

/GEOGRAPHIC PRICE SPREADS
IN WORLD WHEAT TRADE/

by

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Chapter 1

Introduction

In the world grain trade, conditions are of such a competitive nature that price differences as small as one-half cent per bushel or less can determine which seller will make the sale. The spread between the price at the export port and the price at the receiving port of the importing country can be crucial in the decision-making process in this "bids and offers" system. The acceptance of tenders (offers to purchase) can result in gains or losses for the seller depending upon his analysis of the potential for short-run change in locational price spreads.

The purposes of this report are (1) to examine and specify, at least from a theoretical standpoint, the constituent elements of price spreads, (2) to examine the behavior of price spreads for wheat over time between U.S. Gulf of Mexico ports and two major markets to which wheat from Gulf ports is exported, namely Europe and Japan, (3) to examine the behavior of certain component variables contained in price spreads, and (4) to illustrate a mathematical model for analysis of price spreads between Gulf ports and the above destinations.

Cost, risk and competitive factors all influence the size of intermarket spreads. In the international wheat trade, cost and risk factors affecting spreads have both time and space dimensions. Merchandising margins earned by traders may also be influenced by competitive conditions in the market. Exchange rates are considered to

have significant influences on price levels and may have a similar affect on intermarket price spreads.

In a recent study by Binkley and Revelt,^{1/} it was found that transport costs alone accounted for from 5 percent to 15 percent of delivered grain prices depending upon the route and time period involved. The greater the proportion of transport costs in the delivered price of a good, the more significant is transportation in determining the good's production and marketing patterns. Ocean freight costs, as affected by relative supply of and demand for ocean-going bulk freight carriers, may have a significant effect on price spreads.

This study defines intermarket price spreads in development of the analytical model as the difference between F.O.B. and C.I.F. prices at any point in time. F.O.B. (Free-on-Board) prices are export sale prices for prompt or 30-day shipment from the export port. Included in F.O.B. prices are all costs of assembly at the port and costs of loading aboard ship. The buyer is responsible for all subsequent costs including freight costs, losses in transit, damage claims or insurance, unloading costs and any other costs not normally the responsibility of the carrier after loading is completed and grain is accepted for movement. Title to grain passes at the point of origin at the end of the loading spout.

C.I.F. (Cost, Insurance and Freight) prices are arrival prices at the destination port. The seller provides the grain, contracts for and pays for ocean freight services, and he carries insurance on the cargo.

¹Binkley, James K. and Mary E. Revelt, The Role of Transportation in International Agricultural Trade, Purdue University Agr. Ex. Sta. Bull. No. 337:10.

The seller loads the goods at his own expense on board the vessel at the port of shipment within the period specified in the contract. The marine insurance procured by the seller must cover the C.I.F. price plus ten per cent and shall be provided in the currency of the contract. Unless otherwise agreed, the risks of carriage shall not include special risks against which the buyer may wish individual protection. Such special risks would include theft, pilferage, leakage, contact with other cargoes and any other risks peculiar to the particular trade. The buyer is required in this case to receive the goods at the agreed destination and bear, with the exception of the freight and marine insurance, all costs and charges incurred in the course of transit by sea to their destination as well as unloading costs unless such costs have been included in the freight or collected by the freight company at the time freight was paid. The buyer must then bear all risks of the goods once they have effectively passed the ship's rail at the port of shipment. Such risks include cost of collecting loss or damage claims and costs of unusual delays in unloading which are the fault of or at the request of the buyer. If a shipment is delayed through failure of the buyer to give delivery and unloading instructions in time, the buyer must also bear the additional freight costs associated with the delay.

In addition to traders and market analysts, policymakers will be especially interested in marketing spreads with respect to their affects on patterns and volume of trade. A relevant example is possible extension to commercial sales of the current restrictions on U.S. agricultural exports under Public Law 480. Under P.L. 480 agreements, 50 percent of shipments are required to be carried on U.S. flag carriers. Costs of utilizing U.S. flagships are substantially higher

than virtually all other international carriers. These costs are reflected in pricing arrangements which impact costs to the U.S. Government and hence the U.S. taxpayer. Current proposals to force U.S. exporters to utilize the relatively expensive U.S. ships for all U.S. grain exports, including commercial sales, would further raise delivered costs of the products and likely reduce U.S. exports. If the elasticity of demand for U.S. grain exports is greater than unity, which it likely is, revenue from increased C.I.F. prices will not make up for revenue losses from expected reduction in volume of U.S. grain exports in the short run. It would also take a very short time for other grain producing and exporting nations to increase their output to take advantage of an increase in demand for their products due to the slackening of demand for U.S. grains, i.e., elasticity of demand for U.S. wheat may increase as the time period under consideration increases.

There are positive costs involved in the transfer of a commodity from one region to another. Economic theory postulates that the prices will move toward each other until they differ exactly by transfer costs. If transport and handling costs exceed the price differences that exist without trade, then trade would be reduced and at most, be cut off entirely. In the short run, a complete cutoff of grain trade to any importer is unlikely within normal price ranges. If the grain is being stored in the exporter's facilities, costs are accrued. It is preferable for the exporter to keep this grain flowing through his facilities as long as short-run variable costs are covered.

Market spreads may vary over time because of changes in (1) costs of service inputs, e.g., transport costs, storage costs, interest rates,

insurance, and price risks, (2) market factors, e.g., competition affecting returns to merchandisers and to fixed investments, and (3) exogenous factors, e.g., exchange rates. Components of price spreads and their relations to competitive conditions and to international currency exchange rates will be discussed in the next chapter.

Chapter 2

Anatomy and Environment of Price Spreads

Intermarket price spreads are composed of payments for marketing services which are individually and collectively valued in price-discovery environments that are to some degree unique at each point in time. In addition to supply and demand conditions in service markets, competitive conditions in commodity markets and international currency exchange conditions affect the pricing environment for marketing services.

I. COST COMPONENTS OF PRICE SPREADS

Exchange of goods involves at minimum transactions costs of (1) price discovery and (2) the mechanics of change of title. Exchange of futures contracts may involve only costs of brokerage services which encompass price discovery activity and the mechanics of title transfer. Transfer of physical commodities, however, includes transactions costs as indicated above but almost invariably costs associated with time, space or product form. Where all three activities occur "exchange results in three price dimensions for a commodity - one for variations in form, a second for variations in place, and a third for variations in time of delivery."^{2/}

²Paul, Allen B., "Some Basic Problems of Research into Competition in Agricultural Markets," American Journal of Agricultural Economics, Vol. 61, No. 1 (1979), 170.

In the complex world of exchange, prices of the several dimensions of marketing services change over time. Market prices for transactions services, processing services, storage and inventory services, and transport services are each determined in separate markets subject to their own set of supply and demand forces. In aggregate the cost to merchandisers of marketing services creates a structure of prices that change over time as service prices change in a market environment driven and regulated primarily by competitive forces.

Principal categories of costs of marketing services in international trade in wheat are in transactions, space, and time dimensions. Form, as it concerns quality characteristics of a particular lot of wheat, is a significant consideration also but relates to maintenance of original form (quality) as opposed to purposive changes in form (processing) to satisfy the needs of the purchaser. A time dimension of trades introduces a time dimension in markets for services as well as in the pricing of commodities themselves. According to Paul:

"What is confusing is that the prices observable in each of the three dimensions (space, time, and form)... tend to change over time. The observed changes tend to pervade one's thinking and dominate economic analysis. But current anticipations of how prices may differ at successive forward dates result in a current structure of prices for the forward dates."^{3/}

A. Transactions Costs

In markets in which acceptable products may differ in qualities related to product performance, buyer and seller search cost associated

³Paul, IBID, p. 170 (parenthesis added).

with transactions may be higher than in markets where products are homogeneous among sellers in all relevant characteristics. If suppliers offer different credit, lot sizes, delivery dates or other services, search costs may increase over situations where uniform contract conditions exist among suppliers. In international markets simple communications costs between buyers and sellers may vary among markets. Buyers may tend to trade in markets where customs, reliability of sellers, and other characteristics are understood. According to Johnson, Grennes and Thursby, "Buyers may choose suppliers with familiar languages and institutions because they may save enough on transactions costs to outweigh an unfavorable wheat price quotation."^{4/}

Once barriers to price discovery have been overcome, the process of determining the market clearing price still remains. Paul indicates that the process by which a trade price is determined is a rich field for investigation and is attracting wide attention.^{5/} Paul indicates further that translation of traders' ideas into market prices need not necessarily imply that successive prices will converge toward equilibrium. There could be continuous oscillations of price as traders pursue a "feeling out" process in part, by *tatonnement* "--the 'trial' prices and quantities that are entered and revised by buyers and sellers

⁴Johnson, Paul R., Thomas Grennes and Marie Thursby, "Trade Models With Differentiated Products," American Journal of Agricultural Economics, Vol. 61, No. 1 (1979), p. 120.

⁵Paul, op. cit., p. 171.

until a price is reached that would match the amount offered and the amount taken."^{6/}

Intermarket price spreads thus may reduce as institutional barriers to trade are reduced over time and trading rules (e.g., grade specification, financing mechanisms, etc.) are refined and improved. As trading channels become more clearly defined, search costs may also be reduced. In both cases, those portions of price spreads that reflect transaction costs will be reduced.

B. Time-Related Costs

A time structure of commodity prices reflects (1) expected changes in supply/demand relationships with consequent price changes at future dates, and (2) current and expected prices of marketing services required to carry an existing commodity to a future demand period. Within the interval between entering into and fulfilling a contract, market services will be provided for the creation of time utility. Costs of these services include: (1) interest costs on investment in deferred delivery, (2) warehousing service costs, (3) costs associated with risk of price change, and (4) insurance against physical damage.

1. Interest on Investment in Deferred Delivery

In the case of deferred delivery, interest payments on investments are reflected in price spreads to compensate the seller for cost incurred in providing inventory financing. In situations of variable interest charges, price spreads will tend to increase if interest rates

⁶Patinkin, D., Money, Interest and Prices, 2nd Ed., New York, Harper & Row, publishers, 1965 as quoted by Allen B. Paul, op. cit., p. 171.

increase and decline when interest rates decline, other things equal. Interest charge and hence price spread will increase as length of delivery period increases, other things (including interest rate) equal.

2. Warehousing Services

The cost of warehousing services is implicit in price spreads over time for a storable commodity. Paul indicates that:

"Most grain storage is not priced directly. The price is embedded in a commodity carrying charge - the difference between two concurrent market prices for a commodity to be delivered on different dates. The implicit price is derived from the proposition that anyone who wants to act on or before t_0 so as to have a given commodity on t_1 can follow one of two closely related courses: he can buy the commodity (a) for delivery on t_0 and hold it to t_1 or (b) for delivery on t_1 . Under restrictive assumptions, the difference between the price paid for the commodity under one alternative as compared with the other would be the price for the implied storage service.

The assumptions are these:

- 1) The commodity deliverable on t_0 and stored to t_1 is identical with the commodity delivered on t_1 .
- 2) All money payments are made on t_0 , irrespective of when the commodity is deliverable; i.e., interest on investment during the interval $t_0 \rightarrow t_1$ is the same for both methods.
- 3) The hazards of price decline for a commodity deliverable on t_1 are the same on t_0 and put in storage until t_1 .
- 4) A convenience yield does not arise from having command over a commodity while it is in storage from t_0 until t_1 .
- 5) Arbitrage between the two different ways of obtaining the commodity on t_1 is relatively costless and effective."

⁷Paul, Allen B., "Pricing of Binspace - A Contribution to the Theory of Storage," American Journal of Agricultural Economics, Vol. 52, No. 1 (1970), p.3.

The above assumptions don't always prevail in market transactions. For example, convenience benefits of ownership or control of physical product has been associated with reduced or even negative carrying costs. The assumption of no risk premium is also questionable, however, Paul indicates that "...attempts to measure risk-premium have borne little fruit..."^{8/}

Analysis by Paul of the price of bin space used for grain storage in the U.S. for the period 1952 to 1965 concluded that prices responded to (1) changes in demand for commercial bin space measured by changes in number of bushels of grain in commercial storage, (2) demand for grain handling capacity measured by changes in number of bushels of grain entering and leaving commercial bin space in each storage period, and (3) total bin space available.^{9/}

The price of bin space, especially at export ports where congestion in grain export movement has frequently occurred, is volatile and a likely significant factor when deferred delivery involves land-based storage. In international movement, deferred delivery also involves ocean transit time and hence storage during the ocean voyage is incorporated in ocean freight prices. The interrelationship may cause ocean freight charges that are not totally independent of bin space prices. However, changes in export activity will shift demand for services in both bin space and ocean freight markets and is a more

⁸Paul, IBID, p.3.

⁹Paul, IBID, p.6.

likely cause of any correlation in price movements in the two markets than the warehousing/transport interdependence.

3. Risks of Price Change

For agricultural crops, commodity prices in areas of both the seller and buyer are influenced by a multitude of factors. Supply and demand conditions in the surplus and deficit areas of production are of primary importance but we must also consider the methods of commodity market operations. Included in these market operations are the formulation of price spreads between buyers and sellers when geographic distances separate the two. Although the main sources of supply in the international grain trade are localized for climatic reasons, there are enough sources of supply for strong competition among sellers. Wheat from the U.S. is faced with strong competition in Europe from Canada and Argentina and from Canada and Australia in Japan. Geographic price spreads between these sellers and buyers will often determine which seller makes the transaction so factors affecting these spreads are of vital importance.

Flexprice markets are determined largely by supply and demand. In contrast according to J.R. Hicks,^{10/} fixprice markets are ones in which prices are set by producers themselves or by some authority so that they are not determined by supply and demand. Fixprice markets for commodities tend to occur in their manufactured forms yet "list prices" cannot be taken as entirely trustworthy transaction prices.

¹⁰ Hicks, J. R., Value and Capital. Oxford: Clarendon Press, 1939.

Consumer prices in the importing areas of concern are set by government organizations. However, landed price for wheat in the importing area is not fixed (even where consumer prices are fixed) but is determined largely by competitive forces of supply and demand for the commodity and for the machinations of the market with regards to transport, insurance costs, and other variables affecting price structure.

It should be noted that in the international grain trade, there is only a handful of grain trading organizations. Transaction prices may therefore reflect trader strategies unrelated to current supply and demand conditions.

There are five major multinationals operating in the U.S. and world grain trade. These are Cargill, Continental, Bunge, Louis Dreyfus and Garnac. Trade sources have estimated the market share of U.S. wheat exports of these five at over 61 percent for the years 1975/76 through 1979/80.^{11/} This may be understated. In hearings before a U.S. Congress subcommittee in 1975, the major five sellers were reported to have over 80 percent of the U.S. exports of wheat and when Cook Industries was added, these six accounted for well over 90 percent.^{12/} Cargill and Continental consistently account for at least 50 percent of

¹¹ Gilmore, Richard, Presentation on the "United States Grain Industry" delivered at the Canadian International Grains Institute, Winnipeg, October 4, 1982.

¹² U.S. Congress, Senate Committee on Foreign Relations, "Multinational Corporations and United States Foreign Policy" Hearings before the Subcommittee on Multinational Corporations, 94th Cong., 2nd sess., June 1975, Part 16, and various trade data, cited by Richard Gilmore, "United States Grain Industry", 1982, p.21.

U.S. wheat exports in unofficial statistics quoted by Gilmore.^{13/} To these five multinationals can be added two national selling agencies, the Canadian and Australian Wheat Boards. These major players will generally account for 85 to 90 percent of world wheat exports. Argentina played a relatively minor role in world trade during this period.

With this concentration of selling power in a very few hands, each seller zealously guards his pricemaking methods and decisions. In this competitive environment, information about a competitor's offering price is vital. In these circumstances, publicly reported price quotes may deviate at times from actual transaction prices. However, it is assumed that price quotes by reputable authorities closely approximate transaction prices.

The world grain traders must coordinate purchases with deliveries and match supplies from various origins with demands in accordance with specific end-use requirements and generally preserve the integrity of these shipments to satisfy nonrelated foreign buyers. A property of grain which somewhat reduces the complexity of this task is that grain is often sufficiently homogeneous to satisfy the same commercial identity. Thus companies with access to a number of grain sources can substitute one for the other.

4. Insurance

A merchandiser, if storing inventory grain in his own warehouse, is responsible for the physical safety of the stored product. If grain

¹³ Gilmore, Richard, op. cit.

is stored in rented bin space, the warehouse operator is responsible for physical safety, hence insurance is incorporated in warehousing costs whether those charges are implicit or explicit.

