University of Alberta

THE CANADIAN FEED PEA MARKET

by

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Abstract

The Canadian Feed Pea cash market in relation to other selected Canadian, North American and European markets is examined for the ability of the Winnipeg Commodity Exchange Feed Pea Futures Contract to be successful as a risk reducing and price discovery market for Canadian producers.

It is shown that feed peas are a low price risk market relative to other North American crops. Complexities of currency exchange as well as of arbitrage, high arbitrage costs and restricted ability to deliver all adversely affect the usefulness of the feed pea futures contract in reducing market risk to Canadian producers. Specification of the contract reduces the attractiveness of the contract for producers and speculators. Seasonality is found to be unusual and detrimental to post harvest storage hedges. Granger Causality tests show information in price bids in Western Canada to be leading European pea prices and Chicago futures markets. Cointegration testing confirms that price risk between markets for feed peas is small, while the pass-through of exchange increases volatility and the freight pass-through decreases the volatility. The combined effects restrict the usefulness of the contract to producers and speculators.

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OBJECTIVE

Purpose and Objective

This study investigates the Winnipeg Commodity Exchanges Feed Pea Contract and its relationship to the Canadian Feed Pea market. The primary objective is to determine the ability of the Winnipeg feed pea futures contract to reduce pricing and marketing risk for primary producers of feed peas as well as provide price discovery.

The study examines several areas that are critical to the ability of this new futures contract to fulfill the role that futures markets have in risk reduction and price discovery. Addressed in the study are the amount of market risk feed pea producer's face, the simultaneity of price formation (economic causality), the effect of information on prices in different markets (long term equilibrium price between markets), the effect of costs of arbitrage between markets (basis), and the contribution the specification of the contract has on successfully accomplishing the goals of price discovery and risk reduction.

Hypothesis

The hypotheses of this study are:

1) The price risk that faces Canadian feed pea producers is as great as other crops that have successful futures contracts in North America.

2) The price formation of feed peas is simultaneously determined between global protein and feed markets to represent a competitively established global price for feed products.

3) The Canadian and European feed pea cash prices are cointegrated.

4) The basis between feed pea markets changes due to visible changes of basis components.

5) The specification of the Winnipeg Feed Pea Futures Contract reflects theoretical specification needs of futures contracts.

Importance of Topic

How markets function is of interest to the market participants, hedgers, speculators, and traders and also to society in promoting the efficient allocation of crop production resources (Pareto optimality). A well established market for a diversified crop helps to allocate production resources efficiently [Weleschuk and Kerr 1995], and reduces pricing risk. A futures contract is considered a major part of a well-established market. The efficiency gains due to these markets can decrease the demands for government assistance programs to producers, through the ability of producers to decrease market risk themselves.

The feed pea market is an indication of the changing status of a special crop that has matured to become a significant part of Canadian agriculture. A previous example of such changes is the development of canola since World War II. Only since 1977 has canola consistently exceeded the production achieved by dry peas in 1997

The ability to place risk with speculative interests is not the only advantage of a well functioning futures market. The futures market also provides a source of visible price discovery at minimal cost, and provides cost effective contracts, negotiation and enforcement of contracts.

The competitive nature of European, Canadian and U.S. protein markets and feed markets in both production and uses suggests that there should be a significant correlation, if not integration, between these markets. Confirmation of integration between markets other than peas raises the possibility of cross-hedges with other futures markets. This would put the Winnipeg Commodity Exchange (WCE) feed pea futures in a competitive position with other futures contracts at providing an effective futures market for feed peas.

The study of how markets interrelate is crucial to the objective of risk reduction and price discovery. Ravallion [1986] considers that the measurement of market integration is fundamental information to understand how markets act. To be effective in transferring price risk from Canadian producers or users to speculators, the integration of the Canadian farm gate price to the European cash market, from which the feed pea futures contract spot price is derived, becomes very important. For hedgers "Understanding the basis and the factors which affect its behavior are fundamental to successful commodity production and marketing decisions. Unanticipated basis movements reduce the ability of the futures market to transfer risk from hedgers to speculators and...Unexpected changes in this basis create additional risk for the hedge... . Empirical assessment of the magnitude and volatility of the basis and analysis of the factors influencing basis risk may permit development of selected management practices designed to minimize basis risk impacts on market participants' decisions,"[Garcia, Leuthold, and Sarhan 1984, 499].

The delivery process is also crucial to grain futures contracts as it provides the linkage between cash and futures markets [Pirrong et al. 1993].

Study Plan

This study divides into the following chapters:

Chapter 2 presents background information on feed peas and other crops, including the growth in production of field peas in Canadian agriculture and the Canadian production's relationship to world production and markets.

Chapter 3 reviews literature also summarizes the theory of risk, forward sales, and futures contracts, including hedging and basis theory.

Chapter 4 discusses the theories and methodologies to reach the objectives of this study.

Chapter 5 provides the data used for each the studies.

Chapter 6 evaluates qualitatively the Winnipeg feed pea futures contract specifications and compares it to other crop futures contracts.

Chapter 7 provides a quantitative evaluation of the feed pea market. The first section compares the basic market prices to other Canadian and U.S. crops for price risk, as well as correlation to other crop prices. The second section gives results for causality testing of market information flow. The third section reports the results of cointegration tests.

Chapter 8 analyzes the results of the studies and suggests conclusions from the research. A discussion of the weaknesses of the study precedes recommendations concerning the WCE feed pea contract, as well as suggests directions for further research.

Chapter 2

BACKGROUND AND THEORY

This chapter presents the position of Canadian Dry Pea and Feed Peas in changing world pea markets. In particular, the European market has been a major source of demand for peas, and Canada's importance as one of the major sources of supply has grown. The Canadian acreage and production of peas has been expanding to rival some of the established major crops in Canada. The increase in production of peas results in competition for factors of production with some, but not all crops. The competitive and complementary position in use with other crops is shown.

The chapter also indicates the amount of production that has been sold in various markets. These markets are the human consumption, feed and seed segments, as well as the regional and country specific markets. The competitive position in various major markets as well as the market structure that has developed along with the maturing market place for peas is discussed.

Overview

Field peas are reported under various names that in general relate to the markets in which they are sold. Reference to yellow or green peas, denotes the seed coat color, and may be for different human consumption markets, or both can be used in animal feed rations. Green peas are reported separately from Dry peas in some trade reports, but may also be included in the feed pea category when sold as feed. In this study, Field Pea denotes all peas produced in field scale, and include Dry peas whose seeds are harvested as dry seed. In trade reports, Dry peas encompass feed peas, as well as human consumption yellow peas. Trade for human consumption green peas is reported separately as Green Peas. Feed pea includes any pea used in rations for animals.

The production of field peas in Canada increased by over 500 percent in the past decade, with 70 percent of production sold as feed peas. Of the feed pea exports from Canada, 60 percent to 70 percent goes into the European market during the time of this study. In the late 1990's, the percentage going to this market decreases.

Various companies and brokers' contract for peas with producers in Western Canada, but use of pre-harvest contracts for production of peas is small at 10 to 20 percent [Government of Canada, Agriculture and Agri-Food Canada 1994]. As well, contracts that guarantee price on all production are rare in special crops [Government of Saskatchewan 1993]. Consequently, before the introduction of the WCE feed pea contract, the market risk was born mainly by producers, with no methods of transferring market risk.

Feed peas are part of the Canadian specialty crop market, which in its infancy has been described as being less of a spot market, with many buyers and sellers, than a bilateral private contract market. As there is a long time lag between the decision to produce a commodity (investment decision) and the physical sale of the resulting production, ex ante contracting or ex post bargaining to co-ordinate producer-buyer transactions is possible. This market structure may have high transaction costs, or also allow a participant to disproportionately place costs on other participants. The decreased profitability to market participants may result in a restriction of production and marketing of that crop. If either side in the market bargaining process has an advantage, the result decreases diversification and is less profitable to the agricultural community as a whole, and by extension to the country [Weleschuk and Kerr 1995].

As an indication of the maturing of one of the specialty crop markets in Canada, the Winnipeg Commodity Exchange (WCE) opened trading on a feed pea futures contract in November of 1995. This is the first, and only publicly visible pricing mechanism in the world for feed peas [Winnipeg Commodity Exchange 1995b]. The development of the feed pea futures contract should alleviate concerns of market bargaining, provide forward pricing, and be a source of price discovery. This research investigates these aspects of the futures contract.

Background

World Production History

World pea production varies from 10.7 million metric tonnes (mmt.) to 16.6 mmt. in the 1990's, but averages 13.4 mmt.. In 1990, the former Soviet Union accounted for 46 percent of this production, with Europe producing 30 percent, Asia producing 14 percent, and Canada producing 1.5 percent. The World production declined during the 1990's, while Canadian production increased. The resulting percentages of World production for 1997 are Former Soviet Union members producing 20 percent, Europe 32 percent, Asia 15 percent, Canada 15 percent, Australia 3 percent and other countries 12 percent [Food and Agriculture Organization 1998]. Figure 1 (143) shows the major World Dry Pea producers, Figure 2 (144) the major World Dry Pea exporters, and Figure 3 (145) the major World Dry Pea importers in 1997.

Canadian Production History

Canadian production, before the 1980's, was mainly located in Ontario and Quebec. Currently, Eastern Canadian production, is not officially recorded [Government of Canada, Agriculture and Agri-Food Canada 1994]. Western Canada's production increased from 74.5 thousand hectares in 1985, to 791.1 thousand hectares in 1995 (Figure 4, 146). The production from this harvested area varies (Figure 5, 147), but total production has risen from 168.8 thousand mt. in 1985, to 1,762 thousand mt. in 1997 [Food and Agriculture Organization 1998] (Figure 6, 148). To put this into perspective, in 1995 the area of field pea production is greater than the area of winter wheat, or rye. The acreage of peas in 1995 is similar to flaxseed and soybeans, and just less than 79 percent of corn acres, or 66 percent of oat acreage (Figure 7, 149). This results in the production of peas greater than that of rye or flaxseed, and production equivalent to winter wheat in 1995. The reasons for this growth are the development of varieties that are more suitable to Canadian growing conditions, depressed margins in conventional crops, and the need for a diversification in production. The importance of this crop to Canadian agriculture is growing, and peas are becoming a major specialty crop whose area rivals some of the historically major Canadian crops.

Competitive Crops in Use

Feed peas are a high protein feed source, and as well provide a high amount of digestible energy (Table 15, 134). Peas are also high in amino acids and lysine, which make them particularly useful in hog rations [Canadian International Grains Institute 1993] (Table 16, 135).

The primary competitive crops for high digestible energy content in Canada are barley and feed wheat, while the major sources of protein competition come from canola meal and soybean meal. The canola meal has a complementary role in hog feed rations with feed peas, due to a slightly different sulfur amino acid and digestible energy components [Patience and Zijlstra 1997]. Rations of peas and barley mixtures as well may result in some complimentary relationships between these crops [Government of Saskatchewan 1994]. The presence of high levels of the amino acid lysine is important in pricing feed peas. Recently, however, the price of synthetically produced lysine has dropped to about 33 percent of previous levels due to changes in market structure [Macfarlane 1997]. More competitive lysine pricing and decreases the economic advantage that feed peas enjoy.

Western Canada annually imports approximately 225,000 m.t. of soybean meal in recent years, equivalent to 450,000 m.t. of feed peas for protein content for feed purposes [Government of Canada, Agriculture and Agri-Food Canada 1994]. This amount of soybean meal imports represents as protein almost 50 percent of current Canadian exports of feed peas.

Some of the reasons feed peas are not used by the domestic livestock feeding industry are that a consistent and stable supply of feed peas has not been available [Government of Canada, Agriculture and Agri-Food Canada 1994]. Concerns of quality by the swine industry, as well as by export markets are restricting penetration of these feed markets. Increases in pea production address concerns of consistent supply, and the education of both producers and potential users of feed peas has improved. Issues of foreign matter content (FM) and proper sampling techniques are still resulting in quality concerns which reflect on the pricing and risk in the market [Dalton 1998; Machielse 1995] .

Competitive Crops in Production

Major competitive crops in production consist of wheat, barley and canola. While land that produces wheat may have limitations for pea production, due to moisture and heat stress, both barley and canola production areas are highly suitable agronomically for peas. For rotational reasons including fungal diseases, chemical weed control, and insect pests the pea and canola crops take on a competitive relationship, while peas and cereal crops are complementary [Government of Saskatchewan 1994].

The physical resources required to produce specialty crops such as peas are similar to those used in cereal and oilseed production [Weleschuk and Kerr 1995]. Some specialized chemicals, as well as equipment to prevent harvest damage are necessary for successful production[Government of Saskatchewan 1994]. A comparison of profitability of alternative crops requires detail of returns and costs, however, "from a tangible investment perspective, growing specialty crops requires a relatively low incremental investment for existing grain producers."[Weleschuk and Kerr 1995, 239]. This ability to switch factors of production easily may be one of the reasons for the growth in production. The ability to readily use production factors between crops is also a reason to expect correlation of prices between crops using those factors. The major investment by the producer of specialty crops is through the human capital of management and production skills as well as the dedicated inputs of marketing skills for that particular market [Weleschuk and Kerr 1995].

Markets for Peas

The market for dry peas divides into human consumption and livestock feed categories, as well as dividing into domestic and export markets. Human consumption peas are usually differentiated by the color of the seed coat. Yellow peas (65 percent of area harvested) or green peas (35 percent of area harvested) are the predominant types grown in Canada [Government of Canada, Agriculture and Agri-Food Canada 1998d]. The price of either green or yellow seed coat for the higher priced human consumption category may bring a premium to feed peas depending on market conditions. The usual determination of an acceptability for the human consumption market is environmentally caused quality and mechanical damage, and results in peas of all varieties being classed as feed peas. For feed purposes, the distinction of seed coat color is not made. The result of this lack of differentiation makes the market for feed peas the minimum price market for human consumption peas. While there is fluctuation in the distribution of human to feed usage, in 1997-98 the feed category consisted of 70 percent of production [Government of Canada, Agriculture and Agri-Food Canada 1998d].

Approximately 23 percent of Canadian production was consumed domestically as feed, seed, human consumption, and waste prior to the implementation of the WCE futures contact [Winnipeg Commodity Exchange 1995b], but by 1996-97 this quantity rose [Government of Canada, Agriculture and Agri-Food Canada 1998d]. The lack of specific data on domestic consumption of feed peas results in poor quantification of the market, and may result in inaccurate reporting of inventories, and domestic usage (Figure 8, 150). Due to the seed size and the required plant population desired for seeding purposes, a larger portion of the crop is retained for this use (approximately 10 percent to 12 percent) than most other crop kinds [Government of Saskatchewan 1994].

The 1995/96 exports of Canadian peas are over 1 million m.t., but since then they have not increased [Food and Agriculture Organization 1998]. Figure 10 (152) indicates the regions to which Canada exports dry peas in 1996-97. Europe accounts for the greatest percentage, with Spain and Belgium being the major recipients in that region. In 1994, exports of feed peas to Northern Europe were 232,807 tonnes, with the majority being imported through the ports of Antwerp, Belgium, and Rotterdam, Netherlands. Projections for the quantity imported by Europe to grow by 400,000 m.t. annually [Winnipeg Commodity Exchange 1995b], has not materialized according to Food and Agriculture Organization (FAO) data.

Other major countries that Canada exported peas to in 1993 (with the percentage of Canadian exports in brackets) include the U.S. (11 percent), India (10 percent), Japan (5 percent), Venezuela (5 percent), South Africa (3 percent), Columbia (2 percent), and Taiwan (2 percent). By 1996-97, the major importers of Canadian peas were Spain (27 percent), Belgium (20 percent), Cuba (9 percent), India (9 percent), China (6 percent), U.S. (5 percent), Columbia (4 percent), with South Africa, Japan, Trinidad, Venezuela, Brazil and the Netherlands at less than 4 percent each (Figure 11, 153) This shows how the markets for peas tend to be inconsistent and can vary significantly over a few years.

The major direct competition to Canadian feed peas in Europe come from European, Eastern European, and Australian sources (Figure 2, 144). The major competitor to feed peas in Europe is soybean meal; much of this is exported from the U.S. to Europe.

The European production as well as market imports for non-grain, protein rich feeds are shown in Figure 12 (154). For the period of this study, the soybean meal imports are 15.1 to 19.5 million m.t., dry pea imports are between 1.6 and 2.8 million m.t., and green pea imports are 0.36 to 0.66 million m.t. [Food and Agriculture Organization 1998]. During the same period the imports of feed peas are 0.233 to 0.461 million tons from Canada.

Diversification to other markets by the Canadian pea industry is due to anticipation of demand reductions by the European Community (EUC). The diversification to other markets reduced the impact of falling imports of feed peas by the EUC in 1997-98 that are caused by disease in hogs and cheap alternative feeds [Government of Canada, Agriculture and Agri-Food Canada 1998a].

Asian markets are expanding rapidly, but limitations due to trade barriers and tariffs, as well as lack of utilization knowledge restrict exports to this region [Hickling et al. 1997]. Chinese imports from world sources increased dramatically from about 22,000 m.t. in 1995 to 144,500 m.t. in 1996 [Food and Agriculture Organization 1998].

Major national competitors in the world export market for feed peas are Australia, France, as well as the former Soviet Union. The historically major exporters are shown in Figure 13 (155). The increase in Canadian exports are shown in Figure 13 (155) as well as the volatile nature of exports from the Ukraine. The production areas of the world that are increasing production of pulse crops are Australia and Canada [Blade 1998]. Canadian exports through the West Coast may be able to supply the increasing markets in Asia and the Indian sub-continent, but Canadian exports are subject to competition from Australia [Government of Canada, Agriculture and Agri-Food Canada 1998d], which may have a geographic advantage in those markets. The advantage of location is not straightforward and is reviewed later in the literature on ocean freight.

In Canada, the use of feed peas in hog rations is increasing because feed trials show competitive results for rations that include peas. Peas are also becoming a part of poultry feeding programs. As a result, the use of least cost formulations in feeding programs is likely to increase the use of peas domestically [Government of Canada, Agriculture and Agri-Food Canada 1998d].

Producer Marketing

The domestic market historically consists of limited direct sales from producers to livestock feeders and feed processors. Only recently have the major commercial firms in grain marketing and feed processing been taking an interest in the domestic market. An example of this increase in involvement, can be seen in the Alberta Wheat Pool's opening of a feed pea meal and canola meal, production and blending facility at Camrose, Alberta, in November of 1994 [Huff 1995].

The major grain companies, with smaller niche players filling specific markets, have either sold through brokers or been brokers placing bids for peas with producers and have also provided the source of price discovery for the producer. The export market for feed and human consumption is serviced by over 35 firms [Slinkard 1995] of varying sized purchasers, from the major international grain companies, to small brokers [Government of Canada, Agriculture and Agri-Food Canada 1998d].

Forward Contracts

Forward contracts before harvest are offered by some contracting companies, but are not common. These contracts may offer a price on a base grade, and may take a specified percentage of production, but are usually for less than one-half of normal production. The balance may be unpriced, or deferred delivery contracts or pooling contracts may be signed which leaves the pricing subject to the market conditions while restricting competitive bids[Government of Saskatchewan 1993].

As a result, over 80 percent of the average Western Canadian production of peas was totally exposed to price and basis risk, while the remaining 20 percent is only partially protected, often by only one third of expected production. Less than 7 percent of the total Western Canadian production was protected from some form of marketing risk.

Although use of risk reduction markets by agricultural producers is low, producers of higher grades of wheat in Canada are protected by the CWB from a large portion of marketing risk. Feed wheat, canola, rye, flax, oat and barley producers have the availability of futures contracts as well as forward contracts to provide market risk protection.

Price discovery for feed peas in Europe appears to be determined by negotiated contracts, with little visible price discovery. In Canada, the producer often has little knowledge of the market, the potential profitability, or the actual value of the crop. Often, the sources of market information for these producers are the same companies that provide forward contracts or are those who sales have been entered into with [University of Saskatchewan 1997].

Cross Hedging and Futures Marketing

The Winnipeg Commodity Exchange [Winnipeg Commodity Exchange 1995b] claims that there is no effective cross hedge available to pea producers or users, using the competitive crops that are traded in other futures markets.

Researchers such as Loyns, Boyd, and Carter [1992] suggest however, that cross hedges are common for other Canadian crops. These include U.S. soybeans, soybean meal and oil markets are major determinants in pricing of canola markets for both oil and meal. "The time, place and form dimensions of soybeans and canola all come together to give a common price in terms of meal and edible oil.... Corn and barley are also part of the same feed (energy and protein) market when they can be reasonably freely traded." [Loyns et al. 1992, 18], and "this framework can also be applied to most other agricultural commodities" [Ibid., 19]. The prices in Canada should reflect the prices in Rotterdam with the freight handling and time related costs taken into consideration, and only differing by the actual costs of arbitrage between markets including currency differences [Loyns et al. 1992]. This suggests that the use of cross hedges to U.S. markets for Canadian crops may be a viable option for products that are freely traded, and should encompass the major markets of Europe and North America. The possible futures markets that could be used to cross-hedge feed peas would appear to be the major protein and energy contracts. The most likely would include the Chicago soybean meal and corn contracts, as well as Winnipeg canola contracts.

Winnipeg Feed Pea Futures Contract

The Winnipeg Commodity Exchange's belief of no effective cross hedges for feed peas resulted in the creation of the only visible, openly traded market for feed peas in the world [Winnipeg Commodity Exchange 1995b]. The futures contract started trading in November of 1995. The Winnipeg Feed Pea Contract trades for the delivery months of February, May, July, October, and December. Summary specifications are in Appendix A.4 with a more complete listing of the specifications of the Winnipeg Feed Pea Contract in Appendix D.

The introduction of the WCE feed pea contract is not without controversy. Many suggest that it is, "...a weak tool for price discovery or risk management for farmers,"[University of Saskatchewan 1997, 4]. It appears to some that, "The exchange is offering this contract as a hedging tool for the international trade, not the Canadian dry pea producer," [Machielse 1995, 5]. Others say that few of the firms that trade feed peas use the contract or consider the contract useful. The contract specifications call for minimum delivery of 100 m.t. lots, but Machielse [1995] suggests that the practical minimums to deliver appear to be in the magnitude of 5000 m.t.. Basis risk is considered to be substantial in the contract, and to be complex and difficult to establish. According to these sources, the benefits to the producer are indirect and are in two primary areas. These are the greater transparency of the pricing mechanism in Europe gives better pricing signals, and it also allows companies offering forward or delivery contracts to pass on price risk and therefor offer more contracts.

The main concerns in Canada appear to relate to the thinness of trade, the complexity of exchange calculation, the complexity of basis, and the complexity of delivery. Other concerns are that Canadian peas may be considered inferior to French peas at some locations in Europe due to quality issues that include moisture content, foreign matter (F.M.), and protein levels. The concerns of F.M., and consistent protein levels are evident in the Canadian domestic market as well. The liquidity of the contract for European feed formulators as well as Canadian producers is a concern [Pulse Canada 1996].

The moisture content of the delivered product is considerably higher for Canadian product (17.5 percent), in comparison to the Australian limits (12 percent) that are both deliverable on the contract. The Canadian moisture limits are as well, higher than those of other competitors in the European market (14-16 percent) [Pulse Canada 1996]. This moisture limit is also higher than the farm gate Canadian limit of 16.0 percent [Canadian Grain Commission 1995]. While actual deliveries to Europe have not been above 15 percent, this higher potential level causes some concern in the European market.

The foreign matter (F.M.) limit for Canadian feed peas at 8 percent, is considerably higher than limits from other sources, such as the Australian 3 percent, French 2-3 percent, and Ukraine 5 percent [Pulse Canada 1996]. The Canadian farm gate price is determined after cleaning (dressed), or net of dockage or F.M., resulting in considerable difference in price determination between markets [University of Saskatchewan 1997].

There are indications of potential trade barriers being implemented due to the high F.M. content of the contract [Pulse Canada 1996]. Product that has greater than a 5 percent grain limit entering the EU is considered mixed grains and therefore triggers import duties as a compound feed. The effect of this concern is not addressed in this study, as the period studied is before the possible implementation of such a policy.

The specific quality concerns in Europe are readily addressed, and any discounts which may be reflected in prices, are not insurmountable according to industry reports [Pulse Canada 1996].

The major competitor in the European delivery locations, besides feed peas, is U.S. soybean meal, denominated in U.S. dollars per m.t.. The major visible pricing mechanism for soybean meal is the Chicago Mercantile Exchange's soybean meal futures. Braga and Martin [1991] state that Italy has been importing up to approximately 50 percent of its soybean meal needs at the time of their study, with most of the trade conducted by large international companies, or by specialized commodity brokers. Their research also indicates that the three major methods of pricing in Italy are by spot purchases denominated in lira, forward purchases denominated in lira, and basis contracts in U.S.$ based on Chicago Board of Trade soybean meal futures. The Common Agricultural Policy also does not interfere with international trade in soybeans, soybean products or cereal substitutes that enter the community without levies [Braga and Martin 1991].

The WCE developed the feed pea contract, for Canadian (including U.S. as well as Australian) produced feed peas, delivered in Europe, denominated in U.S. dollars, and its expected use is by Canadian hedgers as well as possibly by European, and Canadian commercials [Winnipeg Commodity Exchange 1995b]. Australian peas were added as being acceptable for delivery on contracts from December 1996 onward to increase the possible users of the contract. The primary differences of this contract from other futures contracts used for agricultural risk reduction in Canada, are the uses of a foreign currency, and of a foreign port as the delivery point. The possibility of multi-national sources of product being specified is also unusual. Several other features that may be relevant to the proper functioning of this market include greater financial resources required for delivery against the futures contract than is typical for other agricultural products. These include irrevocable letters of credit for the total value of product to be delivered. Margin requirements also increase upon notice of delivery for hedgers to 30 percent (short) of the total value to be delivered or 100 percent (long) of the total value of product to be received upon notice of delivery [Winnipeg Commodity Exchange 1995c].

The inclusion of ocean freight to the cost of delivery to the WCE feed pea contract changes the risks faced by users of this contract from other North American agricultural futures contracts. Ocean freight variance for agricultural crops is greater and represents a much greater proportion of the total value of agricultural products when compared to many other goods globally traded [Hsu J. and Goodwin 1995]. Hsu and Goodwin [1995] found the coefficient of variation for the grain ocean freight rates was 28.3 percent as compared to the international price of U.S. wheat in Rotterdam of 12.8 percent during the time period they studied. This increased variation increases risk to the seller and adds complexity to the basis calculation required for local price discovery by the producer. The pricing unit for ocean freight is in U.S. dollars per tonne (as are many of the costs incurred outside of Canada) which also adds to complexity of basis calculations.

While feed peas are considered to move to Europe through Thunder Bay ports, various reports indicate that other ports including St. Lawrence and Vancouver may be involved during the winter season, when the Great Lakes are closed [University of Saskatchewan 1997; International Grains Council, Various]. Thunder Bay has a maximum ship tonnage of 25,000 m.t. [University of Saskatchewan 1997] which includes vessels that are referred to as Handysize. Panamax ships are the largest vessels capable of transiting the Panama Canal and are of 55,000 to 65,000 dead weight tonnes [Government of Canada, Agriculture and Agri-Food Canada 1997]. Most grain trade uses the Handysize and Panamax size vessels, while larger vessels called Capesize, with up to 120,000 dead weight tonnage are used mainly for coal and ores.

In 1993-94 peas represent about 67.3 percent (461,000 m.t.) of the other class of grains received at terminal elevators reported by the Canadian Grain Commission. The shipments of other grains from Thunder Bay was 467,000 m.t. and from Vancouver 165,000 m.t.. Although the majority of Canadian grains are exported in bulk, there is a large increase in the use of containerized movement, mainly for human consumption and niche markets. The port of Montreal increased handling of dried peas in containers from 3,357 m.t. to 24,970 m.t. between 1993 and 1997 [Government of Canada, Agriculture and Agri-Food Canada 1998c]. Other ports report similar increases in containerized exports of special crops.

