's bid. This bid can easily be compared--indeed, basis prices are the subject of separate analysis and forecasting in most grain firms--with other quotations and/or analysis. If tne contract is CIF, an additional calculation/investigation of ocean freight will be required. In theory, each of the pieces of a flat price bid may be analyzed separately and comparing relative values (for example, a futures price vs. a U.S. gulf delivery price) is usually easier than analyzing or judging the absolute value of a price. Thus, the most important benefit of becoming more involved and knowledgeable about futures markets is the informational content which can be extracted from a bid and the increased ease with which one's relative position can be assessed.

The additional benefits of becoming involved directly in futures use--either in basis-fixed import contracts with pricing through futures or outright purchase of futures before import contracts are negotiated--are three, flexibility, information, and reduction in price risk. None of these benefits is easily quantified.

The direct use of futures permits importers to price imports at almost any time, up to and including date of shipment. In addition, imports totalling thousands of bushels can be priced almost instantaneously or can be priced over a period of months even though they are to be shipped at one time. Flexibility is valuable, of course, only to the extent that it improves purchasing, which presumably means a lower net price. But, since studies of futures prices show them to be unbiased predictors of eventual spot prices, there are no guaranteed better prices.

Consider two purchase strategies--routinely buying 100,000 bushels of wheat in December versus the more "flexible" purchase of buying 20,000 bushels of December futures in each month July through November. Comparison over a period of years of the mean purchase prices from these strategies would show them to be <u>not</u> significantly different. In fact, comparison of any such routine strategy would produce identical results. There is no statistically provable price advantage in being more "flexible." Flexibility can improve purchase results, but the improvement depends solely upon the quality of the speculative price judgments. If these judgments are currently being constrained because of quantity uncertainties or sizes, the use of futures markets would permit pricing when it is desired, not when it is dictated by other requirements.

The second benefit of direct futures involvement is information improvement. In participating directly, importers are likely to monitor markets more nearly continuously. In addition, since they are likely to be trading through one or more brokerage houses, emerging information will be continuously analyzed and available for further analysis. And while it can be argued that improved information will lead to improved pricing, there are no real world guarantees. Again, therefore, these benefits are not measurable.

The final benefit is the reduction in price risks achievable with price fixing through futures. Risk is not totally eliminated, if only because the futures positions often establish the price level before the basis has been fixed. To the extent that transport costs and currency values vary, import price risks will remain. Futures as well as forward prices for grains are as variable from year-to-year as are spot or cash prices. While this year's cost of grain imports may be known well in advance, the annual variability of import prices will not be reduced significantly. The within-year reduction in price variability can be important. It provides for reliable estimates of costs of foreign exchange, of internal price support (if any) mechanisms, or of any other grain-import related programs well in advance of their expenditure. Again, however, the value of the increased certainty in a planning horizon is country specific and not subject to direct quantification.

Unlike benefits, the direct costs of a futures program are easily quantified. These include execution fees and daily margin costs. Execution fees are negotiable, ranging between $25-$60 per contract which covers both the purchase and subsequent sale of a futures contract. Margin costs are of two types--initial margins and maintenance margins. Initial minimum margins are approximately $1,000-$2,000 per contract currently, but they can and do change frequently. Minimum margins are established by the exchanges. Those required by a brokerage firm are higher and are negotiated with each client. Since these funds may be held in interest-bearing securities (again, a matter of negotiation) there is no real cost in initial margins per se.

However, margins can have significant costs to an importer. Margin funds are used to settle all futures accounts on a daily basis and an importer's margin account will vary daily. If prices move favorably (presumably up since an importer is most likely a purchaser of futures), profits are transferred into the account daily and may be removed. The accumulated profits then enable the importer to purchase the now higher priced cash grain, leaving a net purchase price approximately equal to the original futures purchase price. If the market moves down, margin monies are debited daily and when margin monies fall below approximately one-half of their initial levels, the importer will be required to deposit more money. The accumulated futures losses combined with the now lower cash price of grain will leave a net purchase price approximately equal to the original futures price. Since futures prices are unbiased estimates of subsequent cash prices, the expected value of margin calls is zero.

However, margin costs (gains) are highly visible because of the daily mark-to-the market accounting of the exchanges. Similar losses on a fixed price commitment are just as real, but they are opportunity losses. For example, suppose a forward contract was made today for delivery in six months at \$3.50. In six months time, cash wheat is trading for \$3.00 and there is an opportunity loss of \$.50. This loss will generally not appear as an accounting loss in the records of the importing agency. In contrast (and ignoring basis differentials), suppose a futures position was purchased today at the same \$3.50. By the time the actual wheat is purchased in six at $3.00, the futures position will have lost $0.50, leaving a net purchase price of $3.50. The net purchase price was the same in both strategies--but the futures strategy involved a $.50 loss which will appear as a loss in the accounts of the importing agency because these monies will have been paid in margin calls. The very visibility of these losses or gains may be a cost as well.