Ocean carriers do not have the same accountability for losses occurring during an ocean voyage as applies to land-based warehousemen or even to overland transit. An international conference on maritime legislation in 1921 resulted in a set of rules for the carriage of goods by sea which are known as The Hague Rules. These rules have been incorporated into shipping liability through national legislation by each of the principal maritime nations. The American Carriage of Goods by Sea Act was passed in 1936.^{14/} Under the various national Carriage of Goods by Sea Acts, steamship lines are essentially liable for their own negligence but have extensive exemption from the total carrier responsibility present in the case of goods assigned to overland transporters. The exemptions from liability are sufficiently extensive so that the prudent shipper will insure goods against loss while in transit on the ocean. Hence, marine insurance costs, although relatively stable at least in the short-run, become time-related costs that are incorporated in international intermarket price spreads. Marine insurance to cover cargo risks is generally placed on all shipments moving in international seaborne trade. The insurance may be placed for the exporter's account or for the account of the buyer, or it may be placed by the importer who has selected a particular underwriter.

¹⁴McElhinney, Paul T., Transportation for Marketing and Business Students, Littlefield Adams & Co., 1975, p. 157.

There are advantages to the exporter who places marine insurance. When the sale is F.O.B. vessel the importer's insurance may become effective only when the goods are loaded aboard ship; hence, any loss to the shipment between the exporter's warehouse and the vessel may not be covered. The exporter would need to purchase an inland marine policy or a special clause could be inserted into the policy.

Most marine insurance coverage is termed "free of particular average" which means that if part of a cargo must be jettisoned or is damaged in some way, all the participants engaged in the maritime venture must contribute to the loss in proportion to the value of their property that is safely delivered and covers partial or total loss to the cargo occasioned by major events such as stranding, sinking, fire, explosion, collision and general average contribution. The cost of such insurance must be taken into account when the delivered price is being calculated for the commodity by the concerned party.

C. Space-Related Costs:

A commodity's price at various locations in competitive markets should differ by the minimum cost of transportation between these markets if trade is to occur. Dahl and Thompson attempted to evaluate the U.S. grain industry's intermarket pricing performance by testing whether grain prices at different locations in the U.S. export marketing channel differed only by the transfer costs between locations.^{15/} The authors concluded that price movements at one location in the marketing

¹⁵ Dahl, R. P. and S. Thompson, "The Economic Performance of the U.S. Grain Export Industry, "Technical Bulletin No. 325, University of Minnesota :2.

channel are usually reflected in corresponding movements at every other market location to which the commodity is normally moved. The price spreads at various stages in the U.S. export marketing channels differed largely by costs of transportation between the markets. Other factors which affected the basis prices were found to be seasonal fluctuation in elevation costs, interest charges, insurance premiums and external shocks to the system. Interest charges and insurance premiums have been discussed as time-related costs. Fluctuations in elevation charges are related to competitive adjustments and external shocks to changes in exchange rates. The major space related costs to be discussed in this section are ocean freight and ship loading and unloading costs.

1. Ocean Freight Costs

Transportation costs of any good are dependent upon geographic distances, the nature of the commodity, i.e. its weight, volume, value, etc., and the nature of its transportation, i.e. bagged or bulk containers, the existence of ocean freight routes, etc. The time involved in transporting goods to a buyer is of substantial concern to a buyer requiring a reliable, steady flow in order not to result in logjams at various points in the marketing process.

In data compiled for this report, ocean freight charges accounted for nearly 50 percent of the price spread on average between the U.S. Gulf and Europe. On the U.S. Gulf to Japan route, reported ocean freight charges exceeded the general price spread for reasons to be addressed later.

Ocean transportation is a major international industry more complex and diversified than most manufacturing industries. The operations of the industry include many forms of investment, knowledge,

training and experience. The long term trend in freight values depends upon changes in supply of tonnage (ship capacity) when measured against variation in the total world movement of cargo. This further breaks down into the supply and demand for different sizes or types of vessels creating a series of markets within a market. International freight markets involve a large amount of fixed inputs and any facility expansion involves a considerable time lag. There is a two-year lag between the ordering of a new ship and its delivery date.

It also takes time to transfer shipping capacity from other shipping markets to grain routes if the occasion arises. Consequently, grain shipping capacity is rationed by price and, at least in the short run, supply appears to be price inelastic. Binkley and Revelt found that studies in trade analysis which assume constant transport cost overestimate the benefits of free trade in commodities.^{16/}

As shown in Table 1, a peak of 3,755 million tons of world seaborne trade was reached in 1979. Global recession and a leveling off of U.S. agricultural exports since that time has reacted adversely on the shipping industry. Grain tonnage was slightly below 5 percent of total world seaborne trade in 1976 through 1979 but exceeded 5 percent in 1980 and 1981.

¹⁶Binkley, James K. and M. Revelt, IBID: 24

Table 1

WORLD SEABORNE TRADE

1976-1982

Year	Oil & Products	Iron Ore	Coal	Grain	Other	Total
- (mln. tons) -						
1976	1,682	294	127	146	1075	3324
1977	1,748	276	132	147	1120	3423
1978	1,727	278	127	169	1190	3491
1979	1,817	327	159	182	1270	3755
1980	1,638	314	188	198	1310	3648
1981	1,445	302	207	205	1315	3474
1982	N/A	272	208	201	N/A	N/A

Sources: Taylor, Larry, "Global Economy Dampens Ocean-Freight Market." Cargill Crop Bulletin: September, 1982, p. 8-9. and International Bulk Journal, Vol. 4, No. 2, p. 10.

2. Loading and Unloading Costs

One of the components of price spreads between seller and buyer are transport loading and unloading costs. Trends toward relatively efficient port facilities in North America, Europe and Japan point toward a lessening of total movement cost. The U.S. Gulf is the major grain export area in North America and has the capacity to handle large vessels. Terminal elevators have faster load-out rates than at other port facilities in the United States. This increases demand at these

facilities for exporting grains as opposed to loading at some other export area.

Per unit costs, whether they are quoted by bushel or tonnes are reduced by the handling and transporting of grain in large quantities. This is true whether the method of travel is by rail, barge or ocean vessel. Ports at the U.S. Gulf and in Rotterdam can accommodate large ships with deep draughts while many ports on the American East Coast or in the Pacific Northwest of the United States cannot. Ports in Japan are limited in size to cargoes no greater than 18,000 tons. This will result in higher costs both for ocean freight and loading and unloading operations than if larger vessels could be accommodated.

If scale economies exist and are reflected in ocean freight charges, it would be expected that more ships should be booked to carry grain to Rotterdam from the U.S. Gulf than from alternative U.S. ports. Ships originating from the Gulf carry greater tonnages than ships from other U.S. port areas.

Shipments of U.S. Hard Winter wheat to Japan originated largely from Gulf ports up until 1979. The advent of unit train rates to Pacific Coast ports has altered this situation so that greater volumes of hard red winter wheat to Japan have been shipped from the Pacific Northwest and California ports in recent years. The reduced rail rates have apparently more than compensated for less efficient handling facilities. The fact that Japanese ports have a vessel size limitation undoubtedly detracts from scale economies that could be realized by shipments from the U.S. Gulf. Diseconomies of higher cost ships may be more than offset by other savings such as insurance, overland freight charges, fees to pass through the Panama Canal, etc.

II. COMPETITIVE CONDITIONS

It is a common observation that the level of intermarket spreads, hence rates of return to merchandisers for management services and invested capital, will vary under various degrees of intensity of competition. Economic theory supports the notion of a range for rational pricing of services. The minimum price for occupationally unique facilities is the level of variable costs. The maximum is determined by market conditions, which in the short run bears no relationship to resource costs. Theoretically facilities will not be operated if variable costs are not covered.

Major world grain companies are involved in every facet of the world grain trade. These companies will make every attempt to keep all their facilities from country elevators to mills in foreign lands actively engaged. This may be true in integrated operations even if variable costs for some operations are not covered. Even though one element of the total chain of facilities may be in surplus, and may generate little or no income on their own, these facilities must remain in operation to support other operations and assets of the company.

It is also hypothesized that exporters and importers will remain active in markets that are not profitable to them for extended periods in order to gain information and insights into current and expected supply/demand/price conditions and trends.

In spite of what may be termed "lossmaking" rates, grain companies will not drop out of a world market. This is particularly true in a market of Japan's stature. There is a prevailing and valid belief that in the grain industry, one must be in every major market in order to have a comprehensive view of the total world situation. There is a very

small cadre of players in the world grain market and it can be devastating to the point of bankruptcy if one is caught offguard. That is one reason why companies will suffer losses for what may seem a relatively long period of time in a major market. The belief exists that losses in one period will eventually be offset and exceeded by profits in subsequent market periods.

III. EXCHANGE RATE FLUCTUATION

The U.S. dollar is the world's major trading currency and is generally the currency in which ocean freight rates and sales prices for grain are quoted. Buyers must purchase U.S. dollars on the exchange markets in order to pay ocean freight carriers and grain exporters. To do this, they must use another (usually their own) national currency. As the U.S. dollar fluctuates in value daily, there is a resulting variation in the purchasing power of the buying nation's currency. Thus exchange rate variations have two dimensions that affect spreads. There is (1) the actual exchange cost of marketing services quoted in U.S. dollars and (2) the additional exchange risk in the commodity transaction that is also quoted in U.S. dollars.

Since geographic price spreads are composed of services purchased largely with U.S. dollars, currency exchange rates are theorized to significantly influence the basis prices between exporters and importers. Even if services purchased from a third country national are quoted at rates in U.S. dollars the results will be generally the same. At some point in time there will be a currency conversion and whether or not it occurs concurrently with the actual transfer of the product is immaterial.

Because grain is traded in such large volumes, even small changes in exchange rates between two currencies can greatly affect the amount of the commodity a purchaser can buy. If ocean transport time costs \$10,000 (U.S.) per day, this converts to 2.95 million yen at an exchange rate of 295 yen per U.S. dollar. If the exchange rate changes to 294 yen per U.S. dollar, the buyer gains 10,000 yen. This increases purchasing power of the yen and can make significant adjustments in buying decisions. Price spreads between loading and unloading port facilities can then be adjusted accordingly by the party in control of shipping the commodity in order to gain a profit or cut a loss by even a fraction of a cent per tonne.

When time costs are involved in the trade of a good, the flexibility of exchange rates leaves ample potential for the introduction of instability on commodity markets. This includes international currency markets which are now a potent force to be reckoned with in international trade. Traders must be aware of the risk of exchange rate fluctuations going against them at any time and this can affect the spread they include in their price quotations for future delivery of a product.

In the schematic of Wm. Kost, the devaluation of any exporter's currency would lead to a rise in importer demand.^{17/} If we assume that the exporter is the U.S. and the U.S. dollar is devalued, purchase prices will be lower in terms of the buyer's home currency. If the U.S.

¹⁷ Kost, Wm. E., "Effects of an Exchange Rate Change on Agricultural Trade," Agricultural Economics Research, Vol. 28 No., 3 (1976): 100.

F.O.B. export price remained the same and transfer services also remained the same as prior to the devaluation, the importer could increase quantity purchased with the same amount of expenditure of yen, deutschmark, etc.

Many studies examining exchange rate changes look at only two countries at a time while also ignoring transfer costs or assuming such costs as constants. This is misleading as there are many other factors affecting the exchange rate between two nations in the interdependent world in which we live. Capital markets have evolved over the last decade into international markets. United States banking concerns have greatly expanded into the international sphere. The Eurocurrency market has become established as a potent force in capital markets since the early 1970's.

The effects of exchange rate fluctuation on terms of trade have received mixed reviews. The fact that basis prices are generally not included in these studies renders the conclusions of such studies as even less applicable than if the effects of exchange rate fluctuation on spreads had been included.

Chapter 3

Behaviour of Intermarket Price Spreads

The previous chapter identified certain factors that affect price spreads through the component costs. This chapter will examine the overall behaviour of price spreads for wheat between the Gulf of Mexico and Rotterdam, Holland and between the Gulf and Tokyo, Japan over a six-year period from July, 1976 through June, 1982. The data on all prices were drawn from International Wheat Council Statistics as reported in the Council's Annual report.^{18/} Prices are reported in U.S. dollars per metric tonne.

The Gulf/Rotterdam price spread is the difference between the monthly average F.O.B. Gulf price and the C.I.F. Rotterdam price for U.S., No. 2 Hard Winter Wheat (13 percent protein). Over the time period prices in these markets were more consistently quoted than for U.S. No. 2 Hard Winter Wheat with ordinary protein. Also, Europeans normally look for a high quality wheat to blend with lower quality domestically produced wheat. Thirteen percent protein wheat is also of more comparable quality to the competitive No. 1 Canada Western Red Spring wheat against which it must compete in these markets.

¹⁸International Wheat Council, World Wheat Statistics Annual, 1976-1982, 28 Haymarket, London, SW1Y 4SS

The second price spread considered is between the U.S. Gulf ports and Japan. Figure 1 illustrates the pattern of wheat flows to U.S. port areas. The Hard Winter Wheat areas of the American Midwest generally see their product flow southward to the Gulf ports. Some adjustments in trade flows are likely to have occurred with the adoption of the unit train concept in the late 1970's. It is corn, however, which is the primary user of unit trains. Only Gulf exports are considered in this study, regardless of the foreign destination.

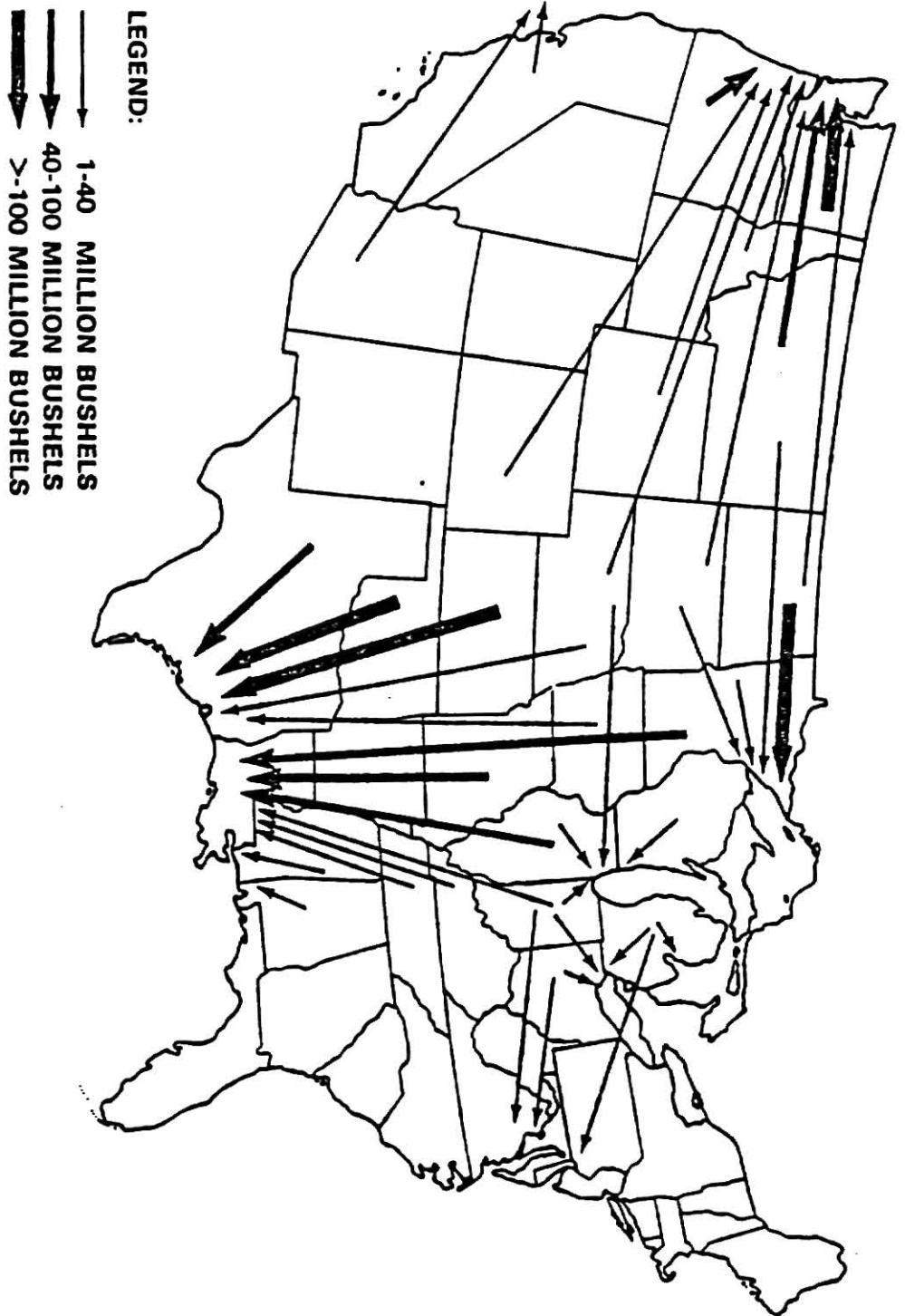
Japan is a major world wheat importer. Average annual purchases of U.S. wheat account for over 50 percent of Japanese wheat imports. In this case, the representative grade of wheat chosen was U.S. No. 2 Hard Winter (ordinary protein). This grade most closely approximates the type of U.S. wheat generally sold to the Japanese Food Agency. Again, all prices were measured in U.S. dollars per metric tonne as compiled and published by the International Wheat Council in London, England.