Summary

This chapter shows the increasing importance of the dry pea to the western Canadian agricultural economy over the last decade. The production of dry peas is increasing to rival older established grains. The exported volumes of feed peas are increasing, and the destination markets for peas are changing as well. The Canadian pea has a major position in the World pea market, and competes with many other crops and producers in those markets. Most of the export trade volumes of peas have been to countries in Europe although this is changing. The export trade by necessity involves ocean transport, mainly in bulk.

The maturing special crop market for feed peas has resulted in a futures market as one source of forward sales, as well as price discovery. The ability of the futures contract to meet the objectives of risk reduction, and price discovery are a source of controversy in the industry.

REVIEW OF LITERATURE AND THEORY

This chapter presents theory and aspects of markets that are temporally and spatially separated. Particular attention is spent to deal with concerns raised in the literature regarding the implementation of the WCE feed pea contract, the effects of specification on a futures contract, and the potentially harmful actions that can prevent a market from achieving the price discovery or price risk reducing roles intended.

Defining risk, the types of risk, and aversion to risk is followed by how risk is measured. Methods for reducing risk in general as well as reducing market risk are discussed. Demand and foreign exchange theory are shown as basic methods of interpreting how prices relate between different crops, and between different global markets. Use of futures markets, a specific method of forward pricing, is shown both a risk reducing method and a tool for price discovery. Characteristics of futures markets are addressed, and the importance of the specification of the contract is stressed. Basis, arbitrage, delivery and spot cash price are shown interrelated and critical to the functioning and to participation in the market. Aspects of basis risk, level and predictability are discussed in relation to the ability to arbitrage between markets. How the failure of arbitrage between markets takes place and the resultant destruction of market integrity and consequent withdrawal of market participation is addressed. Concerns of empirically studying markets that have significant costs of arbitrage are presented. The volatility of markets, potential use of other risk reducing markets for a commodity, and ability to liquidate a market position are shown to be important to the use of a futures market.

The final part of the chapter discusses the importance of ocean freight to markets traded between continents, and the risk that is inherent due to such trade as well as the availability of risk reduction markets for ocean freight. The chapter closes with a brief explanation of the effect that cost of carry has on a market with large arbitrage costs between itself and the market it trades to.

Risk, Risk Measurement and Management

Risk Definition

Risk can be defined in several ways. These include the probability of loss (gain), the variance in expected outcomes, the size of the maximum loss (gain) possible [Barry 1984], as well as the difference from expected outcomes [Novak & Associates Management Consulting and Jeffrey 1997]. It is important to note that positive outcomes are possible as well as the more commonly thought of negative effects. Risk is defined in the context of the measurement used to study it. Each of these measurements may give different results, and each will be more appropriate in certain circumstance than others. The measurements include the probability of an occurrence, the variability of the occurrences, the unexpectedness of occurrences, and the possibility of devastating results.

The overlapping of risk measurement, or the failure of researchers to analyze risk in a system or portfolio approach may result in empirical findings lacking relevance to the individual firms decision process for reducing market risk. Research finds that hedging is used relatively little for risk reduction in agriculture, and while often considered due to complexity, may be due to less need because of the effects of diversification of production (portfolio of risky assets). The market risk removed by formal risk reducing markets for individual crops consequently may be less than that achieved by the use of diversified crops or enterprises. The high costs of hedging and the reduction in risk through crop diversification heavily influences the optimal hedge in studies [Berck 1981], and results in low levels of hedging which are consistent with actual farm levels of hedging [Barry 1984].

Types of Risk

Risk as it relates to the individual or firm is usually broken into business risk and financial risk.

Business risk in agriculture stems from five major sources including production or technical risk, market or price risk, technological risk, legal and social risk, and human sources risk. Production or technical risks include the influence of weather on yields of crops and the differences that the use of drought-resistant varieties has on the affects of weather. Market or price risk relates to the relative prices of factors of production, outputs of crops or livestock, as well as availability of markets. Technological risk occurs due to future technologies that may make the results of current decisions obsolete. These technological risks affect durables, as well as transportation costs. Legal and social risk includes the extra risk that increases in activities such as forward contracting produce, as well as changing environmental responsibilities. Human source risks include labor disruption, management abilities, health risks and objectives of those involved in the decision process [Barry 1984].

Financial risks, which relate to the debt, equity and structure of the firm combine with the business risk to influence the total risk faced by the entity [Barry 1984].

Risk Aversion

Risk aversion measurement is dependent upon the individuals information, expectations, circumstance, capital constraints, resource endowments, and methods available for responding to the perceived risk, and may differ between decision makers for different monetary outcomes [Barry 1984]. Risk neutral decision-makers have a utility curve that is linear, where the choices are ordered by their monetary value. Risk averse decision-makers have a concave utility curve where a choice of a definite return will be preferred to an equal return that is uncertain. Novak & Associates Management Consulting and Jeffrey [1997] suggest that the context in which risk is assessed, whether by itself or as part of a more complex association of risky events, influences the interpretation of the amount of risk and implications of that risk. The analysis done in this paper does not deal with portfolio theory, or the resulting substantial reduction in risk that diversification of crops may make available to the individual decision-maker. The focus is on comparing the risks of the individual crops in relation to one another.

In most analysis of producer marketing, the assumption is that producers have risk aversion to adverse price change as the major objective of hedging [Loyns et al. 1992]. The rest of this paper assumes risk averse producers, but it should be remembered that this may not be valid under several conditions including diversified production, or when there is low probability of profitable margins of production.

Risky Decisions

Risky decisions occur when there may be more than one outcome from an action. In agriculture, the time lag between the decision being made and the results of the decision being known often contribute to the size of the risk [Barry 1984]. Decisions made by a producer, " ... are intended to yield good outcomes. Good decisions, however, do not insure good outcomes due to the effects of risk," [Barry 1984, 111]. The result is an attempt by some to reduce the effects of this risk.

The unexpected variation the decision-maker experiences, rather than variation itself, creates the risk according to Fleisher [1990]. Consequently, a crop may have less price risk than another may, even if the variation around the mean is greater, because of the ability to forecast the price results in fewer deviations from the expected price. A commonly accepted method of reducing risk, the use of fertilizer, may increase the maximum and mean yield of a crop, but it leaves the lower production limit at zero due to other factors. This larger range of possible outcomes from the addition of fertilizer will result in the actual risk increasing from the decision to reduce risk [Fleisher 1990].

Measurement of Risk

The following discussion on measurement of risk, and marketing decision models is based on Barry [1984]. Measurement of risk may be through subjective expectations of the decision-maker, or by objective measures of historical or experimental data.

The major decision rules that apply to risk can consist of 1) those rules requiring no probability information 2) safety first rules and 3) expected utility maximization theory.

The first set involves rules that require no probability information. These are considered theoretically weak and are not considered useful. The second set involves the probability of loss. The choice of chance of loss, or variance is critical to the decision of greater risk.

The subjective expectations of risk are unique to the decision maker, and are expressed in attitudes toward forward pricing, production practices, insurance, liquidity reserves held, diversification, liability management and more. Measurement of risk attitudes often uses expected utility models (EU) and the concept of lexicographic utility.

Lexicographic utility requires the highest priority goal to be achieved before the next is considered. Safety first rules (SF) that are often used in risk analysis have safety of the firm having a greater priority than profit maximization. Even in these cases, there may be different choices by different decision-makers due to how the rules are interpreted. These decision rules may rate expected returns, maximum return with least probability of return below the safety threshold or the least probability of loss differently. EU models focus on variance of outcomes, while the safety first models (SF), focus on the probability of loss. SF models may not penalize large deviations below the mean as EU and mean semi-variance models do.

The value of a choice by a decision-maker is dependent upon the uncertainty of the expectations. While the axioms used are that the decision-maker is rational and is consistent in choice, factors such as differences in information, expectations, endowments, capital and methods available will affect the perception and interpretation of risk by the decision-maker. The uncertainty of expectations and differences in endowment result in apparent differences in ordering between individual decision-makers and even between decisions by rational decision-makers.

EU relies on subjective probabilities and risk preferences, and is therefore dependent upon the decision-maker and can not be computed from historical or experimental data. However, the expected utility theory (EU), where $(EU)j = f\ (uj, \sigma 2j, M3j, M4j, \ldots)$ max or under restrictive assumptions of U being quadratic or that profits are normally distributed, results in $(EU)j = f\ (\mu j, \sigma 2j)$ max, results in variance representing an unambiguous, single dimensional index of risk. If there is skewness or kurtosis present then this is no longer true.

Mean Variance Models (EV) are based on EU models. The efficient frontier is found by minimizing the variance of net returns, subject to successive fixed levels of an expected return vector. The frontier is sensitive to how forecasts are constructed and the assumed functional form.

As subjective risk analysis is dependent upon the users needs, and may be dependent on the ability to achieve good probability estimations, objective probabilities of risk analysis is often preferred. Objective probabilities use historical data to determine the frequency of events in a number of observations.

Statistical estimates of forecasting equations with explicit variance components are one method of measuring random variability in time series.

The objective probability information of EV models is useful in providing alternatives that producers can use while considering their individual risk outlooks.

Risk Reduction

Tools for managing risk fall into three categories. These include self-protection, which reduces probability of loss (i.e. spreading cash sales), self-insurance that reduces the impact of loss (i.e. holding cash, or inventory), and market insurance that reduces the impact of loss (i.e. Crop insurance). As the cost of market insurance varies not only with the size of loss, but with the probability of loss, there is an incentive to use market insurance for protection against low probability losses [Fleisher 1990].

Risk reducing activities are defined as activities that when they are repeated over time, they reduce the variability of returns, and of profits. If profits increase as a result of these repeated activities, the decision-makers objective may be profit maximization rather than risk reduction, and the motivation behind the action may be unclear. Many of the methods commonly purported to reduce risk have a dual nature to them. Marketing techniques such as selective hedging where the objective is to increase the mean price as well as reduce the variability of returns and the use of options to truncate the adverse outcomes possible, while gaining from favorable price changes are examples of this dual nature [Barry 1984].

Risk management tools strive to alter the distribution of outcomes by 1) changing the dispersion of the distribution an example being use of futures markets, 2) shifting the expected value, an example being governmental policy shift such as tax cuts, 3) changing the shape of the distribution, by using risk management techniques such as irrigation, 4) truncating the distribution, by using options and forward contracts [Fleisher 1990].

Risk reducing activities for production can include diversification of enterprises or crops if the correlation between the enterprises or crops is less than one, and ideally negative and close to one. The firm's resources, including endowments, the climate in which it operates, and economies of scale may all counter the advantages of diversification in reducing risk [Barry 1984].

Often analysis of single crops, rather than diversified producing entities may distort the risks and find empirically that utilization of risk reducing methods is less than would seem optimal [Novak & Associates Management Consulting and Jeffrey 1997].

Reduction of Market Risk

Information

The availability of information is critical for analysis of risk and determining risk-reducing strategies. Information is useful to market participants in marketing, computation of seasonal variations, and of recognizing trends in comparing local prices of first handlers to other markets [Fleisher 1990]. Such information and data can be very expensive to generate, has large economies of scale, and yet the marginal cost of an additional user of that information or data is zero. The information once generated is difficult to control or restrict, and benefits many that are not direct users. These issues suggest why the price discovery function of public markets is so important. This importance of information also suggests why market information available from private traders may not provide the producer with suitable information for decision making on marketing and resource allocation.

Market risk reducing activities include enterprises with low price variability, inventory management, and forward contracting. Investment in skills and information, as well as sales over time and storage are other examples of market risk reducing activities [Barry 1984].

Some marketing alternatives separate pricing from the delivery of the product. Forward contracting and futures markets are examples. The separation of pricing from delivery is considered risk reducing, but forward contracting increases other risks such as the inability to fulfill the contract due to lower than expected yields or quality. Opposite party risk is also increased where the contracting party is unable to fulfill it's obligations [Barry 1984]. Contracts that require unpriced delivery or rights of refusal also eliminate competitive price bids for the product. Hedging using futures markets introduces basis risk as well as indivisible contract size, costs of brokerage, margins, as well as requiring increased skills, management time, and informational requirements compared to forward contracting. Some research indicates that routine hedging shows no decrease in variability when compared to spreading of cash sales over time, while selective hedging may reduce the variability in comparison to spreading cash sales over time [Barry 1984].

The effect of forward contracting on market risk is not consistent over the range of likely production. When the proportion of contracted production to expected production increases, the price risk decreases and then increases, and affects access to credit and borrowing costs, which in turn affects other production and marketing choices [Barry 1984]. Even the benefit of reduction in risk usually attributed to hedging, is questioned in the event of negative profit margins [Dayton and Baldwin 1989], although it may be used to minimize losses [Loyns et al. 1992]

The market risks in agriculture increase as globalization occurs and as exchange rates and interest rates are determined to a greater extent by market action [Fleisher 1990]. Volatility of grain prices are increasing, at a time when global trade agreements stress that agricultural subsidies must decrease. The producer must become more adept at interpreting markets and decreasing exposure to risk. Futures markets are important in accomplishing both goals.

Demand Theory and Correlation of Prices

The correlation and integration of crop markets is related to commodity grouping and product separability, which are major components of demand theory. Separable, by definition, is that the ordering of preferences within the group of goods compared, will not be affected by consumption levels outside of the group. Weak separability restricts the substitutability of goods between groups. The substitution of bean oil for a high protein feed is not likely, and as a result the expectation of cointegration (or even a high correlation) is much lower between those two products, than the expectation of cointegration between soybean meal and feed peas, which are both high protein feed sources.

The composite commodity theorem states that if prices move in parallel between commodities, then that group of commodities can be treated as a single good in consumer demand [Deaton and Muellbauer 1994]. While this concept is used often in consumption analysis, its implications on the supply side of agricultural crop marketing is often overlooked. The theory would expect that two crops using similar resources (factors) in production, with no or few technological changes required between producing them, would maintain relative price stability. This stability is due to the shifting of production resources toward the more profitable crop that will increase that crops supply while conversely decrease the supply of the crop from which the resources were withdrawn. The degree of correlation will be dependent however, on the relative elasticity of the supply and demand curves of the two crops. This separability of preferences can be used to define groups of goods that are substitutable in production as well as in consumption.

Weak separability is necessary and sufficient for the second stage of two-stage budgeting [Deaton and Muellbauer 1994]. This weak separability is often considered to include preferences that are weakly intertemporally separable. This means that a tonne of feed peas in one period is different to the consumer than a tonne of feed peas in another period. This preference for a good in different periods is the basis for carrying charge markets, the use of storage, and futures markets to distribute products between time periods. For markets like grains that have large supplies produced seasonally and are storable, the price incentive to carry crops between periods becomes a market driven consumer demand for supplies now and in the future. This price incentive will result in costs of storage and interest charges being the difference between cash and futures prices (carrying charge) as well as between different delivery months. This price differential will also dictate (ignoring convenience yield) whether the crop is stored or brought to market immediately. Convenience yield is the price amount a participant is willing to forfeit to maintain inventory for day to day operational efficiency. These premises result in the transfer of market information between cash and futures markets and are the basis for claims of all market information being in the current prices observed [Tomek 1997].

These suggest that substitution between protein feed crops will be high, but that even non-substitutable crops in demand, may be substitutable in production resulting in high correlation, if not cointegration, expectations of some degree among most crops that use similar factors of production. In general as demand increases, the general price level may increase to maintain supplies of both crops, and the relative prices may not change (assuming similar elasticities). The general change in prices is considered systemic risk and cannot be eliminated by diversification within the particular market [Novak & Associates Management Consulting and Jeffrey 1997]. As well, the increased demand for a crop may increase the price of a crop that uses similar resources in production, but that cannot be used as a close substitute. An example would be an increase in the price of canola drawing resources such as land into canola production, decreasing the supply of land for pea production and increasing the equilibrium price of peas. Consequently, the correlation between crops that are not close substitutes to one another in use will likely be positive because of the substitutability of resources of production.

Foreign Exchange Trade Theory

Producers having to deal only in the local currency obscures foreign exchange components of most grain trade transactions from the producer level of marketing in most countries. The concept of changes in farm gate prices due to currency change is often acknowledged [Loyns et al. 1992], but the degree of change is not. Some consider the effects of exchange to be significant on not only the producer, but to the nation as well. "Exchange rate movements can easily swamp or obscure the desired price, trade, and production effects of any specific agricultural commodity policy," [Houck 1992,158]. Others such as Novak and Unterschultz [1996] have found little risk due to exchange rate change in some markets. The risk associated with exchange rates is not limited to the direct effect on commodity prices. Many of the basis costs in global trade are denominated in currencies other than the local currency. In Feed Pea markets the ocean freight and many of the costs of arbitrage and insurance components are denominated in U.S. dollars.

If exchange rate induced price change is not passed through completely, there may be loss to the sector and by extension to the nation because of poor market signals, resulting in uninformed investment decisions. Even short periods of poor market signals may induce resource allocation on capital items that have long term effects. Crops that are produced yearly have non-capital decisions reached for resource allocation before planting that will affect the supply for periods of at least sixteen months into the future. Capital expenditures will result in even larger time horizons. Poor market signals will result in poor inter-year as well as intra-year stocks allocation decisions that can result in greater price volatility or excessive supply or shortage of the physical commodity later.

The complication of trade using two or more currencies is addressed in the trade literature. The formal testing of the Law-of-One-Price (LOOP) [Richardson 1978; Protopapadakis and Stoll 1983; Ravallion 1986; Goodwin and Schroeder 1990; Delpachitra and Hill 1994], parity pricing, Pricing to Market (PTM) [Pick and Carter 1994] as well as exchange rate pass-through [Knetter 1993], is the basis for testing of cointegration. Many of the empirical studies show extended periods of non-parity pricing, failure of the LOOP, and poor exchange rate pass through.

The hypothesis of most of these studies of the LOOP is that a product that is homogeneous, and readily traded between nations using different currencies (that are competitively traded) will vary in price in each currency by the difference between currencies. The studies where there is lack of empirical evidence confirming the LOOP are most often shown to be related to differentiation of the products. The locale of production can even be the determinant of differentiation [Armington 1969], although the more usual causes are different characteristics [Delpachitra and Hill 1994] or non-tradable prices contained within the product [Goodwin et al. 1990]. Under non-competitive conditions, failure of the LOOP, and the related pricing to market (PTM) observed, may be related to lack of arbitrage possibilities, the size of arbitrage costs, or to the desire to maintain stable prices or market share [Dunn 1970]. The methods used to analyze these markets are often refined by the researchers to deal with potential statistical problems, but the results usually indicate that homogeneity, few non-tradables and extended time frames [Delpachitra and Hill 1994; Goodwin and Schroeder 1990] will favor confirmation of the LOOP. The time required to achieve cointegration varies with the type of good being traded. Results indicate that financial instruments trade quickly with little difference in price between markets, commodities trade less so and individual differentiated products least so.

Imperfect competition may also generate synchronized price movements between markets [Monke and Petzel 1984]. This may be due to traders who have market power using percentage, absolute or combinations of percentage and absolute premiums between markets. The confirmation of the LOOP may indicate non-competitive price formation in a market if not all costs of arbitrage are accounted for.

Exchange rate uncertainty within a contract leads to different optimal hedging strategies by a trader. This risk difference is not only from the exchange rate risk, but also from the other risks associated from a more complex basis structure [Thompson and Bond 1987]. An example is the freight component of basis consisting of some segments denominated in foreign currency (ocean freight) and some in local currency (rail freight), for a Canadian producer hedging feed peas.

The exchange risk in most major markets can be mitigated through forward contracts. Often futures markets are also available to provide competitive markets dealing specifically with exchange rates. These markets are readily available to provide price discovery and risk reduction for Canadian, United States and many European currencies.

Forward Pricing

Flexible methods of marketing become available to the producer when the delivery of the physical product is separated from the legal transfer or sale of the product. There are many variations of forward contracts that accomplish this separation, but all basically consist of the following:

A Cash Forward Contract, which is a binding contract specifying price, quality and quantity to be delivered at a specific time and location in the future.

A Minimum Price Forward Contract, which is a binding contract similar to the cash forward contract with a minimum price specified, as well as some method of sharing increases of price should market prices increase.

A Deferred Pricing Contract, which is similar to the cash forward contract with price determined at some point in the future using a specified market price or index.

The Futures Contract, is a binding contract that is more easily liquidated than most other forward contracts, and specifies the price at the time of transaction.

Options Contracts, when purchased give the right, but are not an obligation to an underlying futures contract at a set price, within a set time in the future.

Forward contracts and Futures contracts

A forward contracting market consists of a network of brokers or commercial companies that offer forward pricing contracts. The contract specification may vary, the specific date of delivery is set, and there are no price limits.

Delayed price contracts and cash sales at a future time are affected by variance in both futures price and by basis. A true hedge is subject only to basis risk, while a basis contract is only subject to the risk of the future prices [Dayton and Baldwin 1989].

Futures Markets

Futures markets provide one type of forward sale that provides information on estimates of the future cash prices (price discovery) and also allows the opportunity to lock in prices of commodities for the future time periods (price risk reduction). Price discovery, relates to the efficiency of the markets ability to use all of the available information relevant to the market to arrive at competitive prices for market clearing (supply and demand equilibrium). The use of all available information does not mean that the price forecast will be accurate for the future date, due to the continual arrival of new information that can change the supply and demand equilibrium [Tomek 1997]. Price discovery to a producer also relates to the degree of predictability of basis between the cash spot market of the futures contract and the producers cash market.

Futures markets are generally considered a good method of discovering competitive market clearing prices. Requirements for prices discovered to be competitive are that participants be too small to affect the market by their actions, that there is a homogeneous product, that resources can enter and exit the market freely, and that there is perfect information, [Leuthold et al. 1989].

Some researchers however, question whether formal futures are necessarily more efficient than informal futures markets, such as broker networks who offer forward contracts, at interpreting and distributing information [Herbst 1986][1]. This may be due in part to the noise created by large numbers of poorly informed market participants present in many futures markets.

Price Discovery

A major advantage of futures trading is often considered it's forecasting ability of price for decision making by market participants. The price of a futures contract is often considered the

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[1] Herbst raises the possibility, that "… if one accepts that (the market) is dominated by a few large firms, then it should not be surprising that prices would be more predictable in the absence of a formal futures market. Economic self-interest would suggest that these firms might act to harmonize the price…with macroeconomic variables, thus making prices more predictable." [Herbst 1986, 15]. The analysis of supply and demand conditions in such a dominated market may as well be more accurate and have less noise than in a more public market were the participants may be less versed in the complexities of the market.

markets consensus of what the price of that commodity, at the future specified delivery period, will be with the currently available information [Purcell 1991]. There are various theories as to whether there is bias in futures prices to induce speculative activity. Keynes and Hicks suggested that hedgers pay a premium by backwardization (the futures are downward biased in a normal hedger short market), and Working suggests that hedging is done to capture anticipated favorable basis change [Leuthold et al. 1989]. The empirical work [Leuthold et al. 1989] suggests that there is little evidence of risk premiums in most commodity markets.

For storable commodities the futures price can be considered the current cash price with the costs of storage and interest costs added [Hull 1998]. Studies do suggest though, that the spring prices indicated on futures contracts may not be good indicators of delivery period prices, particularly when carryover stocks are low [Tomek 1997]. Demand for crop products is considered stable compared to supply of crop products. This is mainly due to the amount of new information that becomes available on supplies over the relatively short growing period, as well as the decreasing flexibility of supply and demand to find alternatives other than price rationing. Both contribute to the poor forecasting [Tomek 1997]. This lack of reliability of forecast prices indicates that the futures prices that are available at the time of decision making by hedgers, are effectively forward prices, and must be used as such to establish that forward price. The use of the futures price to allocate resources, without establishing a hedge, should be avoided [Kenyon et al. 1993]. While this indicates that futures prices may be unbiased, it also suggests that if the allocation of resources to a particular enterprise is deemed the most desirable decision, and the decision is dependent upon currently available forward prices, then hedging the price is required to reduce the market risk of the decision.

The marginal value of the commodity should be reflected in the price to give accurate and unbiased information that can be used to allocate resources efficiently [Fackler 1993]. If this information is unreliable or expensive to acquire, there is not an efficient bargaining position occurring in that market [Weleschuk and Kerr 1995]. This lack of efficiency is more likely to occur when the ability to monitor the supply and demand conditions of a foreign market is concerned. It is also more likely that traders who are participants in both markets have advantageous information relative to traders who are participants in only one market.

Trader Expectations and Resources

The costs used by a rational trader are those of the average attainable, but are not necessarily those of the individual trader [Buccola 1984][2]. This for example allows larger firms operating

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[2][Buccola 1984, 713] "A rational bidder takes into account, not the minimum or even his own storage costs, but his expectation of the costs that others expect to incur. Similarly, a bidder optimally characterizes the risk premium portion of Ea(St) by estimating, not his own risk preferences, but the mean risk premium assumption

in both European and North American markets to have lower arbitrage costs than the arbitrage costs of an individual hedging producer, and yet the market has a weighted average cost of arbitrage built into the basis. This results in a smaller net price to producer hedgers, or greater margins for commercials, depending upon the average trader's estimate of those costs and risks. Either case seems to result in disincentives for producer delivery to a hedge compared to farm gate cash sales and a higher basis built into the farm market price than is actually experienced by those moving the product if there are any impediments to delivery against futures markets (skill, financial resources, contacts, storage capability).

The risk premium or arbitrage costs inherent in the feed pea market may as a result of changing the responsibility for the risk from large commercials to the hedger, become greater than before the implementation of futures trading, if the risk premium or arbitrage costs are rationally determined. The high relative level of these delivery costs compared to other crop types, and higher basis risks may result in hedge ratio concerns [Netz 1996] and may result in less hedging as well as less production of feed peas than other grains. As markets grow both domestically and in the Pacific region, the reduced relevance of the European futures price due to the larger basis risk may reduce activity of futures trading. The development of new cash markets for price discovery and basis relevance is already evident in western Canada [Brindle 1997].

Characteristics of Futures Markets and Contracts

The common characteristics of commodities that appear to be successfully traded in futures contracts include 1) homogeneity of the product to be traded; 2) capacity to describe the commodity through grading and standardization; 3) variable and uncertain cash prices; 4) a large and active commercial market; 5) availability of public information; 6) fulfill an economic need of risk transfer; 7) evenly balanced between buyers and sellers, and 8) liquid [Leuthold et al. 1989].

The major reasons a contract may fail include 1) a poorly written contract favoring either the buyers or sellers and resulting in one side of the market refusing to participate; 2) commercial interests with market power refusing to participate; 3) legislative restrictions may hamper or outright ban the contract; 4) loss of the economic rationale behind the contract due to changing market conditions; and 5) failure to attract speculators resulting in lack of liquidity [Leuthold et al. 1989].

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implicit in the market. In sum, an optimal cost forecast is an average and is fully endogenous as an optimal price forecast."

Lack of liquidity results in large spreads between bid and ask prices, making hedging more difficult and consequently reducing hedging activity. Even the lack of price movement prevents speculative interest and reduces further the liquidity that speculators provide [Leuthold et al. 1989].

The high expense of introducing a new contract results in exchanges working with industry to correctly write or specify the contract. This is done to generate the hedge, commercial and speculative interest in the market that is required for a successful contract [Leuthold et al. 1989].

The futures market determines the farm gate price of most grains in Canada, even for producers who do not use futures markets, due to extensive use of the WCE by elevator companies [Loyns et al. 1992]. Even for grains handled by the Canadian Wheat Board (CWB), world influences dictate the Canadian prices, which will be reflected in competitive futures markets, both within and outside of Canada.

The futures market also reduces the risk of renegotiated markets after the allocation of resources is undertaken. When there is no alternative market, and price is not contracted, the ability to extract rent in a renegotiated price is possible. While the rent may be small enough to not prevent allocation of resources, the effect is detrimental to the Pareto optimal solution. In the case of non-competitive renegotiations, the institutionalization of clauses allowing changes of price, quantity, or shifting of transaction costs is possible [Weleschuk and Kerr 1995] .

Contract Specification

The futures contract is a legally binding contract between a buyer and a seller to exchange a commodity at a specific time in the future. The contract specifies the quantity, quality, location and time that the sale is finalized. The price is fixed at the time of entering the futures market.

Traded Commodity

Standardized grades or qualities that are common to the cash market describe the commodity being traded. This homogeneity of product allows buyers to be confident of what they are purchasing. The specifications may include premiums or discounts for a range of grades [Hull 1998].