IX. HOLDING GRAIN RESERVES IN FUTURES CONTRACTS

Thus far, the discussion has focused upon alternative strategies available to importing countries to purchase annual import requirements. The annual framework was convenient in that both the planning horizon of the import decision and the available maturities of futures contracts were coincident even though, as noted in the examples, the placement of actual hedges did not have to coincide with the expected timing of imports since the futures position could be rolled forward easily. In principle, the choice of maturities into which the hedge is placed is determined by the relative liquidity of the contracts and by expectations about the changes in the price spreads among the contracts. And, in the example, using nearer term futures and rolling the position forward added $.04½ per bushel to the cost of the imported grain because the spreads widened from January to December. If instead, the spreads had narrowed (due to, for example, declining interest rates) the cost of the imported grain would have been commensurately reduced.

The important point is that the timing of the actual purchases does not have to be coincident with the maturity of specific futures positions for the hedge to be effective. By extension, futures positions can be used to price (within bounds, as will be explained below) anticipated or desired cash market positions which are more distant than the available futures options such as reserves of grain in excess of those required for emergency and operational purposes. The present paper does not analyze whether grain reserves are themselves economically desirable. Rather, it assumes that the decision to price this commitment has been made and examines alternative ways to effect that decision.

In principle, long term positions are more cheaply priced in futures markets than in today's spot market with the incumbent requirement of storage until the time the grain is to be used. Price spreads between futures contracts will never be more than the full costs of storage and are often significantly less. Thus, the futures position will be generally cheaper to maintain (though moving the position forward by rolling over contracts) than the equivalent size of physical stock. The principal argument is demonstrated by example below. The requisite caveats to the general case are then discussed.

Consider first two alternative ways of holding a reserve of grain: holding a physical stock and holding futures positions. For simplicity, assume that the basis is a constant, i.e., that the difference between Chicago prices and CIF prices in the country of interest are constant, and that currency values are constant vis-a-vis the dollar. The decision to initiate the reserve is made in the summer of 1976, a period when wheat prices were relatively low. Finally, for illustrative purposes, assume that the reserve is not needed for three and a half years, until December 1979.

Table 8 presents the results of the two main alternative means of holding that reserve. All prices are Chicago equivalents. In the first strategy, wheat is purchased over a four-month period at the end of summer 1976. In addition, available financing requires renewal in January of each year. In these calculations, the average U.S. prime rate for the year is assumed to be known in January and is applied to the market value of the wheat in January. Interest and physical storage costs added to the purchase price give a net cost of the reserve's wheat of $4.93 in December 1979.

With the basis (CIF port in the importing country) assumed to be $0.50, these costs translate to an initial cost of $3.31 in 1976 and a total cost of $5.43 in December 1980. The assumptions of constant basis, equal interest rates and equal physical storage costs imply the country is indifferent to where the grain is actually stored, in the importing country or in the U.S. Obviously, the latter alternative implies that the reserves here are only those in excess of stocks needed to meet operational or emergency needs because time is required to transport grain.

The second strategy holds the reserve in futures contracts instead of as a physical stock. The nearby future--December 1976--is purchased

Table 8.--Comparative Costs of Three Food Reserves Schemes

The reserve is to be purchased over August, September, October and November 1976 in equal installments. Given the subsequent course of prices, it is not used until December 1979, nearly 3½ years later. At the time of purchase, annual physical storage costs were $.36

Strategy 1: Commodity Reserve with Annual Refinancing

Commodity purchases[1]		
August 1976	$3.01	
September 1976	$2.89	
October 1976	$2.72	
November 1976	$2.60	
Average purchase price		$2.81
Physical storage costs		$1.17
Interest cost[2] 1976		$ .048
" " 1977		$ .185
" " 1978		$ .244
" " 1979		$ .473
December 1979 cost of reserve wheat		$4.93

Strategy 2: Futures Reserve

1976 December futures purchases on	
August 1	$3.43
September 1	$3.27
October 1	$2.87
November 1	$2.77
Average cost December 1976 future	$3.08

Futures gains and losses

December 1, 1976:	Sell December	@ $2.55 3/4	-.52½
	Buy July	@ $2.73½	
July 1, 1977:	Sell July	@ $2.40	-.33½
	Buy December	@ $2.58	
December 1, 1977:	Sell December	@ $2.66 3/4	+.08 3/4
	Buy July	@ $2.85 3/4	

Table 8 (continued)

Futures gains and losses (continued)

July 1, 1978:	Sell July Buy December	@ $3.17½ @ $3.26¼	+.31¾
December 1, 1978	Sell December Buy July	@ $3.74¼ @ $3.29½	+.48
July 1, 1979	Sell July Buy December	@ $4.43 @ $4.63	+1.13½
December 1, 1979	Sell December	@ $4.30	-.33