I. MONTHLY AND ANNUAL AVERAGE PRICE SPREADS

Monthly average price spreads between the Gulf and Rotterdam and the Gulf and Japan are reported in Table 2. Also indicated are crop year averages of the reported monthly averages. Either F.O.B. or C.I.F. prices or both were not reported for those months in which spreads are missing from Table 2. Intermarket price spreads for the six-year period are illustrated in Figure 2.

FIGURE 1

PATTERNS OF WHEAT FLOWS TO PORT AREAS DURING 1977



Source: Lowell D. Hill, Mack N. Leath and Stephen W. Fuller, *Wheat Movements in The United States: Interregional Flow Patterns and Transportation Requirements in 1977*, North Central Regional Research Bulletin 274, Jan. 1981.

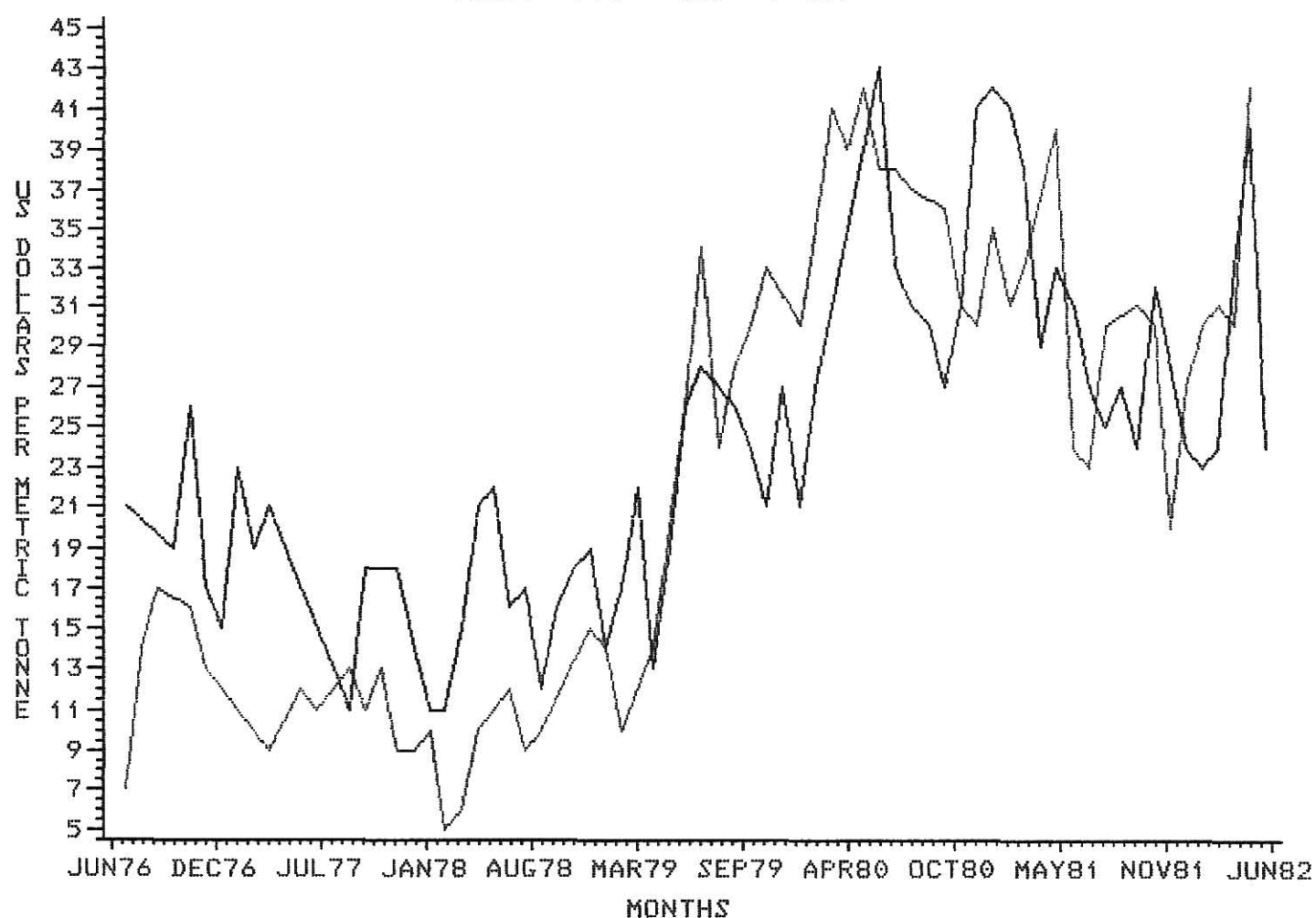
Table 2: Price Spreads for U.S. Gulf to Rotterdam and
U.S. Gulf to Japan, No. 2 Hard Red Winter Wheat,
Monthly Averages, July 1976 through June, 1982

<u>U.S. Gulf to Rotterdam</u>						
<u>Month</u>	<u>1976/77</u>	<u>1977/78</u>	<u>1978/79</u>	<u>1979/80</u>	<u>1980/81</u>	<u>1981/82</u>
	- U.S. dollars per tonne -					
July	-	-	16	28	33	27
August	-	-	17	27	31	25
September	-	11	12	26	30	27
October	19	18	16	24	27	24
November	26	18	18	21	31	32
December	17	18	19	27	41	-
January	15	14	14	21	42	24
February	23	11	17	27	41	23
March	19	11	22	-	38	24
April	21	15	13	-	29	33
May	-	21	19	-	33	40
June	-	22	26	43	31	24
12 Month						
Average	<u>20.00</u>	<u>15.90</u>	<u>17.42</u>	<u>27.11</u>	<u>33.92</u>	<u>27.55</u>

<u>U.S. Gulf to Japan</u>						
July	7	11	12	34	38	23
August	14	12	9	24	37	30
September	17	13	10	28	-	-
October	-	11	-	30	36	31
November	16	13	-	33	31	30
December	13	9	15	-	30	20
January	-	9	14	30	35	-
February	11	10	10	35	31	-
March	-	5	12	41	33	-
April	9	6	14	39	-	-
May	-	10	-	42	40	-
June	12	-	26	38	24	-
12 Month						
Average	<u>12.38</u>	<u>9.91</u>	<u>13.56</u>	<u>34.00</u>	<u>33.50</u>	<u>26.80</u>

Source of Data: International Wheat Council, World Wheat Statistics,
Annual 1976-1982, 28 Haymarket, London, SW1Y4SS.

FIGURE 2: Gulf-Japan vs. Gulf-Rotterdam Price Spread
(JULY 1976 - JUNE 1982)



---- GULF-JAPAN PRICE SPREAD ---- GULF ROTTERDAM PRICE SPREAD

A. Gulf-Rotterdam

Price spreads on the Gulf-Rotterdam route have varied during the six-year period from a low of (U.S.) \$11.00 per tonne in September 1977 and February to March 1978 to a high of (U.S.) \$43.00 per tonne in June 1980. Spreads averaged (U.S.) \$17.50 per tonne over the first three years studied, i.e. July 1976 to June 1979. Since that time, from July 1979 to June 1982, spreads exhibited a greater variability and averaged nearer \$30 per tonne.

In the July 1976 to June 1977 crop year, the annual average price spread between U.S. F.O.B. prices and C.I.F. Rotterdam prices was \$20.00. This fell over 20 percent to below \$16 the following crop year but recouped some of this lost ground during the July 1978 to June 1979 year to average out at almost \$17.50 per tonne. The annual average spread in July 1979 to June 1980 stood at over \$27 per tonne, rising to almost \$34 per tonne for the next crop year. This level subsequently declined in the July 1981 to June 1982 year to an average of \$27.50 per tonne. The first three-year period saw a low spread of \$11 per tonne in November 1976 to a high of \$26 per tonne in June 1979. Over the last three years of this study, July 1979 to June 1982, spreads showed greater variability with a low of \$21 per tonne in November 1979 and January 1980 and a maximum of \$43 per tonne in June 1980.

B. Gulf-Japan

Price spreads between F.O.B. Gulf and C.I.F. Japan followed a similar pattern to those of the Gulf-Rotterdam route over this six-year period. This spread varied from a low of (U.S.) \$5 per tonne in March, 1978 to a high of \$42 per tonne in May, 1980.

The July 1976 to June 1977 F.O.B. - C.I.F. price spread averaged over \$12 per tonne. This declined to an average of under \$10 per tonne in the following year. As exhibited on the Gulf-Rotterdam route, the Gulf-Japan basis increased in the July 1978 to June 1979 year to a level reached two years previously. In this case the spread exceeded \$13 per tonne. Price spreads expanded markedly during the 1979 to 1980 crop year, averaging \$34 per tonne. The following year's average saw virtually no change. In the final July 1981 to June 1982 year the basis fell back 20 percent to below \$27 per tonne.

II. STATISTICAL MEASURES OF VARIATION

Standard deviations from annual means in each market and for the six-year period are illustrated in Table 3, coefficients of variation for the same data aggregates are also shown in Table 3.^{19/}

¹⁹The standard deviation is the measure of the amount of variation among the values of x in a population. The variance (sum of the squared deviations of the measurements about their mean, divided by $n-1$) and the standard deviation of this set of measurements (square root of the variance) enables one to compare variability between sets of measurements. It also interprets the variability of a single set of measurements by using the empirical rule. The Empirical rule explains the spread or variation of a set of measurements by stating the percentage of measurements that one may be expected to find within certain distances from the mean. Thus, in a normal frequency distribution, the interval from the mean to plus or minus one standard deviation will contain approximately 68 percent of the measurements. The mean plus or minus two standard deviations may be expected to contain approximately 95 percent of the measurements. The mean plus or minus three standard deviations would contain approximately all of the measurements.

The coefficient of variation, or cv , expresses the average deviation as a percentage of the value of a measure of central tendency. This is simply the standard deviation of a set of measurements divided by the mean multiplied by 100. Being dimensionless, the cv is easier to recall.

Table 3: Statistical Summary - Standard Deviations and
Coefficients of Variation of the Price Spreads

<u>U.S. Gulf to Rotterdam</u>			
<u>Crop Year</u>	<u>Annual Mean</u>	<u>Standard</u>	<u>Coefficient</u>
	- U.S. Dollars	Deviation	of Variation
		per tonne	Percent
1976/77	20.00	3.70	18.49
1977/78	15.90	4.12	25.92
1978/79	17.42	3.87	22.23
1979/80	27.11	6.51	24.01
1980/81	33.92	5.20	15.32
1981/82	27.55	5.32	19.30

<u>U.S. Gulf to Japan</u>			
1976/77	12.38	3.38	27.30
1977/78	9.91	2.59	26.10
1978/79	13.56	5.10	37.63
1979/80	34.00	5.69	16.74
1980/81	33.50	4.70	14.02
1981/82	26.80	4.97	18.54

Source of Data: Calculated from Table 2.

A. Gulf-Rotterdam

With regards to the Gulf to Rotterdam route, for the 1976/77 crop year, the standard deviation of the F.O.B. - C.I.F. price spread was \$3.70 per tonne. Approximately 68 percent of a population's measurements would lie within a range of \$16.30 and \$23.70 per tonne with a mean of \$20.00 per tonne. The following year's observations for 1977/78 indicated a standard deviation of 4.12, an 11 percent increase. The 1978/79 crop year showed a standard deviation of 3.87 units from a mean of 17.42. This is an 8 percent decline from the previous year. The standard deviation rose markedly in 1979/80 to 6.51 units from a mean of 27.11. This is a 68 percent rise in one year. It is apparent from this summary that monthly average standard deviations vary markedly from year to year. The average changes in these standard deviations are not closely related to changes in the size of the annual means, e.g. for the year 1976/77 and 1977/78 the standard deviation increased while there occurred a decline in the annual means.

If one looks at the coefficients of variation for these years, a different statistical picture emerges. The cv for 1976/77 of 18.49 percent increased 40 percent to 25.92 in 1977/78. This indicates that the second sample is more variable than the first. This when compared to the 11 percent rise in standard deviations for the two years, implies greater variability than first appears to be the case. The cv for 1978/79 of 22.23 percent is 14 percent below the previous year's, a 6 percent greater decline than exhibited with the standard deviation. The cv for 1979/80 of 24.01 percent is only 8 percent above the previous year, much different than the 68 percent rise in the standard deviation. The variability of the price spreads in this year are then not as great

as might first be assumed. It can be seen from this brief summary that the cv's vary significantly from year to year. A high cv is associated with the lowest mean while the highest mean concurs with the lowest cv.

B. Gulf-Japan

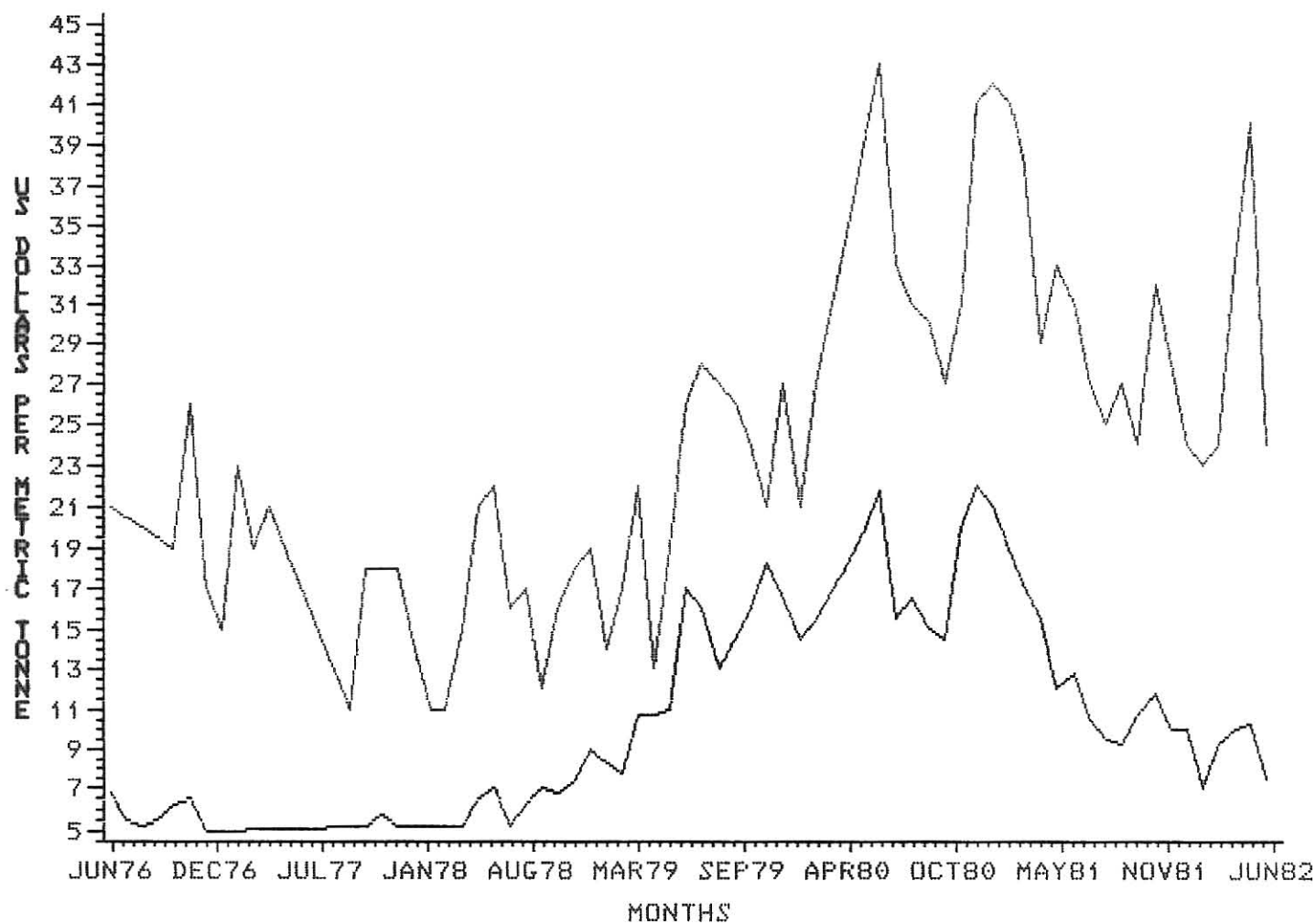
Standard deviations of the price spreads on the Gulf to Japan route are also in Table 3. For the 1976/77 year, the standard deviation was 3.38. Thus approximately 68 percent of the measurements for the population would lie within a range of \$9.00 and \$15.76 per tonne with an annual mean of 12.38. In 1977/78 the standard deviation of 2.59 was 23 percent lower than the previous year. The cv for 1977/78 of 26.10 percent was only 4 percent below that of the previous year. There did not, thus, seem to be a great decline in variability of the spreads even though the standard deviation indicated such. The standard deviation for 1978/79 of 5.10 units was almost double that of 1977/78. The cv, however, rose only 44 percent to 37.63 percent. Many of the same comments can be stated for this route as were stated for the previous route. There is marked variability between standard deviations from year to year. These changes between standard deviations are not closely related to changes in the size of the annual mean, e.g. differences in direction between the years of 1980/81 and 1981/82. The cv's differ significantly from the first three years to the last three years as well as from one year to the next. The cv's indicate a greater average variability of the sets of measurements than would be indicated by using only the standard deviations.