Contract Size

The amount of commodity that constitutes one contract relates to the size of common cash market transactions and to the perceived users of the contract [Hull 1998]. Small size allows small users and divisibility of needs, but the cost of each contract may be prohibitive for larger transactions. Canadian grains futures contracts are often in 20 m.t. job lots or 100 m.t. board lots, while U.S. markets may be 1000 bushel, 5000 bushel or 100 ton lots. These sizes roughly correspond to truck and rail car capacities. Other regions may have different standard sizes such as Matif Rapeseed futures contract being 50 m.t. in size where physical delivery is specified in barge contracts [Marche a Terme International de France 1998].

Delivery Arrangements

The acceptable location for delivery, as well as what constitutes delivery, is specified. Terms of delivery that are broad may make the relevance of the market vague, while restrictive terms result in distortions and in the inability to arbitrage. The location may be in a licensed facility, on track or onboard ship at a single or multiple locations. If multiple locations are the case, premiums or discounts may be established so one location or region is the par delivery point. By having several locations, the possibility of distortion of the market is reduced. To not disrupt or change the physical flow of the cash market product the choice of location should be a normal cash market in a major trade route between producer and consumer. Otherwise, to fulfill demand only caused by arbitrage market demand for delivery on the contract can be costly [Leuthold et al. 1989].

Price Quotes

The procedure for reporting and trading the contract in price terms is usually in terms associated with the cash market and is easily understood by market participants. The unit of measure, currency, and fractions thereof are all specified. The minimum price difference (tick size) allowable as well as the maximum price movement allowed in any given day (limit up/down) will be specified to prevent overreaction and excessive price movement. These limits may have wider limits during delivery months, or after successive days of limit moves. The range is usually set to encompass normal fluctuations in the market, while allowing time for reflection on major news events influencing the commodity. The range may also be changed by the exchange if economic conditions are deemed to warrant it [Leuthold et al. 1989]. The artificial restriction to rapid price change that may be originating in the cash commodity leaves the benefit of such restrictions open to controversy [Hull 1998].

Position Limits

Position limits are placed by the exchange to limit the number of contracts that a speculator may hold at one time, and may regulate the contracts held for a single delivery month to prevent undue speculative influence. These position limits do not apply to hedgers [Hull 1998]. In U.S. markets, contracts in excess of some level must be reported by all traders as reporting speculator, reporting hedger, or reporting spreader indicating the total futures and cash positions [Leuthold et al. 1989].

Using Futures Contracts for Hedging

Hedging as it relates to grain marketing is defined as "A trade designed to reduce risk."[Hull 1998, 454]. Those who hedge are Hedgers. Using futures markets to reduce risk by grain producers can become very complex with the use of options, futures contracts, hedge ratios, offsetting cash positions, and various combinations.

In its most basic form, a producer with an unwanted cash commodity price exposure, can hedge or reduce the risk using futures contracts in the following manner. The assumptions are that the exposure to price risk is expected to last for a defined period and the producer has access to a traded futures contract as well as local cash market.

1) The producer sells a futures contract at a set price that expires at a time equal to or greater than the expected time of the cash sale of the physical product.

2) When the expected sale of the physical product takes place, the futures contract is bought back.

If any change in the futures market is reflected in the cash market, a change in price in the producer's cash market is equaled in the futures market. Due to the ownership of the physical, and having sold the product by contract, the value of the two items (physical and contract) change inversely to one another. Any price change is mirrored between markets, and there is no price risk left to the producer.

Motivations for Producers to Hedge

The four main reasons for hedging are avoidance of risk in the cash market by taking an opposite and equal futures market position, to profit from anticipated basis change, the protection of profits, and the futures contract is held as an asset of a diversified portfolio to maximize profit. The second and fourth reasons here are also motivated by profit maximization, so when considered in relation to the risk definition considered earlier would not be true hedges.

Hedging normally results in the decision to speculate on the normally less volatile basis in preference to price speculation. This speculation reduces the overall level of risk exposure of the hedger, but will not eliminate risk due to basis and exchange risks. The futures and cash markets may each have different amounts of risk as well.

Basis, Arbitrage and Delivery

Basis, arbitrage and delivery are concepts that relate to one another. This interaction is important to spatially separated cash markets, temporally separated futures markets, form separated cash markets and all combinations thereof.

Basis Definition

Basis is the difference in price between two cash market prices, or a cash market price and a futures contract price or between two different delivery months of a futures market. It consists of the costs to move the physical product between the cash markets or the delivery market for the futures. The costs, considered costs of arbitrage, include the time, spatial, and form components. Arbitrage is the action of trading in an attempt to profit from mispriced goods between two or more markets, and is accomplished through the ability to deliver between markets, and is the actual method of linking the two markets together.

Arbitrage can be across time (temporal), as between futures contracts and consists of the storage, interest costs and convenience yield. Arbitrage can also be between locations (spatial) as in North America and Europe and consists of the freight as well as related costs of moving the product between markets. Arbitrage can as well be between form as when soybean meal and soybean oil relate to soybeans and the costs of transforming soybeans into the two components. Various combinations of these forms of arbitrage are possible as well.

The normal expectation of pricing between futures and producer price is:

Basis = Producer cash price - Futures price of contract hedged

Importance of Basis

As mentioned in Chapter 1, the basis and the costs that affect basis are fundamentally important to the process of hedging. Risk caused by unanticipated basis movement, or basis change that is greater than price risk negates the anticipated benefits of risk reduction decisions, and reduces the use of futures contracts and reduces the production of the commodity.

"By far the two most important bases for hedging are those which exist when a hedge is placed and when it is lifted,"[Loyns et al. 1992, 13]. As the basis changes due to changes in its components, forecasts of the basis at the expected time of lifting the hedge are required to estimate the price protection the hedge provides. Basis forecasts are, consequently, critical to hedging decisions.

Basis may be calculated from any delivery point, however the greater the number of events that impact on the costs of arbitrage between the delivery point and the central pricing market, the greater the potential variability and more unsure the basis prediction is likely to be. The functioning of the futures and cash markets can best be analyzed at the cash delivery point for the futures contract, although markets such as Vancouver cash canola have exhibited problems that impacted on futures prices [Martin and Cousineau 1995]. To restrict the inclusion of non-tradable components within prices, the comparison between export crops is best analyzed at border locations [Goodwin et al. 1990].

The predictability of the basis is critical to the analysis of the market [Brandt 1985; Zapata and Fortenbery 1996] and should stem from the predictability of the components of basis.

The basis may then be negative or positive depending upon the relative location of the two markets. Basis may also be negative or positive before expiration due to characteristics of the commodity traded, or to market differences between cash and futures. The basis may become smaller, or larger, but it affects the success of a particular hedge [Hull 1998].

Basis Components

Basis is the difference in prices between markets and consists of the costs of arbitraging between those markets. These costs include the elevation costs, transportation costs, storage and interest costs, and may include premiums or discounts due to quality. These costs often are aggregates of even more detailed cost structures. In most cases, the costs of arbitrage are competitively established, but non-competitive markets may establish profit levels within the basis calculation.

Normally included in the storage and interest component of basis is convenience yield. Convenience yield is the cost a user is willing to incur to have a constant physical supply for immediate use [Hull 1998]. Due to it's subjective nature and the dependence on the perceived supply of product available, establishing the value of the convenience yield is difficult.

Another component that may be variable and create difficulties in studies of basis are the premiums or discounts that are given for grade differences from those specified in the futures contact. A company will also use these price differentials to signal its willingness to purchase. Risk premiums and discounts may apply which would differ for individual transactions. For example the purchase of product to top off a current shipment, has a different risk and cost associated with it, than a purchase that does not have an immediate offsetting transaction.

Examples of the structure of basis calculations, for wheat sold by the Canadian Wheat Board and for feed peas by the United Grain Growers are shown in Appendix B.1 and B.2

Basis Risk

Basis risk is caused by unpredictable changes in costs of arbitrage. Basis risk has significant negative impacts on storage levels, production, cash market position and hedge ratios of producers, affecting the usefulness of futures for risk management, and consequently results in less use by hedgers who will self-insure to a greater degree [Netz 1996]. Normally basis variability is less than price variability and basis has a predictable seasonal pattern [Leuthold et al. 1989]. When basis risk exceeds flat price risk, traders participate less in markets [Martin and Cousineau 1995], which provides incentive for policy makers and commodity exchanges to specify contracts to minimize basis risk.

If basis levels fail to reflect the actual costs of arbitrage, delivery becomes crucial in maintaining the integrity of prices between markets. This arbitrage forces the futures price to converge to the cash price and to limit basis risk to actual costs of delivery.

Basis Level

The level of basis may dictate the type of arbitrage activity that will force convergence. Arbitrage has different costs for diverting product from other markets compared to the cost of withholding inventory for another period (storage), and is a primary reason for locating the delivery point on a major trade route.

Predictability and Stability of Basis

As long as the relationship between the various cash markets is stable and reflects actual costs, the effectiveness of a hedge is not influenced by access to nearby delivery locations. However, events that can cause unstable basis are supply and demand imbalance, changing convenience yield, and variable arbitrage costs [Hull 1998]. As the time to deliver against a distant contract increases, new information or changing costs of delivery that affect the basis have more opportunity to decrease the effectiveness of a hedge. In a properly functioning market, this variability of basis is predictable according to arbitrage costs, relative value of substitutes, and the supply and demand in cash markets and the futures market [Leuthold et al. 1989]. Changing basis levels unrelated to arbitrage costs are used to signal the markets demand for product. Consistently wider basis levels than the costs of arbitrage, transfer some of the price risk or basis risk back to the seller. Ultimately, it is the predictability and/or stability of basis that is important for effective risk reduction by futures markets [Purcell 1991].

Cash Settlement

Cash settlement is a method of settling contracts without the high costs of physical delivery when contracts are inconvenient or impossible to deliver to [Hull 1998], or where the physical product is difficult to define or the size of commercially traded product does not match the futures contract. Issues with cash settlement include the ability to transfer risk, the temporal spread, changing basis risk, and the markets liquidity. Cash settlement is dependent on regular and reliable competitively established cash quotes, and can reduce potential for market manipulation [Leuthold et al. 1989].

Future Spot Delivery Price

The future spot delivery price is the most important link in the functioning of the futures market in relation to the cash market. "It is extremely important that the cash series used for settlement be representative of trade in the actual cash market, be competitively determined, and be free from potential manipulation"[Purcell 1991, 335]. Otherwise, the analysis of market risks becomes largely undeterminable for market participants.

Delivery

Threat of delivery ensures that prices between markets do not differ by more than the actual costs of arbitrage. Properly functioning markets consequently, are in no need of physical delivery of the product providing there is no artificial restriction preventing delivery to the contract. This results in liquidation of the contract through an offsetting transaction being a low cost alternative to delivery and the preferred method of contract closure. Most futures contracts are specified so that they are not expected to have the transfer of ownership of the physical product as an objective [Hull 1998]. The actual delivery of the commodity to fulfill the futures contract can be an indication of an improperly functioning market due to cash prices and futures prices that are not converging properly or indicate that the contract is not specified properly. Poorly functioning futures markets in Canada are to blame for the grain trade using futures contracts as a market for the legal transfer of ownership [Martin and Cousineau 1995].

Delivery Time

Grains moving from interior points of North America to European ports can take considerable time, which increases risk of price and basis change. Eight weeks is reported as common [Hauser and Neff 1993], but the time to reach even the export port from interior points can range from three days to six weeks in various markets [Martin and Cousineau 1995]. Containerized product can move to European ports from the Canadian interior in three weeks [Government of Canada, Agriculture and Agri-Food Canada 1998c]. The risk faced by market participants on arbitrage costs and price change may be quite different because of the large and varied time to arbitrage between markets.

Delivery and Improper Performance of Markets

The delivery process is an essential link between futures markets and the cash market. Critical to the proper functioning of the market is that policy, regulation, or non-competitive behaviors not restrict delivery opportunity. Excess deliveries to fulfill contracts divert commodities from the normal trade channels and distort trade, while restricted delivery opportunities weaken price discovery and create the opportunity for manipulation of price.

Manipulation Definition

Economically, the ability to influence price and the ability to create an artificial price using non-competitive behavior in futures markets is considered manipulation and is critical in the functioning of futures markets [Fackler 1993]. The price discovery function and the ability to predict basis are impeded and the effects are compounded by restricted delivery opportunities.

Manipulation of markets is a concern for market participants and society in general. The costs to society of manipulation include the disruption of normal physical flows, the failure of the price discovery function, and decreased hedging effectiveness. For the market, these may all reduce futures market participation, affecting both volume and liquidity [Fackler 1993].

Manipulation with Restricted Delivery

A trader holding all the contracts on one side of the market has the ability to restrict the supply of offsetting contracts, by standing for delivery on all contracts held. Usually asymmetric information is associated with this type of manipulation, but large commercials may accumulate large futures positions in their normal day to day business, and are capable of physically handling large volumes of the product. As a dominant long trader's profit function is not affected by the method of acquiring commodity it takes, either cash purchase or standing for delivery, the dominants only concern is the number of deliveries in each market (futures and cash). A manipulation may take place if supplies are restricted, because the marginal cost to deliver increases and the supply curve is positive, caused by more expensive search costs, or transfer costs [Fackler 1993]. The impact of this increased transfer of physical product can also affect prices in other regions through changes in the supply and demand equilibrium. Fackler [1993] goes on to say, "As a contract matures, it takes on the characteristics of a local cash market for the delivery points. When traders use the market to hedge a product that is expensive or impossible to use for delivery, the dual nature of the futures market creates the possibility for manipulation,"[701].

"Commercial firms that hedge and have facilities to take deliveries may routinely hold long positions well into the delivery period as protection in anticipation of a possible squeeze. This circumstance increases the possibility of a corner in the market. This suggests the need to consider delivery specifications carefully and the possibility of inadequate competition among the commercial firms with product handling capabilities at delivery locations"[Fackler 1993, 701-702].

When market manipulation is attempted, it is usually from the long side. Manipulations may be "corners" where control of large amounts of deliverable product as well as futures contracts are required, or may be "squeezes," that result from scarcity of supply of deliverable product causing higher than normal liquidation prices [Leuthold et al. 1989]. Both futures and cash prices are bid up where control of deliverable supplies and supplies of offsetting futures contracts are both controlled by one entity or group. In effect there become two markets (cash and futures contract), each having its own supply and demand curve. The number of contracts that the manipulator stands for delivery on, verses the number offset is related to the elasticities of the two markets.

The restricted deliverable supplies or inappropriate delivery terms are critical to potential manipulation and highlight the need for proper specification in the contract. The increased costs of hedging, or reduction in hedge effectiveness decreases the usefulness of futures markets to hedgers in these circumstances, and consequently exchanges take the integrity of such markets seriously [Leuthold et al. 1989].

Concerns such as these, as well as multiple cash market price quotes at one location and thinness of trade resulting in poor price discovery and increased basis risk are causes of changes to futures contracts such as the WCE Canola contract [Martin and Cousineau 1995], and Chicago Board of Trade contracts [Fackler 1993].

Statistical Determination of Coefficients

In statistical studies involving trade between markets, the observed prices in markets may give indications that markets are exhibiting some degree of pricing autarky. The range that prices can move within a market without affecting other markets, and yet not be an autarkic market are referred to as transaction bands, and are due to the costs of arbitrage making trade unprofitable. If the costs of arbitrage are large, and many observations fall within the range where arbitrage is unprofitable, the estimation of coefficients statistically may be difficult or impossible. Consequently, price series will exhibit more independence and appear to be less integrated, or the possibility of erroneously rejecting cointegration of prices when empirically studying the price relationships increases [Protopapadakis and Stoll 1983]. If continuous trade is observed, then the price levels are not within these bands [Goodwin et al. 1990]. Profit seeking firms would also be expected to always place bids in the market that covered the costs of arbitrage between markets.

Futures Volatility

Volatility of futures markets is important to the hedger (long or short), speculator, and trader alike. Without large numbers of traders, producers and consumers, the monopolistic (or monopsonistic) conditions created would result in insufficient price volatility to induce speculation [Atkin 1989]. Without the trading caused by this speculative activity, the fixed costs of the futures market will not be covered [Hennessy and Wahl 1996]. The different attitude to risk by hedger and speculator creates the liquidity that futures markets require to function.

Inflexibility of supply and demand functions of the cash market can induce market volatility, as can resolution of uncertainty as to price [Hennessy and Wahl 1996]. Once resources are allocated to crop production, the supply function is limited, and this results in greater volatility as demand is forced to adjust to reach price equilibrium.

Full carrying charge

A full carrying charge market is one where the price difference between temporal contracts is different by the costs of holding (arbitrage) the commodity for the extra time [Leuthold et al. 1989]. These costs would include storage and interest.

Cross Hedging Commodities

Cross hedging of commodities is the use of a futures contract to hedge a commodity that is not deliverable to that futures contract. To be effective, the variances and covariance of the cash price movements of the produced commodity must be consistent to the futures traded commodity. Under these conditions, cross hedging to the other commodity contract becomes a viable alternative if the produced commodity does not have a futures traded contract, or if basis risk between cash and futures markets is large.

Liquidation Liquidity

Affecting the risk of hedging is the ability to exit the contract when it is desirable. Illiquid markets may prevent unwinding of the hedge, or may be lumpy in quantity, and price. Because of this illiquidity, the price risk will be larger, and the basis risk may be undeterminable before hand.

Ocean Freight

Previous studies of the Law of One Price (LOOP) and cointegration have usually considered that costs of arbitrage are either constant, or they are a function of the price of the series examined [Hsu J. and Goodwin 1995]. These assumptions are because of difficulties in acquiring information on actual arbitrage costs. Usually, ocean freight is not considered volatile, or it is considered unalterable due to geography and as a result the variance is unlikely to significantly affect trade [Binkley and Harrer 1981]. Hsu and Goodwin [1995] suggest that most analysis of international grain market relationships overlook the role of shipping markets, even though the cost may be a substantial proportion of the delivered price of bulky, low-value agricultural crops. In the study of Canadian crops, the issue of rail freight volatility can be easily assumed to be constant and may be ignored because historical statutory freight rates were only changed yearly. The issue as well relates to the marketing structure for the primary Canadian crops. Since the marketing of wheat and barley off-shore has been conducted by the Canadian Wheat Board, analysis of effects of the total freight and arbitrage costs on Canadian farm gate markets has been hidden from public scrutiny by pooled pricing, and from providing market price signals as a result. Even such non-board crops as canola, rarely have analysis of arbitrage costs and risks in relation to the price to the end user. This lack of knowledge of value may restrict development of prairie agriculture due to resource misallocation caused by weak pricing signals to the primary producer.

Researchers, such as Hsu and Goodwin [1995], find that ocean freight is responsive to factor costs such as fuel costs, while being relatively unresponsive to demand shocks for shipping, within the normal level of relatively low capacity utilization of shipping they observe. They also find that the ocean freight rates for grain are more volatile during the period of the 1970's and 1980's than are international grain prices (a period of relatively large grain stocks). A coefficient of variation of U.S. wheat in Rotterdam of 12.8 percent, compared to 28.3 percent for ocean freight is observed [Hsu J. and Goodwin 1995, 283 note 1] and indicates the relative risk between price and basis.

Ocean Freight Risk Markets

The Baltic International Freight Futures Exchange was formed in 1985 to provide a risk market for those affected by volatility and uncertainty of ocean freight costs. The futures market uses the statistical Baltic Freight Index which measures the Capesize vessel rates on various trade routes, many of which are not grain related. A second index (Baltic Exchange Handy Index) was established in 1997 to reflect the Handysize vessel rates which represent the vessel size carrying some 50 percent of grain transported on ocean vessels in 1995 [Government of Canada, Agriculture and Agri-Food Canada 1997].

Cost Determination of Ocean Freight

Binkley and Harrer [1981] find that the distance effect is nonlinear, with costs increasing at a decreasing rate with increases in distance. The cost advantage of shorter distance is relatively small, and economies of scale for ship sizes that are less than 50,000 ton are evident. Diseconomies, assumed to be due to port costs, are evident with larger ship sizes. The volume of trade between ports is found to decrease the costs of shipping between ports due to port efficiencies, or perhaps due to increased back haul potential.

The relative costs of ocean freight Binkley and Harrer [1981] find from various ports on average to Europe are: Saint Lawrence $9.88 per ton, Canadian Great Lakes $17.90 per ton, U.S. Great Lakes $17.13 per ton, U.S. Gulf ports $11.94 per ton, Australian east coast ports $17.40 per ton, and $18.51 per ton from the Australian west coast. The average size of shipment is 26,689 ton from the U.S. gulf ports, 15,580 ton from the Canadian Great Lakes, and 20,757 ton from the Australian East Coast. The US Gulf has a competitive advantage in volume and shipment size to all the other ports. The St. Lawrence and Canadian East Coast are the only ports having a similar or cost competitive advantage on shipment to Europe, when shipment size and distance are considered to U.S. Gulf ports. Great Lake ports, while having an advantage due to distance to Europe, are at a significant disadvantage when shipment size was considered.

As, "A producers competitive position in world grain trade depends upon its comparative advantage in shipping as well as production," [Binkley and Harrer 1981, 53], the comparison of markets for grains is dependant on the costs of the trade routes that the grains follow. Ocean freight rates from ports near major shipping routes such as the Eastern U.S. and Canada are lower than less well positioned ports such as Australian, North Pacific, and the Great Lakes ports. Improved grain handling facilities and larger ship size will continue the trend of reducing the effect of distance on patterns of international trade. While density of shipping is important to freight rate structure, that density is dependent on inland transportation costs as well. Binkley and Harrer [1981] conclude that in addition to distance, shipment size and trade volume, overall efficiencies of inland freight movement, as well as efficient ports and heavy ship traffic are necessary for a cost competitive advantage in global trade. They also express that relative transportation costs do not necessarily or even primarily depend upon the unalterable geographic constraints normally associated with costs in economic analysis.

An important relationship expressed in the Binkley and Harrer [1981] study, is that increases in vessel size with more efficient handling facilities may decrease the distance related component of competitive advantage. As the Great Lakes are restricted on increased ship size, the current competitiveness that Canadian crops hold in markets using this trade route are likely to erode when compared to crops shipped from Australia and U.S. gulf ports. While these factors may decrease the easterly flow of grains through the Great Lakes, they may also increase the flow of grains through the West Coast ports. This is due to increases of volumes moving through Pacific ports, to the larger ship size those ports are capable of handling, and the increased volumes of shipping resulting in further reductions of rates. Currently peas may move to Europe during the December to March closure of the Great Lakes through Vancouver at $5 U.S. per tonne less than from Thunder Bay ports [University of Saskatchewan 1997]. This indicates that the freight component for export trade must be able to accommodate changing trade patterns to remain relevant for price discovery and basis estimation.

Storage Decisions and Costs of Arbitrage

It is observed that for a product like grain that is produced seasonally, prices do not increase at an equivalent rate to the costs of storage and interest, as theory suggests. This difference is caused by storage at different locations having different costs due to distance from the central market. Due to the cost of transportation to the central market, the value of the commodity is less in outlying markets, resulting in less interest chargeable in the costs of storage. The farther the crop is from market (in cost terms), the longer it is stored, and the lower the producer price is in relation to the central market price [Benirschka and Binkley 1995].

The overall arbitrage costs in world grain markets influence the source of the final delivered good to the consumer. While the initial price of the grain may be higher in one market than in other source markets, the final landed price to the buyer dictates the supplier [Government of Canada, Agriculture and Agri-Food Canada 1997]. Infrastructure has a significant impact on these arbitrage costs. Argentina, for example, has deepened some rivers to allow Panamax size vessels to be loaded at interior ports, making their crops more competitively priced when landed in Europe than previously [Government of Canada, Agriculture and Agri-Food Canada 1998b].

Summary

The examination of risk literature indicates that of the various methods of interpreting risk, standard deviation, and coefficient of variation are effective quantitative methods that do not require knowledge of the preferences of the individual decision maker to establish the ordering of preferences.

Demand theory shows that competitive crops in production as well as use are expected to have a positive correlation. Foreign exchange theory also shows that prices between markets should only vary by the costs of arbitrage. The Law of One Price is found to depend on the homogeneity of the traded items.

Futures markets are important methods of forward contracting to reduce risk and to provide price discovery. The importance of basis to efficient hedging is stated, and the critical need for delivery to force convergence and to maintain relevance between cash and futures markets is stressed. The importance that basis is comprised of only arbitrage costs, whether spatial or temporal is emphasized. The contribution that major arbitrage costs such as ocean freight can have on statistical studies, as well as on price and basis risk of globally traded goods is asserted. Risk reduction markets for ocean freight and exchange is mentioned, as are the effect of carrying charge on basis due to distance from a central market.

Chapter 4

METHODOLOGY

This chapter introduces the theory and then the methodology that is used to reach the objectives outlined in Chapter 1. These include amount of price risk, causality or direction of information flow, seasonality and long term price equilibrium relationship between markets (cointegration).

Theory of Granger Causality

Causality in economic terms is usually expressed in the terms set forth by Granger. It is not one of physical cause, but one of being predictive in nature. This means that the "cause" is visible before the "effect". Caution must be used in interpreting results of causality tests due to the possibility of other unknown causes affecting markets at differing rates. Should futures prices respond more quickly than cash prices to a change in information, the tests may indicate Granger causality, while a third factor may be the actual cause. In this case, the futures response is simply reflecting futures markets ability to disseminate information sooner. This lagging of price change in the cash market can also explain the tendency of cash prices to show less rapid or extreme movement, and shows how futures markets can be more volatile than cash markets and yet result in cash markets being less volatile than if the futures market did not exist [Herbst 1986]. Therefore, the third factor would be the data that is most useful and should be modeled in an analysis. If this third factor is not observable, is not known, does not have data available, or the relationship is poorly understood, it may not be used. Statements of economic cause are to be interpreted in this context of predictive rather than causal.

The interpretation of causality between cash and futures markets can be made even more complex, when the possibility of the type of information that initiates the change is considered. For example, while information of a trade agreement may change the expected future period demand, resulting in futures prices "causing" the change in cash prices, an unanticipated change in current consumption demand will impact cash prices first, "causing" the change in the futures market price [Dewbre 1981].

Theory of Cointegration

Prices of many commodities have a tendency to move together [Malliaris and Urrutia 1996]. The fact that two price series are cointegrated indicates that some form of error correction process is at work to maintain the relationship. This may be due to simply the microeconomic theory of competitive pricing, due to factor costs of products, or it may result from arbitrage trading such as spreading [Malliaris and Urrutia 1996]. The confirmation of cointegration may indicate that these are not independent price series, or may be the result of non-competitive price formation.

The statistical modeling of cointegration is useful for analysis of interrelationships between markets. The statistical cointegration of markets is important to the evaluation of markets, but must not be confused with the concepts of efficient markets or competitive markets. In this study the statistical cointegration results are used to compare some of the assumptions involved in the study, to provide benchmark comparisons with other crops, and to indicate areas were further research by other cointegration methods may clarify ambiguities.

Theory of Market Efficiency

The study of how well a market discovers the competitive equilibrium price (price discovery) is often a study of market efficiency. The efficient market hypothesis states that all information is in the price and that new information is a randomly occurring event that can not be forecast. If efficient, the market price is expected to have no pattern in its formation and is expected to immediately reflect the random changes in the information set. Markets are considered efficient when price forecasts of future prices are unbiased, and have minimum variance. Even if markets are found to be efficient, this may not be the competitive equilibrium price, unless the information set of, and the bargaining power of both buyers and sellers is equal [Buccola 1984].

Market efficiency is often broken into three basic types. Strong market efficiency uses all information available, private as well as public within the information set to produce a forecast price. Semi-strong pricing efficiency uses all publicly available information as the information set to create the price forecast. Weak pricing efficiency uses only the series of past prices as the information set to create the forecast.

Buccola [1984] presents an explanation of interactions of rational expectations, various forms of market efficiency, and the information set. With rational expectations, he claims that markets must be weak form efficient. This precludes ARMA processes and autoregressive changes are not possible. Econometric price forecasting, due to the high costs of developing information, may not be fully shown in the price. Because of this failure to fully reflect the information available from econometric forecasting, informed traders may have a smaller mean square forecast error that is not self-defeating, when compared to other traders.