Total futures profits[3]	-0.83½
Purchase cash wheat December, 1979	4.26
December 1979 net cost of reserve wheat	$3.42½

Strategy 3: Commodity Reserve With Long-Term Financing @ 6.8 percent

Average purchase price	$2.81
Physical storage costs	$1.17
Interest costs	$ .62
December 1979 cost of reserve wheat	$4.60

1 Cash prices are monthly average, Chicago.

2 Calculated using January's market value of wheat (Chicago) and the annual average prime rate for the indicated year.

3 Profits of 0.83½ are shown with a minus sign since they reduce the net cost of wheat in December 1979.

in equal amounts on the first of each of the four purchase months. Subsequently, all futures positions are rolled forward approximately six months on the first day of a delivery month. For example, on December 1, 1976, the December futures are sold (at a net loss of 52¼¢) and July futures are purchased. As indicated, by December 1, 1979, this series of futures transactions accrues a $0.83½ profit. Purchasing cash wheat at $4.26 in December less the futures gain gives a net cost of the futures-held reserve wheat of $3.42½. Adding the $0.50 of transport costs gives an in-country equivalent price of $3.92½.

The futures reserve is significantly less costly than the physicals reserve. Per bushel, the costs of physical commodity storage are not constant since they depend largely upon interest rates. However they will always be positive. The difference between two future contracts is also nonconstant and is described by Working's theory of the price of storage (see Section V, above). The price of storage (the difference in the futures prices) will never be more than physical storage costs and is frequently less, even negative as it was on December 1, 1978. Thus, in the U.S. a futures-held reserve will always be cheaper to maintain than a physical stock of the commodity.

Comparing Strategies 1 and 2 for an importing country assumes that interest rates are identical in the importing country and in the United States and that the purchase of grain must be refinanced each year. If, as seems likely, an importing country has access to long-term, fixed rate financing at rates comparable to or below market rates, then the comparative costs are altered significantly. The results of this assumption are shown as Strategy 3 in Table 8. Here, the market rate in the U.S., 6.8 percent, prevailing in 1976 is used. The value of the reserve wheat in 1979 drops to $4.60 (i.e., $5.00 in the importing country) still significantly greater than the futures reserve cost. However, compensatory financing could make the comparative costs quite close.

A second critical assumption here is the equivalence of storage costs. If the physical reserves are to be held elsewhere, then local storage costs and interest rates are appropriate. If these are significantly less than U.S. costs, then the costs of a physical reserve will be commensurately reduced.

Third, changes in freight rates between initiation of the reserve and its actual use become important. That is, the assumption of a constant basis is a very strong assumption. If, as seems likely, high commodity prices are accompanied by high freight rates, the balance could easily swing in favor of the importing country-based reserve. For example, if in 1976, freight was $.40 per bushel and long-term financing is assumed, then an importing country based reserve (from Strategy 3) provides for a net cost of wheat of $5.00 in 1979. Then, as prices increased in 1979, freight might also increase to say $.70 per bushel. Then the futures strategy results in a cost of reserve wheat delivered to the country of $4.12½ much closer in cost to the physical stock alternative.

Fourth, currency considerations are important. If the importing country expects a significant currency devaluation over the period the reserve might be held, the cost comparisons will become closer, perhaps resulting in the physical reserve becoming significantly cheaper than a necessarily U.S.-based futures reserve.

Finally, there may be U.S. regulator constraints to holding a very sizable reserve in futures contracts, particularly if the importing country is also using futures to hedge actual requirements. At a minimum, it is likely that permission from the CFTC would have to be obtained before proceeding with a futures reserve.

In sum, the futures-held reserve is always the cheaper alternative in U.S. equivalents. The caveats to this proposition when applied to a reserve held in an importing country are several and require detailed relative price and cost data to evaluate.

X. CONCLUSIONS

Commodity futures markets provide reference pricing for virtually all internationally traded wheat and corn. Much of that trade is reflected directly in these markets in exporters' positions as they hedge successful bids on import contracts. Thus importers who offer contracts and must evaluate bids are at a serious disadvantage if they are unfamiliar with the operation of these markets. Indeed, the greatest benefit of becoming more knowledgeable about futures markets is simply increased knowledge. These markets provide continuous quotations of prices at least one year away against which specific contract bids may be more readily evaluated.

Ultimately, the decision to use futures markets directly is situation and country specific. It will depend, among other things, upon the internal organization of the buying agency--its ability to make independent buying decisions and its relationships with the central bank as to the ready availability of foreign currency. Finally, futures strategies are only one among many possible purchase strategies. Which strategy is chosen will be specific to individual contracting circumstances. That is, even if futures markets are used to price a portion of requirements in any one year, they may be no more appropriate than forward contracting for the remainder of the requirements that year or all of the requirements in another year. The examples developed above show futures strategies will be most useful in circumstances where pricing is desired but actual contracts cannot be negotiated due to timing or quantity uncertainties.

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