III. RELATIONSHIP OF SPREADS TO OCEAN FREIGHT RATES

A. Gulf-Rotterdam

Ocean freight rates are popularly regarded as the major determinant of intermarket spreads. Figure 3 is an illustration of the Gulf-Rotterdam price spread and the quoted ocean freight rate on this route over the six year time span. The July 1976 to June 1979 period showed similar patterns for the ocean rates and the basis prices. Periods of rising ocean freight rates were mirrored with periods of a widening price spread between F.O.B. and C.I.F. quotations. Ocean freight rates appear to follow the general trends apparent in the fluctuations found in the spreads. In the case of the Gulf-Rotterdam route, ocean freight costs averaged below 50 percent of the price spread during the six year period. Price spreads from July 1976 to mid-1979 were at relatively low levels averaging (U.S.) \$17.50 per tonne. Over this same period, ocean freight rates were often at loss-making levels averaging only (U.S.) \$6.50 per tonne. Freight rates gradually rose as a proportion of this spread from about one-quarter during the 1976/77 year to one-third during 1977/78 and to one-half during 1978/79. Beginning in mid-1979 both the price spreads between the Gulf-Rotterdam points and ocean freight rates increased, sometimes markedly, and also exhibited much greater fluctuation as can be seen from Figure 3. The price spreads during this second three-year period averaged just below U.S. \$30 per tonne. After reaching what may be seen as a peak at over 60 percent of the price spreads in 1979/80, ocean freight rates receded to approximately one-half the level of the spreads during 1980/81 and continued this downward trend (along with the spreads) to account for just over one-third of the spread during the 1981/82 year. These trends

FIGURE 3: Gulf-Rotterdam Price Spread vs. Ocean Freight Rate
(JULY 1976 - JUNE 1982)



----- GULF-ROTTERDAM PRICE SPREAD

----- OCEAN FREIGHT RATE

in ocean freight costs exhibited a similarity in pattern to the price spreads evident between the source (Gulf) and destination (Rotterdam) of these grain exports.

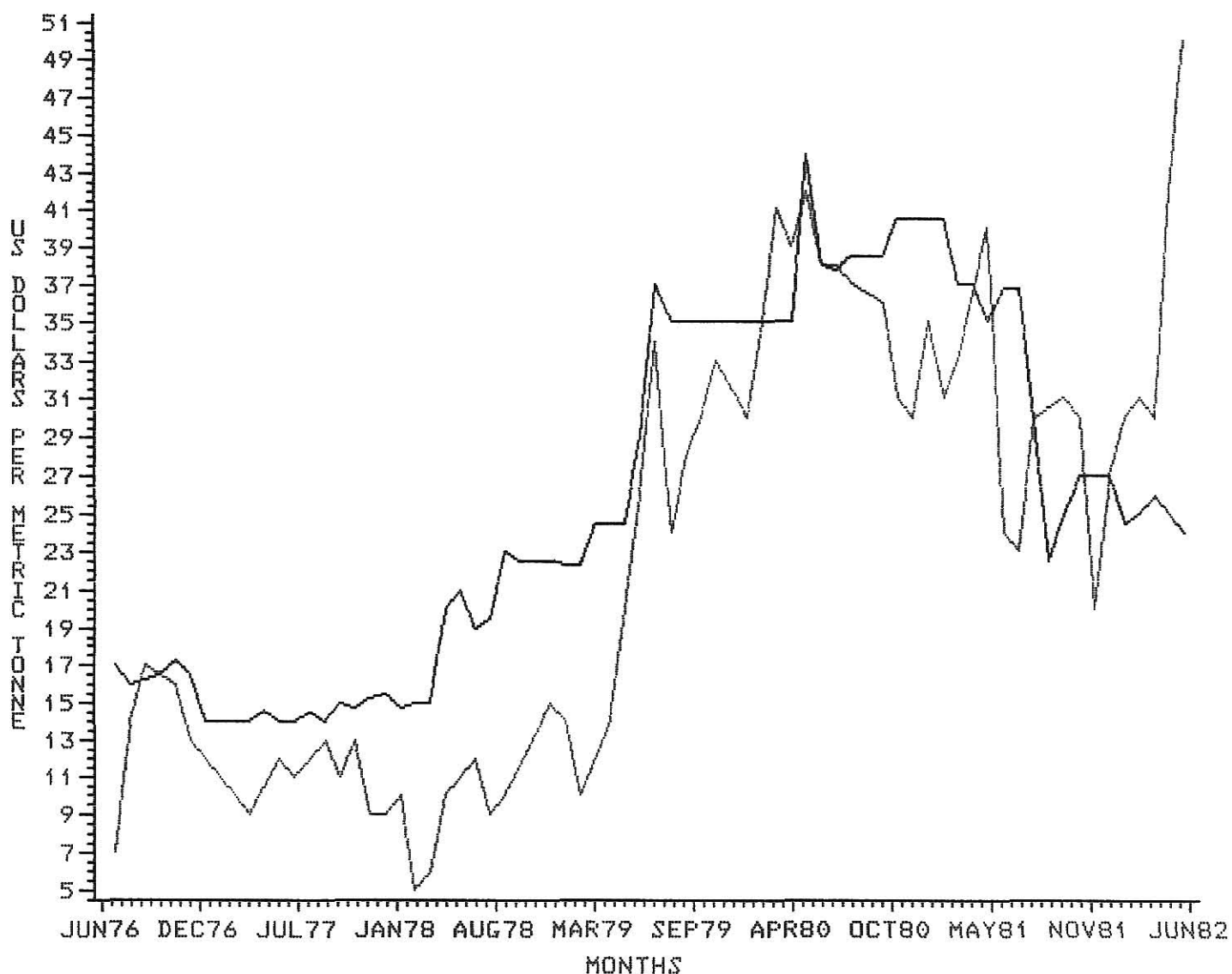
B. Gulf-Japan

Figure 4 compares the price spread between the U.S. Gulf-Japan and the reported voyage charter ocean freight rates on the same route. In the case of the Gulf-Japanese route, ocean freight costs as quoted averaged 137.5 percent of the spread for the six-year period. During the July 1976 to June 1979 period, quoted ocean freight rates consistently exceeded price spreads. For the 1976/77 year, rates averaged one-third higher than the spreads. The succeeding year saw rates exceed spreads by two-thirds on average and this relationship widened to three-quarters by 1978/79.

From mid-1979 to mid-1982, the relationship between freight rates and price spreads (F.O.B. and C.I.F.) tended to exhibit a narrowing differential. Freight rates peaked in 1980 and subsequently fell 40 percent by mid-1982. Spreads showed a similar trend peaking in 1980 and followed by a sharp decline into 1982 as shown in Figure 4.

There is a correlation between price spreads geographically and ocean freight rates. In a simple correlation between the price spread and the ocean freight rate on the Gulf to Rotterdam route, an r value of plus .774 was found. The same calculation on the Gulf to Japan route resulted in a positive r value of .899. Positive correlations are certainly evident on both routes. The correlation coefficient is a measure of the closeness of linear relationship between two variables. The sample correlation coefficient r lies between negative one and positive one. Positive values of r indicate a tendency of the two

FIGURE 4: Gulf-Japan Price Spread vs. Ocean Freight Rate
(JULY 1976 - JUNE 1982)



---- GULF-JAPAN PRICE SPREAD

---- OCEAN FREIGHT RATE

concerned variables to increase together. As the graphs illustrate, both have a tendency to move in the same general direction regardless of whether the spreads are greater than or less than the freight rates.

Transport rates that exceed market spreads are not the expected relationship. Possible explanations for this relationship include: (1) freight rates from the Gulf to Japan foreclosed grain movement over this route during this period, (2) grain movement occurred only to the extent of maintaining the Japanese presence in the market for information and longer-term potential for favorable price and transport conditions and (3) voyage charter rates used here do not represent true transport costs over this route.

Table 4 gives some indication of grain movement from the United States to Japan during the calendar years 1976 to 1982, including the proportion flowing from the Gulf ports.

Table 4: Grain Flows - U.S.A. to Japan
1976 - 1982 *(calendar years)

<u>Calendar Year</u>	<u>Total Shipped</u> - thousand tonnes -	<u>Shipped from Gulf</u>	<u>Gulf Share of total</u> -percent-
1976	15,607.2	11,357.1	72.8
1977	17,094.2	13,066.1	76.4
1978	18,278.6	12,808.0	70.0
1979	19,721.8	12,539.1	63.6
1980	23,597.0	12,687.1	53.8
1981	22,493.4	12,902.4	57.4
1982	21,106.2	15,216.1	72.1

* Includes wheat, oats, barley, rye, flaxseed, corn, sorghum and soybeans.

Source: U.S.D.A. Grain Market News, various issues.

This table indicates that in spite of the fact that reported freight rates on the Gulf to Japan route exceeded apparent market spreads, grain movement continued at a high level. In fact, it reached its zenith in

the final year, 1982, exceeding 15.2 million tonnes representing 72 percent of the total grain shipped from the U.S. to Japan. This clearly shows that grain movements from the U.S. Gulf to Japan were not foreclosed by the fact that quoted freight rates exceeded the marketing margins.

There is some validity in the explanation that continued trader involvement in the Japanese market may be for informational returns as well as for potential profits in the future. The President of Bunge Corporation has asked: "Why keep on with something that has been a money-losing venture?"^{20/} He continued: "Even though port capacity is now in surplus and the port elevators generate little or no income on their own, they and we have to keep operating to support the rest of the originating inland assets of the company." Idle facilities whether they be terminal storage or ships in port are not conducive to good business practice. Losses may be more amenable for short periods of time to costs of shutting down and then restarting facilities or vessels.

Japan is a steady reliable customer for top grades of wheat and pays high prices to receive that quality. Grain companies who have the opportunity to make these sales may then be more likely to slice profits or even accept some loss on the transfer portions of the contract in order to keep the business. Major grain companies will not drop out of a wheat market, particularly one of Japan's importance, even if a loss does occur. The belief is predominant that if one wishes to

²⁰ Klein, Walter C., President of Bunge Corporation, Speech in Kansas City, Missouri, quoted in Milling and Baking News, Vol. 63, No. 2, March 13, 1984: 32.

know the total world situation in the grain trade, one must be involved in every major market. The international grain trade is so closely tied together there must be a constant analysis of economic characteristics relating to market potential and growth. Lack of information as much as wrong information can breed indecision and/or serious errors in judgment leading to more serious financial inadequacies. Japan is such a major market.

Another possible explanation is that quoted average spot freight rates may not be applicable to the Japanese freight route. Japanese grain imports are one of the least variable in the world. It is a matter of Japanese governmental policy to diversify their sources of grain imports as well as to purchase regular quantities over various time periods. Therefore most grain shipped to Japan is done on an annual charter basis. One grain company, for example, may be relatively certain of being awarded two cargoes per month from the U.S. Gulf to Japan as may another seller be fairly sure of two cargoes per month from East Coast, Australia or West Coast, Canada. When such awards on grain tenders from the Japanese Food Agency are so predictable, it is possible for the seller to plan his shipments to such an extent that he can do so on an annual charter basis.

These annual charter rates for freight are not released publicly but they are generally known to be substantially below the single voyage rates quoted in official publications. Voyage charter rates from the Gulf ports to Japan are consistently \$2 to \$5 (U.S.) per tonne higher than from Pacific Northwest ports. This converts to 5 to 13 cents (U.S.) per bushel and would lead one to believe that grain shipments from the Gulf should be reduced to virtually nothing and be replaced by

shipments from West Coast ports assuming overland transport costs are not prohibitive. This has not been the case. Shipments from the Pacific Coast ports to Japan have risen and now exceed wheat shipments from the Gulf but substantial amounts are still shipped via the Gulf.

Grain is used as a backhaul from Gulf ports to Japan. Japanese industrial exports to America are unloaded often times at the Gulf ports to save on trans-continental rail and/or trucking costs. It is more economical for these ships, often owned and operated by the huge Japanese mega-companies, to load grain at the Gulf to haul back to Japan rather than return empty or only partially-loaded. These mega-companies are likely to have interests in manufactures, automobile production, and high technology equipment as well as agricultural products. They consider the total economic picture in deciding shipping routes, back-hauls, etc. Ships on this route are generally on continuous contract. Thus the possibility of a return trip to Japan with empty holds is unappealing.

IV MARKET MARGINS

Price spreads less freight costs represent market margins available for merchandising, storage and related activities in sales of export wheat. Size and variations in market margins are discussed below.

A. Gulf-Rotterdam

The following table illustrates the margins on the Gulf to Rotterdam route.

Table 5: Marketing Margins *

<u>Month</u>	<u>U.S. Gulf to Rotterdam</u>					
	<u>1976/77</u>	<u>1977/78</u>	<u>1978/79</u>	<u>1979/80</u>	<u>1980/81</u>	<u>1981/82</u>
		- U.S. dollars per tonne -				
July	-	-	10.75	12.00	17.50	16.50
August	-	-	10.70	14.00	14.50	16.00
September	-	7.05	5.00	11.50	15.00	17.75
October	12.75	12.75	9.25	8.00	12.50	13.50
November	19.50	12.25	10.65	2.75	11.00	20.25
December	12.00	12.75	10.00	10.50	19.00	-
January	10.25	8.75	5.75	6.50	21.00	14.00
February	18.25	6.25	9.25	11.50	22.25	16.00
March	14.25	6.25	11.25	-	21.00	14.75
April	16.25	9.75	2.25	-	13.50	23.00
May	-	14.50	8.00	-	21.00	29.75
June	-	15.00	9.00	21.25	18.25	16.50
12 Month						
Average	<u>14.75</u>	<u>10.53</u>	<u>8.49</u>	<u>10.89</u>	<u>17.21</u>	<u>18.00</u>

* Difference between price spreads and ocean freight rates

The Gulf to Rotterdam marketing margin over 1976/77 averaged U.S. \$14.75 per tonne with a range of \$9.25. The highest monthly rates occurred during the winter months of November, 1976 and February, 1977. The annual crop year average fell during 1977/78 to U.S. \$10.53 per tonne with a range of \$8.75. The third quarter of 1977 exhibited margins above \$12.50. These subsequently declined to \$6.25 per tonne in the first quarter of 1978. By the end of the crop year, the margins reached their highest monthly average of the year at \$15.00 per tonne. The 1978/79 crop year saw a further decline in average marketing margins. The annual crop year average fell to U.S. \$8.49 per tonne with a range of \$6.25. As ocean freight rates and price spreads increased, the marketing margins declined. A recovery in marketing margins appeared during 1979/80. The annual average reached U.S. \$10.89 per tonne with a range of \$18.50. Fluctuations of margins increased

beginning at \$12.00 in July, 1979, falling to \$2.75 in November, 1979 and then peaking at \$21.25 in June, 1980. These margins increased over the following 12 months to average U.S. \$17.21 per tonne in 1980/81. The range during this year was \$11.25. Margins declined from their July, 1980 high of \$17.50 until the winter months of December, 1980 to March, 1981 exhibited an average margin exceeding \$20 per tonne. Some decline was seen going into the summer months. Marketing margins in the final 1981/82 crop year averaged U.S. \$18 per tonne. The range again increased to \$16.50 per tonne. After peaking at over \$20 in November 1981, the margin fell until the April - May period of 1982 when they rose to approach \$30 per tonne.