Since both analysts and market participants must estimate expected costs of arbitrage, including risk premiums, and since analysts have an inferior vantage point to perform the forecasting, the analysis of pricing efficiency may be impossible [Tomek 1997].

Methodology

This study begins with basic descriptive statistics of various crops, to compare markets in which feed peas must compete. These involve the central tendencies and measures of dispersion. The correlation between various crops is also a starting point for cointegration analysis. It is basic to understanding the diversification of crop production that primary producers use to reduce the market risks they face. As the complexity of the diversification increases so does the importance of the correlation between various components [Novak & Associates Management Consulting and Jeffrey 1997].

The second focus of research is that of causality. The location of price formation is of interest to those looking for leading indicators, and for indications of how the market price is established. Testing for the direction of price formation is done using Granger causality criteria.

The third area researched, cointegration, is due to the possibility of temporal as well as spatial considerations when the feed pea markets are compared between the sale at the farm gate in Canada and delivery into European ports. The cointegration of the price series is tested using the stationarity of residual method.

Modeling: Basic Data Statistics

Basic statistical results on the data series are presented to give an overview of various crops, and to determine comparative results for different crops and markets.

The mean, standard deviation, and coefficient of variation are of particular interest and easily understood when all crops are measured in the same units. The comparison of these statistics shows the amount of market risk, as well as the price a crop has in relation to other crops. The same statistics in nominal form of the local currency provides information to the individual producer, whether priorities are risk aversion or profit seeking, that when the individuals cost of production is known suggests where resources should be allocated. The information is advantageous to the trade, to understand the relationship between crops that may be used interchangeably, and the likely price relationships that are exhibited when supply and demand equilibrium change due to price changes of other crops.

Anova tests on means and Bartlett's tests on variance are used to check several price series (Soybean Meal Export (Smm) and Soybean Meal Cash (Smc), Alberta Peas Cash (Abpc) and Peas Farm (Pf)) for similarities. Comparison of weekly data to monthly data is of interest to compare the potential loss of information that data aggregation creates. These test results are in Appendix E.1.

Correlation of crop prices is of interest in assessing the relative market movements and risks of growing various crops and is a base point from which cointegration modeling can develop, as well as provide a base for portfolio analysis.

Basic Statistics

Basic Statistics provide an initial quantitative comparison of crop prices regarding variability of prices and risks of price movements. The most common statistics used are the measures of central tendency and of dispersion.

Central Tendency

The measures of central tendency include the arithmetic mean, median and mode. The arithmetic mean is the mean commonly considered 'the average'. The median is the middle value once the data has been sorted from smallest to largest. The mode is the most frequently occurring value and is not useful for continuous variables. The arithmetic mean is affected by extreme observations, while the mode is not [Griffiths et al. 1993]. If the distribution is normal the arithmetic mean, median and mode will have the same value. If the distribution is skewed, the arithmetic mean will be located toward the extreme observations or the longer tail.

Dispersion of Data

The dispersion of data may be found using range, variance, standard deviation, quartiles, deciles, percentiles, or coefficient of variation.

Range uses only the largest and smallest values and is subject to outliers. Quartiles, deciles, and percentiles group the data and may be useful for reducing the effects of outliers [Webster 1995].

The most common measurements of dispersion are the variance and standard deviation. Variance of the sample results in large numbers that have units that are difficult to interpret. The standard deviation is the square root of the variance and has the advantages of smaller numbers and the units of measure are the same as the original data [Griffiths et al. 1993]. The limitation on standard deviations arises when comparing distributions having different means or different units. A relative measure of dispersion, the coefficient of variation, is the standard deviation divided by the mean resulting in a percentage comparison. The variance, and standard deviation are more appropriate to long term analysis, while mean square error and root mean square error are more appropriate to short term risk measurement of variance that is different from the expected (or forecast) variance [Novak & Associates Management Consulting and Jeffrey 1997].

Kurtosis is a measure of the peakness of the normal distribution. If the tails of the distribution contain a greater number of observations than are normal, the result is a positive kurtosis number, while fewer observations in the tails than for a normal distribution result in negative kurtosis.

Skewness depicts the amount of the asymmetry of the sample. The mean of the distribution tends towards one side of the distribution because of the effect that outliers have on the mean, as compared to the median and mode.

Covariance and Correlation

Covariance is used to express the amount of covariation between two random variables. The sign of the covariance indicates if there is a linear relationship between the variables, and if it is positive or negative.

Correlation is calculated by dividing the covariance by the standard deviations of the variables. The resulting number must be between or equal to –1 and +1, and is a measure of the linear relationship. The greater the absolute value of the correlation the greater the strength of the linear relationship. The sign again indicates if the relationship is positive or negative. A strong positive relationship indicates prices move similarly, while a strong negative relationship indicates that as one price falls the other rises. Independent variables exibit a zero covariance and correlation, but zero covariance and correlation can occur if there are non-linear relationships [Griffiths et al. 1993].

Equality of Means and Variance

Analysis of variance tables (ANOVA) do testing for the equality of mean and Bartlett's statistic is used to test for equality of variance. These tests are used to compare data series for differences in information they contain. These same tests also compare claims of bid series to transaction series, as well as compare data that is aggregated to other series.

Methodology, Granger Causality

Several methods of testing for Granger causality are in the literature, but they usually are of two basic premises. One is that the lagged variables of the two suspect series are regressed to determine significance upon one another. The second method is much the same, only using lead variables to check for significance. The second method results in greater loss of freedom

[Charemza and Deadman 1993] and is not used this study. A potential problem with non-stationarity of data is possible, and is a concern in these types of studies. Stationarity of the series is tested and results shown before cointegration testing is done, and the results suggest similar integration orders between the series used for Granger testing.

The actual testing consists of choosing an appropriate lag length, which can be done using Akaike Information Criterion (AIC) or the Schwartz Criteria (SC) from regressions run on lag periods thought to be valid on theoretical grounds. If there is discrepancy between the AIC and SC, the AIC is preferred for small sample sizes. The arbitrary selection of the lag length has an influence on results [Johnston and DiNardo 1997].

Several authors suggest that the exogenous variable be lagged a minimum of one or more periods [Brown 1991; Gujarati 1988] which gives results of Granger causality. Other authors [Charemza and Deadman 1993] suggest that by not lagging the exogenous variable, and by starting at j=0 it will indicate instantaneous causality, for the time periodicity of the data. Lag length was chosen using AIC criteria for lag lengths of j=1 through j=6. Instantaneous testing is not reported due to the objective of finding leading indicators of price formation.

After the Error Sum of Squares ($ESS = \Sigma(Y_t - \hat{Y}_t)^2$) is saved from the unrestricted regression, the exogenous variables (The variable X in equation 1, and the variable Y in equation 2, are removed and the regression is run again. The ESS from this restricted regression are then used in an F test having a null hypothesis that the exogenous variable does not cause the endogenous variable (alternate is that it does).

$$F_{r,n-k-1} = \frac{(ESS_r - ESS_u)/r}{ESS_u/n-k-1},$$

r = number of X 's removed (restrictions)

n-k-1 =number of degrees of freedom in the unrestricted regression

If the F test is rejected, the conclusion is that the endogenous variable is Granger caused by the exogenous variable. When the test is done on the reverse equation, if y also causes x then bi-directional causality is indicated. If neither regression indicates causality then independence of the variables are indicated and a reevaluation of the theory should be considered.

Methodology, Cointegration Stationarity

Unit Roots

Unit roots are an indication of non-stationary data. A regression that involves data series of different integration order may produce spurious results. The first step in cointegration testing is to determine if unit roots are present in the data series to be regressed. The presence of unit roots can be determined by using Augmented Dickey-Fuller (ADF) tests. The following explanation is from Shazam [1997]. The tests are done on the two following regressions;

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \Sigma^p_{j=1}\gamma_j \Delta Y_{t-j} + \varepsilon_t \qquad (1)$$

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 t + \Sigma^p_{j=1}\gamma_j \Delta Y_{t-j} + \varepsilon_t \qquad (2)$$

The test statistics are:

Null hypothesis	Test statistic	
$\alpha 1=0$ in (1)	(i) $N\alpha 1$	
$\alpha 1=0$ in (1)	(ii) t-ratio	
$\alpha 0=\alpha 1=0$ in (1)	F-test $\Phi 1$	Unit root test (zero drift)
$\alpha 1=0$ in (2)	(i) $N\alpha 1$	
$\alpha 1=0$ in (2)	(ii) t-ratio	
$\alpha 0=\alpha 1=\alpha 2=0$ in (2)	F-test $\Phi 2$	Unit root test (zero drift)
$\alpha 1=\alpha 2=0$ in (2)	F-test $\Phi 3$	Unit root test (non-zero drift)

When $\alpha 1=0$ the series Y_t is not stationary, and standard distributions of test statistics are not valid. Various researchers have determined different critical values. Charemza and Deadman [1993] have also suggested that there are indeterminate regions as well as that there are large differences between critical values determined by different researchers.

The reported value for the tests are compared to the critical value reported. The null hypothesis of a unit root is maintained if the test value is greater than the critical value. The power of these tests is not great.

When a data series shows evidence of a unit root, the series is differenced and retested. When the series passes the test for stationarity (no unit root) it is considered to be integrated of the order of the number of differencings it required becoming stationary. A variable X that has been differenced d times to become stationary is expressed as X~ I(d).

Cointegration

The tests for cointegrating relationships use residuals from the previous tests, which if there are no unit roots, indicates a stationary relationship between the series. Again, the explanation is from Shazam [1997].

$$Y_{t1} = \beta_0 + \Sigma^m{}_{j=2}\beta_j Y_{tj} + \mu_t \qquad (A)$$

$$Y_{t1} = \beta_0 + \beta_1 t + \Sigma^m{}_{j=2}\beta_j Y_{tj} + \mu_t \qquad (B)$$

$$\Delta\hat{u}_t = \alpha.\hat{u}_{t-1} + \Sigma^p{}_{i=1}\phi_i \Delta\hat{u}_{t-i} + \upsilon_t \qquad (C)$$

The test statistics of (C) are:

Null hypothesis	Test statistic
$N\,\hat{\alpha}\cdot=0$	$N\alpha 1$
$\alpha\cdot=0$	t-ratio

If the test statistic is less than the critical value, there is evidence of cointegration. A high R^2 and a low Durbin-Watson (D.W.) value are also indicators of cointegration. Malliaris and Urrutia [1996] suggest that a D.W. critical value at 5 percent significance would be <.386.

Phillips-Perron (P.P.) cointegration tests use non-parametric correction for serial correlation correction. An explanation is in Shazam [1997, 167]. The same critical values as the ADF test are used. The use of non-parametric tests may provide better interpretation in case of model mispecification.

The tests for cointegration conducted use the price series that appear to be relevant to the feed pea market. Some of the regressions use time series that do not indicate the same order of integration as most of the time series in the previous tests (Integration Order Results). However the reasons for differing orders are not obvious and the statistical rejection in most cases is not strong, and is dependent upon different author's significance tables. The period studied may also affect this outcome.

Summary

In this chapter, Granger causality, cointegration testing, and market efficiency are discussed. The methodologies to find the basic statistics, which are important to tests that follow, are discussed. These basic statistics include the central tendency, dispersion of data, correlation, and equality of means and variance. The methods of finding Granger causality, the stationarity of the data series and cointegration are developed.

Chapter 5

DATA

This chapter shows the data series used, the observation frequency and the period that the study encompasses. Adjustments to the data series are discussed.

Data Sources

A summary of the data series this research uses is found in Table 20 (139). The period of this study is from May 1988 through June 1996, resulting in a maximum of 97 monthly observations in most studies. Monthly observations are used in most instances, as the resolution of most of the data is of this frequency. Some of the data collection is in daily or weekly observations, and is used in that resolution in some cases. In all cases, the data having the least resolution dictates the resolution of the other series used. If different data resolution or period is used, it is stated in the study results, as well as the reason necessitating the change.

Data consists of time series from multiple sources. The freight series has the greatest number of missing observations, and is the most crucial. Most, but not all of the missing observations are a result of the St. Lawrence Seaway being closed for the winter season. Further detailed description of numbers of missing observations, maximum number together, and how these are dealt with for all price series are in Appendix C.

Grain Prices

Feed Pea Prices

The feed pea data used in this study initially consist of nominal weekly prices, starting in May 1988, and continuing to June 1996. It consists of a Western Canadian producer price for feed peas in the Canadian prairies (Pf), loaded rail, derived from bids by firms of major special crops. The series includes a price between dealers at Thunder Bay for feed peas (Ptb), and a price for feed peas' cargo, insurance, and freight (CIF) at Antwerp (Pe). The data is obtained in a weekly format from STAT Publishing.

The producer price is in Canadian dollars per metric tonne. Thunder Bay price is in Canadian dollars per metric tonne, and the European price is in U.S. dollars per metric tonne.

Alberta Cash Prices

Alberta local cash prices (either Red Deer and/or Calgary) for feed peas (Abpc), feed wheat (Abwc), feed barley (Abbc), canola (Abrc), and oats (Aboc) is in a monthly format obtained from Alberta Agriculture.

European Cash Prices

Soybean cash (Soyeuc) prices for Europe, as well as corn European cash prices (Cce) are in a monthly format that is from various issues of the World Grain Statistics. Soybean meal CIF Rotterdam (Sme) is from the USDA, Foreign Agricultural Service, Oilseeds and Products.

United States Cash Prices

Soybean meal prices for Chicago futures spot cash (Smc), corn future spot cash (Cc), wheat future spot cash (Wc), oat future spot cash (Oc), bean oil future spot cash (Boc), soybean future spot cash (Sc) are obtained from Glance Market Data. U.S. export location (gulf) soybean meal (Smm) is from the USDA, Foreign Agricultural Service, Oilseeds and Products. Corn export cash prices from U.S. gulf ports (Ccx), are in a monthly format and are from various issues of the World Grain Statistics

Canadian and United States Futures Prices

Soybean meal prices for Chicago futures (Smf), as well as Chicago futures for soybean (Sf), wheat (Wf), corn (Cf), bean oil (Bof), oats (Of), and IMM Canadian dollar (Cdf) are obtained from Glance Market Data. Canadian grains futures prices for wheat (Wwf), oats (Wof), canola (Rsf) are also obtained from Glance Market Data.

Exchange, Interest and Price index

Cash Canadian exchange rates with US dollars (Cdac) is in a monthly format from the Cansim data base as is the Canadian treasury bill rate (Cdtbc), Canadian Consumer Price Index (Cpic), and the US Consumer Price Index (Cpiu). U.S. treasury bill futures (Tbf) are from Glance Market Data.

Freight

Ocean Freight

Freight rate prices for the Saint Lawrence (Fstla), Great Lakes (Fgrla), and Gulf (Fgulf) ports to the European ports of Antwerp and Rotterdam ($0.10 U.S. per metric tonne premium) consist of monthly observations from various issues of the World Grain Statistics as well as directly from The International Grains Council. These freight rates are for wheat, corn, sorghum and soybeans and are estimates of mid-month rates for loading three to four weeks ahead. Rates for the Great Lakes from December through March inclusive are for shipment from Saint Lawrence ports due to the closure of the seaway for the winter.

Major concerns statistically are the three ocean freight price series. These series have missing observations as well as monthly prices that are unvarying, (perhaps indicating poor data recording, the use of yearly averages for monthly data, or that the prices were invariant) early in the years of the study. Because of the unvarying nature of the monthly prices, missing data points are replaced by yearly average prices for the first thirteen and final twelve observations. Internal missing points are replaced with averages of the observed points on either side of the missing observations. The yearly averages are not in some cases the same as those of another source, raising more concerns, as to the reliability of the data. The problem is not limited however to one ocean freight series, but it did influence the Great Lakes freight series to the greatest extent. The Great Lakes freight rate is reported to include movement to St. Lawrence ports during the period the Seaway is closed. During more recent years, reports indicate that feed peas move through Vancouver during the winter [University of Saskatchewan 1997]. Due to difficulties in obtaining ocean freight series, the ocean freight series are used rather than shortening the study period or changing to yearly analysis. Cointegration testing using the 72 central data observations is also done in an attempt to obtain better coefficients. These results are shown as "Restricted Data" with the results of the longer period in the cointegration results. The concern of the ocean freight rates data is discussed further in the results and analysis chapters dealing with cointegration.

Rail Freight

Alberta Agriculture supplied the Alberta freight series (Fcdn) in a yearly format due to the statutory nature of Canadian rail freight pricing.

To facilitate comparison of results, units for all grains are converted to metric tonnes when they originated in other units of measurement. Conversion factors for crops that are converted to metric tonnes are shown Table 20 (139).

Summary

The data is from various sources, from differing observation frequencies, and different units of measure. There are a number of conversions to make comparison possible between series. Concerns of the ocean freight series, which are critical to much of the study, are mentioned. Other concerns are mentioned, with a more detailed analysis of aggregation and comparison of different series in Appendix E.

Chapter 6

QUALITATIVE EVALUATION OF THE WCE FEED PEA CONTRACT

In this chapter, the Winnipeg Commodity Exchange Feed Pea Futures Contract is analyzed as to how well the contract follows the criteria for successful futures contracts, and the effects when it does not. When compared to theoretical guidelines, the specifications of the feed pea contract have many significant differences.

The WCE Feed Pea Futures Contract Specification

The specifications of the feed pea contract (Appendix D.1 Winnipeg Commodity Exchange Feed Pea Futures Contract) when compared with other futures contracts has some significant differences.

Asset

The commodity description allows delivery of either North American peas or Australian peas. As Canadian peas are specified with different foreign matter (F.M.) and moisture contents than Australian peas, the products are not homogeneous. The North American product deliverable is not homogeneous with the product delivered at the farm gate due to both moisture content and foreign matter and dockage definitions between export peas and domestic peas. The deliverable moisture and foreign matter on the contract, as well, is higher than that of competitive peas from other regions. The perception of Canadian pea quality compared to production from other countries such as France appears to be dependent upon this market [Pulse Canada 1996]. Although the Canadian Feed pea price in European ports may have a discount because of this difference of quality or perception, the indications from trade missions to examine the market indicate that a price differential is not quantified in those markets. Other European price series for feed peas were not found to analyze these possible differences.

While differences in F.M. and moisture levels may appear small, such differences can be crucial. The Chicago Mercantile Exchange Frozen-Pork-Bellies contract required re-specification after it traded for several years due to specification problems, including a specified shrinkage allowance of 0.50 percent compared to an actual shrinkage of 0.25 percent. This was enough to restrict usage of the contract by hedger-sellers, and speculators deserted the market due to small amounts of hedger activity [Powers 1967]. The homogeneity of product is one of the critical requirements of competitive price discovery.

Contract Size

The contract size is comparable to other North American grain and grain products contracts in both units of measure and size. This provides both producers and commercials with sizes related to cash delivery methods, resulting in divisibility and yet economical contract size.

Delivery

The delivery arrangements of the feed pea contract differ from other agricultural contracts. The normal practice of a delivery point along a major trade route between producer and consumer is maintained, but the distance in geographic and economic terms is stretched much farther than normal. The comparable market actions from North America to Europe use futures contracts with delivery in central U.S. locations. While the total cost of arbitrage between the two markets may be the same regardless of the delivery point, the risk of basis change is transferred, to a greater extent from the buyer to the seller, the further along the trade process that transfer of legal ownership takes place. As mentioned earlier, Braga and Martin [1991] suggest that Italian buyers often use basis contracts against Chicago soybean meal futures.

The implication of some of the costs of physical delivery (ocean freight) being denominated in a foreign currency adds complexity to the risk faced by the seller, while reducing the risk the buyer faces.

International trade skills and capital requirements are much greater than experienced under other agricultural contracts. These include documentation for CIF paid delivery, irrevocable letters of credit for 100 percent of product value, as well as margin accounts for 30 percent (seller) to 100 percent (buyer) of the total value of the contract. These restrictions make economies of scale for delivery much larger than for other agricultural contracts and are likely to act as an institutionalized barrier to producer delivery. As mentioned, restrictions to delivery and commercial holding of large positions are potentially damaging to the proper functioning of futures markets, and cause small hedgers and speculators to reduce use of the market.

The contract months for feed peas are February, May, July, October, and December. The number of months is similar to other contracts and reflects the critical times in the marketing process. Some grain futures have two or three more contract months in comparison, including the Winnipeg canola and Chicago soybean and soybean meal contracts. The compromise between the needs of hedgers and the needs for speculative liquidity appears to be met by this reduced number of contracts. Winnipeg feed wheat, western barley, canola, as well as Chicago soybean meal and most other U.S. grains use March rather than February as a contract month. The use of February may reflect the physical transfer problems relating to the closure of the Great Lakes shipping season over the winter, and the resulting change in basis expectations.

Price Quotation

The price quotation for the feed pea contract is very different from other agricultural products traded on futures exchanges in North America. The use of a foreign currency for price quotations is unusual. Even if one takes the perspective from the delivery location the product will be supplied from Canadian, Australian, and possibly U.S. producers. The final consumer is dealing in local European currencies. The location of delivery may necessitate the use of U.S. dollars to be comparable, or to simplify the large number of potential currency conversions that are likely to take place between producer and consumer. The exchange rate embedded in the pea price is likely to be more of a weighted average or index, than one related to any particular market. This results in more basis risk for any particular hedging transaction. The use of currency markets would give a more transparent exchange price discovery with perhaps a more competitively established exchange rate due to the liquidity, as well as the low transaction costs of such markets. Cash cross-rates for currencies are readily available making the conversion from other local currencies to Canadian dollars no more complex than to U.S. dollars. The resulting exchange conversion that is added to the Canadian seller's basis calculation adds complexity to understanding and comparing the price quotes between markets. Often when such complexity is added to the market, rules of thumb appear in the information available to producers. An example is "Calculate cash price by taking nearby WCE feed pea futures value. Consider it as in Canadian dollars and apply the basis for a delivered port price. Subtract rail freight to your local siding for FOB value" [University of Saskatchewan 1997, 3]. As major portions of the basis, consisting of costs from the export location, are in U.S. currency, exchange changes combined with rules of thumb decreases the transparency of the price discovery process, and the price signals to the market. The exchange risk is transferred from the normal Canadian or U.S. contract where as with export commodities, the exchange risk is with the buyer, to the seller holding the exchange risk. Australian and U.S. sellers will each be holding different exchange basis risk as well.

The added complexity of the calculations, if the exchange rate pass through is complete, should not be detrimental to the price discovery function of the contract. As cross prices between currencies maintain exchange rate changes between any three currencies, price change due to exchange rate change in competitive markets will result in comparable price movements. The major concern is that some of the exchange rate risk is transferred from the buyer to the seller compared to other commodity contracts. This appears to be the institutionalization of a transfer of risk from the buyer, and increases basis risk to the seller while decreasing basis risk to the buyer. The effect of conversion to a European currency from the U.S. currency for the buyer was not explored, nor is the combined effect of the European to U.S. to Canadian currency.

The reliability of the cash price series used for the contract is a source of concern due to poor visibility or reporting. The cash series used for the spot delivery price is one, if not the most critical components of a properly functioning futures market, and has been blamed for inefficiency in the previous WCE Canola futures contract. The basis risk as a result was considered greater than the flat price risk faced in the cash market by some commercials, and resulted in less use of the contract or increased the use of cross hedges to other exchanges [Martin and Cousineau 1995]. The competitive establishment of price requires perfect information. Futures markets represent the weightings of expectations, aversion to risk, hedge ratios, wealth, forecasting ability, costs of trading, and costs of information of all traders [Leuthold et al. 1989]. Large traders operating in multiple markets, or providing one side of a market may result in less competitive price establishment.

Daily Limits

The daily limit on feed peas of $5 U.S. per m.t. is lower than Chicago soybean meal of $10 U.S. per short ton, wheat $0.20 per bushel ($7.35 U.S. per m.t.) but similar to corn at $0.12 per bushel ($4.72 U.S. per m.t.). However, other Winnipeg contracts are similar to feed peas at $5 Canadian (feed wheat, western barley) while canola is $10 Canadian. The lower limits compared to U.S. contracts may tend to relatively decrease the volatility of the market but also restricts its movement relative to competitive contracts when new information becomes available. This combination would tend to decrease the appeal of the contract to speculative traders and to commercials with cash exposure when prices are at limits and no hedging or lifting of positions can take place. As cash price quotes for grains are based on the futures contract, the slowing of the market may be advantageous to participants having large cash market exposure, allowing adjustment of cash market prices before large changes in futures contracts occur.

Position Limits

Position limits place no limits on hedgers, and therefore do not affect large commercials who may have large holdings in the normal course of business. The legal definition of hedger allows for some anticipatory and cross hedges, and allows any firm handling product to be considered a hedger. This is a concern expressed in much of the literature where manipulation usually requires control of large cash product, as well as control of quantities of futures contracts [Hull 1998; Leuthold et al. 1989; Weleschuk and Kerr 1995]. This concern arises because such positions may be achieved in legitimate business transactions and without the intent of creating a manipulation. The process of accumulating futures contracts can be used by commercials to source physical product so as to maximize profit by restricting offsetting contract liquidation [Weleschuk and Kerr 1995]. These large commercials are not obligated to report large futures positions because the transactions are hedges. While the grain trade in Canada often perceives the Canadian grains futures markets as a means of physically obtaining grains [Martin and Cousineau 1995], properly functioning cash and futures markets will have no economic justification for actual delivery of commodities above token levels. Indifference to the method of acquiring stocks, or desire to stand for delivery of futures by commercials holding large positions in both cash and futures markets as shown earlier increases the potential for market manipulation. The possibility of manipulation will restrict use of the contract by both small hedgers and all speculators. With this restricted use, liquidity suffers, compounding the problem. These concerns also affect the competitive establishment of price, which requires that individual participants be too small to influence or affect price, and that resources can enter and exit the market with little cost. Markets with less than 100 contracts traded per hour are considered small and will have high spreads between bids and ask prices, increasing the costs of transactions, [Leuthold et al. 1989].

Summary

In summary, this chapter shows how the specifications of the Winnipeg feed pea futures differ from other agricultural futures contracts. Some of the unusual specifications are necessary considering the chosen location of the spot cash market (denomination in U.S. currency), and may be innovative, (multi-national sources of product). The majority of these unusual specifications add complexity (exchange rate, heterogeneous product definition, basis), decrease transparency of price discovery (delivery location, exchange rates, basis calculations), institutionalize modifications of risk levels (exchange risk, basis risk), and restrict delivery (delivery location, deposits). Concerns of the size of market participants, homogeneity of product, ability to enter or exit the market and have low transaction costs, as well as have perfect information are also relevant to the establishment of competitive prices by futures markets. Most of these modifications detract from the usefulness to short hedgers by increasing basis and exchange risk and to all speculators by decreasing volatility and by increasing the potential for manipulation due to restricted delivery opportunities. The advantages mainly accrue to the buyer (or long) by reducing basis risk and to large commercials by allowing greater flexibility in acquiring physical product.

Chapter 7

QUANTITATIVE EVALUATION OF THE FEED PEA MARKET

The quantitative analysis of this chapter shows that feed peas have low market risk when measured by standard deviations, or coefficient of variation. The market risk in comparison to other Canadian, North American and European markets is one of the lowest when measured in either real or nominal form in either Canadian or U.S. currency. The arbitrage costs of feed peas is found to be larger than other crops studied. The freight component of basis is shown to be larger than other crops and to represent a greater proportion of the costs of arbitrage than other crops. The risk as shown by standard deviations added by freight changes are larger in absolute terms through the Great Lakes system than from Gulf ports but is less in relative terms, shown by coefficient of variation. The basis seasonality is abnormal from both the theoretical expectation, and empirical findings for other crops.

Causality testing shows the Canadian bid price offered to producers before the implementation of the WCE pea contract is predictive of not only the European pea price, but the Chicago Soybean meal futures. The cointegration testing for long term equilibrium relationships shows that the individual basis components (freight and exchange) between western Canada and Europe for feed peas are either not passing price signals through properly or are complex enough to prevent decomposition.

Results of Descriptive Statistics

Means of Crop Markets

The results of the means and dispersion of data for some Canadian crops are shown in Table 1 (115) and Figure 14 (156), United States crops are shown in Table 2 (116) and European markets in Table 3 (117). The results are consistent in units of measure and are in real U.S.$ per metric tonne (1988 = 100).