During the July, 1976 to June, 1979 period the average annual market margins on the U.S. Gulf to Rotterdam route ranged from \$8.49 per tonne per year to \$14.75. As with the ocean freight rates and price spreads, the final three years of the study, July, 1979 to June, 1982, experienced a distinct increase in marketing margins and as well, much greater fluctuation. The range of average annual marketing margins over these three years was from \$10.89 to \$18.00. The ranges of these margins during the course of these years was also of interest. Monthly average margins over the first three years to end-June, 1979 ranged from \$6.25 per tonne to \$9.25. During the July, 1979 to June, 1982 period the monthly margin averages ranged from \$11.25 to 18.50 on an annual basis.

B. Gulf-Japan

The following table illustrates the margins on the Gulf to Japan route.

Table 6: Marketing Margins*

Month	U.S. Gulf to Japan					
	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82
	- U.S. dollars per tonne -					
July	-10.00	-3.00	-7.00	-3.00	0.25	-13.75
August	-2.00	-2.50	-10.45	-11.00	-1.50	0.00
September	0.75	-1.00	-13.00	-7.00	-	-
October	-	-4.00	-	-5.00	-2.50	6.00
November	-1.25	-1.75	-	-2.00	-9.50	3.00
December	-3.50	-6.25	-7.50	-	-10.50	-7.00
January	-	-6.50	-8.25	-5.00	-5.50	-
February	-3.00	-4.75	-12.25	0.00	-9.50	-
March	-	-10.00	-12.50	6.00	-4.00	-
April	-5.00	-9.00	-10.50	4.00	-	-
May	-	-10.00	-	-2.00	5.00	-
June	-2.00	-	-3.00	0.00	-12.75	-
12 Month						
Average	-3.25	-5.34	-9.38	-3.18	-5.05	-2.35

* Difference between price spreads and ocean freight rates

The Gulf to Japan marketing margins were negative in the majority of months under review. The average annual marketing margin over 1976/77 was a negative U.S. \$3.25 per tonne. The range was from a minus \$10.00 to a plus \$0.75, i.e. \$10.75 per tonne. In 1977/78 the marketing margin averaged a minus \$5.34 per tonne with a \$9.00 range over the year. From a relatively small negative margin of from \$1.00 to \$3.00 in the first July to September quarter, the margin fell to a negative \$10.00 per tonne by March, 1978. The market margin declined to an annual average of a negative \$9.38 per tonne in 1978/79. The range over the year was \$10.00 as the first quarter average margin exceeding a negative \$10.00 declined to a minus \$7.50 by December, 1978, before again approaching its widest margin of the year at \$12.50 in March, 1979. The 1979/80 crop year marketing margin averaged a negative U.S. \$3.18 per tonne with a range of \$18.00 in the monthly margins. Negative

margins of as much as \$11.00 during August, 1979, swung around to a plus \$6.00 margin by March, 1980. An average marketing margin of negative U.S. \$5.05 was recorded for the 1980/81 crop year. Margins ranged from a plus \$5.00 per tonne in May, 1980 to a negative \$12.75 in the following month of June, 1980. In the final year 1981/82, marketing margins averaged a negative U.S. \$2.35. Margins were unavailable for the final half of the year under review. The range of average monthly margins was \$19.75.

The average annual market margins ranged from a negative \$9.38 for 1978/79 to a negative \$2.35 in 1981/82. The final three years of the statistics exhibited reduced negative margins from those seen in the first three years. The ranges of these marketing margins within years however corresponded to some extent with ranges on the Gulf to Rotterdam route. Within year ranges for the July, 1976 to June, 1979 years were from \$9.00 to \$10.00 in absolute numbers versus \$6.25 to \$9.25 on the Rotterdam route. Over the final 36 months of the study, within year ranges of market margins on the Gulf to Japan route were between \$17.75 and \$19.75 versus \$11.25 to \$18.50 on the Gulf to Rotterdam route.

V HYPOTHESES CONCERNING BEHAVIOUR OF SPREADS

There has been virtually no published work found on studies of price spread behaviour in world grain markets. Various studies will focus on certain aspects of such spreads, e.g. ocean freight, but not on the spread as a whole. Price spreads take into account many variables, not all of which are quantifiable.

Since freight rates are a major factor in world price spreads, due to both their proportion of the spread and their variability, factors affecting these freight rates, might be expected to significantly affect

spreads. The two major factors determining freight rates for dry bulk commodities in general and for grain in particular are the state of trade and the availability of shipping capacity. Since grain production and trade are more susceptible to unpredictable influences, especially the weather, its state is difficult to forecast accurately. Even though there has been an underlying growth in world grain trade in total, predictions are not any easier to make because actual markets and the shipping routes involved are constantly changing.

Demand for shipping capacity depends on the distance over which cargos are moved and the total volume of trade. There has been a generally slow growth in the average distance of trade flows. In a rising freight market, shippers prefer to take tonnage on a time-charter basis in order to lock in their costs before the market rises further. Conversely, in a declining freight market, shippers will want to operate more on a voyage charter rate to take advantage of future lower rates.

Ladd and Reed^{21/} noted that ocean shipping costs have not been constant and have not experienced a sustained trend. Ocean shipping costs have an effect on the cost of imported grains to the importing country. Previous studies found that the quantity of imports by a country was not responsive to the price incorporated in the model. The reason for this could be that costs of ocean freight were excluded from the feedgrain price. A profitable trade for a company depends to a large degree on how accurately they assess freight values and how

²¹ Reed, Michael R. and George W. Ladd, Feed Grain Imports and Feed Grain Prices in Importing Countries, Iowa State University Research Bulletin No. 588, 1980: 970.

efficient they are in chartering or buying that freight on terms to suit the sales contract.

Carter and Schmitz contend that "the world wheat market is usually dominated by buyers and that it is a buyer's market rather than a seller's market."^{22/} Taken together, the European Community, Japan, the U.S.S.R. and the P.R.C. (China) account for 30 - 40 percent of world wheat imports. Consequently they have a direct impact on world wheat prices. Japan and the European Community maintain strict import quotas or utilize some type of levy system which effectively divides their domestic markets from the world markets. Once the product reaches their shores, prices to domestic wheat millers no longer bear any relationship to their landed price. The prices of concern will be the to-arrive prices in port rather than any prices derived solely in the domestic importing nation. A multinational trader then must take into account not only his domestic export price but also factors such as the currency to be used for payment and associated exchange fluctuations, competitor's prices, government controls or restrictions and the methods and costs of transferring the commodity between buyer and seller.

A study comparing Canadian and American wheat marketing systems was done in 1979 at Michigan State University by Watt, Mitchell and Ross,^{23/} Their results indicated that a large portion of the

²²Carter, C and A. Schmitz, "Import Tariffs and Price Formation in the World Wheat Market," American Journal of Agricultural Economics, Vol. 61 No. 3 (1979): 517.

²³Watt, David L., Donald O. Mitchell and John Ross. A Comparison of the Current United States and Canadian Wheat Marketing Systems, Michigan State University Staff Paper no. 79-22.

variability of both U.S. and Canadian wheat prices delivered at Rotterdam are explained by traditional economic relationships. More than 99 percent of the price variability of American wheat in the landed port was explained by the world wheat price, the exchange rate and the ocean freight rate. The authors utilized the Kansas City wheat price as the proxy for the world price and the West German mark as the exchange currency representing importing nations. All three variables differed from zero at the one percent level of significance.

The authors' Canadian model^{24/} differed in that while world wheat prices and exchange rates were important variables in explaining Canadian wheat price behavior, ocean freight rates were not significantly different from zero in statistical tests. In periods of declining prices and world demand, Watt, et. al. argue that price-cutting by Canada's monopoly wheat agency permits them to clear more of their exportable surplus from domestic stocks than does the U.S.A. via their multinational corporations. In such situations the U.S. grain exporters would be induced to cut their margins between origination and destination points i.e. the spreads, in order to be competitive in international markets.

²⁴I bid

Chapter 4

Behaviour of Major Factors Affecting Spreads

I OCEAN FREIGHT

Freight is a commodity in its own right and responds to the pressures and opinions of the marketplace. It is bought and sold every day by shippers and by shipowners and its value can and does fluctuate widely.

A. Factors Affecting Ocean Freight Charges

Policies to improve shipping and handling technology will certainly affect ocean freight charges. Improvements in this technology can raise the volume of trade leading to lower freight charges. This has the effect of reducing geographic distances among the major exporters and as a consequence theoretically leads to more competitive markets. Economies of scale combined with physical limitations of facilities can directly impact upon changes in the sizes of ships on major world grain routes.

It was during the 1950's that oil tankers became available for grain cargoes. With the development of new cleaning techniques tankers became available to enter the trade whenever grain freight rates are more attractive than the oil freight rates. As a result the supply of shipping for grain movement then became more elastic than before the 1950s. Other factors of interest in determining ocean freight rates are opportunities for return loading, the possibilities of port disruption or congestion, port restrictions on the size of vessels that can be

accommodated, loading and unloading facilities, traffic volumes on various trade routes, canal tolls if applicable, and numerous other factors not all of which are quantifiable.

B. Level and Variation in Ocean Freight Rates

Ocean freight rates for grain are negotiated between shipowners and grain shippers through shipbrokers. Most shipping contracts are made well in advance of actual shipping dates. Relationships between the short-term supply and demand will determine an approximate level of rates. In the short term, supply tends to be fairly stable but demand can vary substantially. Steady availability of ocean vessel capacity results in substantial changes in the level of ocean freight rates when demand changes. A tight supply of cargo space influences rates upward while idle capacity dampens charter rates. Mid-month voyage charter rates as reported by the International Wheat Council, London, England for U.S. Gulf/Rotterdam and U.S./Japan for the period July, 1976 through June, 1982 are displayed in Table 7.

Table 7: Ocean Freight Rates,
U.S. Gulf to Rotterdam and Japan
Mid-month Voyage Charter Rates
July, 1976 through June, 1982

<u>U.S. Gulf to Rotterdam</u>						
<u>Month</u>	<u>1976/77</u>	<u>1977/78</u>	<u>1978/79</u>	<u>1979/80</u>	<u>1980/81</u>	<u>1981/82</u>
	<u>- U.S. dollars per tonne -</u>					
July	5.50	4.25	5.25	16.00	15.50	10.50
August	5.25	4.00	6.30	13.00	16.50	9.50
September	5.50	3.95	7.00	14.50	15.00	9.25
October	6.25	5.25	6.75	16.00	14.50	10.75
November	6.50	5.75	7.35	18.25	20.00	11.75
December	5.00	5.25	9.00	16.50	22.00	10.00
January	4.75	5.25	8.25	14.50	21.00	10.00
February	4.75	4.75	7.75	15.50	18.75	7.00
March	4.75	4.75	10.75	16.90	17.00	9.25
April	4.75	5.25	10.75	18.25	15.50	10.00
May	4.75	6.50	11.00	19.75	12.00	10.25
June	4.75	7.00	17.00	21.75	12.75	7.50
12 Month						
Average	<u>5.21</u>	<u>5.16</u>	<u>8.93</u>	<u>16.74</u>	<u>16.71</u>	<u>9.65</u>

<u>U.S. Gulf to Japan</u>						
July	17.00	14.00	19.00	37.00	37.75	36.75
August	16.00	14.50	19.45	35.00	38.50	30.00
September	16.25	14.00	23.00	35.00	38.50	22.50
October	16.50	15.00	22.50	35.00	38.50	25.00
November	17.25	14.75	22.50	35.00	40.50	27.00
December	16.50	15.25	22.50	35.00	40.50	27.00
January	14.00	15.50	22.25	35.00	40.50	27.00
February	14.00	14.75	22.25	35.00	40.50	24.50
March	14.00	15.00	24.50	35.00	37.00	26.00
April	14.00	15.00	24.50	35.00	37.00	26.00
May	14.60	20.00	24.50	44.00	35.00	25.00
June	14.00	21.00	29.00	38.00	36.75	24.00
12 Month						
Average	<u>15.34</u>	<u>15.73</u>	<u>23.00</u>	<u>36.17</u>	<u>38.42</u>	<u>26.65</u>

Source: International Wheat Council, World Wheat Statistics Annual,
1976-82, 28 Haymarket, London, SW1Y 4SS.

World seaborne trade increased from 1976 to 1980. Ocean freight charges increased concurrently from a low of \$4.00 (U.S.) per ton in 1977 to \$20.00 (U.S.) and above in 1980 on the U.S. Gulf-Rotterdam route.

A major influence on ocean freight rates is bunker fuel costs. Such costs generally account for about 65 percent of a shipowner's operating costs. Rising fuel costs were a major factor in the 1979 increase for a single voyage grain freight rate from the U.S. Gulf to Rotterdam (20,000 - 30,000 ton vessels) from \$7.75 (U.S.) per long ton to \$18.25 (U.S.) per long ton.

During the 1976/77 crop year (July-June) ocean freight rates on the U.S. Gulf-Rotterdam route were quiet, showing little price variation for the year at a level of about \$5.00 per long ton. Freight rates on the U.S. Gulf-Japan route were in the \$14.00 - \$17.00 (U.S.) range and also showed some decline toward the end of the period. Rates over this twelve month period generally declined concomitant with sales volume declines to the major destinations in Europe and Japan.

The general level of freight costs during July 1977 to June 1978 on both major trade routes under consideration remained at rates unofficially described as "lossmaking" into the early months of 1978. I.W.C. statistics indicate that as of April 1978, the number of laid up dry cargo vessels reached a peak at 417 vessels. Rates had been as low as \$4.00 (U.S.) per long ton on the Gulf-Europe route and \$14.00 (U.S.) per long ton on the Gulf-Japan route. These rates remained generally depressed until mid-April of 1978 when they began to reflect internal transportation problems in North America as well as port congestion in Argentina. Severe winter weather in North America created a chaotic

situation along the domestic waterways. Barge traffic was halted on many rivers, including a large stretch of the Mississippi River, a major thoroughfare of grain traffic to the U.S. Gulf. Simultaneously, there occurred a serious shortage of grain-carrying railcars. Elevator explosions also reduced the availability of grain for export. These combined problems resulted in a backlog of ships waiting for export grain. These port delays were reflected in increased ocean freight rates.

Early in the July 1978 to June 1979 year, a substantial purchase of U.S. wheat by the People's Republic of China (P.R.C.) placed upward pressure on freight rates particularly to Far East Asian destinations. Levels rose from \$19.00 (U.S.) to \$23.00 (U.S.) per long ton on the Gulf-Japan route. This price level was largely maintained until the middle of 1979. Ocean freight rates were similarly pressed upwards in the third quarter of 1978 but not to the same extent as routes to the Far East. A slowdown in world oil shipments in the early months of 1979 released carriers into the dry cargo trades. This resulted in surplus available tonnage on North Atlantic routes lowering ocean rates from \$9.00 (U.S.) to \$7.75 (U.S.) per long ton. A resumption of oil exports from Iran in March 1979 and increased grain export volume pushed ocean rates upward. By June 1979 ocean rates on the Gulf-Rotterdam route reached \$17.00 (U.S.) while on the Gulf-Japan route they reached \$29.00 (U.S.). Increased bunker fuel costs were a major cause of the increases and many charter rates began including an escalation clause as a result of the marked rise in world oil prices.

The third quarter of 1979 saw a decline in ocean freight rates reflecting a normal Northern Hemisphere summer harvest slowdown. Rates

to Europe fell 20 percent to \$13.00 (U.S.) while those to Japan stabilized at \$35.00 (U.S.). This rate to Asia remained high due to heavy shipments to the P.R.C. Bearish pressures on freight rates were (1) decreased oil prices and (2) trade-disruptions such as the Iraq - Iran war. Widespread labour disputes in major industrialized nations were largely resolved by September 1979 and expected new import demand lent strength to the market.