Comparison of North American and European Market Means and Variances

Soybean meal prices in Europe are on average higher than U.S. cash prices by about $8.18. The mean ocean freight rate is $10.58 from gulf ports, and indicates that arbitrage costs between these markets exceed on average the difference in price between markets. The risk in absolute (standard deviation) and relative terms (coefficient of variation) is almost identical in both markets.

Mean corn prices are higher in Europe by $13.31 over US export prices and $37.05 over Chicago cash prices. (Canadian fobbing of export wheat for 1985 – 1995 averaged $6.37 Canadian at St. Lawrence ports). The freight and fobbing charges appear to account for the price differential between these markets, and are used as bench marks for comparison of other crops. The coefficient of variation is less in Europe than for U.S. futures or cash.

Soybean mean prices are higher in Europe by about $46 per metric tonne than U.S. prices at Chicago delivery points. This exceeds the corn mean difference from Chicago by about $9/m.t.. Europe as well has variance that results in a slightly smaller coefficient of variation than U.S. markets.

Feed pea prices in Europe have a mean price about $32.42 ($165.66 verses $133.24) higher than Thunder Bay prices with a greater standard deviation by $4.66 per m.t. ($26.33 verses $21.67). Great Lakes' freight has a mean of $21.94 and a standard deviation of $3.80. Again, fobbing charges for wheat during roughly the same period averaged $6.37 Canadian.

With the exception of Soybean meal and feed peas, the standard deviation in European markets exceeds the standard deviation in North American markets by slightly less than the standard deviation of freight between markets. Soybean meal in Europe has only $0.15 greater standard deviation while the standard deviation of feed peas in Europe exceeds that in Canada by slightly greater than the freight standard deviation.

Variance of Crop Markets

The determination of the order of market risk of the crops is dependent on how the risk is measured. Alberta barley prices (Abbc) have the smallest standard deviation (15.6), but a high coefficient of variation (.233). Feed Peas Farm (Pf) rank second least in price risk faced by Canadian producers when measured by standard deviations (20.68). The crop with the greatest risk measured by standard deviation to the Canadian producer is Canola (29.57), Figure 14 (156). Nominal comparisons in local currencies are similar (Figure 15, 157).

When the ranking of risk is by relative terms (Figure 16, 158), the smallest coefficients of variations are in the Winnipeg futures (Rsf) and Alberta cash markets (Abrsc) for canola (.133 and .144). Thunder Bay peas (Ptb) followed by Peas farm (Pf) show the next lowest coefficients of variation (.163 and .172). While the standard deviation of wheat and oat markets is not large, the coefficient of variation is much larger than for other crops observed (Alberta wheat cash (Abwc) .293, Winnipeg wheat futures (Wwf) .264, Alberta Oat cash (Aboc) .286 and Winnipeg oat futures (Wof) .287). Again when compared nominally in local currency the results are similar (Figure 17, 159).

For comparisons the results from U.S. crops is shown in Table 2 (116). This is as well in real U.S.$ per metric tonne. The smallest standard deviation for the U.S. crop markets is corn cash (Cc) (15.1) followed by corn futures (Cf) (15.4) and the highest Bean oil cash (Boc) (63.4), followed by bean oil futures (Bof) (60.4). Canadian Feed Peas Thunder Bay (Ptb) in comparison has the second lowest cash price standard deviation (21.67) with Cash wheat a close third (Wc) (21.74).

When compared by coefficient of variation however, the smallest coefficient of variation is Bean oil futures (Bof) (.140) followed by Bean oil cash (Boc) (.146). In comparison, Canadian Feed Peas Thunder Bay (Ptb) (16.26) are the next least risky crop market, followed by Corn Cash Export (Ccx) at (.1653). In nominal local currencies, Feed Peas Farm (Pf) have the lowest coefficient of variation of all North American crops studied (Figure 18, 160).

The four North American crops sold in Europe are compared in Table 3 (117). These markets are as well in real U.S.$ per metric tonne. European corn (Cce) has not only the smallest standard deviation, but also the smallest relative variance as shown by the coefficient of variation. Feed peas in Europe (Pe), while having a higher standard deviation than corn (Cce) (26.3 to 16.5), have only a slightly higher coefficient of deviation (.159 to .149). Soybean meal Europe (Sme) has the highest standard deviation (40.9) and the largest coefficient of variation (.220).

The standard deviations of markets in Europe are very similar to their North American cash counter-parts (Corn cash Europe (Cce) 16.5 to Corn cash (Cc) 15.11 and Corn cash export (Ccx) 16.3; Soybean cash Europe (Soyeuc) 38.8 to Soybean cash (Sc) 37.2; and Soybean meal cash Europe (Sme) 40.9 to Soybean meal cash (Smc) 40.7) with feed peas exhibiting the largest difference in standard deviations (Peas Europe (Pe) 26.3 to Peas Thunder Bay (Ptb) 21.7). Of note here is that the export cash corn series (Ccx) which is effectively a border price, has a very similar standard deviation to that of cash corn in Europe (Cce). The risk as expressed by standard deviations is very similar between these two border prices for corn (a difference of $0.22/m.t.). The Thunder Bay cash pea price (Ptb), also a border price for the feed pea market, has a smaller standard deviation than does European Feed Peas (a difference of $4.66/m.t.), but substantially larger standard deviation than corn. The freight standard deviations (from the next section) indicate that Great Lakes freight risk (Fgrla) ($3.80/m.t.) compared to Gulf freight (Fgulf) ($1.95/m.t.). The standard deviation of freight from Western Canadian farm (Fttl) to Europe rises to $4.32/m.t. for feed peas which would represents a major portion of the risk in the European market. The risk of freight prices appears to be evident in the price differential between pea markets while not evident between corn markets.

All crop markets in Europe exhibit less risk in the form of coefficient of variation than the North American counterparts (Figure 19, 161). While corn (Cce) is again the least risky market in relative terms (.1493), Feed Peas in Europe (Pe) are a close second (.1589).

Nominal Comparison

When the comparisons of risk using standard deviations or coefficients of variation are conducted on the same crops using nominal local currencies, the results may differ from those that use real U.S. dollars. This view may be suitable for examining the information used by the producer for short-term decisions of crop production and marketing.

The standard deviation of Canadian crops in nominal Canadian dollars indicates that Peas Farm (Pf) have the lowest absolute risk and the lowest coefficient of variation of the North American crops in the study.

Summary of Risk (Standard Deviation and Coefficient of Variation)

Canadian cash peas (Pf) in real U.S. $ had a combination of both a lower means and lower variance resulting in a lower coefficient of variation than all other crops with the exception of Bean Oil Cash (Boc) and Alberta Canola Cash (Abrsc). In nominal terms, Peas Farm (Pf) has the lowest coefficient of variation of any North American crop in the study.

The Canadian pea price has a low coefficient of variation that would indicate that there is relatively little price risk to be transferred by hedging for the producer, compared to that of other crop markets. In both real U.S. dollars and nominal Canadian dollars the standard deviation and coefficient of variation rank Peas Farm (Pf) as one of the least risky price markets in North America or Europe.

These results do not preclude lessening the market price risk by hedging of Feed Peas using futures contracts. There are successful futures contracts having similar standard deviations or coefficients of variation as Peas Farm (Pf). These include Chicago bean oil (Bof), Chicago corn (Cf), and Winnipeg canola (Rsf), however corn is the only one with both low absolute and low relative risk. The perceived lack of volatility (both absolute and relative) to producers may make hedging less of a priority than for some other crops. The low combination of absolute and relative risk may also make the market less attractive to speculators. The appearance of the arbitrage risk of freight being equivalent of the additional price risk in European peas may indicate that the basis risk is being transferred into price risk, which is important when discussing the market participants that must accept this risk.

Freight Mean and Variance

Test results of freight rates (Table 4, 118) between the various ports show that the Great Lakes (Fgrla) have a mean price over twice as high as Gulf (Fgulf) or St. Lawrence ports (Fstla) to Europe. The variance in absolute terms as shown by the standard deviation is also twice as high shipping via the Great Lakes (Fgrla), but the coefficient of variation is lower than either the Gulf ports (Fgulf) or the Saint Lawrence ports (Fstla), indicating relatively less risk.

The rail freight in Canada (Fcdn) is affected late in the study period by much higher rates due to removal of the Crow-Rate subsidy (Figure 20, 162), and results in a high coefficient of variation. The rail freight (Fcdn) average is large enough to be almost three-quarters of the Gulf ocean freight (Fgulf) to Europe. Nominal US.$ per mt. Rates are shown in Figure 21 (163).

The Freight Total (Fttl) which is the Freight Canadian (Fcdn) added to the Great Lakes Freight (Fgrla), results in a much larger risk for shipping peas when measured against standard deviations of freight of competing crops shipped from Gulf ports. The coefficient of variation though is low for Freight Total (Fttl), as is the coefficient of variation of the Great Lakes freight (Fgrla).

In dollar terms the difference between standard deviations of Gulf freight (Fgulf) and Great Lakes (Fgrla) freight is $1.85 per metric tonne in real U.S.$.

The freight component between Western Canada and Europe for Feed Peas (Fttl) is greater in dollar terms, percentage of crop value (Figure 22, 164) and risk is greater in standard deviations than for other crops exported from North America to Europe. However, the risk is less in relative terms as expressed by the coefficient of variation, than for crops being exported through gulf ports.

Correlation

The correlation matrix for Canadian crop prices at the farm gate is shown in Table 5 (119). The results suggest that feed peas (Pf) have a slightly less diversifying effect on market prices received by the producer than does canola (Abrsc). The correlation of feed peas to canola prices is effectively the same as other cereal crops have to canola.

The correlation of North American and European markets for all the study crop markets is quite high with a range of .936 to .965. (Table 6 120).

Human Consumption Pea Correlation to Feed Peas

Table 7 (121) is a correlation matrix of Peas Europe (Pe), Peas Thunder Bay (Ptb), Peas Farm (Pf), a yellow human consumption Pea (Pcen), a green human consumption Pea (Pgreen), and the Alberta feed pea cash (Pfeed), in the rest of the study referred to as (Abpc). All data used is from weekly raw series, in nominal form. Panel 1 shows the correlation without conversion of Peas Europe (Pe) to Canadian dollars. Peas Europe (Pe) is converted in the second panel to Canadian $ by Canadian Dollar Futures series (Cdf). The time is from September 23, 1988 to January 19, 1996. The total observations are 383, but any observation missing any data point has been removed, leaving 283 observations containing all series for comparison.

As stated earlier series Peas farm (Pf) and Peas Alberta feed pea cash (Pfeed as Abpc) are compared, and Alberta feed pea cash (Pfeed) is not used further in testing due to the similarities with Peas farm (Pf). In this study, because the yellow human consumption pea (Pcen) and green human consumption pea (Pgreen) are from the same data source the inclusion of Alberta feed pea cash (Pfeed) helps to compare the results. The two Prairie cash feed pea series Peas farm (Pf) and Alberta feed pea cash (Pfeed) correlate highly with one another and with Thunder Bay peas (Ptb). The inclusion of exchange Canadian Dollar Futures (Cdf) (next closest futures exchange price with the U.S.$) improves the correlation dramatically with Peas in Europe (Pe) as it should. Canadian Dollar futures (Cdf) is used because it has a weekly observation set for the period studied, while Canadian Dollar cash (Cdac), the cash exchange rate is observed monthly.

Yellow human consumption peas (Pcen) are correlated to Alberta feed peas (Pfeed .726), and to Peas farm (Pf .659) as well as to Peas Thunder Bay (Ptb .623). The inclusion of exchange rates increases the correlation with Peas Europe (Pe) from .260 to .534. This correlation is little better than feed peas (Pf and Pfeed) to Peas Europe (Pe .534) without currency conversion (Pf .526, Pfeed .474). Green Human consumption peas are correlated to the yellow human consumption peas (Pcen) at the relatively low .558, and to all of the other pea prices poorly (highest .452 to Europe (Pe)).

When compared to European Feed pea prices (Pe), the producer price of Green Human Consumption Peas (Pgreen) seems to be not responding in the same manner to the major world currency (U.S.$) changes that are influencing the prices of peas exported to Europe (Pe). The other possibility would be that Peas in Europe (Pe) are not being responsive to exchange rate change as expected by LOOP theory.

In summary, Peas farm (Pf), Alberta feed peas (Pfeed), Peas Thunder Bay (Ptb), and Peas Europe (Pe) appear to form a highly correlated market, and it appears that to a lesser extent, Yellow Human consumption peas (Pcen) are correlated to the feed pea market. It also seems that the exchange conversion may not be influencing the price of yellow human consumption peas (Pcen) in the same manner as the feed pea prices (Pe) are influenced. Green human consumption Peas (Pgreen) appear as a differentiated market from the other peas, and when sold globally, the exchange effect from the U.S. dollar, at least compared to feed pea prices in Europe (Pe) and Yellow human consumption Peas (Pcen), has little effect. It also appears that the price received by producers for Green human consumption peas (Pgreen) is not well correlated to the U.S., Canadian exchange rate as well.

Basis

The basis between European and Canadian Feed Pea markets for the study period is shown in Figure 23 (165). The average weekly seasonal feed pea basis between Europe and Canadian markets for the period of this study is shown in Figure 24 (166).

The mean basis for the crops traded between North America and Europe show that Soybean meal had the smallest basis, while Feed Peas Farm (Pf) followed by Feed Peas Thunder Bay (Ptb) has the largest basis. This mean basis is shown in Figure 25 (167).

The relationship of freight to the basis shown in Figure 26 (168), indicates that freight on soybean meal averages 129 percent of the difference in prices between Chicago and European markets. This large portion of basis indicates that trade does continue even when apparent price differences in studies would preclude such trade. This also shows that mean prices are not necessarily indicative of individual market actions, and that highly volatile markets allow opportunity to trade at levels that mean differences would not indicate. A potential explanation of this soybean meal basis result, may also be found in that other studies [Pick and Park 1991] have indicated pricing to market and marketing irregularities are common in the global Soybean meal markets.

Feed Peas also have a high freight to crop basis ratio between Europe and Canada. The freight component of basis for Peas Thunder Bay (Ptb) to Europe (Pe) averages 67.7 percent and for Peas Farm averages 69.5 percent. Soybean and corn have about 40 percent of the basis absorbed by freight.

In summary, Feed Peas with or without the rail component have a high absolute and relative freight component. The various ways of interpreting freights effect on the total basis show that freight is a major component for feed peas in terms of absolute dollars, and relative value to the crop, when compared to other U.S. crops exported to Europe.

Basis Examples

Table 17 (136) shows an example of the yearly costs of basis for Canadian Wheat Board wheat shipped from mid-prairie locations to export position. The marketing cost of private industry in relation to the Canadian Wheat Board costs indicated in the appendix is unknown, however, if the individual basis costs of feed peas and wheat are similar due to weights and values, several generalities are of interest from this table.

An example would be the loading of a rail car directly by the producer, with payment at a later time, will result in elimination of the primary elevation, storage and interest costs, dockage removal costs and much of the shrinkage costs from the basis calculation. These changes will institutionalize the risk of these factors back to the producer. Rail and Great Lakes freight consist of 27.9 percent and 43.8 percent of the remaining basis, totaling 71.7 percent of the total costs on average during roughly the same time period as the feed pea study. An additional 10.0 percent of costs is in additional handling and storage of Great Lakes transshipment when ocean going vessels do not load at Thunder Bay. This may be somewhat less if ocean going vessels only have to top off their cargoes after clearing the Great Lakes. The overall average costs are $40.60 Canadian at Thunder Bay and $18.83 Canadian through Pacific ports.

Several important points come from these numbers. 1) Shipment from Pacific ports yields an immediate border price basis reduction of about 50 percent. 2) Shipment via the Great Lakes is an expensive method of getting grains to ocean locations from Western Canada. Technological change (See Ocean Freight), is likely to make this method of exporting become less competitive in costs, even for grains exported to European destinations, in the future.

The information here indicates that the freight component is by far the largest visible and theoretical cost of arbitrage forming the basis between the farm and Europe for feed peas. If the Canadian pea price and basis are calculated from the European market, sales to domestic and North American markets as well as the markets served via Pacific ports experience greater basis risk. In a market with large basis risk and low price risk, the possibility of basis risk exceeding price risk contradicts basic premises of reasons for using futures markets. Greater basis risk results in less use of futures markets, and results in less than Pareto optimal allocation of resources. With less than Pareto optimal returns to producers, the full development of the industry is restricted.

This is due to the rational trader considering the costs of the other market participants and pricing accordingly. This would indicate that firms that are large enough to purchase inputs of arbitrage at discounts to the average either continue to price as if the discounts did not exist or continue to conduct trade within transaction bands at prices that appear to be unfavorable for arbitrage. Market participants faced with poor information of value sell at prices that are lower than the value to buyers, have smaller profits, and consequently do not allocate as many resources to that sector.

Issues such as foreign matter content (F.M.) make the analysis of arbitrage opportunities difficult, as actual levels present are difficult to confirm in comparison to specification limits. Prices may reflect real levels of FM trading, regardless of what the upper limits of F.M. are, or may discount to take into account the maximum allowable F.M.. Initial problems with measurement of F.M. at Thunder Bay, apparently even between terminals, is one of the reasons that Thunder Bay was rejected as the delivery point for the futures contract [Machielse 1995].

Basis Seasonality

The regression results of seasonality tests are shown in Appendix E.2. A summary comparing results of Alberta Wheat cash (Abwc) to Winnipeg Wheat futures (Wwf), Alberta Canola cash (Abrsc) to Winnipeg Canola futures (Rsf), and Peas Farm (Pf) to both Peas Thunder Bay (Ptb) and Peas Europe (Pe) is shown in Table 8 (122). The seasonal data using real U.S. dollars per metric tonne is shown in Figure 27 (169). With Figure 29 (171) using nominal Canadian dollars, it can be seen that the pea seasonality visible to the producer is similar to that found using real U.S. dollars for measurement.

Seasonality is usually calculated between a cash market and a futures market, but can be between any two markets. The Canadian crops Wheat (Abwc) and Canola (Abrsc) are calculated between Alberta cash prices and the Winnipeg Futures market prices (Wwf and Rsf). The delivery point and thus the spot futures cash prices during the period of the study represent border prices at Thunder Bay and Vancouver. Feed peas in this analysis use cash to cash for locations comparable to either a border location (or delivery point for some Canadian futures contracts) or to the new WCE Feed Pea Futures delivery location (Europe). The European location also allows comparison of cash seasonality between the U.S. crops traded to Europe and Feed Peas traded to Europe.

Canadian Farm to First Market Seasonality

The Pea Farm (Pf) to Europe (Pe) results are discussed later with the other crops traded from North America to Europe rather than with the Canadian domestic markets in Table (8). The summary shows seasonality results using real U.S.$ per m.t.. The adjusted R^2's are very low except for wheat (.3244). The F test of significance indicates that seasonality is not significant for Peas Farm (Pf) traded to Thunder Bay (Ptb), while wheat and canola tests are statistically significant. The intercept, which includes the seasonal effects of the month of April, is significant for all except wheat. The time coefficient is significant for wheat, but not peas or canola. There were no months significant for peas between farm (Pf) and Thunder Bay (Ptb). Months significant (with coefficient signs) for canola are June (-) and February (+) while wheat had no significant months.

North America to Europe Seasonality

A summary of the seasonal effects of markets trading between North America and Europe is in Table 9 (123). Peas farm (Pf) to Peas Europe (Pe) from Table 8 is also discussed here.

The Adjusted R^2's are quite low except for the Feed Peas traded to Europe from both Farm and Thunder Bay. The F test of significance indicates that seasonality is important for peas traded to Europe from both Farm and Thunder Bay, just significant for soybean meal, and not significant for soybeans or corn traded from North America to Europe. The intercept is significant for all crops traded, but again Soybean meal is just significant. The intercept also contains the month of April's contribution to seasonality, but for peas, soybeans, and corn the coefficient and significance are greater than can be accounted for by the month effect of April.

Time is significant for peas from either location in Canada going to Europe, as is time for soybeans. Time significance implies that there is a trend over the time of the observations, although the prices used are already in real terms. Time is not significant for soybean meal or corn. Peas Farm (Pf) to Peas Europe (Pe) have several months with significant results (+ positive coefficient or – negative coefficient). These months are June (-), August (+), September (+), and October (+). Peas Thunder Bay (Ptb) have no months showing significance. Soybean meal is the only other crop exhibiting a significant month, which is January (-).

As can be seen in Figure 27 (169) and Figure 29 (171) that the seasonal basis is similar in both real U.S.$ and nominal Canadian $.

The seasonality exhibited by Feed Peas is contrary to the theoretically expected seasonality, and that exhibited by the other crop results. Theoretically, the basis is expected at harvest to normally be widest, and to narrow later in the crop year [Leuthold et al. 1989]. With Feed Peas however, the narrowest basis is at harvest and it widens later in the crop year. The seasonal pattern exhibited by Feed Peas may be due to the need to physically move peas before the freeze up of the Great Lakes, when the increased costs of rail movement to the St. Lawrence ports is greater than the costs of storage and interest. While movements through Vancouver were indicated in the research for the winter season, the rail freight costs for peas from the eastern prairies to Vancouver may also be greater and therefore restrictive on westward movement.

This reversal of expectations has implications for hedging where the change in basis can be important to the net effect of the hedge. In particular the hedging of Feed Peas once the product is assured (i.e. post harvest), results in basis widening during the period of the hedge, and results in a decreased net effect of the hedge by a short producer, and it supplements the net effect of the hedge of a long buyer. Pre-production anticipatory hedges by producers with cash sales at harvest benefit from this seasonality.

Results, Granger Testing:

The selection of lag length is necessary before proceeding with Granger testing. The lag length is chosen using AIC criteria for lag lengths of j=1 through j=6 (months 1 through 6). The AIC is reported for the three lowest results when both of the explanatory variables are lagged (Table 10 (124)).

The lowest AIC, in all but two tests, involve the most recent endogenous variable. (The most recent own price has the greatest possibility of having the lowest AIC). The two cases where this is not true is in the testing of Soybean meal in Europe (Sme) being tested to Chicago Soybean meal futures (Smf) and when Peas Farm (Pf) are tested to Peas Europe (Pe). The Soybean meal Europe (Sme) test has a three period lag of own price while Peas farm (Pf) lagged by six periods. These two relationships also have the second and third lowest AIC exhibiting the same characteristic. One other test has the second lowest AIC with the endogenous variable having a lag greater than one (Peas farm (Pf) to Soybean meal futures (Smf)). Two other tests have the third lowest AIC exhibiting this result as well; both involve Peas Europe (Pe) with Soybean meal Europe (Sme) and Soybean meal cash (Smc) to Peas Europe (Pe)). The comparison of the different lag lengths gives some indication of the robustness of the lag selection, as well as indicating markets with unusual lags. The significance of the endogenous variable having a lag length of up to six periods is not explored but may indicate efficiency problems. Instantaneous testing is not reported due to the objective of finding leading indicators of price formation.

The results of Granger testing are shown in Table 11 (125). AIC lags actually used are from one to five periods in length, as determined in the previous section.

The results of Granger tests indicate that statistically, Peas Europe (Pe) have no effect on Peas Farm (Pf), while Peas Farm (Pf) have an effect on Peas Europe (Pe). This in Granger causality terms indicates that the Price of feed peas in Europe are formed using information from the Pea price in Canada, but the pea price in Canada is not formed by information in Peas Europe. The implication of the bid process in price formation of feed peas in Western Canada will be discussed later.

The Granger test of whether Peas Europe (Pe) or Soybean Meal Europe (Sme) causes the other is statistically inconclusive. The next test of which market is instrumental in forming Soybean meal prices is that Soybean Meal Europe (Sme) is formed from information in the Chicago Soybean meal Futures market (Smf). The tests of Peas Europe (Pe) prices indicate that Chicago Soybean meal futures (Smf) is also useful for information on European pea price formation. The tests indicate as well that there is causality of European pea prices (Pe) by Chicago spot cash Soybean meal (Smc) prices.

The Granger test of Peas Farm (Pf) with Chicago Soybean meal futures (Smf) shows that Chicago Soybean meal futures (Smf) is not significant to Peas Farm (Pf), but that Peas Farm (Pf) causes Chicago Soybean meal futures (Smf). The indication is that the Pea Farm price (Pf) is a leading indicator of the Pea Europe (Pe) price and of the Chicago Soybean meal futures price (Smf). The implication is that the price set by bidders for peas in Western Canada are more efficient than the Chicago futures market at anticipating prices in these protein markets. This may be an example of a market where the superior information and analysis by professional traders results in less error of forecasts than the noisier futures market that also contains more poorly informed traders, hedgers and speculators. This result is addressed later in discussion of results under various types of market efficiency.

The overall implications of the Granger tests is that the price in Europe for feed peas (Pe) is set by the price paid in Western Canada (Pf) and that the bid price in Western Canada may be a more efficiently established forecast price than is the Chicago Soybean meal futures. This result also shows that prices discovered by professional traders are more efficient than those likely to be achieved under futures trading of feed peas with less skilled or informed participants.

Results: Cointegration Stationarity

The first step in cointegration testing is to establish the order of integration of the time series involved. The results of test for unit roots and the order the tests implied are shown in Table 12 (126). The orders of integration indicate some potentially troublesome price series.

These potentially difficult series include the series Freight Gulf (Fgulf), Oat futures (Of), Soybean futures (Sf), Soybean Europe (Soyeuc), Bean oil cash (Boc), and Bean oil futures (Bof). Of these series when critical values from other sources [Charemza and Deadman 1993]are used the Oat futures (Of) no-trend and Freight Gulf (Fgulf) with trend remain a concern and are integrated order 0. Due to the large number of series checked there is an expectation that some series will fail statistically.

There is no reason, however, to suspect economically that any of the price series should be integrated at other than the order of the rest of the price series. For example to suspect that wheat should be increasing at an ever-increasing rate, or that the Canadian, U.S. exchange rate is changing at an ever increasing rate is not considered likely. The period of the study, in particular for the exchange rate may be the cause of the higher integration order in some tests. The power of the tests may also cause ambiguous results. A visual inspection of price series for the period of the study, and for a greater period shows the importance of perspective of the period studied in relation to the overall price movement (Figure 30, 172). Due to the above discussion, the integration orders for the series used are considered to be of the order 1.

Cointegration by Residuals

Cointegration tests are done on data in natural logarithms. The cointegration test results for North American markets with European markets is shown in Table 13 (131). The Feed Pea Farm market cointegration with various markets is shown in Table 14 (133). Two sets of results are shown for each set of locations tested. The first set is for the entire ninety-seven observations used in most of the other analysis (real U.S. $ per metric tonne). The second results shown in brackets and referred to as "restricted data" is for the same data set with the leading thirteen and final twelve observations deleted. This results in seventy-two observations, and is done because of the limitations of the freight data set as explained in the data chapter. The expectation is that for the series that require freight the results of cointegration testing should be more accurate using the restricted data. For series not involving freight, the longer period of observations is preferred, due to a greater number of observations.

The statistical tests show that the presence of a high R^2 combined with a low Durbin-Watson statistic (D.W.) does not indicate a cointegrating relationship according to other tests. A D.W. at 5 percent critical value of 0.386 is suggested as being "low"[Malliaris and Urrutia 1996]. The lowest of the Durbin Watson statistics in this study was .3787 and is in a relationship that other tests reject as being cointegrating. Several non-cointegrating relationships have high R^2's. The use of R^2 and low D.W. statistics appears to be of low power and of use only when used in conjunction with other tests.

Phillips tests (PP) rejected cointegration on one of fourteen tests, while Augmented Dickey – Fuller tests (ADF) rejected six of fourteen tests. The case of rejection by the Phillips test is on a test of the restricted data. Phillips tests tend to confirm cointegration in most cases. However, non-parametric tests like the Phillips test are more reliable when population distributions are not normal [Spiegel 1992]. The series tested are expected to have strong relationships, so that the large number of accepted cointegrating relationships is not surprising, and the difference in test results may be due to assumptions of the population distribution, or could be due to model misspecification.

Augmented Dickey –Fuller tests (ADF) tests are the most likely to reject cointegration in this study. The rejection of cointegration is split evenly between three rejections of cointegration for each set of data (full data and restricted data). Four of the rejections are consistent at rejecting cointegration for both restricted and complete data sets of a relationship. This test seems to be the opposite of the Phillips test, in that it tends to reject cointegration perhaps too easily, and again may relate to a non-normal population distribution. The warning in Goodwin et al. [1990][3] that statistical failure should not necessarily be interpreted as economic failure of cointegration may be important to these tests.

Corn and soybean results of cointegration testing indicate that for markets between North America and Europe, both Augmented Dickey–Fuller tests (ADF) and Phillips tests (PP) for both series of observations show cointegration. Soybean meal market results confirm cointegration with the exception of the ADF test on the full data set (were Freight concerns are a factor). The ADF test rejects cointegration of Feed Peas Thunder Bay (Ptb), with Feed Peas Europe (Pe) for both restricted and full data sets.

All four cointegration tests on markets for Peas Farm (Pf) confirm cointegration to Peas Thunder Bay (Ptb). Pea Farm (Pf) cointegration to Peas Europe (Pe) are rejected by the ADF test but accepted by the PP tests for both restricted and full data sets. ADF and PP tests of the cointegration to Chicago Soybean meal futures (Smf) confirm cointegration by Peas Farm (Pf) for the full data set, but both tests reject cointegration in the restricted data (neither test uses freight, and so the full data set is the preferred result).

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[3] "McCloskey's distinctions between the statistical and economic significance of empirical results are especially relevant here.[8] In several cases, small standard errors result in statistical rejection of the LOP in cases where the price coefficients are close to one. However, in an economic sense, care should be used in interpreting these results as significant evidence against the LOP. [8] Mcloskey notes: "In the usual test of purchasing power parity, a sample size of a million yielding a very tight estimate that $\beta = .999$, 'significantly' different from 1.0, could be produced under the usual procedures as evidence that the theory had 'failed'. Common sense, presumably, would rescue the investigator from asserting that ... we should abandon purchasing power parity"(McCloskey, p.202)." [Goodwin et al. 1990, 688].

Coefficients

Freight Coefficients

The freight coefficients are statistically significant in all cases studied with the exception of the restricted data for Peas Farm (Pf) to Peas Thunder Bay (Ptb). This freight series is the rail freight and was statutorily set yearly. The lack of freight significance does not cause rejection, by the tests for cointegration of prices between the two markets (Pf to Ptb), however.

The sign of the freight coefficient is dependent upon the location of futures market delivery point relative to the market discussed. The U.S. crops traded with Europe all exhibit positive coefficients for freight rate change. As freight rates increase, the freight cost is added to the price of the delivered product in Europe. Feed Peas have a negative coefficient for freight (Farm to Europe, Thunder Bay to Europe and Farm to Thunder Bay) indicating that as freight rates increase the producer price decreases.

The coefficient for freight for corn is higher than the other crops, perhaps indicative of the lower value of corn in relation to freight costs. For peas, the restricted data increases the freight coefficient (in absolute terms) while the restricted data decreases the coefficient of freight for the other crops (corn marginally). The restricted data is considered to have a neutral (but smaller sample) effect on all variables except for ocean freight, where the restricted freight series should be more accurate. The freight coefficients from the restricted data (Soybean .0791, Soybean Meal .0955, Feed Peas $|-.0710|$) are close to one another. The mean freight as a percentage of crop value at North American border points was Soybean .05, Soybean Meal .06, and Feed Peas .17. When other arbitrage costs are included, the soybean and soybean meal freight coefficients appear reasonable, but the feed pea freight coefficient is lower than anticipated.

Currency Coefficients

Currency coefficients are significant in all the tests between pea markets. The currency data is entered as US. $ per Canadian $. This results in positive coefficients resulting in negative changes in the dependent variable price. The currency coefficient for both Peas Farm (Pf) and Peas Thunder Bay (Ptb) markets to Europe is large (1.5946, 1.7102). While the restricted data results in smaller coefficients (1.3658, 1.2964), the effect is still large. The effect is to amplify the price response in feed peas to currency change by thirty percent or greater than if the pass through of the actual change in the exchange rate was perfect.

In cointegration tests of Peas Farm (Pf) to Chicago Soybean meal futures (Smf), the restricted data currency coefficient (Cdac) is not significant, while the unrestricted data currency coefficient (Cdac) is significant. In this relationship, freight is not a variable, and so the full data set is considered more reliable. The coefficient of the full data set currency (Cdac, .5512) dampens the changes in pea prices (Pf) due to change in the exchange rate. This may be due to the market taking longer than one period to fully reflect the change of exchange rate in pea prices, or it may be due to a more competitive establishment of exchange effects.

Crop Coefficients

All crop coefficients with the exception of the restricted data Soybean meal futures (Smf) coefficient are statistically significant.

The coefficients (using restricted data) for Corn, Soybeans, and Soy Meal (.6058, .7060, .7630) between the U.S. and Europe are much further from the theoretical one than is Feed Peas at Thunder Bay (Ptb) traded to Europe (Pe) (.9257). The coefficient when Peas Farm (Pf) are traded to Europe (Pe) (1.0072) is closer to the theoretical one than is expected.

The coefficient found when testing Peas Farm (Pf) to Soybean meal Futures (Smf) (full data) is statistically comparable (t-test 13.342) to the significance of the coefficient of the U.S. crops traded to Europe in the restricted data (Corn t-test 17.878, Soybean Meal 15.317, Soybean 18.058). Use of restricted data for European comparison is due to the statistically better freight data than in the unrestricted data.

The coefficient of Soybean meal futures (Smf) to Peas farm (Pf) of .6470 is not expected to be one when comparing price change between feed peas and soybean meal. This is due to the market pricing components such as protein and energy in relation to other competitive feed products. The protein component (Soybean meal 44 percent to 48 percent, Feed Peas 22 percent) leads to an expectation of the coefficient to be .45 to .50. The energy component (ME) (Soybean meal 2825 kcal/kg, Feed Peas 3200 kcal/kg.)[4] for swine would result in a coefficient of 1.13 to 1.27. The markets in the price formation weight the importance of the components, but a naïve expectation is for a coefficient of .51 to .64 .

The restricted results of testing for cointegration between Peas Farm (Pf) and Soybean meal futures (Smf) indicate a statistically poor relationship. As the data is the same for this test as the non-restricted test but with fewer observations, an explanation is in order. The original data Figure 30 (172) consists of a period with high grain prices at the beginning of the observations and the end of the observations (a complete price cycle from high to high). The restricted data truncates the study data to include only the lower price relationships. The impact of high arbitrage costs (i.e. freight) is most evident in the crop price formation when crop prices are low. The arbitrage costs also influence to the greatest degree the commodity having the lower price relative to the arbitrage costs. These two factors may result in difficulty of estimating coefficients during the restricted data period when transaction band effects on

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[4] The protein and energy component of grains will vary due to method of extraction, variety, agronomic factors, and environmental conditions while growing. Different animal species have different abilities to use these components in feed rations. Information that is more recent suggests that energy content of Alberta feed peas range from 3250 kcal/kg. to 3600 kcal/kg., and is more important than protein content to hog production [Gowans 1998].

feed peas will be the greatest. Other possible contributory effects could be due to different elasticity of the energy and protein components, resulting in less correlation to Soybean meal during periods of low Soybean meal prices (the protein component). Anticipatory reactions by market participants may also be greater at price extremes than at prices closer to the long term mean. Another contributory factor could be the foreign matter (F.M.) content making coefficient determination more difficult under conditions of different price levels.

Analysis

The overall conclusions of the cointegration testing are that the Feed Pea market from Canada to Europe, while statistically not cointegrated may be economically cointegrated. The coefficient for the relationship between Peas Farm (Pf), and Peas Thunder Bay (Ptb) and Peas Europe (Pe) is far closer to one than any other coefficient found in this study. The Feed Pea market also exaggerates the price response of exchange rate change. The sign of the freight coefficients show that the Canadian producer pays the freight and accepts the risk not only to Thunder Bay but to Europe as well. The increased amount of price risk evident in the European price is equivalent to the increased freight risk in the basis. The payment of freight by the Pea market to Europe is different from the U.S. crops. The location of the spot cash market results in the short pea hedger being exposed to basis risk to Europe, while the US. Short hedger is faced with basis risk to only Chicago. The size of the freight coefficient indicates a less than perfect pass-through of freight change that counters some of the exchange pass-through. This apparent excessive exchange reaction combined with muted freight change may be due in part to the basis being composed of costs denominated in both currencies.

There is evidence that the Pea Farm (Pf) price is cointegrated with the Chicago Soybean meal futures (Smf) market, but that the relationship may not be holding over all price levels. The possibility also exists that a more complex relationship with Chicago (i.e. including Corn) results in cointegration over the complete price level. If the relationship to the Chicago Soybean meal market holds, the exchange response results in less volatility due to exchange over the short period, than the effect of exchange to markets for Peas between Canada and in Europe.

The exaggeration of exchange volatility of the relationship with European Peas (Pe) by Feed Peas Farm (Pf) in Canada, as well as the dampening of price change shown by the freight coefficient for peas, which result in the European Pea coefficient (Pe) of 1.0072 may indicate price formation by non-competitive means, although it could possibly be the result of poor data or model misspecification.

Summary of Quantitative Results

The study of means and variance of Feed peas indicates that Feed Pea markets are one of the lowest price risk markets in this study. This low risk is in real and nominal terms, in absolute dollar risk per m.t., and in relative terms as expressed by the coefficient of variation.

The basis for feed peas is larger than for other crops traded to Europe. The freight component of basis represents a larger proportion of the basis than other crops with the exception of soybean meal, which as noted earlier may have non-competitive pricing. Other components of basis represent a relatively small amount of the visible basis when the Canadian Wheat Board example is used as a guide. The visible basis for shipment through the Great Lakes is much larger than the shipment from pacific ports. The increased risk associated with Great Lakes shipment over Gulf shipment is less than the domestic reduction in costs of shipment via Pacific ports.

The seasonal tests show that feed Peas show little evidence of a seasonal price relationship between Peas Farm and Peas Thunder Bay, unlike Canadian wheat or canola. Feed Peas do show a much stronger seasonal relationship with Europe than do any of the U.S. crops traded to Europe. The Pea Farm price also shows high seasonality to European peas, indicating that the effective first market is in Europe, and not Thunder Bay. The seasonal prices between Peas Farm and Europe indicate an abnormally narrow basis at harvest that widens over the storage period rather than narrows as expected. The basis pattern exhibited is detrimental to storage hedges that are dependent on basis being stable or narrowing, while being advantageous to pre-production hedging with cash sales in the harvest period. The seasonal effect in peas is evident in both real U.S. dollar and nominal Canadian dollar tests.

The testing of lag length for Granger causality in peas has own price lag lengths that are greater than one, which is different from other crops with the exception of Soybean meal. The Granger testing shows that Peas in Europe (Pe) and Soybean meal in Europe (Sme) do not statistically cause one another, but that both Peas (Pe) and Soybean meal in Europe (Sme) are caused by both Chicago Soybean meal cash (Smc) and Chicago Soybean meal futures (Smf) markets. The tests indicate that the Pea Farm (Pf) price causes the European Pea price (Pe), and as well, the Chicago Soybean meal futures (Smf) price. This relationship is suspected of being the result of buyers in Western Canada having superior forecasting skills and information from which to place bids for feed peas (Pf). The implication is also that the Chicago Soybean Meal futures (Smf) market is not efficient. This indicates that when considering hedging opportunities, the producer is in a market where the skills and information required to succeed are substantial, and that professional participants have an advantage. The indication is also that producers may be forfeiting some price discovery efficiency by the advent of a futures pea market due to the noise brought to the market by less efficient price forecasters.

The cointegration testing show the U.S. crop markets to have a long-term equilibrium price relationship (be cointegrated) with Europe, while this is not statistically found in half of the tests for Feed peas. However, the coefficient for feed peas from the farm (Pf) to Europe (Pe) is 1.007 and statistically significant. The finding of a coefficient of one is exceptional when the next closest coefficient is Soybean meal at .7630. The freight coefficients are similar for feed peas when compared to the soybean meal and soybean crops traded to Europe, but is expected to be greater due to the greater percentage that freight consists of the pea value. The other markets to Europe have the buyer paying the freight cost from Chicago markets, and having the risk associated with those costs. The exchange coefficient for peas is statistically significant, large and would contribute to volatility in market price in most cases. The combination of a greater than expected exchange coefficient combined with a smaller than expected freight coefficient may be due to basis components denominated in both currencies. The finding of the price coefficient of 1.007 with a currency coefficient of 1.3658 and freight coefficient of -.0904 suggests the error correction in this long-term price relationship is achieved through currency and freight adjustment rather than through price adjustment. The price coefficient also suggests that the bid price offered in Canada is perfect. The freight risk between markets is opposite for feed peas when compared to American crops exported to Europe. The overall combined effect of currency, freight and price change results in a coefficient on price of one in the feed pea market, while the closest of the American crops is.763.

Chapter 8

CONCLUSIONS AND RECOMMENDATIONS

The study set out to answer several hypotheses. The conclusions reached are:

1) The market risk of feed peas, as defined by standard deviation and coefficient of variation, is found to be among the lowest of any of the crops compared for Canadian, North American and European markets tested. This result is found in both absolute terms and relative terms for both real U.S. dollars and nominal Canadian dollars. Other markets with evidence of low risk (i.e. barley) usually have either a high standard deviation (absolute risk) or a high coefficient of variation (relative risk). However, the futures market for corn in Chicago indicates that both low absolute and relative risk is not enough to preclude a large risk market from developing.

2) The feed pea price in Granger causality terms indicates that the Western Canadian pea price may be leading the European market price of peas. The indications also are that Chicago Soybean meal prices relate to the pea prices in Canada. The leading, or cause of Chicago Soymeal prices by Canadian pea farm bids may indicate that pea traders are more efficient at the forecasting of protein market prices than is evident in the noisier Chicago market, rather than the pea price actually causing (in the literal sense) the soybean meal price.

3) The Canadian farm price of feed peas statistically fails tests of cointegration to Europe in some cases, but can be considered economically integrated to European prices due to the close interaction of prices. The price coefficient between pea markets is much closer to one than the U.S. crops traded to Europe. The latter do, however, pass statistical tests of cointegration better.

4) The basis components of the feed pea market have some abnormalities in comparison with the U.S. crops traded to Europe. The freight coefficient is similar to the U.S. crops although the coefficient is expected to be larger for peas due to greater basis costs in relation to crop price. The exchange coefficient is larger than the expected value for currency pass through, but due to no other crops traded to Europe having exchange in this study a direct comparison is not available. The comparison of Canadian farm pea price to Chicago soybean meal however, indicates a much smaller exchange coefficient. The combination of some basis costs being denominated in different currencies may make the determination of coefficients less precise for freight and currency. The perfect pea price coefficient of 1.007 from the farm gate to Europe, when compared to a price coefficient between Chicago and Europe of Soybean meal of .763 is a concern (soybean = .706, corn = .606). The high currency coefficient, low

freight coefficient, and perfect price coefficient bring into question who holds the market risk not only of the currency and freight aspects of basis, but also the competitiveness of price formation in Canada. The indication is that the worst case risk in the market to Europe is transferred back to the producer in Canada (the freight standard deviation risk) while the U.S. market has market risk from Chicago to Europe, that is not carried by the U.S. producer.

5) The specification of the WCE Feed Pea Futures Contract institutionalizes historical cash market practices that may be detrimental to the use of futures markets according to theory. These include high foreign matter limits in Europe while deducting foreign matter from the producer. Restricted opportunity for delivery reduces competitiveness of price formation and normally increases basis variance. Delivery in Europe also transfers risk normally assumed by buyers in other markets back to the short hedger in Canada. The seasonal price formation evident in peas appears to be related to the trade channel going through the Great Lakes, which not only increases basis costs, but also restricts movement during winter months. The seasonality results in basis change being an advantage to pre-harvest hedging and detrimental to post-harvest hedges.

However, the visibility of price formation thus created by the WCE contract may result in changes to the cash trade conducted to Europe. The foreign matter, currency risk, and freight rate risk by becoming visible cause pressure on the market for more competitive pricing and results in increased transfer of risk between market participants. Such changes should be beneficial to issues of societal resource allocation, but may reduce incentives to some market participants. While overall market activity increases, trade along old routes may decrease.

The Winnipeg Commodity Exchange Feed Pea Contract has not been successful in gathering market participants, and is in the midst of being re-specified. The success of the contract depends upon the degree of success at understanding the weakness of the original contract, as well as understanding the needs of successful contracts. Reasons that futures markets may fail as mentioned in the review of literature bear repeating here. The possible reasons a contract may fail include 1) a poorly written contract favoring either the buyers or sellers and as a result one side of the market refuses to participate; 2) commercial interests with market power refusing to participate; 3) legislative restrictions may hamper or outright ban the contract; 4) loss of the economic rational behind the contract due to changing market conditions; and 5) failure to attract speculators resulting in lack of liquidity [Leuthold et al. 1989].

The success of a contract requires the participation of all those involved in the market. The mentioned problems of specification, lack of use by major traders [University of Saskatchewan 1997], complexity and lack of delivery opportunities for producers, with a non-volatile cash price that makes speculative activity unattractive, contribute to a contract that proves not to be useful to potential participants.

Currently, the unequal bargaining positions (bilateral price negotiation, lack of knowledge of value or price by sellers) that are present in the specialty cash markets are visible through the

WCE feed pea contract. The refusal of producer hedgers to participate stems from not only the apparent inequities created by contract specification (skill, information and resources to deliver, size of delivery), but from the appearance that the cash trade is already cushioning the price, therefore removing the volatility and incentive for price protection. The lack of small hedgers combined with the lack of volatility and unequal bargaining position keep the speculative trader out of the market.

Recommendations

The removal of currency conversion allows the currency risk markets to be used by those requiring currency hedges rather than the worst case currency risk being placed with the short hedger. Domestic sales are less affected by changing exchange rates in such a scenario.

The removal of the worst case freight cost (North America to Europe, via Thunder Bay) from the basis improves the price level and due to increased volatility of prices creates more incentive for producers to seek market risk protection. The trade is able to calculate actual basis costs to the various global markets and bid competitively for the feed peas in Western Canada, dependent upon the actual export route and costs. Those requiring risk protection for ocean freight have at their disposal risk markets now for hedging their needs. Fluctuation of ocean freight rates in this scenario does not influence to the same extent the domestic sales price.

Removal of the institutionalized foreign matter (F.M.) content, and moisture differences in the contract, as well as locations of supply makes the discovery of price reflective of quality and value and therefore results in more optimal bargaining between market participants. The removal of complexity of delivery, as well as complexity of financial, informational and management skills needed, allows more active use by producer hedgers, which in turn results in more activity by speculators, creating the liquidity needed to provide risk markets.

The removal of restrictions to delivery is the most effective method of improving the functioning of the market, and results in the greatest increase in market participation.

The removal of these impediments to the contract require the delivery point to be moved not only back to Canada, but to the interior producing area where the delivery process can be unfettered. In this type of location, the market can competitively establish the price formation and basis components of arbitrage to other markets, whether markets are domestic, Asian or European. The competitive establishment of market price results in optimal allocation of scarce resources, and creates the greatest net social benefit.

The cash price for settlement of such a contract is difficult to establish, and is critical to the functioning of the market. The market place is required to competitively establish arbitrage costs to other markets. A concern with limited information and ability to arbitrage by smaller market participants, is that the price formation irregularities may become no longer visible, but could continue to pass worst case market risk back to the producer, affecting the market detrimentally by restricting producer profitability and resource allocation as a result.

Concerns and Further Research

Concerns

In a study with many data sources, the issue of compatibility of the data, the integrity of the data and the aggregation of data are all of concern. While some tests are done to compare aggregation and compatibility of the data, few of the series have the data to be checked. Dating of aggregated series can result in comparisons that are not for the same date. Although the dates for all series are within two days of one another, the aggregation, or lead-time could conceivably be for differences of up to a month or more.

Feed pea data in particular seems to be considered proprietary, and not generally available. Indeed this is one of the reasons stated for the creation of the WCE contract. Many different participants suggest the best source of price data to be the source that has provided the feed pea data. The feed pea series is openly presented as containing some synthetic observations. The finding of a coefficient of 1.007 between Peas Farm and Peas Europe is particularly troubling, and could be influenced by the synthetic data. Comparison of the Western Canadian pea price provided against Alberta Agriculture data seems to confirm the plausibility of the data, but due to the proprietary nature of most pea data can not be tested.

Results from averaged data may hide significant effects evident in individual transactions. The use of means can accomplish comparisons of markets from an overall view, but cannot be used to analyze specific trades or may not apply to other periods. Changing means or variance in the market may make statistical comparison between price levels or different times difficult.

Further Research

Several potentially interesting areas of research appear to be available now. The increased length of observations of data, as well as the feed pea futures price availability allows checking the results of this study over a greater period. The futures data also allows the comparison of basis risk of time, storage, and convenience yield between contracts. Other comparisons are the structural effect of the futures contract on the cash market (there was evidence of structural change on the Thunder Bay pea market data in November of 1995). Data availability of futures contracts for ocean freight also allows for comparing the freight component within the feed pea price structure to the competitively established futures price interpretation of ocean freight risk.

Asymmetric testing of price response along with distributed lag testing is of interest in confirming or rejecting the competitiveness of market price formation. The lag testing also indicates the efficiency of assimilation of information into the market price.

The decomposition of risk for both Canadian markets, U.S. markets and the combined markets (where possible) gives some insight into the use of futures markets to decrease risk, and the actual risk composition of various markets. The availability of historical futures data on the feed pea market that is now available allows a comparison of futures forecasting of prices as opposed to the naïve methods available without futures data and makes comparisons to other futures to spot cash comparisons more uniform.

The price risk faced by the importer and exporter are different at the same locations in the U.S. export grain market [Hauser and Neff 1993]. The use of different currencies in their model as well as European pricing is of interest to the feed pea market. The examination of crops such as canola as well as feed peas in this manner may give indications of how risks are structured through to final user from producer. Such research is of interest to all segments of the Canadian grain industry.

The analysis of market risk faced by a producer with diversified crops or crops and livestock through portfolio theory as suggested by Novak & Associates Management Consulting and Jeffrey [1997] may shed considerable light on the apparent lack of empirical evidence of market risk reducing activity by producers. The understanding of individual markets and producers use of futures contracts will be enhanced by such research.

The Winnipeg Commodity Exchange Feed Pea contract has shown some of the difficulties that occur in the maturing of markets for special crops. The importance of price discovery and risk reduction functions to the success of futures contracts is stressed. The problems associated with the feed pea contract are in general due to known weaknesses in the establishment of futures contracts and establishment of competitive prices. To be viable, the contract must change to reflect these known principles. Although such change does not guarantee success, specialty crops like canola have grown to be major crops and futures contracts associated with those markets have required contract respecification. This respecification can be looked at as a continuation of the process of the market maturing. The success of the canola contract gives hope that changes in the pea contract will provide the price discovery and risk transfer functions that are of such importance to Canadian agriculture.

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APPENDIX

Appendix A; Summary Contract Specifications

The following are summaries of Specifications for Winnipeg Commodity Exchange Contracts as presented by the WCE.

A.1 Specifications WCE Canola Contract

Pricing Basis: Free on Board (F.O.B.) at points in the PAR region.

Delivery Months: January, March, May, July, August, September, and November.

Delivery Specifications: Non-commercially clean Canadian Canola with a maximum dockage of 8%; all other specifications to meet No.1 Canada Canola, with the privilege of delivering;

commercially clean No.1 Canada Canola at a premium of $5.00 per net tonne; OR

commercially clean No.2 Canada Canola at a discount of $8.00 per net tonne; OR

non-commercially clean Canadian Canola with maximum dockage of 8%, all other specifications to meet No.2 Canada Canola, at a discount of $13.00 per tonne.

Delivery Regions: ParPar area in Saskatchewan (approx. 150 km. radius from the midpoint between North

Central Non-par locations in Saskatchewan with a differential currently at a $2.00 per tonne discount.

Eastern Non-par locations in Manitoba with a differential currently at $2.00 per tonne discount.

Western Non-par locations in Alberta with a differential currently at $6.00 per tonne premium.

Contract Size: 1 contract – 20 tonnes. ("Job Lot") A minimum of 5 contracts (100 tonnes) is required to register a quote or trade. ("Board Lot")

Trading Hours: 9:30 a.m. to 1:15 p.m. Central Time

Last Trading Day: Seven clear business days prior to the end of the delivery month.

Last Delivery Day: Last business day of the delivery month.

Minimum Price Fluctuation: 10 cents per tonne

Daily Limit: $10.00 per tonne above or below previous settlement.

[Winnipeg Commodity Exchange 1998a]

A.2 Specifications WCE Feed Wheat Contract

Pricing Basis: Instore Thunder Bay Ontario.

Delivery Months: March, May, July, October and December.

Delivery Specifications: Deliverable at Par: No.3 Canada Western Red Spring. Deliverable at $5.00/tonne discount; No.2 Extra Strong Red; No.2 Canada Prairie Spring Red; Canada Western Feed. The above grades are deliverable with maximum 2% dockage.

Delivery Regions: Par Licensed regular elevators in Thunder Bay, Ontario.

Non Par Manitoba -Licensed regular elevators in Manitoba.

Non Par Saskatchewan -Licensed regular elevators in Saskatchewan.

Non Par Alberta -Licensed regular elevators in Alberta.

Note: Upon delivery Par price is paid. Upon shipping, freight to Thunder Bay, weighing, inspection and cleaning is deducted.

Contract Size: 1 contract – 20 tonnes. ("Job Lot") A minimum of 5 contracts (100 tonnes) is required to register a quote or trade. ("Board Lot")

Trading Hours: 9:30 a.m. to 1:15 p.m. Central Time

Last Trading Day: Seven clear business days prior to the end of the delivery month.

Last Delivery Day: Last business day of the delivery month.

Minimum Price Fluctuation: 10 cents per tonne.

Daily Limit: $5.00 per tonne above or below previous settlement.

[Winnipeg Commodity Exchange 1998c]

A.3 Specifications WCE Western Barley Contract

Pricing Basis: At buyer's facility in Lethbridge, Alberta.

Delivery Months: March, May, July, October and December.

Delivery Specifications: Deliverable at Par: Weight 48 lb/bu., Maximum moisture 14.8%, Maximum Dockage 2%, All other specifications to meet standards of #1 C.W. Barley.

Deliverable at $5.00/tonne discount: Weight 46 lb/bu., Maximum moisture 14.8%, Maximum Dockage 2%, All other specifications to meet standards of #1 C.W. Barley.

Contract Size: 1 contract – 20 tonnes. ("Job Lot") A minimum of 5 contracts (100 tonnes) is required to register a quote or trade. ("Board Lot")

Trading Hours: 9:30 a.m. to 1:15 p.m. Central Time

Last Trading Day: Seven clear business days prior to the end of the delivery month.

Last Delivery Day: Last business day of the delivery month.

Minimum Price Fluctuation: 10 cents per tonne.

Daily Limit: $5.00 per tonne above or below previous settlement.

[Winnipeg Commodity Exchange 1998d]

A.4 Specifications WCE Feed Peas Contract

Pricing Basis: Cost, Insurance and Freight (CIF) Antwerp, Rotterdam, Amsterdam, or Ghent, from any Canadian port; or effective with the December 1996 contract, from any Australian port.

Delivery Months: February, May, July, October and December. (January, March, May, July, August, September, and November.)

Delivery Specifications: North American origin peas of any variety, with a maximum of 8% foreign material, 17.5% moisture; or effective with the December 1996 contract, Australian origin peas of any variety, maximum 3% foreign material, 12% moisture, fair average quality for the season, weight and quality final at loading as per independent surveyors certificate.

Delivery: C.I.F. Antwerp/ Rotterdam/ Amsterdam/ Ghent at the seller's option, from any Canadian port, in accordance with conditions for physical delivery contained in GAFTA 25 contracts. When tendering notice of delivery, a short cannot nominate a currently strike bound port. Minimum deliverable quantity 100 mt gross.