The U.S. suspension of grain sales to the Soviet Union in January 1980 shifted ocean rates downward from \$16.50 (U.S.) to \$14.50 (U.S.) per long ton to European ports. These rates soon rebounded to over \$21.00 (U.S.) on the Rotterdam route and to near \$40.00 (U.S.) on the Japanese route by mid-1980. European importers were taking advantage of depressed U.S. grain prices to make additional purchases of U.S. grains. This raised demand for ocean freight on European routes. Also, the U.S. embargo forced the Soviet Union to find alternative sources of grain. Since Argentina was the major winner in this trade debacle, longer voyages were required which withdrew ship availability from other routes. In addition, increased U.S. grain exports to Japan and other Far East Asian nations led to a vessel shortage on these routes and drove up charter freight rates. Ocean freight rates to Europe over this July to June period accounted for over two-thirds of the price spread - the highest percentage of the six-year period. Rates on the Gulf-Japan route were virtually equal to the price spread as opposed to the more usual situation on this route of the spread being exceeded by the quoted freight rate.

The third quarter of 1980 experienced the normal decline in ocean rates as North American grain exports slowed preceding fall harvests in

the Northern Hemisphere. Grain shipments to the Soviet Union under the U.S.A. - U.S.S.R. grain pact were set to expire at the end of September 1980. This development of excess tonnage weakened freight rates to Europe from above \$16.00 (U.S.) to \$14.50 (U.S.) per long ton. Factors soon intervened to strengthen the market. An Australian coalminers strike in August 1980 shifted demand to the North American continent for both coal and ships. Both grain and coal are carried in the same type of vessel plus the major grain importers and exporters are also the major coal consumers and producers. By late 1980, Soviet and Chinese (P.R.C.) freight chartering had assisted in boosting freight rates considerably. Speculation persisted that the U.S. embargo on grain shipments to the Soviet Union would soon be lifted. Ocean rates on the U.S. Gulf to Rotterdam route rose 30 percent to \$22.00 (U.S.) per long ton by the end of 1980. Rates on the U.S. Gulf to Japan route also increased and exceeded \$40.00 (U.S.) per long ton. The first quarter of 1981 saw more relaxation in ocean grain freight rates. While U.S. grain exports remained strong, they were below the levels of the final quarter of 1980. There occurred a decline in world trade of other major commodities such as iron ore, oil and coal. A miners strike in the United States then reduced ore exports and allowed some shifting of bulk carriers back into grain trade routes. By June 1981, ocean grain rates to Europe had fallen over 40 percent from their December 1980 high to only \$12.75 (U.S.) per long ton. Rates to Japan fell 10 percent from their annual high to \$36.00 (U.S.) per long ton.

The July 1981 to June 1982 crop year saw a build up of large surpluses of available freight tonnage. Newly built vessels entered the freight market that had been ordered in 1979 when there were

expectations of increasing traffic in coal and grain. Ocean rates on virtually all major grain routes fell about 30 percent over the course of the July 1981 - June 1982 crop year. Rates on the U.S. Gulf-Rotterdam route returned to what may be termed "lossmaking" at only \$7.50 (U.S.) per long ton by June 1982. Rates on the U.S. Gulf-Japan route fell to \$24.00 (U.S.) per long ton from a high of \$36.75 (U.S.) in July 1981.

To summarize freight conditions over the period of the 1970's into the 1980's, ocean freight rates rose from lossmaking rates in the mid-1970's to a peak in 1980 encouraging shipowners to order large numbers of ships with larger carrying capacities. The world economic situation turned from "boom to bust" by 1980 severely affecting voyage charter freight rates for goods traded on the world scene. On the U.S. to Rotterdam route, voyage charter rates accounted for less than one-quarter of the price spread in 1976/77. This percentage increased to over two-thirds of the spread in 1979/80 but then declined to account for only one-third of the spread in 1981/82. Voyage charter rates from the Gulf to Japan were approximately one-third above the price spreads quoted in 1976/77. By 1979/80 these rates were about equal to the price spreads between ports. Rates by 1981/82 were again above quoted price spreads by about 10 to 15 percent on this route.

C Predictability of Rates

Upon the consummation of any grain sale, the cost of freight to move that grain may be fixed on an individual voyage basis, for a fixed number of consecutive voyages or on a time charter basis. On a time charter basis, the charterer/shipper takes over operation of the ship for a fixed period of time.

The bulk of U.S. grain exported is not done on a long term contract basis. This is unlike the three other major exporters, i.e. Canada, Australia and Argentina where it is customary for over 50 percent of their annual exports to be on a long-term contract basis and often with other state trading agencies. Freight commitments for U.S. grain then are not generally made on a long-term basis thus leading to greater variability and less predictability. Most U.S. grain sales are made for shipment in nearby positions, i.e. 30 to 90 days shipment.

Chartering of grain vessels on the various ocean trade routes has always been highly competitive. Rapid communication by telex, cable or telephone is an essential ingredient. Freight is traded worldwide on London's Baltic Exchange, New York's telephone market and in Tokyo.

Predicting such an international market is fraught with uncertainties. Ocean freight rates and the supply of ships to transport bulk commodities reflect to a large extent the complete world economic situation as well as international grain movements. Any predictions regarding ocean freight costs are then as wide-ranged as are economic predictions on broader fronts.

Bulk commodities such as grain are transported in shiploads which do not follow regular schedules in most instances.^{25/} Entry to such a freight market is unrestricted. Rates are set by bargaining between shippers and shipowners. Such a shipping market can be expanded by three events:

²⁵ The U.S. Gulf to Japan route is likely the exception to the rule.

- 1) deliveries of new vessels
- 2) more intensive use of existing vessels
- 3) entry of capacity from other shipping markets

Conversely, if freight rates dip low enough, shipowners may try to reduce costs through various short-term and long-term methods. These may include:

- 1) layups of tonnage
- 2) the crossover of tonnage into more profitable ocean routes or commodities
- 3) orders for ships in use to 'slow steam' to reduce fuel costs
- 4) scrap older, less efficient vessels

More intensive ship use can be accomplished by operating at greater speeds but this also raises fuel consumption, and hence, costs. When demand for tonnage slackens, speeds can be reduced thus lowering fuel needs and costs. The time lags over which many of these adjustments must take place make their prediction that much more difficult.

Cyclical variations in voyage charter rates are often very similar for the major trading routes. Both actual quoted charter rates and price spreads on the Gulf to Rotterdam and the Gulf to Japan routes follow similar patterns over time.

When rates are low, the majority of the bulk fleet will remain in service even with the owners accepting negative cash flows simply because it is more economical to operate at a loss for a period of time than go to the expense of vessel lay-up. L.C. Taylor predicts that by the autumn of 1985 ocean freight rates will escalate sharply as the world economy slowly improves.^{26/} The innumerable variables involved in

²⁶ Taylor, Lawrence C., Unpublished remarks on the subject of "Ocean Transportation" delivered at Kansas State University, June 21, 1983.

such predictions for freight markets make it very difficult, if not impossible, to arrive at firm conclusions about future rates.

D. Relation of Wheat Prices to Ocean Freight Rates

Ocean grain rates as a proportion of the C.I.F. Rotterdam price during the very low freight rate levels in 1976 to 1978 were between 3.5 percent to 4.8 percent. As costs of freight rose and world recession took hold in 1979 and 1980, ocean rates as a percentage of C.I.F. Rotterdam prices increased from just over 5 percent to at times over 10 percent of the total. These levels began to fall as ocean rates declined to the lowest levels since 1977 by early 1982. Ocean grain rates as a percentage of U.S. Gulf F.O.B. grain prices consistently were about one percentage point above their percentage of the C.I.F. prices. From July 1976 to June 1978 ocean rates were from about 4 percent to 5.5 percent of the U.S. F.O.B. rates. From July 1978 to early 1981, ocean rates to Europe were on a rise from 5 percent to over 12 percent of the F.O.B. export price at the U.S. Gulf. From early 1981, ocean rates as a percentage of U.S. F.O.B. prices declined to from 5 percent to 7 percent.

Ocean freight charges from the U.S. Gulf to Japan followed a similar pattern. Charges as related to C.I.F. prices in Japan from July 1976 to June 1978 were approximately from 11 to 13 percent of the C.I.F. price. From July 1978 to the early months of 1981 ocean freight costs increased as a percentage of C.I.F. prices from 13 percent to periods exceeding 20 percent. On average they were in the 17 percent to 19 percent range. From early 1981 to mid-1982 these costs declined as recession took hold. Ocean costs as a proportion of C.I.F. Japan prices declined from over 16 percent to levels near 12 percent as they were in

1978. Ocean freight costs to Japan as a proportion of U.S. Gulf F.O.B. export prices from July 1976 to June 1978 varied from 12 percent to nearly 16 percent of F.O.B. export prices. From July of 1978 to early 1981 ocean freight as a percent of F.O.B. rates increased from 15 percent to at times, exceeding 22 percent. The average was near 20 percent. From early 1981 to June 1982 ocean rates to Japan as a percent of U.S. Gulf F.O.B. prices declined from over 20 percent to approximately 14-15 percent.

Ocean freight rates in relation to F.O.B. and C.I.F. prices followed a similar pattern as they do with the spreads, which is to be expected. Freight rates account for about 4 percent to 6 percent of grain prices when rates are very low on the Gulf-Rotterdam route. These rates accounted for about double this percent of the grain price when rates were very high in 1979 and 1980. On the Gulf-Japan route, freight rates account for from 11 percent to 17 percent of the C.I.F. and F.O.B. prices respectively when rates are at low levels. When rates were more than double 1976 through 1978 levels in 1979 and 1980, they accounted for from 15 percent to 27 percent of grain prices.

II CURRENCY EXCHANGE RATES

Over the six-year time span of this study the U.S. dollar - West German deutschmark average annual exchange rate fluctuated by a maximum of 26 percent. The 1976/77 year bore an exchange of 2.42 deutschmarks to the dollar. The strengthening of the West German currency in relation to the dollar over the next three years reduced the exchange rate such that by the 1979/80 year it took only 1.79 deutschmarks to buy one U.S. dollar. With the U.S. economic recovery beginning in 1980/81,

the dollar strengthened. By 1981/82 one U.S. dollar was valued at 2.35 deutschmarks, only 3 percent below its value in 1976/77.

Price spreads on the Gulf-Rotterdam route exhibited a mixture of declining and increasing levels so that no apparent relationship between price spread and the exchange rate was discernible by visual examination of the data.

The average annual exchange rate between the U.S. dollar and the Japanese yen between July 1976 to June 1982 exhibited greater annual fluctuations than that for the deutschmark-dollar. From a 286.36 yen to the dollar mark in 1976/77, the exchange level reached 200.65 yen to the dollar in 1978/79. This increased to 233.47 yen to the dollar (up 16 percent) the following year. Following a resurgence of the yen in 1980/81, the final annual average (1981/82) exchange rate exceeded 233 yen to the dollar, almost 19 percent below the 1976/77 year.

No discernible relationship could be seen between the strengthening yen's value versus the dollar and the price spreads on the Gulf-Japan route. These spreads fell, rose and fell again during the six-year study period.

III OTHER NON-FREIGHT FACTORS AFFECTING SPREADS

Geographic price spreads reflect cost factors in addition to ocean freight charges and exchange rate fluctuations. These include insurance and interest charges at a minimum. Rates of return to management and to fixed investments of exporters and importers vary over time. Competition from other exporters both domestic and foreign will be reflected in the ability of U.S. traders to earn returns above current outlays.

A. Cost Factors

In principle, the difference between F.O.B. and C.I.F. trade values represent the outlays for insurance and freight. Some of the costs inherent in price spreads in domestic markets are already taken into account in the F.O.B. price. These include assembling of like qualities of product, loading and transporting to export position, blending to buyer specification and cleaning of grain when necessary. However, additional costs not included in transport rates that are reflected in spreads are interest on investment in deferred delivery, insurance and other product safety costs and any risk premium or convenience factors that may be associated with ownership in transit.

1. Interest costs

A significant and increasing inventory cost is the interest on money invested in wheat while it is in transit. Interest cost at 15 percent on a 30,000 ton cargo of \$5.00 per bushel wheat with 30 days transit is approximately \$69,000. At a 12 percent interest rate, interest cost is \$55,000. The difference per tonne is 46.66¢ or about 1.25 cents per bushel.

On the Gulf-Rotterdam route 47 cents was about 1.7 percent of the price spread in 1981-82 and 2.6 percent of the market margin over transport cost. A 15 percent interest charge was \$2.33 cents per ton, 8.5 percent of the total spread and 13 percent of average annual market margins. Interest cost is a significant cost factor and changes in interest charges are capable of reflection in price spreads.

2. Product Safety

One of the time costs as a component of price spreads will be the cost of insurance to cover the possibility of loss or damage to the

commodity while in transit from seller to buyer. The time component of the price spread bears within it the risk of loss of the grain itself or at least some portion of it. The guarantee of the safety of the product between farm producer to end-user must be borne by someone and the way to mitigate possible loss is to spread the risk by way of securing product insurance for the time period involved. Average cost of marine insurance on a voyage from the Gulf to Japan or Rotterdam would be \$2500 (approxiamtely .085¢ per tonne on a 30,000 tonne cargo). This cost varies from 3 to 8 percent as a proportion of the spread prices. In years with low spreads, the proportion is on the high side and vice-versa. Marine insurance as a percent of market margins ranges from 5 to 10 percent again dependent upon the size of the margin.

3. Risk Premiums or Convenience Factors

Another cost included in price spreads is similar to insurance costs but is largely unquantifiable, i.e. a premium for risk. Risk management is essentially identifying and quantifying future losses. It covers all potential disasters, from environmental mishaps to wars to contract cancellations. The traditional way to reduce risk exposure is to buy insurance and spread the costs among more people. The premium must be commensurate with the degree of risk or hazard that is transferred to the insurer. The amount of premium built in to price spreads, in addition to insurance costs, will vary with each contracting seller and with each trade route. There is likely to be only a small risk premium on the two routes under consideration.

B. Competitive Factors

The identified cost factors are primarily transport, interest and insurance. It can be assumed that interest and insurance costs are

roughly equal. Then for 1981/82, for example, these identified factors account for 35 percent and perhaps 8.5 percent each (for interest and insurance) of average Gulf to Rotterdam spreads.

In 1980/81 the freight factor accounted for 49 percent of the spread while interest and insurance accounted for approximately 7 percent each.

In 1981/82 the average margin was slightly above \$13 per tonne above transport, interest and insurance costs. In 1980/81 the average margin was over \$4 per tonne above identified cost factors.

If this remaining margin is considered as a transaction cost, i.e. returns to traders, this amount will be influenced by competitive conditions. These conditions will determine in conjunction with the identified factors, trade flows and participants (companies and/or nations) in such trade.

A facet of this competition is likely to be the form of the product. There is no single market for wheat as a homogeneous commodity. Rates of substitution vary with types and qualities of cereal commodities to be processed with the various types of wheat and the level of milling and baking technology. Certain nations will import a particular type of wheat preferred by its consumers even though cheaper wheats are available.

While product identification by country of origin is not a necessary condition for non-homogeneity, it can take this form. The differentiation may be due to inherent characteristics of the product owing to varying weather patterns, soil conditions, agricultural practices, varieties of the grain or the marketing policies of the exporters. Thus the variety composition of wheat exports will vary by

country as they are influenced by climatological constraints (competitive factors) of differing geographical areas.

IV. INDIVIDUAL TRADE FACTORS

On individual trades, price spreads between export prices and import prices can reflect the difference between securing the business for the U.S. exporter or whether competitors from other exporting nations will secure the market. Factors which would affect trade and trade pricing spreads include transport cost as well as possible discriminatory or preferential trade agreements, language barriers, proximity of the trading partner and other perhaps more political factors.

There appears to be a high correlation between not only the export prices of the major grain exporters but also between the price spread relationships on F.O.B. and C.I.F. bases between exporters. This indicates rather stable relationships. Export price spreads as well as the prices themselves have a tendency to move together. A graph of the price spreads between the U.S. Gulf to Rotterdam and the Gulf to Japan illustrates such a tendency.

In spite of the fact that wheats of various classes and from different sources are close substitutes, importing nations must take account of factors other than an export sales price when making their purchasing decision. Certain of these factors will affect the price spreads between seller and buyer and may be tangible or intangible. Consistency or guarantee of supply in the specified time period can affect the granting of the business and the spread. If there has been a pattern of late delivery of shipments the buyer may insist on a

shaving between the F.O.B. and C.I.F. price of even a cent or fraction of a cent per bushel before he grants the seller the contract.

The level of handling and marketing facilities may affect the spread as certain buyers require their wheat to be in bags while most buy in bulk shipments. If the wheat must be bagged before delivery this is an added cost and can add to the price spread.