Contract Size: 1 contract – 20 tonnes. ("Job Lot") A minimum of 5 contracts (100 tonnes) is required to register a quote or trade. ("Board Lot")

Trading Hours: 9:30 a.m. to 1:15 p.m. Central Time

Last Trading Day: Seven clear business days prior to the end of the delivery month.

Last Delivery Day: Notice of delivery shall be made through the Clearing House at the option of the seller on any business day prior to the end of the delivery month. The Clearing House matches the longs and the shorts, advising the shorts of the respective longs; and advising the longs of the destination port, shipment port, and the respective shorts.

The short is responsible to submit to the buyer within three business days of making notice of delivery, a signed C.I.F. contract for the delivered minimum/maximum quantity for feed peas, maximum 8% foreign material, maximum 17.5% moisture, in accordance with the sampling method used by the Canadian Grain Commission.

Within one day of making notice of delivery, margin funds on deposit in the Clearing House for the account of the seller shall be no less than 30% of the total value of the merchandise, based on the settlement price of the previous day's close.

Within one day of receiving notice of delivery, margin funds on deposit in the Clearing House for the account of the buyer shall be no less than 100% of the total value of the merchandise, based on the settlement price of the previous day's close.

A Futures Commission Merchant, acting as an agent for a customer, shall obtain from the customer, an irrevocable letter of credit payable to the Futures Commission Merchant, representing 100% of the settlement price of the deliverable contract.

The return of the duly signed performance form to the Clearing House, will cause the release of the above guarantees to the respective parties.

Price Basis: U.S. dollars per metric tonne.

Minimum Price Fluctuation: U.S. 10 cents per metric tonne.

Daily Limit: U.S. $5 dollars per metric tonne.

[Winnipeg Commodity Exchange 1998b]

Appendix B; Basis

The following discuss several basis calculations for Canadian grains.

B.1 Canadian Wheat Board

A comparison of basis calculations of Canadian Wheat Board (CWB) wheat for export presents information on costs associated with moving a heavy grain from the interior of Canada to export position. This comparison provides costs of arbitrage other than freight, which are not normally visible. The differences in costs of various components of basis that are shown here for the CWB and those costs for private enterprise are not known. The assumption is that costs such as fobbing would be similar. The costs are shown in Table 17 (136).

B.2 United Grain Growers

An example of the basis calculation for the WCE feed pea contract as presented by the United Grain Growers is shown in Table 18 (137).

B.3 Feed Pea Example

An example of the Canadian Wheat Board wheat basis example without the internal costs of arbitrage is shown to indicate the percentage of the total arbitrage costs that freight composes for product that is loaded as clean product on rail cars in Western Canada. This is shown in Table 19 (138).

Appendix C; Data

This Appendix deals with some of the issues and concerns of the data, its sources, formation and manipulations used for analysis.

Peas

A part of the markets ability to allocate product is accomplished by grain buyers signaling to sellers the markets need for grain through the price bids offered for product. The published bids may be an indication to producers by a firm that it is not interested in purchasing at that point in time, and consequently the bids are not necessarily a good indication of actual transaction prices. Due to this concern, the feed pea series has been developed with the intent of representing transaction prices rather than bid prices, according to the supplier of the feed pea data. Results of a comparison to Alberta Agriculture price series representing bid prices are shown in Appendix E. These results are interpreted as confirming the suppliers claim. A further concern is that the European feed pea price series (Pe) contains synthetic data for some missing data points according to the supplier. According to the source, the synthetic formula is found reasonably accurate when compared to known transactions. The exact numbers of missing data points and how the synthetic points are derived is not known, but is a possible source of error. Industry representatives indicate that the source of the feed pea price series is the best available outside of the proprietary information of those individual firms that are competing in the market.

As there has been no visible market price (before the WCE contract), and the transactions are between brokers and considered proprietary, the data series may neither be as accurate, nor reflect more competitive bids that may not be wide spread. Prices acquired from brokers may be incomplete, while quality premiums or discounts relating to the product may not be stated. Issues such as F.M. content result in the product priced not being homogeneous in nature. Other concerns include that the price bid by firms may have had larger variance due to concerns of unknown risk when the market was less developed.

The pea data used in this study initially consisted of nominal weekly prices, starting in May 1988, and continuing to June 1996. It consists of a Western Canadian producer price for feed peas, loaded rail, derived from bids by major special crop firms. The series includes a price between dealers at Thunder Bay for feed peas, and a price for feed peas, cargo, insurance, and freight paid (CIF) at Antwerp in U.S.$.

Conversion Units of Measure

Many of the original time-series required the conversion of units to consistent units of measure to make comparison possible or convenient between series. The potential for unit conversion discrepancy exists due to reports using metric tonne, metric ton, and ton. There is some concern that the listed measurement may not be proper consequently. An example is the freight series which are reported in U.S.$ per ton, but in other recent literature the data is listed as U.S.$ per m.t.. The freight data was not converted due to the assumption that the series is in fact reported in U.S. $ per metric tonne.

U.S. Chicago futures prices were converted in units of measurement similar to the technique used for soybean meal, were the futures price is the nearest futures in U.S. dollars per ton converted to metric tonne by multiplying 2204.6/2000 (number of lbs. per metric tonne divided by the lbs. per short ton) times the price. All futures prices are based Chicago (Winnipeg) nearest futures, using the closing value for the week or month quoted as appropriate. As futures contracts are not traded for all months, this does result in difficulty when comparing to cash series that are monthly. This raises issues including the amount of convergence in the futures series, as well as the cointegration between cash and futures. Comparison of different futures markets with different delivery months, or unequal time between delivery months may affect results as well.

Any reported units using metric are left as such, while any reference to ton is converted to metric tonne unless noted previously. Conversion factors and original units are in Table 20 (139). If the series is misrepresented the conversion is not be correct.

Conversion Units of Time

Most studies are done using monthly observation periods. As some price series are acquired as daily or weekly series, data aggregation problems may arise from the conversion to monthly formats. Many monthly series may have similar problems when received from the original data sources as the method of formation is rarely specified. Some series may be monthly averages, or may be for specific days, or for specific dates. For instance, one series that is known to be different is ocean freight rates, and consists of a mid-monthly average of rates for loading two to three weeks in the future. Most futures and cash price series are month end closing prices. The consequences of using this combination of data sources are not known, but the assumption is that it could result in less precise or inaccurate test results. Whatever the data generation process, the series used are dated within two days of one another for any given month. The ocean freight rate is effectively a known price for loading in the future at the beginning of each period. The May start date is for the end of May. Most series had no missing data points, but some are missing several (Cce for example has 5 missing points with a maximum of 2 together). The two missing points together are filled using comparative numbers from another price series for corn delivered to the same ports. Due to the incompleteness of this other series, the remaining missing observations are arbitrarily filled with the average of the two points on either side of the missing observation. As mentioned in the following, some series have unknown characteristics.

Currency

All series are initially in nominal prices, and denominated in the currency of the local market. Canadian dollar cash prices are used in most studies when converting to U.S. dollars. Additional prices used, are the nearest futures price of the Canadian dollar in relation to the U.S. dollar. Canadian exchange rates are inverted compared to the usual interpretation in Canada, with the rate expressed as 1.25 rather than .80.

Comparison using futures prices for conversion of currency, with cash prices of feed peas can be a source of concern. This concern lead to the use of Canadian cash currency exchange whenever possible rather than the futures data which has higher resolution, but lacks observations for some of the time period. The use of exchange futures seems to be relevant to the analysis in some cases to decrease exchange risk to the trade for a product to be delivered in Europe in the future. The currency exchange ratio is therefore expected to be of importance to the costs to dealers. For this study, the exchange ratio is considered to be exogenous to the dealers, as exchange ratios are not expected to be affected by the volume of trade of feed peas or soybean meal.

Non-Homogeneous Commodity

A concern that is particularly evident in the protein level of soybean meal may also affect other price series. The Chicago specifications currently call for 48 percent protein for soybean meal. The level specified in the FAS tables for U.S. soybean meal are reported as 44 percent protein until the 1991/92 season when 48 percent is also reported. Rotterdam CIF prices are reported as 44 percent until 1989/90 when 45 percent to 46 percent is the reported protein level. The yearly averages reported thereafter do not reflect any changes in historical prices, indicating that the comparisons of price are of tonnes officially having different protein content. The series used are for the longer time period, so that soybean meal export (Smm) is consistent at 44 percent protein throughout the study (this series was compared to Chicago soybean meal spot cash price (Smc), and statistically found to be the same and was dropped from further use.) Unfortunately the series soybean meal Europe (Sme) does not have data to explore this discrepancy and to make a comparison. No conversions are made to any of the data to adjust for changing quality regulations or reporting standards. As no method of checking the integrity of the reported prices or qualities has been found, the possible implications must be considered throughout this study that the qualities and prices may not be consistent due to issues like the percentage of protein or energy in various grains.

Appendix D; Contract Specification

The sources of the following information in this appendix are the Winnipeg Commodity Exchange [1995a] and the Winnipeg Commodity Exchange [1995c].

D.1 Winnipeg Commodity Exchange Feed Pea Futures Contract By-law XIX

FEED PEA FUTURES CONTRACT
BY-LAW XIX

FEBRUARY 1996 AND SUBSEQUENT FEED PEA FUTURES CONTRACTS

Except where specifically provided in this By-Law or Regulation 1000, the procedures and practices for trading in Feed Pea Futures Contracts are subject to the same procedures and practices as those governing trading in other commodities, as established in the By-laws and Regulations of the Exchange.

Throughout this By-law and Regulation 1000, all reference to "seller" means the Clearing Member holding a short futures position and all reference to "buyer" means the Clearing Member holding a long futures position.

19.01 Contract Grades

Feed Peas deliverable against this futures contract shall be of North American origin. Contract deliverable grades, premiums and discounts shall be as the Board may determine from time to time.

Provided that, effective with the December 1996 Feed Pea Futures Contract, the origin of the Feed Peas deliverable against this futures contract may include Feed Peas of Australian origin. Contract deliverable grades, premiums and discounts shall be as the Board may determine from time to time,

19.02 Par Pricing Basis

Bids and offers shall be made in U. S. funds at a price based upon par C.I.F. delivery. The seller shall arrange conveyance by vessel from any Canadian port of shipment to seller's option of berth at any of the following ports of destination:

a, Antwerp. Belgium; or
b. Rotterdam, The Netherlands; or
c. Amsterdam. The Netherlands; or
d. Ghent, Belgium.

Provided that, effective with the December 1996 Feed Pea Futures Contract, the seller shall arrange conveyance by vessel from any port of shipment as determined by the Board from time to time.

19.03 Delivery

a. Delivery through the Clearing House against any Feed Pea Futures Contract shall made at the option of the seller, who holds an existing short Feed Pea Futures contract position, by presentation to the Clearing House of a Delivery Notice in such form as prescribed by Winnipeg Commodity Clearing Ltd.

b. Such presentation shall be made by 11:50 a.m. Central Time on any business day of the delivery month, provided that on the last delivery day such presentation may be made by 1:30 p.m. Central Time.

c. Upon presentation, the Clearing House shall forward a Delivery Notification Form, in such form as prescribed by Winnipeg Commodity Clearing Ltd., to the Clearing Member with the oldest long futures position.

d. The Clearing House shall immediately provide the seller with a copy or the Delivery Notification Form.

19.04 Minimum Deliverable Quantity

The minimum quantity deliverable against Feed Pea Futures Contracts shall be 100 metric tonnes (gross tonnes).

19.05 C.I.F. Contract

a. The seller shall provide the buyer with a signed, completed C.I.F. contract at such time and in such manner as the Board may determine, in the form of or incorporating by reference the Grain and Feed Trade Association (GAFTA) Contract No. 25 For Feed Pulses Bulk as modified, and amended from time to time, and attached to these By-laws as "Annex 18A".

(1) Modifications or amendments to the GAFTA Contract No. 25 shall not apply to contracts entered into prior to the implementation of the

modifications or amendments.

(2) Provided that, modifications or amendments made to the GAFTA Contract No. 25 during a delivery month shall not apply to C.I.F. contracts for delivery in such delivery month unless mutually agreed upon by the buyer and the seller.

b. The buyer shall provide the seller with a copy of the completed CI.F. contract, duly signed by the buyer, at such lime and in such manner as the Board may determine.

The buyer and seller shall notify the Clearing House, in such form as provided in "Annex 18", that performance on the C.I.F. contract has been satisfactorily completed.

19.06 Nomination of Ports

At the time of tendering a notice of delivery, the seller is prohibited from nominating a strike bound Port.

19.07 Responsibility of Clearing Members

The Clearing Member shall be accountable and responsible for the fulfillment of the contract consummated by the beneficial owner.

19.08 Disputes

a. All questions of disputes or misunderstandings relating to any commercial aspect of the contracts which may arise between members may be submitted to Arbitration in accordance with Arbitration Rule 125 of the Grain and Feed Trade Association (GAFTA).

b. Any other disputes or misunderstandings encountered subsequent to delivery through the Clearing House and prior to signing of the C.I.F. contract, by both parties, may be submitted to Arbitration in accordance with the By-laws of the Exchange pertaining to Arbitration.

FEED PEA FUTURES CONTRACT

REGULATION 1000

FEBRUARY 1996 AND SUBSEQUENT FEED PEA FUTURES CONTRACTS

Except where specifically provided in By-law XIX or this Regulation, the procedures and practices for trading in Feed Pea Futures Contracts are subject to the same procedures and practices as those governing trading in other commodities, as established in the By-laws and Regulations of the Exchange. Reference to C.I.F contracts throughout this Regulation pertains to contracts between the buyer and seller based upon Grain and Feed Trade Association (GAFTA) contract No. 25 (Contract for Feed Pulses Bulk) in accordance with the text attached as "Annex 18A" as modified and amended from time to time. Delivery against the Feed Pea Futures Contract is based on par pricing C.I.F.

Throughout this Regulation and By-law XIX, all reference to "seller" means the Clearing member holding a short futures position and all reference to "buyer" means the Clearing Member holding a long futures position.

1000.01 Contract Deliverable Grades

Feed Peas acceptable for par delivery against Feed Pea Futures Contracts must be of:

a. North American origin (no standard grade)
-maximum 8% foreign material
-maximum 17.5% moisture
in accordance with the sampling method used by the Canadian Grain Commission;
OR

b. (effective with the December 1 1996 Feed Pea Futures Contract)
Australian origin
-maximum 3% foreign material
-maximum 12% moisture
-fair average quality for season weight and quality final at loading as per independent surveyors certificate.

1000.02 Contract Delivery Months

The Board has authorized trading in Feed Pea Futures Contracts for the following contract months:

a. February
b. May
c. July
d. October
e. December

1000.03 Automatic Provision of Trading Facilities

The Board has authorized trading facilities in Feed Pea Futures Contracts for five (5) successive delivery months.

1000.04 Trading Hours

Trading shall be conducted between 9:30 a.m. and 1:15 p.m. Central Time.

1000.05 Currency

Bids, offers and trades shall be in U.S. dollars.

1000.06 Price Fluctuation Unit

Bids or offers, up or down from the previous quotation shall be made in units of ten (10) cents U.S. per tonne.

1000.07 Units of Trade

Job Lot - 20 metric tonnes (gross tonnes)

Board Lot - 100 metric tonnes (gross tonnes)

1000.08 Limits on Daily Price Movement

a. Trading, bidding or offering at a price more than five ($5.00) dollars U.S. per tonne higher or lower than the settlement price of the previous session is prohibited.

b. In the case of trading in a new contract delivery month, such limits shall be based on the Board Lot quotations following the first actual trade in that futures contract month.

1000.09 Expansion of Daily Price Limits

Whenever two (2) of the nearest three (3) contracts close at normal limit up (traded or bid), or normal limit down (traded or asked) an expanded daily price limit schedule shall go into effect as follows:

a. On the next business day the daily price limit on all contract months shall be one and a half (1 .5) times the normal daily price limit and shall remain there for three Successive business days.

b. If any two (2) of the nearest three (3) contracts close at the expanded limit up (traded or bid), or the expanded limit down (traded or asked) on the last business day of the expanded limit period then the limits will remain at one and a half (1.5) times the normal daily price limit for another three (3) day period.

c. Limits will remain at one and a half (1 .5) times the normal daily limit for successive periods of three (3) business days until any two (2) of the nearest three (3) contracts do not close at the expanded limit up (traded or bid), or the expanded limit down (traded or asked) on the last day of the period.

d. If on the last day of a three (3) day business period any two (2) of the nearest three (3) contracts do not close at the expanded limit up (traded or bid), or the expanded limit down (traded or asked) then the normal daily price limit shall be reinstated on the following business day.

1000.10 Expansion of Daily Price Limits - Delivery Month

Whenever a futures contract that is eligible for delivery in that month closes at normal limit up (traded or bid), or normal limit down (traded or asked) an expanded daily price limit schedule shall go into effect as follows:

a. On the next business day the daily price limit on that contract month shall be one and a half (1 .5) times the normal daily price limit and shall remain there for three successive business days.

b. If that contract month closes at its expanded limit up (traded or bid), or its expanded limit down (traded or asked) on the last business day of the expanded limit period then the limit will remain at one and a half (I .5) times the normal daily price limit for another three (3) day period.

c. The limit will remain at one and a half (1 .5) times the normal daily limit for successive periods of three (3) business days until that contract does not close at its expanded limit up (traded or bid), or its expanded limit down (traded or asked) on the last day of the period.

d. If on the last day of a three (3) day business period that contract does not close at its expanded limit up (traded or bid), or its expanded limit down (traded or asked) then the normal daily price limit shall be reinstated on the following business day.

1000.11 Cessation of Trading and Deliveries

a. Trading in Feed Pea Futures Contracts shall cease seven (7) clear business days prior to the end of the delivery month.

b. Notice of Delivery shall be made through the Clearing House at the option of the seller on any business day prior to the end of the delivery month.

1000.12 Ports of Shipment

The seller shall nominate any Canadian port of shipment or, effective with the December 1996 Feed Pea Futures Contract, any Australian port of shipment.

1000.13 Vessel Loading

The Feed Peas shall be loaded on a vessel and ready for shipment from the nominated Port on or before the last delivery day of the delivery month, in accordance with the C.I.F. contract.

1000.14 Delivery Process and Confirmation of Performance

a. The seller, shall submit a Delivery Notice to Winnipeg Commodity Clearing Ltd., who shall forward a Delivery Notification Form to the Clearing Member with the oldest long futures position.

b. No later than 3:00 p.m. Central Time on the business day following the notification of delivery through the Clearing House:

(1) margin funds on deposit in the Clearing House (Or the account of the seller shall be no less than thirty percent (30%) of the total value of the contract.

(2) margin funds on deposit in the Clearing House for the account of the

buyer shall be no less than one hundred percent (100%) of the total value of the contract.

c. No later than 3:00 p.m. Central Time on the third business day following notification of delivery through the Clearing House, the seller shall provide the buyer with a C.I.F. contract, in accordance with Annex 18A of these By-laws, signed by the seller.

d. No later than 3:00 p.m. Central Time on the fifth business day following notification of delivery through the Clearing House, the buyer shall provide the seller with a copy of the C.I.F. contract, signed by the buyer.

e. The buyer and seller shall complete and sign the Performance Form (Annex 18), indicating that the bill of lading has been presented and that payment has been made.

f. The buyer and seller shall forward a signed copy of the Performance Form to the Clearing House, at which time the Clearing House shall release the applicable margin funds on deposit in the Clearing House to the buyer and seller.

1000.15 Account Opening

Upon accepting the first order to trade Feed Pea Futures Contracts for any customer, Futures Commission Merchants shall obtain a document signed by that customer, that is applicable to all trades in Feed Pea Futures Contracts made on his behalf, undertaking to accept full responsibility for performance of the contract. Such document shall be substantially in the form attached to this Regulation as Annex D1. A copy of the signed document shall he forwarded to the carrying Clearing Member.

1000.16 Relations with Customers

a. The Clearing Member shall be accountable for the fulfillment of the contract consummated by the beneficial owner.

b. The Clearing Member acting as an agent for a customer shall ensure that the contractual requirements have been met by such customer, pursuant to thc provisions contained in Annex Dl, before delivery. Such requirements shall include the establishment of an irrevocable letter of credit payable to the Futures Commission Merchant, representing 100% of the settlement price of the deliverable contract.

Appendix E; Comparison of Data Series

E.1 Data Check

This appendix looks at comparisons of data from different sources, data aggregation concerns, and data series that are supposedly independent data. Results are tabulated in Table 21 (141).

The first comparison of data received from two different sources and consists of Peas Farm (Pf) and Alberta Peas Cash (Abpc). Peas Farm (Pf) is presented as a weekly transaction price series (as were Peas Thunder Bay (Ptb) and Peas Europe (Pe)), rather than a bid price series as is Alberta Peas Cash (Abpc). The series Alberta Peas Cash (Abpc) has fewer data points (342) than Peas Farm (Pf) (383) in the period analyzed. Testing allows for comparison of data generation, and for substantiation of whether there is a difference between the two series, as claimed by Stat Publishing, the source of Peas Farm (Pf).

Peas Farm (Pf) is a prairie wide series while Alberta Peas Cash (Abpc) is a more localized Alberta series. The expectation is the basis levels for Alberta Peas Cash (Abpc) should be greater for feed peas moving to Europe through the Great Lakes than the more general Peas Farm (Pf) basis. However, Alberta Peas Cash (Abpc) price may represent feed peas that are being exported through Pacific ports to a greater extent than Peas Farm (Pf), causing some differences in the comparison with Alberta Peas Cash (Abpc). If this is the case, the expectation is that the resulting decrease in basis costs results in a higher means and/or less variance in the Alberta Peas Cash (Abpc) series. The comparison shows a higher mean, higher minimum and lower standard deviation with series Peas Farm (Pf), as is expected from a transaction series compared to a bid series. The higher maximum in series Alberta Peas Cash (Abpc) could be due to the location advantage of Alberta peas for export through Vancouver. The coefficient of variation is less for Peas Farm (Pf) due to both a higher mean and lower standard deviation, which is expected from a transaction price series. Anova f-tests reject that these series have the same mean and Bartlett's test of homogeneity of variance rejects that the variance is statistically the same. Overall, it appears that the claim of being a transaction price is substantiated for Peas Farm (Pf), but that the series do not differ by enough to compromise the validity of one another.

Another check of data series is done between monthly nominal U.S. dollar denominated Soybean Meal Export (Smm) and Soybean Meal Cash (Smc). Soybean Meal Export (Smm) is a monthly series denoting U.S. export prices of soybean meal at Decatur, Illinois. Soybean Meal Cash (Smc) is the cash soybean meal series that is generated using daily Chicago data for cash spot prices (effectively the same location). This allows a comparison of sources of data, as well as a check on data aggregation for prices that should be equivalent. The Soybean Meal Export (Smm) series is from the USDA which supplied as well the Rotterdam price (CIF) of Soybean Meal Europe (Sme). Soybean Meal Cash (Smc) series is from Glance, who also supplied all of the futures prices as well as all of the U.S. cash spot futures prices. The export price is expected to differ from the cash price in Illinois by the arbitrage costs between Illinois and the Gulf ports, but these arbitrage costs have not been found for this study. As both export prices and cash prices are supposedly at the same location, it is of interest if these were indeed different price series or the same price series.

Results indicate that these series are effectively the same. Mean, standard deviation, minimums, maximums and coefficients of variation are almost identical. Anova f-tests and Bartlett tests confirm this result of similar means and variance. Although the possibility of these being different series and that the aggregation of daily data to monthly results in similar price series results, I conclude that these results indicate that there are not serious aggregation problems when daily data from Glance is aggregated to form monthly observations. It also seems to indicate that data from these different sources is likely to be compatible for statistical purposes. The soybean meal series Soybean Meal Export (Smm) is not used for any further testing, as it does not represent any new information.

E.2 Seasonality

Seasonality regression results of feed peas, wheat and canola as well as U.S. crops to European markets are shown in this appendix and in Figure 27 (169) and Figure 27 (169). Regressions use the basis between markets.

All Data Real U.S.$ in

Peas Farm to Peas Europe [Pf-Pe]

Regression Statistics	
Multiple R	0.754
R Square	0.569
Adjusted R Square	0.508
Standard Error	7.067
Observations	97.000

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	12.000	5542.186	461.849	9.248	0.000
Residual	84.000	4195.138	49.942		
Total	96.000	9737.324			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept**	-59.100	2.860	-20.664	0.000	-64.787	-53.412
Time**	0.242	0.026	9.388	0.000	0.191	0.293
May	0.510	3.436	0.148	0.882	-6.324	7.343
June*	-6.109	3.543	-1.724	0.088	-13.155	0.936
July	2.320	3.541	0.655	0.514	-4.722	9.361
Aug*	6.138	3.539	1.734	0.087	-0.901	13.176
Sept*	6.119	3.538	1.730	0.087	-0.917	13.155
Oct*	6.939	3.537	1.962	0.053	-0.094	13.973
Nov	2.196	3.536	0.621	0.536	-4.835	9.228
Dec	0.463	3.535	0.131	0.896	-6.566	7.493
Jan	2.185	3.534	0.618	0.538	-4.844	9.213
Feb	2.429	3.534	0.687	0.494	-4.599	9.456
March	2.434	3.534	0.689	0.493	-4.593	9.461

Significant Coef. * 90%=1.671

** 95%=2.000

Peas Farm to Peas Thunder Bay [Pf-Ptb]
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.417
R Square	0.174
Adjusted R Square	0.056
Standard Error	5.085
Observations	97.000

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	12.000	457.595	38.133	1.475	0.150
Residual	84.000	2171.754	25.854		
Total	96.000	2629.349			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept**	-12.905	2.058	-6.271	0.000	-16.997	-8.812
Time	-0.027	0.019	-1.439	0.154	-0.064	0.010
May	-0.121	2.472	-0.049	0.961	-5.037	4.796
June	-3.976	2.549	-1.560	0.123	-9.046	1.093
July	2.342	2.548	0.919	0.361	-2.725	7.408
Aug	4.207	2.547	1.652	0.102	-0.857	9.272
Sept	1.981	2.546	0.778	0.439	-3.081	7.044
Oct	2.585	2.545	1.016	0.313	-2.475	7.646
Nov	0.650	2.544	0.256	0.799	-4.409	5.709
Dec	2.799	2.543	1.101	0.274	-2.259	7.857
Jan	3.184	2.543	1.252	0.214	-1.873	8.241
Feb	2.545	2.543	1.001	0.320	-2.511	7.601
March	2.073	2.542	0.815	0.417	-2.983	7.129

Significant Coef. * 90%=1.671

** 95%=2.000

Peas Thunder Bay to Peas Europe [Ptb-Pe]
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.831
R Square	0.691
Adjusted R Square	0.647
Standard Error	5.576
Observations	97.000

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	12.000	5835.949	486.329	15.644	0.000
Residual	84.000	2611.412	31.088		
Total	96.000	8447.361			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept**	-46.195	2.257	-20.472	0.000	-50.683	-41.708
Time**	0.269	0.020	13.210	0.000	0.228	0.309
May	0.630	2.711	0.232	0.817	-4.761	6.022
June	-2.133	2.795	-0.763	0.448	-7.692	3.426
July	-0.022	2.794	-0.008	0.994	-5.578	5.534
Aug	1.931	2.793	0.691	0.491	-3.623	7.484
Sept	4.138	2.791	1.482	0.142	-1.413	9.689
Oct	4.354	2.791	1.560	0.122	-1.195	9.903
Nov	1.546	2.790	0.554	0.581	-4.002	7.094
Dec	-2.336	2.789	-0.838	0.405	-7.882	3.210
Jan	-1.000	2.789	-0.359	0.721	-6.545	4.546
Feb	-0.116	2.788	-0.042	0.967	-5.661	5.428
March	0.361	2.788	0.130	0.897	-5.183	5.905

Significant Coef. * 90%=1.671

** 95%=2.000

Corn Cash to Corn Cash Europe [Cc-Cce]
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.289
R Square	0.084
Adjusted R Square	-0.047
Standard Error	6.711
Observations	97.000