Export promotion tools are used by most major trading nations. One of these tools may be some type of concessional sale utilizing a lower sales price or some assistance afforded to the buyer the interest rate offered or currency utilized in the transaction. The Public Law 480 programme of the United States government offers reduced rates of interest to buyer nations, long periods for repayment of 20 to 40 years but also requires shipment to be made in U.S. flag vessels. These vessels have a substantially higher cost than non-U.S. vessels but this cost is borne by the U.S. government. In such situations once the F.O.B. export price has been decided upon, the exporter can adjust his margin on the geographic price spread to increase his profit or offset any possibility of a loss which may have occurred in some other component of the total transaction from producer to consumer.

In certain situations an exporting company may unwittingly find itself holding excess stocks in terminal positions or even on-board ships at dock or at sea. This could occur through cancellation of contracts by either the buyer or seller for reasons known only to them or by government edicts or weather concerns, etc. This would virtually be unquantifiable in the sales transactions.

Port facilities for loading and unloading grain can affect price spreads. In some ports grain must be unloaded by hand and may even have to be bagged onboard ship as in Bangladesh. This will increase the cost and delay the time involved for the chartering of the ship to other destinations. These costs will increase price spreads between ports but may not necessarily be observable. Port congestion similarly affects spreads.

Canal fees to pass through the Panama Canal or Welland Canal in the St. Lawrence Seaway System will raise price spreads to cover such costs. Harbour depths may prevent the use of large bulk carriers as in Japan. This raises costs of carriage and hence price spreads.

Price factors which could also affect spreads would be tariff rates and export taxes. Such government-induced trade restricting actions would act to raise price spreads between seller and buyer.

Centrally-planned countries often ship their wheat imports on their own vessels. Costs for these vessels are substantially lower due to their fixed price schedules. These nations generally buy on an F.O.B. basis so their geographic price spreads are not only reduced from those in competitive markets but are also closely-held secrets.

Chapter 5

A Model for Empirical Analysis

The previous chapter identified certain factors which affect price spreads. This chapter discusses a regression procedure for estimating price spreads and some of the problems associated with statistical estimation.

I. REGRESSION TECHNIQUE

A. The Model

Regression analysis estimates relationships between two types of variables, independent and dependent variables. Independent variables can be referred to as predictor variables and can either be set to a designated value or take on values that are observed but not controlled. The dependent or response variable (variables) depends upon or is caused by the independent variable(s). Since we are interested in discovering how changes in the predictor variables affect the value of the response variable, we are searching for a relationship of the response variable to one or more of the predictor variables.

Regression analysis is a method of estimating the relationships among variables. A simple linear regression model describes the net relationship between one independent, explanatory variable and one dependent variable. The equation to describe this model is:

$$Y_i = B_0 + B_1 X_i + E_i$$

where $i = 1, 2, \dots, n$

Y_i = observed dependent variable

B_0 = Constant (intercept) when $y = 0$

B_1 = population parameter to be estimated (i.e. the rate of change in the mean of Y given X for a unit change in X)

X_i = the observed independent variable

E = unexplained error term

The method of least square is used to obtain estimates of B_0 and B_1 from the data. The method consists of selecting values of B_0 and B_1 such that the sum of squares of the deviations of the observations from the regression line (function) is a minimum. The predicted regression line is the regression equation of the line computed by the least squares method. This line is the "best" straight line through the given data to relate the y and x variables. For a particular sample observation on Y , it is highly improbable that it will be exactly the same as its predicted value. Thus there arises the existence of an error term. This error term may arise from a number of sources. Some of the independent variables which affect the dependent variable may have been omitted. Independent variables may be unknown, difficult to quantify or of little importance when taken individually. The model may not be specified correctly. The variables being used may be incorrectly measured or data incorrectly aggregated. Also the economic theory itself used to explain the observed phenomena may not be adequate.

Multiple regression uses exactly the same principles as the single linear regression model. The only difference is that more than one independent variable is used in the computation. The general equation used for the multiple linear regression model is:

$$Y_i = B_0 + B_1 X_1 + B_2 X_2 + \dots + B_n X_n + E_i$$

where $i = 1, 2, \dots, n$

Y_i = observed dependent variable

B_0 = constant (intercept) when $y = 0$

$B_{1\dots n}$ = population parameters to be estimated

$X_{1\dots n}$ = the observed independent variables

E_i = unexplained error term

This report uses the multiple linear regression model.

Essentially this model hypothesizes the sources of variability in world geographic price spreads and specifies possible causal factors for these spreads. Then Y , the geographic price spread, is expected to be some function of $x_1, x_2 \dots x_n$; the number of factors which exhibit a cause and effect relationship to y .

B. Statistical Parameters

The results of analysis and the significance of estimated parameters of the model are illustrated by several statistical concepts.

1. Multiple Correlation Coefficient (R^2)

The multiple correlation coefficient, or R^2 , measures the degrees of linear association between the dependent variable and the collective independent variables. This correctness of fit statistic measures the percentage of the total variation of the dependent variable about the mean which is explained by the independent variables in the regression model. Since R^2 is the square of the correlation coefficient, it can take on any value between 0 and +1. The larger the R^2 statistic, the better the equation is said to explain the variation in the dependent

variable. An R^2 of .90 indicates that 90 percent of the variation in the price spreads is explained by the independent variables utilized in the regression model. It is virtually impossible empirically to achieve an R^2 of 1.0.

2. Adjusted R^2

A large R^2 does not necessarily imply that the fitted model is a useful one. Observations may have been taken at only a few levels of the independent variables. Adding more independent variables to a model can only increase R^2 and never reduce it. It is sometimes suggested that a modified measure be used which recognizes the number of independent variables in the model, i.e. the adjusted R^2 or adjusted coefficient of multiple determination. It is suggested by Draper and Smith^{27/} that the adjusted R^2 may be useful as an initial gross indicator, but that is all.

3. Regression Coefficient

A correlation analysis is an attempt to study the joint relationship between variables whenever two or more variables are measured. The regression coefficient measures the linear association between the dependent and each independent variable and lies between a negative one and a positive one. If the correlation is positive one, then the variables being examined are positively correlated and observed values of the variables lie on a straight line with a positive slope. If the correlation coefficient is a negative one, the variables are

²⁷ Draper, N.R., and H. Smith, Applied Regression Analysis, 2nd edition, John Wiley & Sons, New York, :91-92.

negatively correlated and the observed values lie on a straight line with a negative slope. If the correlation coefficients have values near zero, the observed variables are uncorrelated or unassociated with each other.

4. The t-Statistic

Each independent variable included in a regression equation represents an hypothesis to be tested. The hypotheses are accepted or rejected by objectively collecting relevant data and comparing these with the tentative theory through statistical analysis. The t-statistic is used to evaluate the significance of the relationship between dependent and independent variables. The t-statistic is the estimated regression coefficient divided by the standard error of the estimate. The standard error provides a measure of variability in the same units as the independent variable. A relatively small standard error of estimate is preferred. The t-statistic tests for statistical significance of the individual coefficients at a predetermined level of significance. Whenever such tests are performed, the null hypothesis being tested is that the coefficient equals zero. If the absolute value of the t-statistic is greater than or equal to the t-value from the t-table used by statisticians for a given level of significance, the estimated coefficient is said to be statistically different from zero and means there is a significant relationship between the tested explanatory variable and the dependent variable. A general rule-of-thumb is that if the t-statistic exceeds a value of two (2), then the variable is significant at the 95 percent confidence level, i.e. there is only a 5 percent chance that the null hypothesis could be true with a t-value of two or greater. There are two types of error

that can occur in such scientific hypotheses. There is a type I error, i.e. a true hypothesis may be rejected, or a type II error, i.e. a false hypothesis may be accepted. Through the use of the student's t-test, a researcher can accept or reject an hypothesis through deductive information on the probability of committing each type of error.

The number of degrees of freedom of the sample size affects the t-statistic. The degrees of freedom is the sample size minus the number of independent variables used in the equation. The higher the number of degrees of freedom, the lower the t-statistic can be and still be significant.

5. The F-Test

The F-ratio is the ratio of the explained to the unexplained portions of the total sum of squares, adjusted for the number of regressors and the number of observations. When the value of F is high, the estimated regression equation statistically provides an adequate explanation of the overall deviations in the dependent variable from its mean. If the computed value of the F-ratio is greater than a critical value found in the table of F-values then the overall fit of the equation is declared to be statistically acceptable; otherwise it is not acceptable. It tests the hypothesis that the explanatory variables do not influence the dependent variable.

6. Mean Square Error

The mean square error describes the variance about the regression and represents a measure of the error in using the regression equation. A low mean square error indicates smaller variability.

7. Multicollinearity

Multicollinearity occurs when two or more of the independent variables are highly correlated. If this is the case, large standard errors of the regression coefficient may result. The presence of multicollinearity can be detected by the size of the correlation coefficients between the independent variables. If the correlation between any two of the independent variables exceeds 0.8 certain researchers suggest that one of the variables in question should be omitted from the model. Various researchers have concluded that least-squares regression will not produce seriously inaccurate results if this intercorrelation is less than 0.9. To correct this problem one of the variables in question should be omitted from the model.

8. Autocorrelation

Autocorrelation appears when the error terms or variables in successive time periods are correlated. Often values in an economic time series are heavily influenced or determined by the values that precede them. Other possible causes of autocorrelation are errors in the observations on the variables, an incorrect specification of the functional relationship between the variables and/or the omission of relevant variables from the model. The d-statistic calculated by Durbin-Watson tests this relationship. If the d is greater than the upper limit the random disturbance assumption is considered to be justified. If d falls between the upper and lower limit, the test is inconclusive and further observations are required. Autocorrelation can be minimized by reformulating the model with new variables and by then specifying a new functional relationship.

II REGRESSION ANALYSIS ILLUSTRATED

A. The Model

1. Dependent Variable

Dependent variables in the regression model are the price spreads between the U.S. wheat price F.O.B. Gulf ports and C.I.F. prices (1) at Rotterdam and (2) in Japan. The base grade of wheat considered is U.S. No. 2 Hard Winter Wheat (13 percent protein). This grade was chosen due to the fact that prices were more consistently quoted than for U.S. No. 2 Hard Winter Wheat (ordinary protein). Also, Europeans normally look for a high quality wheat in order to blend with their generally lower quality domestically produced crop. The higher quality wheat is also necessary in the Japanese market due to the types of breads consumed in that country. This grade of wheat is also of more comparable quality to the competitive No. 1 Canada Western Red Spring wheat against which it must compete in these markets.

The dependent variable first examined was the basis price between the U.S. Gulf ports and Rotterdam Europort in the Netherlands. The data on all prices were drawn from the International Wheat Council Statistics annual publications. These data are reported in U.S. dollars per metric tonne.

The Gulf ports are the major grain export ports from the United States. The Rotterdam ports were chosen as the receival point in Europe due to its preeminent position as the major entry point for grains being imported into the European Community.

2. Independent Variables

Initially, five independent variables were chosen for each trade route under consideration.

a. Ocean Freight Charges

Possibly the most significant variable chosen for these models was the level of ocean freight charges. It has been noted previously that ocean freight costs generally account for a good portion of the price spreads.

b. U. S. Wheat Price - No. 2 HRW

This particular grade of wheat was chosen for two reasons. One, the prices for this grade are more consistently quoted by trade organizations than certain other grades and, two, both European and Japanese millers look for a high quality wheat for blending purposes with their own crop or for strict specifications required for their products. This class and grade meets most buyer specifications.

c. Canadian Wheat Price

In the case of the Gulf-Rotterdam route, the next variable was the price of the grade No. 1 Canada Western Red Spring wheat (C.W.R.S.) with 13.5 percent protein.

Competitive wheats chosen for the regression analysis on the Gulf - Japanese route were No. 1, Canada Western Red Spring wheat (12.5 percent protein) in export position at Vancouver. These particular grades of wheat correspond to reported sales of these exporters to the named destinations.

In spite of the fact that wheat of various classes and grades as well as from different sources are close substitutes, importers must take account of other price factors which may or may not be tangible. Consistency of quality or guarantee of supply in a specified time period will affect trade flows and the price spreads. Regressions were run utilizing both F.O.B. and C.I.F. quotations. The No.1 C.W.R.S. wheat is

competitive with high quality U.S. wheats in Europe. It may be expected to have a positive coefficient with regard to fluctuations in bases prices.

d. Argentine/Australian Wheat Price

A fourth independent price variable is the price of Argentine bread wheat (Trigo Pan) at Buenos Aires, Argentina. For the Gulf to Japan route, the second competitive wheat was Australian Standard White wheat based at East Coast ports in Australia. Regressions used both F.O.B. and C.I.F. prices for this grain. Prices were also measured in U.S. dollars per metric tonne.

e. Currency Exchange Rate

The currency exchange rate was chosen as a fifth variable. The exchange rate between the U.S. dollar and the West German deutschmark was chosen for the U.S. Gulf to Rotterdam route. The West German deutschmark is specified in units per U.S. dollar. The deutschmark was chosen because of its price stability over time. Political stability in the Federal Republic of Germany also resulted in this country and its currency being least affected by international currency fluctuations and/or political manipulations. The Japanese yen was the obvious currency of concern on the Gulf to Japan route.

B. The Data

1. Ocean Freight

The ocean freight rates used are monthly average voyage charter rates as published by the International Wheat Council. These rates are based on information provided to the Council by a consortium of shipbrokers on the Baltic Exchange in London. Each broker specializes in particular freight markets and in the trade of certain member

countries. All freight rates are voyage charter rates measured in U.S. dollars per metric tonne.

2. U. S. Wheat Price

The U.S. No. 2 Hard Red Winter wheat futures price was reported by the Kansas City Board of Trade. These were monthly average prices of weekly statistics measured in U.S. dollars as recorded by the U.S. Department of Agriculture for nearby months. In months in which the futures month expired, the next contract month's average was used.

3. Canadian Wheat Price

The chosen competitive wheat from Canada was No. 1 Canada Western Red Spring wheat (C.W.R.S.) with 13.5 percent protein. Quotes were on an F.O.B. basis at Thunder Bay, Canada, the major eastern export port for Canadian grains. These average monthly prices were as announced by the Canadian Wheat Board.

4. Argentine/Australian Wheat Price

The Argentine bread wheat (Trigo Pan) price was as reported at Buenos Aires to the International Wheat Council (I.W.C).

Prices used for Australian A.S.W. wheat were those reported to the I.W.C. by the Australian Wheat Board, based on East Coast shipment

5. Currency Exchange Rate

All currency exchange rates are monthly averages published in International Financial Statistics from the International Monetary Fund. They are the rf series quoting rates in units of national currency per U. S. dollar. These par rate/market rate statistics provide conversion factors for trade and other flow or average statistics.

6. Data Manipulation

a. Lagged independent variables

Various lags were attempted in regression analysis to explain variations in the basis prices. A lagged variable can reflect the continuation of existing patterns of trade and its various components. Ocean freight rates and currency exchange rates were lagged one month in some variants of the model.

b. Wheat price differentials

In additional attempts to explain the variations in basis prices, regression analysis was used replacing quoted F.O.B. prices at the respective competing sources of shipment by the price differentials between same. The Gulf to Rotterdam route Canadian and Argentine F.O.B. price variables were replaced with the differentials between these points and the U. S. Gulf F.O.B. price. It was hoped that these data manipulations would enhance the statistical test results.

C. Data Limitations

Certain data limitations are present which have a detrimental effect on the statistical test results. One limitation occurs with the actual price level of trades between buyer and seller. Since the grain trade has few sellers and a large number of buyers, there is great reluctance on both partys to divulge exact sale prices. Therefore both F.O.B. and C.I.F. prices are quotes only and may or may not be the price levels at which the sale was made.

A similar situation occurs with ocean freight rates. Publicly available information are quotes by knowledgeable observers and actual charter rates are not necessarily those reported. All the variables are

monthly averages and are sharply affected by sudden changes which may occur on a daily basis.

The negative margins on the Gulf to Japan route are a limiting factor as they do not reflect the actual cost of ocean freight. Japanese mega-companies use grain as a back-haul to defray at least a portion of their variable costs. Grain companies selling on a C.I.F. basis to Japan can operate with a certain amount of reliability that due to Japan's diversification of suppliers, set quantities will flow on a regular monthly basis. These companies are then able to charter freight on an annual or other long term basis at considerable reductions in cost to the quoted freight rates.

D. Illustrative Results

A total of twenty-six different variations were run on both the U. S. Gulf to Rotterdam and the U. S. Gulf to Japan statistics.

The t-statistics in the majority of tests did not indicate significant relationships between the dependent and independent variables. The best result was achieved using six variables. The R^2 was .8316.

<u>Independent Variable</u>	<u>Regression Coefficient</u>	<u>T-Value</u>
Canadian F.O.B. Export	-0.1150	-1.384
Ocean Freight	1.3265	4.520
Lagged ocean freight	0.4388	1.559
Difference between Argentine and U.S. F.O.B. Export	0.1263	2.594
Exchange rate	16.5428	6.306
Kansas City futures close	3.0832	1.028
Other statistics		
Intercept	-22.0074	
R^2	0.8316	
SSE	655.180	
F-ratio	41.163	
Durbin-Watson d-statistic	1.857	
Frequency	Monthly	
Period	1976: III - 1982: II	

The R^2 of .8316 shows that 83.2 percent of the variation in the price spread between the U.S. Gulf and Rotterdam is explained by the six independent variables. The t-values of three of the variables were significant. These were the exchange rate, ocean freight rate and the price spread between the Argentine and U. S. F.O.B. export quotes.

It should be noted that there is a possibility of autocorrelation when using the least squares method of regression analysis on time series data. Most equations did exhibit the existence of autocorrelation.

Multicollinearity was also present as the following correlation matrix illustrates.

	Intercept	Canfex	Argfex	Ocefr	Laocefr	Exrat	Laexrat	KCW
Intercept	1.000	-.8679	-.2182	.8117	-.7656	.5687	-.6676	.7873
Canfex		1.000	-.1620	-.7398	.8722	-.8393	.8900	-.9479
Argfex			1.000	.0904	-.0528	.3510	-.2682	.0195
Ocefr				1.000	-.6998	.5464	-.6027	.5501
Laocefr					1.000	-.8767	.9142	-.8910
Exrat						1.000	-.9914	.8430
Laexrat							1.000	-.8901
KCW								1.000

The R^2 levels varied a great deal on both routes under consideration. The better results were obtained in equations using F.O.B. price differentials rather than the actual quoted prices.

E. Potential Model Improvement

The explanatory variables worked fairly well in explaining the price spread between the U.S. Gulf and Japan. They were less useful on the Gulf to Rotterdam route. Utilizing differences between F.O.B. prices from relevant exporters appeared to give better results than using the actual price quotes themselves. Certain other variables may also have to be brought in to the equation such as the size of the bulk carrier fleet, the volumes of world seaborne trade including the world grain trade tonnage, grain stock levels and positioning in both the exporting and importing nation and seasonal as well as annual factors. Certain of the factors are not quantifiable. Some of these factors include proximity of the trading partner, language, customs and political considerations.

Chapter 6

Summary and Conclusion

This report studies the effects of certain variables upon the geographic price spreads in international wheat trade.

Trade flows are determined by world price fluctuations as affected by innumerable factors varying from exchange rates, freight rates, government regulations and language to personal business relationships. Certain of the factors may or may not be quantifiable. The proximity of the trading partner and political considerations are additional non-quantifiable factors. Japan, for example, values regularity and dependability of supply. They sign annual purchase agreements with both Canada and Australia and have an "understanding" with the U.S.A. of grain quantities to be purchased each year.

Eastern European nations, i.e. centrally-planned countries, prefer to deal with governmental selling authorities rather than multinational traders. They also prefer longer-term (usually 3 to 5 years) contracts to assure continuity of supply with several suppliers for diversification purposes.

Various components of price spreads are costs of completing the transaction, as well as more time-related costs such as interest on investment, costs of storage, insurance and the risk of price changes and exchange rate fluctuations between time of sale and time of delivery. Ocean freight costs and costs of loading and unloading the product are of obvious importance.

The price spreads fluctuated in a corresponding fashion over the six years under consideration. The price spreads between origin and destination were correlated as can be seen in the graphs included in the report.

Generally, results indicated that on the Gulf to Rotterdam route none of the variables considered were significant with the exception of the exchange rate in the equation with the best adjusted R^2 . Even though the t-statistic did not show it, it appears reasonable that the ocean freight would also have to be of relatively strong importance in determining such a price spread. Results of regressions utilizing the differences between F.O.B. price levels rather than the prices themselves indicated significant variables to be ocean freight rates, the exchange rate and the Argentine - U.S. F.O.B. price difference.

Results on the Gulf to Japan route indicated through regression that the Australian C. & F. price for wheat and the cost of ocean freight were significant factors to be considered in determination of the price spread between the geographic areas. Results of statistical tests utilizing price differentials rather than actual prices indicated significant variables were, in addition to that of ocean freight rates, the Kansas City futures market close and the currency exchange rate.

Further analysis on the topic of price spreads is warranted due to their importance in the determination of trade flows and in their effect upon final prices in the importing area. There should also be some attempts made to reduce the degree of autocorrelation and multicollinearity in the statistics.

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TABLE 1: STATISTICS - GULF TO ROTTERDAM ROUTE

Y	CANFEX	CANCFEX	ARGFEX	ARGCFEX	OCEFR	EXRAT	KCW
.	168	.	141	.	5.50	2.5743	3.7395
.	145	162	.	158	5.25	2.5277	3.2675
.	136	156	122	138	5.50	2.4921	3.1405
19	128	148	111	125	6.25	2.4295	2.8650
26	124	145	101	123	6.50	2.4110	2.6269
17	121	139	93	106	5.00	2.3851	2.7019
15	124	145	.	111	4.75	2.3904	2.7388
23	128	147	.	113	4.75	2.4042	2.7706
19	128	140	.	114	4.75	2.3914	2.7070
21	124	134	.	113	4.75	2.3679	2.5575
.	117	.	92	.	4.75	2.3583	2.4388
.	111	.	87	.	4.75	2.3543	2.3585
.	107	.	96	.	4.25	2.2840	2.3744
.	105	.	95	.	4.00	2.2840	2.3125
11	112	.	98	.	3.95	2.3153	2.4750
18	117	139	106	.	5.25	2.3237	2.5869
18	124	145	112	.	5.75	2.2777	2.7513
18	123	141	115	133	5.25	2.2415	2.7465
14	125	147	118	.	5.25	2.1526	2.7425
11	128	156	125	138	4.75	2.1184	2.6894
11	131	153	126	140	4.75	2.0755	2.7875
15	137	.	135	.	5.25	2.0341	3.0450
21	137	.	131	.	6.50	2.0404	3.0138
22	138	.	131	.	7.00	2.1060	3.0700
16	136	162	127	.	5.25	2.0841	3.0594
17	136	162	124	.	6.30	2.0539	3.0550
12	139	.	129	.	7.00	1.9962	3.1631
16	142	.	135	.	6.75	1.9708	3.2750
18	148	.	133	167	7.35	1.8438	3.3300
19	150	.	128	153	9.00	1.8980	3.2363
14	149	162	129	.	8.25	1.8823	3.2113
17	151	161	129	154	7.75	1.8473	3.2288
22	152	167	130	155	10.75	1.8562	3.1990
13	149	159	130	153	10.75	1.8603	3.2438
19	155	170	141	162	11.00	1.8938	3.4990
26	179	188	154	169	17.00	1.9076	4.1631
28	194	.	187	184	16.00	1.8828	4.3075
27	189	.	178	179	13.00	1.8239	4.1010
26	190	216	176	.	14.50	1.8291	4.2744
24	193	221	176	.	16.00	1.7955	4.3269
21	198	210	174	.	18.25	1.7889	4.2980
27	199	210	178	.	16.50	1.7750	4.4367
21	196	.	193	214	14.50	1.7342	4.3945
27	192	221	218	.	15.50	1.7236	4.3644
.	178	.	216	.	16.90	1.7472	4.2200
.	168	.	213	.	18.25	1.8494	3.9869
.	175	.	199	.	19.75	1.8728	4.1835
43	177	.	190	.	21.75	1.7917	4.0856
33	193	.	195	.	15.50	1.7671	4.3670
31	198	.	198	.	16.50	1.7471	4.3963
30	202	.	204	.	15.00	1.7901	4.7775
27	221	.	218	.	14.50	1.7895	4.9405
31	231	.	219	.	20.00	1.8407	4.9419
41	225	.	207	.	22.00	1.9201	4.6745
42	227	.	213	.	21.00	1.9727	4.6563
41	219	.	211	.	18.75	2.0076	4.4719
38	208	.	211	.	17.00	2.1436	4.3719
29	204	.	202	.	15.50	2.1087	4.4460
33	204	.	190	.	12.00	2.1602	4.3450
31	194	.	179	.	12.75	2.2915	4.2269
27	193	.	177	.	10.50	2.3758	4.3240
25	187	238	183	.	9.50	2.4399	4.1894
27	188	.	180	.	9.25	2.5010	4.3081
24	190	228	182	.	10.75	2.3573	4.3340
32	196	.	183	.	11.75	2.2522	4.4125
.	188	.	180	.	10.00	2.2245	4.2765

Y	CANFEX	CANCFEX	ARGFEX	ARGCFEX	OCEFR	EXRAT	KCW
24	189	.	178	.	10.00	2.2920	4.1763
23	181	.	176	.	7.00	2.3665	4.0819
24	169	201	178	.	9.25	2.3791	3.9488
33	170	204	178	.	10.00	2.3966	4.0215
40	166	.	177	.	10.25	2.3077	3.7606
24	164	198	173	.	7.50	2.4298	3.6344

Y - Price spread between U.S. Gulf F.O.B. U.S. No. 2 HW (13 percent) and Rotterdam C.I.F. No. 2 Dark Hd. Winter (13.5 percent)

CANFEX - Canadian export price F.O.B. Thunder Bay (#1 CWRS 13.5 percent protein)

CANCFEX - Canadian export price C.I.F. Rotterdam (#1 CWRS 13.5 percent protein)

ARGFEX - Argentine export price F.O.B. Buenos Aires (Trigo Pan)

ARGCFEX - Argentine export price C.I.F. Rotterdam (Trigo Pan)

OCEFR - Ocean freight rate Gulf to Rotterdam

EXRAT - Exchange rate between West German Deutschmarks and U.S. dollars

KCW - Kansas City wheat futures close, nearby month.

TABLE 2: STATISTICS - GULF TO JAPAN ROUTE

Y	CANFEX	CANCFEX	AUSFEX	AUSCFEX	OCEFR	EXRAT	KCW
7	180	201	135	150	17.00	294.78	3.7395
14	158	179	128	141	16.00	290.74	3.2675
17	149	168	124	142	16.25	287.66	3.1405
.	137	153	112	128	16.50	290.93	2.8650
16	131	147	110	125	17.25	295.05	2.6269
13	125	141	104	116	16.50	294.72	2.7019
.	127	144	107	119	14.00	291.08	2.7388
11	130	146	110	120	14.00	285.07	2.7706
.	130	146	110	122	14.00	280.57	2.7070
9	129	145	108	120	14.00	275.12	2.5575
.	125	141	105	116	14.60	277.62	2.4388
12	118	136	104	113	14.00	272.98	2.3585
11	113	132	107	118	14.00	264.82	2.3744
12	113	130	105	116	14.50	266.64	2.3125
13	120	137	105	116	14.00	267.04	2.4750
11	124	139	105	116	15.00	255.07	2.5869
13	129	145	110	122	14.75	244.82	2.7513
9	131	145	114	124	15.25	241.28	2.7465
9	133	149	119	131	15.50	241.13	2.7425
10	136	153	125	135	14.75	240.28	2.6894
5	142	156	130	139	15.00	231.51	2.7875
6	148	164	137	149	15.00	221.68	3.0450
10	148	164	138	.	20.00	226.40	3.0138
.	149	.	137	.	21.00	214.34	3.0700
12	147	159	143	153	19.00	199.90	3.0594
9	147	164	140	.	19.45	188.45	3.0550
10	150	166	143	.	23.00	190.16	3.1631
.	153	171	143	.	22.50	184.13	3.2750
.	158	.	141	157	22.50	191.36	3.3300
15	159	180	139	158	22.50	196.29	3.2363
14	154	177	138	157	22.25	197.72	3.2113
10	155	178	137	153	22.25	200.56	3.2288
12	155	178	137	155	24.50	206.13	3.1990
14	158	181	137	156	24.50	216.09	3.2438
.	167	191	146	165	24.50	218.16	3.4990
26	189	223	165	202	29.00	218.89	4.1631
34	204	236	179	209	37.00	216.41	4.3075
24	199	230	168	201	35.00	217.91	4.1010
28	200	233	170	201	35.00	222.26	4.2744
30	203	236	169	.	35.00	230.37	4.3269
33	202	239	164	204	35.00	244.88	4.2980
.	202	238	171	210	35.00	240.70	4.4367
30	199	235	169	205	35.00	237.96	4.3945
35	197	233	173	206	35.00	244.05	4.3644
41	191	233	166	205	35.00	248.62	4.2200
39	185	225	162	199	35.00	251.67	3.9869
42	196	231	170	202	44.00	228.80	4.1835
38	199	234	166	201	38.00	218.05	4.0856
38	215	247	172	205	37.75	220.95	4.3670
37	220	252	178	211	38.50	224.45	4.3963
.	226	257	177	222	38.50	214.85	4.7775
36	237	271	190	224	38.50	209.12	4.9405
31	240	276	198	234	40.50	213.04	4.9419
30	228	265	192	225	40.50	209.86	4.6745
35	230	274	191	227	40.50	202.00	4.6663
31	228	267	185	223	40.50	205.89	4.4719
33	222	262	177	213	37.00	208.82	4.3719
.	229	269	178	212	37.00	215.14	4.4460
40	230	270	173	208	35.00	220.66	4.3450
24	219	262	166	198	36.75	224.20	4.2269
23	213	248	165	205	36.75	231.96	4.3240
30	204	238	165	204	30.00	233.69	4.1894
.	203	236	173	202	22.50	230.02	4.3081
31	202	232	168	203	25.00	231.37	4.3340
30	201	232	.	206	27.00	223.74	4.4125
20	194	223	174	202	27.00	218.84	4.2765

Y	CANFEX	CANCFEX	AUSFEX	AUSCFEX	OCEFR	EXRAT	KCW
.	196	227	167	194	27.00	224.59	4.1763
.	195	.	166	.	24.50	235.17	4.0819
.	194	.	159	.	25.00	240.72	3.9488
.	197	.	159	.	26.00	244.86	4.0215
.	191	.	157	.	25.00	236.54	3.7606
.	189	.	157	.	24.00	251.04	3.6344

- Y - Price spread between U.S. Gulf F.O.B. U.S. No. 2 HW (ord)
and Japan C.I.F. U.S. No. 2 HW (ord)
- CANFEX - Canadian export price F.O.B. Vancouver (#1 CWRS 12.5 percent
protein)
- CANCFEX - Canadian export price C.&F. Japan (#1 CWRS 13.5 percent
protein)
- AUSFEX - Australian export price F.O.B. (ASW)
- AUSCFEX - Australian export price C.&F. Japan (ASW)
- OCEFR - Ocean freight rate Gulf to Japan
- EXRAT - Exchange rate between the Japanese yen and the U.S. dollar
- KCW - Kansas City wheat futures close, nearby month.

GEOGRAPHIC PRICE SPREADS
IN WORLD WHEAT TRADE

by

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B.A., Brandon University, 1969

AN ABSTRACT OF A MASTER'S REPORT

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MASTER OF SCIENCE

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The international grain trade of today is of a highly competitive nature. A price difference as small as one-half U.S. cent per bushel is often the determining factor in deciding the source of a sale. Major exporters will be highly competitive in setting their F.O.B. export prices. The relatively small number of world wheat exporters makes this a close competition. Consequently, the price spread between export position and importing area can significantly affect the patterns and flows of the world wheat trade.

The objectives of the report are (1) to examine and specify constituent elements of price spreads, (2) to examine the behaviour of wheat price spreads over time between U.S. Gulf of Mexico ports and two major markets, i.e. Europe and Japan, (3) to examine the behaviour of certain component variables contained in price spreads and, (4) to illustrate a possible model for analysis of these price spreads.

Regression analysis results indicated that on the Gulf-Rotterdam route, only the exchange rate was a significant variable affecting the basis price. More stringent statistical techniques would be expected to also show that ocean freight rates are an important variable in determining these prices between port areas. Regressions utilizing differences between F.O.B. values instead of the actual price levels did indicate significant variables to be ocean freight rates as well as the differential between the Argentine and U.S. F.O.B. prices.

Results on the Gulf to Japan route indicated that there were two significant variables in basis price determination. These were ocean freight costs and the Australian C. & F. price. Regression results utilizing F.O.B. price differentials did indicate two other significant

variables. These were the futures market quotations at Kansas City and the U.S. dollar - Japanese yen currency exchange rate.

Further study on this topic would be warranted using various statistical techniques not utilized in this report. Certain other important variables could also be included in such a study to better describe the data.