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	12.000	344.705	28.725	0.638	0.804
Residual	84.000	3782.719	45.032		
Total	96.000	4127.424			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept**	-37.971	2.716	-13.981	0.000	-43.372	-32.570
Time	0.021	0.024	0.844	0.401	-0.028	0.069
May	1.567	3.263	0.480	0.632	-4.922	8.056
June	3.548	3.364	1.055	0.295	-3.142	10.238
July	1.575	3.363	0.468	0.641	-5.112	8.262
Aug	2.082	3.361	0.619	0.537	-4.602	8.766
Sept	-2.456	3.360	-0.731	0.467	-9.138	4.225
Oct	-1.828	3.359	-0.544	0.588	-8.507	4.851
Nov	-1.893	3.358	-0.564	0.574	-8.570	4.784
Dec	-1.990	3.357	-0.593	0.555	-8.665	4.685
Jan	-0.867	3.356	-0.258	0.797	-7.541	5.807
Feb	-0.404	3.356	-0.120	0.904	-7.077	6.269
March	-0.647	3.355	-0.193	0.847	-7.320	6.025

Significant Coef. * 90%=1.671

** 95%=2.000

Soybean Meal Cash to Soybean Meal Europe [Smc-Sme]
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.522
R Square	0.273
Adjusted R Square	0.169
Standard Error	10.204
Observations	97.000

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	12.000	3284.103	273.675	2.629	0.005
Residual	84.000	8745.439	104.112		
Total	96.000	12029.542			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept*	-7.753	4.130	-1.877	0.064	-15.965	0.459
Time	0.043	0.037	1.150	0.253	-0.031	0.117
May	2.371	4.962	0.478	0.634	-7.495	12.238
June	4.310	5.115	0.842	0.402	-5.863	14.482
July	0.278	5.113	0.054	0.957	-9.889	10.445
Aug	6.791	5.110	1.329	0.187	-3.372	16.954
Sept	-0.664	5.108	-0.130	0.897	-10.823	9.494
Oct	-5.532	5.107	-1.083	0.282	-15.687	4.623
Nov	-6.385	5.105	-1.251	0.214	-16.537	3.767
Dec	-8.103	5.104	-1.588	0.116	-18.253	2.047
Jan**	-14.376	5.103	-2.817	0.006	-24.524	-4.228
Feb	-7.793	5.102	-1.527	0.130	-17.939	2.354
March	-1.792	5.102	-0.351	0.726	-11.938	8.354

Significant Coef. * 90%=1.671

** 95%=2.000

Soybean Cash to Soybean Europe [Sc-Soyeuc]
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.395
R Square	0.156
Adjusted R Square	0.036
Standard Error	11.707
Observations	97.000

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	12.000	2133.493	177.791	1.297	0.236
Residual	84.000	11513.263	137.063		
Total	96.000	13646.756			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept**	-57.006	4.738	-12.031	0.000	-66.428	-47.583
Time**	0.138	0.043	3.230	0.002	0.053	0.223
May	-3.423	5.693	-0.601	0.549	-14.744	7.898
June	5.702	5.869	0.971	0.334	-5.970	17.374
July	0.873	5.866	0.149	0.882	-10.793	12.539
Aug	3.866	5.864	0.659	0.511	-7.794	15.527
Sept	2.393	5.861	0.408	0.684	-9.263	14.049
Oct	-4.146	5.859	-0.708	0.481	-15.797	7.506
Nov	-3.417	5.858	-0.583	0.561	-15.065	8.231
Dec	-1.414	5.856	-0.241	0.810	-13.060	10.232
Jan	0.603	5.855	0.103	0.918	-11.041	12.246
Feb	-0.741	5.854	-0.127	0.900	-12.383	10.901
March	-0.136	5.854	-0.023	0.982	-11.777	11.505

Significant Coef. * 90%=1.671
** 95%=2.000

Alberta Canola Cash to Winnipeg Canola Futures [Abrsc-Rsf]
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.470
R Square	0.221
Adjusted R Square	0.110
Standard Error	11.413
Observations	97.000

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	12.000	3103.777	258.648	1.986	0.036
Residual	84.000	10942.045	130.262		
Total	96.000	14045.822			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept**	-38.371	4.619	-8.307	0.000	-47.557	-29.186
Time	0.039	0.042	0.930	0.355	-0.044	0.122
May	4.199	5.550	0.757	0.451	-6.837	15.235
June*	-10.669	5.722	-1.865	0.066	-22.047	0.710
July	3.107	5.719	0.543	0.588	-8.265	14.480
Aug	3.861	5.716	0.675	0.501	-7.507	15.229
Sept	-3.375	5.714	-0.591	0.556	-14.739	7.988
Oct	4.777	5.712	0.836	0.405	-6.582	16.136
Nov	5.874	5.710	1.029	0.307	-5.482	17.230
Dec	3.128	5.709	0.548	0.585	-8.225	14.481
Jan	4.586	5.708	0.803	0.424	-6.765	15.937
Feb**	12.968	5.707	2.272	0.026	1.618	24.317
March	6.628	5.707	1.161	0.249	-4.721	17.977

Significant Coef. * 90%=1.671

** 95%=2.000

Alberta Wheat Cash to Winnipeg Wheat Futures [Abwc-Wwf]
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.639
R Square	0.409
Adjusted R Square	0.324
Standard Error	7.356
Observations	97.000

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	12.000	3143.022	261.918	4.840	0.000
Residual	84.000	4545.241	54.110		
Total	96.000	7688.263			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-1.854	2.977	-0.623	0.535	-7.774	4.066
Time**	-0.172	0.027	-6.414	0.000	-0.225	-0.119
May	-1.553	3.577	-0.434	0.665	-8.666	5.560
June	3.149	3.688	0.854	0.396	-4.185	10.482
July	5.643	3.686	1.531	0.130	-1.687	12.973
Aug	3.776	3.684	1.025	0.308	-3.551	11.102
Sept	-2.936	3.683	-0.797	0.428	-10.259	4.388
Oct	-2.338	3.681	-0.635	0.527	-9.659	4.983
Nov	-0.786	3.680	-0.213	0.831	-8.104	6.533
Dec	-2.969	3.680	-0.807	0.422	-10.287	4.348
Jan	-1.600	3.679	-0.435	0.665	-8.916	5.716
Feb	-1.752	3.678	-0.476	0.635	-9.067	5.563
March	-1.905	3.678	-0.518	0.606	-9.220	5.409
Significant Coef.	*	90%=1.671				
	**	95%=2.000				

TABLES

Table 1: Price Mean, Median, Standard Deviation, and Coefficient of Variation, Selected Crops, Canada, May 1988 – June 1996 (Real U.S. $/m.t.)

Data Crop (Variable)	Mean Price	Median Price	Standard Deviation	Coefficient of Variation
Alberta Canola Cash (Abrsc)	205.45	199.02	29.57	0.144
Winnipeg Canola Futures (Rsf)	238.99	236.15	31.81	0.133
Alberta Barley Cash (Abbc)	66.90	62.73	15.59	0.233
Alberta Oats Cash (Aboc)	72.44	66.12	20.74	0.286
Winnipeg Oat Futures (Wof)	83.94	75.36	24.06	0.287
Alberta Wheat Cash (Abwc)	80.06	79.40	23.45	0.293
Winnipeg Wheat Futures (Wwf)	90.63	85.52	23.96	0.264
Peas Farm (Pf)	120.54	117.48	20.68	0.172
Peas Thunder Bay (Ptb)	133.24	128.94	21.67	0.163

Source: Study Results

Table 2: Price Mean, Median, Standard Deviation, and Coefficient of Variation, Selected Crops, United States, May 1988 – June 1996 (Real U.S. $/m.t.).

Data Crop (Variable)	Mean Price	Median Price	Standard Deviation	Coefficient of Variation
Corn Cash (Cc)	84.74	83.31	15.11	0.178
Corn Futures (Cf)	87.77	85.50	15.39	0.175
Corn Cash Export (Ccx)	98.42	95.40	16.28	0.165
Oats Cash (Oc)	104.58	89.81	36.52	0.349
Oat Futures (Of)	91.06	79.21	30.91	0.339
Wheat Cash (Wc)	113.90	109.67	21.74	0.191
Wheat Futures (Wf)	116.16	112.01	22.13	0.190
Bean Oil Cash (Boc)	433.35	425.07	63.36	0.146
Bean Oil Futures (Bof)	432.83	422.61	60.43	0.140
Soybean Cash (Sc)	196.01	186.97	37.23	0.190
Soybean Futures (Sf)	199.49	190.12	38.52	0.193
Soybean Meal Cash (Smc)	177.48	164.37	40.71	0.229
Soybean Meal Futures (Smf)	182.94	171.0533	38.06	0.208

Source: Study Results

Table 3: Price Mean, Median, Standard Deviation, and Coefficient of Variation, Selected Crops, Europe, May 1988 – June 1996 (Real U.S. $/m.t.).

Data Crop (Variable)	Mean Price	Median Price	Standard Deviation	Coefficient of Variation
Corn Cash Europe (Cce)	110.49	106.50	16.50	0.149
Soybean Cash Europe (Soyeuc)	223.42	212.69	38.81	0.174
Soybean Meal Europe (Sme)	185.66	172.94	40.86	0.220
Feed Peas Europe (Pe)	165.66	163.39	26.33	0.159

Source: Study Results

Table 4: Price Mean, Median, Standard Deviation, and Coefficient of Variation, Selected Ocean and Rail Freight Rates, May 1988 – June 1996 (Real U.S. $/m.t.).

Data (Variable) Freight from Port to Europe	Mean Price	Median Price	Standard Deviation	Coefficient of Variation
St. Lawrence Ports (Fstla) to Europe	9.47	9.94	2.14	0.226
Great Lakes Ports (Fgrla) to Europe	21.94	22.20	3.80	0.173
U.S. Gulf Ports (Fgulf) to Europe	10.58	10.37	1.95	0.185
Western Canadian Rail to Thunder Bay (Fcdn)	7.44	6.89	2.48	0.334
Western Canadian Rail (Fcdn) + Great Lakes Ports (Fgrla)	25.08	24.15	4.32	0.172

Source: Study Results

Table 5: Correlation, Selected Canadian Farm Cash Crop Prices May 1988 – June 1996.

Variable	Correlation Matrix				
Peas Farm (Pf)	1.000				
Alberta Canola Cash (Abrsc)	.536	1.000			
Alberta Barley Cash (Abbc)	.620	.546	1.000		
Alberta Wheat Cash (Abwc)	.636	.467	.922	1.000	
Alberta Oats Cash (Aboc)	.798	.546	.800	.674	1.000
	Peas Farm (Peas Farm (Pf))	Alberta Canola Cash (Abrsc)	Alberta Barley Cash (Abbc)	Alberta Wheat Cash (Abwc)	Alberta Oats Cash (Aboc)

Source: Study Results

Table 6: Correlation, Selected North American and European Cash Prices May 1988 – June 1996.

North American Market (Variable)	European Market (Variable)	Correlation between North American and European Market
Corn Cash (Cc)	Corn Cash Europe (Cce)	0.939
Soybean Cash (Sc)	Soybean Cash Europe (Soyeuc)	0.965
Soybean Meal Cash (Smc)	Soybean Meal Cash Europe (Sme)	0.962
Peas Farm (Pf)	Peas Cash Europe (Pe)	0.936
Peas Thunder Bay (Ptb)	Peas Cash Europe (Pe)	0.942

Source: Study Results

Table 7: Correlation, Selected Dry Pea Price Markets, Canadian and European Cash Prices, May 1988 – June 1996.

Nominal Local Dollars Panel 1

	Pe	*Ptb*	*Pf*	*Pcen*	*Pgreen*	*Pfeed*
Pe	1					
Ptb	0.5255	1				
Pf	0.5258	0.9411	1			
Pcen	0.2597	0.6231	0.6592	1		
Pgreen	0.4230	0.4335	0.4367	0.5581	1	
Pfeed	0.4743	0.9000	0.9076	0.7260	0.4382	

Panel 2 Nominal Canadian Dollars

	*Pe*cdf*	*Ptb*	*Pt*	*Pcen*	*Pgreen*	*Pfeed*
Pe*cdf	1					
Ptb	0.9308	1				
Pf	0.8808	0.9411	1			
Pcen	0.5395	0.6231	0.6592	1		
Pgreen	0.4522	0.4335	0.4367	0.5581	1	
Pfeed	0.8372	0.9000	0.9076	0.7260	0.4382	

Pe Peas (Europe CIF) (U.S.$)
Ptb Peas (Thunder Bay Cash Dealer)
Pf Peas Farm (Prairie Feed Cash)
Pcen Peas Century (Human Consumption Yellow Alberta Cash)
Pgreen Peas Green (Human Consumption Alberta Cash)
Pfeed Peas (Feed Alberta Cash)
cdf Canadian Dollar Futures Chicago

Source: Study Results

Table 8: Seasonality, Regression Summary Results, Canadian Canola, Wheat, Feed Peas, May 1988 – June 1996.

Seasonality between Markets	$\bar{R}^2$	F(12,84) (p)	Significant Variables @ 90% Critical Value Coefficient (t-ratio)					
Pea Farm (Pf) to Pea Thunder Bay (Ptb)	.0560	1.475 (.1500)	Constant –12.905 (-6.271)					
Pea Farm (Pf) to Pea Europe (Pe)	.5076	9.2477 (4.4E-11)	Constant –59.10 (-20.66)	Time .2420 (9.387)	June –6.109 (-1.724)	Aug. 6.138 (1.734)	Sept. 6.119 (1.730)	Oct. 6.939 (1.962)
Alberta Wheat Cash (Abwc) to Winnipeg Wheat Futures (Wwf)	.3244	4.840 (5.4E-6)		Time –0.172 (-6.414)				
Alberta Canola Cash (Abrsc) to Winnipeg Canola Futures (Rsf)	.1097	1.9856 (.0355)	Constant –38.371 (-8.307)		June –10.67 (-1.864)			Feb. 12.968 (2.272)

Source: Study Results

Table 9: Seasonality, Regression Summary, Selected North American and European Markets, May 1988 – June 1996 (Real U.S. $/m.t.).

Seasonality between Markets	$\bar{R}^2$	$F_{(12,84)}$ (p)	Significant Variables @ 90% Critical Value Coefficient (t-ratio)		
Pea Thunder Bay (Ptb) to Pea Europe (Pe)	.6467	15.644 (9.82E-17)	Constant -46.195 (-20.472)	Time .2686 (13.210)	
Soybean Meal Cash (Smc) to Soybean Meal Europe (Sme)	.1691	2.629 (.00498)	Constant -7.753 (-1.877)		January -14.376 (-2.817)
Soybean Cash (Sc) to Soybean Europe (Soyeuc)	.0358	1.297 (.2356)	Constant -57.006 (-12.031)	Time .1379 (3.230)	
Corn Cash (Cc) to Corn Cash Europe (Cce)	.4741	.6379 (.8041)	Constant -137.971 (-13.981)		

Source: Study Results

Table 10: Granger Causality Lag Length Selection, AIC Criteria

Endogenous Variable	Exogenous Variable	Lag Length (Endogenous, Exogenous) AIC (Min.)	Lag Length (Endogenous, Exogenous) AIC (2ndMin.)	Lag Length (Endogenous, Exogenous) AIC (3rdMin.)
Peas Farm (Pf)	Peas Europe (Pe)	6,1 -6.199	6,4 -6.188	4,1 -6.184
Peas Europe (Pe)	Peas Farm (Pf)	1,2 -6.544	1,3 -6.542	1,5 -6.537
Peas Europe (Pe)	Soybean Meal Europe (Sme)	1,3 -6.549	1,2 -6.545	4,3 -6.539
Soybean Meal Europe (Sme)	Peas Europe (Pe)	1,3 -6.284	1,6 -6.259	1,2 -6.252
Soybean Meal Europe (Sme)	Soybean Meal Futures (Smf)	3,1 -6.541	2,1 -6.539	4,1 -6.521
Soybean Meal Futures (Smf)	Soybean Meal Europe (Sme)	1,4 -6.225	1,6 -6.217	1,5 -6.216
Peas Europe (Pe)	Soybean Meal Futures (Smf)	1,2 -6.544	1,3 -6.542	1,4 -6.536
Soybean Meal Futures (Smf)	Peas Europe (Pe)	1,4 -6.229	1,5 -6.216	1,6 -6.211
Peas Europe (Pe)	Soybean Meal Cash (Smc)	1,2 -6.544	1,3 -6.542	1,4 -6.536
Soybean Meal Cash (Smc)	Peas Europe (Pe)	1,5 -5.991	1,4 -5.988	5,6 -5.987
Peas Farm (Pf)	Soybean Meal Futures (Smf)	6,1 -6.142	4,1 -6.1355	1,6 -6.1350
Soybean Meal Futures (Smf)	Peas Farm (Pf)	1,4 -6.228	1,6 -6.219	1,5 -6.217

Source: Study Results

Endogenous variable = lagged endogenous variable + lagged exogenous variable

Table 11: Granger Causality, Selected Markets, May 1988 – June 1996.

Endogenous Variable	Exogenous Variable	F-test D.F.(3,94)
Peas Farm (Pf)	Peas Europe (Pe)	.0485
Peas Europe (Pe)	Peas Farm (Pf)	3.6263**
Peas Europe (Pe)	Soybean Meal Europe (Sme)	1.1601
Soybean Meal Europe (Sme)	Peas Europe (Pe)	.3730
Soybean Meal Europe (Sme)	Soybean Meal Futures (Smf)	18.2116***
Soybean Meal Futures (Smf)	Soybean Meal Europe (Sme)	.5020
Peas Europe (Pe)	Soybean Meal Futures (Smf)	3.6859**
Soybean Meal Futures (Smf)	Peas Europe (Pe)	.5279
Peas Europe (Pe)	Soybean Meal Cash (Smc)	3.7383**
Soybean Meal Cash (Smc)	Peas Europe (Pe)	.2302
Peas Farm (Pf)	Soybean Meal Futures (Smf)	0.0082
Soybean Meal Futures (Smf)	Peas Farm (Pf)	4.1493***

Source: Study Results
Null Hypothesis that exogenous variable does not cause endogenous variable.
Paired results; significant exogenous variable indicates causation of endogenous variable, if both significant feed back relationship. If neither significant no relationship.
Significance *.10 = 2.18; **.05 = 2.76; ***.01 = 4.13

Table 12: Augmented Dickey-Fuller, Unit Root Orders.

Variable Level, Natural Logarithm , Real local	A.D.F. Test statistic Constant, No-trend. a) c)	A.D.F. Test statistic Constant, Trend. b) c)	Lag	Integration Order I(order) d)	
				No-trend	Trend
Peas Farm (Pf)	-2.224	-1.695	0		
Peas Thunder Bay (Ptb)	-1.675	-1.070	0		
Peas Europe (Pe)	-2.040	-1.742	0		
Soybean Meal Europe (Sme)	-1.782	-0.860	0		
Soybean Meal Cash (Smc)	-2.194	-1.486	0		
Soybean Meal Futures (Smf)	-2.178	-1.424	0		
Soybean Europe (Soyeuc)	-2.855*(**I)	-2.186	6	0(I)	
Soybean Cash (Sc)	-2.337	-1.690	0		
Soybean Futures (Sf)	-2.787*(**I)	-2.390	0	0(I)	
Corn Cash Europe (Cce)	-0.473	-0.928	0		
Corn Cash (Cc)	-0.793	-0.463	0		
Corn Futures (Cf)	-1.035	-0.697	0		
Corn Cash Export (Ccx)	-1.484	-0.649	3		
Wheat Cash (Wc)	-1.781	-0.964	9		
Wheat Futures (Wf)	-1.708	-1.708	0		

Continued

Alberta Wheat Cash (Abwc)	-1.210	0.207	9		
Winnipeg Wheat Futures (Wwf)	0.089	0.244	0		
Oats Cash (Oc)	-1.736	-1.260	0		
Oat Futures (Of)	-3.474***(*)	-2.187	1	0(0)	
Alberta Oats Cash (Aboc)	-1.508	-1.172	1		
Winnipeg Oat Futures (Wof)	-0.988	1.034	0		
Alberta Canola Cash (Abrsc)	-2.021	-2.593	0		
Winnipeg Canola Futures (Rsf)	-1.967	-2.363	0		
Bean Oil Cash (Boc)	-2.597*(**I)	-2.524	0	0(I)	
Bean Oil Futures (Bof)	-2.715*(**I)	-2.610	0	0(I)	
Freight Gulf (Fgulf)	-2.943**(**I)	-3.230*()	0	0(I)	0()
Freight St. Lawrence (Fstla)	-1.765	-2.432	0		
Freight Great Lakes (Fgda)	-1.462	-1.400	3		
Freight Canadian Rail (Fcdn)	-0.375	-1.859	0		
Freight Total (Fttl) = Fcdn + Fda	-0.874	-0.923	3		
Canadian Dollar Cash (Cdac)	-0.499	-1.935	8		
Canadian Dollar Futures (Cdf)	-0.474	-2.309	0		
Consumer Price Index Canada (Cpic)	-2.563	-1.509	2		
Consumer Price Index U.S. (Cpiu)	-2.012	-2.322	7		

Significant ADF t-test indicates rejection of null hypothesis of unit root a) A(1)=0 C.V. *10% –2.57 **5% -2.86 ***1% -3.43 b) A(1)=0 C.V. *10% –3.13 **5% -3.41 ***1% -3.96 ; c) Using critical values of Charemza and Deadman 1993 () = significant, (I) = indeterminate region; d) () = integration order;

Panel 2

Variable Differenced 1, Natural Logarithm, Real local	A.D.F. Test statistic Constant, No-trend. a) c)	A.D.F. Test statistic Constant, Trend.b) c)	Lag	Integration Order I(order) d)	
				No-trend	Trend
Peas Farm (Pf)	-4.418***	-5.030***	3	1	1
Peas Thunder Bay (Ptb)	-3.835***	-4.864***	3	1	1
Peas Europe (Pe)	-6.014***	-6.568***	2	1	1
Soybean Meal Europe (Sme)	-5.334***	-6.024***	2	1	1
Soybean Meal Cash (Smc)	-3.914***	-4.396***	3	1	1
Soybean Meal Futures (Smf)	-3.958***	-4.562***	3	1	1
Soybean Europe (Soyeuc)	-2.946**	-3.457**	5	1	1
Soybean Cash (Sc)	-5.434***	-6.070***	2	1	1
Soybean Futures (Sf)	-5.247***	-5.911***	2	1	1
Corn Cash Europe (Cce)	-4.440***	-5.203***	2	1	1
Corn Cash (Cc)	-4.077***	-4.533***	2	1	1
Corn Futures (Cf)	-5.690***	-6.198***	1	1	1
Corn Cash Export (Ccx)	-4.015***	-4.564***	2	1	1
Wheat Cash (Wc)	-2.003(*I)	-2.676	9	(1)	

Continued

Wheat Futures (Wf)	-1.791(*)	-2.326	9	(1)	
Alberta Wheat Cash (Abwc)	-1.999(*I)	-3.235*	8	(1)	1
Winnipeg Wheat Futures (Wwf)	-4.812***	-5.629***	2	1	1
Oats Cash (Oc)	-7.068***	-8.216***	1	1	1
Oat Futures (Of)	-7.431***	-8.360***	1	1	1
Alberta Oats Cash (Aboc)	-6.050***	-6.700***	1	1	1
Winnipeg Oat Futures (Wof)	-6.9177***	-7.894***	1	1	1
Alberta Canola Cash (Abrsc)	-2.816*	-3.324*	9	1	1
Winnipeg Canola Futures (Rsf)	-5.650***	-5.981***	2	1	1
Bean Oil Cash (Boc)	-4.025***	-4.002***	5	1	1
Bean Oil Futures (Bof)	-3.957***	-3.982***	5	1	1
Freight Gulf (Fgulf)	-4.121***	-4.112***	5	1	1
Freight St. Lawrence (Fstla)	-4.478***	-4.451***	3	1	1
Freight Great Lakes (Fgrla)	-4.165***	-4.159***	5	1	1
Freight Canadian Rail (Fcdn)	-5.113***	-5.236***	3	1	1
Freight Total (Fttl) = Fcdn + Frla	-3.462***	-3.520**	6	1	1
Canadian Dollar Cash (Cdac)	-2.648*	-2.657	7	1	
Canadian Dollar Futures (Cdf)	-2.409(**I)	-2.417	8	(1)	
Consumer Price Index Canada (Cpic)	-2.342(**)	-3.000	7	(1)	

Continued

Consumer Price Index U.S. (Cpiu)	-2.510(**I)	-3.051	6	(1)	

Significant ADF t-test indicates rejection of null hypothesis of unit root. a) A(1)=0 C.V. *10% –2.57 **5% -2.86 ***1% -3.43 b) A(1)=0 C.V. *10% –3.13 **5% -3.41 ***1% -3.96 ; c) Using critical values of Charemza and Deadman 1993 () = significant, (I) = indeterminate region; d) () = integration order ;

Panel 3

Variable Differenced 2, Natural Logarithm, Real local	A.D.F. Test statistic Constant, No-trend. a)	A.D.F. Test statistic Constant, Trend. b)	Lag	Integration Order I(order)	
				No-trend	Trend
Wheat Cash (Wc)	-6.679***	-6.703***	9	2	2
Wheat Futures (Wf)	-8.115***	-8.071***	2	2	2
Alberta Wheat Cash (Abwc)	-5.594***	-5.613***	8	2	2
Canadian Dollar Cash (Cdac)	-6.943***	-6.918***	7	2	2
Canadian Dollar Futures (Cdf)	-6.709***	-6.681***	8	2	2
Consumer Price Index Canada (Cpic)	-3.685***	-3.651**	9	2	2
Consumer Price Index U.S. (Cpiu)	-5.204***	-5.179***	7	2	2

Significant ADF t-test indicates rejection of null hypothesis of unit root. a) A(1)=0 C.V. *10% –2.57 **5% -2.86 ***1% -3.43 b) A(1)=0 C.V. *10% –3.13 **5% -3.41 ***1% -3.96

Table 13: Cointegration between Selected North American and European Markets, May 1988 – June 1996 (June 1989 – June 1995).

Crop Dependent Variable (Natural Logarithms)	Independent Variables (Natural Logarithms)	Coefficient n=97 (Coefficient Restricted Data n=72)	T-Test a (T-Test Restricted Data)	R2 DW	ADF Test b PP Test b	ADF & PP 10% 5% 1% C.V.
Corn Cash Europe (Cce)	Corn Cash (Cc)	.7584 (.6058)	30.724**** (17.878****)	.9191 (.8492)	-4.209** (-4.259**)	-3.45 -3.74 -4.29
	Freight Gulf (Fgulf)	.1784 (.1771)	8.114**** (8.895****)	1.116 (1.305)	-6.060*** (-5.855****)	
	Constant	1.001 (1.5800)	8.554**** (10.112****)			
Soybean Cash Europe (Soyeuc)	Soybean Cash (Sc)	.8492 (.7060)	36.549**** (18.058****)	.9419 (.8266)	-5.154*** (-4.330***)	-3.45 -3.74 -4.29
	Freight Gulf (Fgulf)	.1000 (.0791)	4.802**** (4.377****)	1.468 (1.190)	-8.745*** (-5.392***)	
	Constant	.7810 (1.480)	6.456**** (6.926****)			
Soybean Meal Cash Europe (Sme)	Soybean Meal Cash (Smc)	.8798 (.7630)	32.491**** (15.317****)	.9260 (.7728)	-2.975 (-4.531***)	-3.45 -3.74 -4.29
	Freight Gulf (Fgulf)	.1320 (.0955)	4.431**** (2.890****)	1.016 (.8996)	-5.809*** (-4.613***)	
	Constant	.3450 (1.0315)	2.390**** (3.720****)			

Continued

Feed Peas Thunder Bay (Ptb)	Feed Peas Europe (Pe)	1.1495	(.9257)	36.142**** (14.665****)	.9372 (.7637)	-3.335 (-3.326)	-3.81 -4.10 -4.64
	Canadian $ Cash (Cdac)	1.7102	(1.2964)	26.081**** (13.557****)	.9590 (1.221)	-5.250*** (-5.634***)	
	Freight Great Lakes (Fgda)	-.0476	(-.0710)	-2.231*** (-3.712****)			
	Constant	-.9865	(.2950)	-5.924**** (.897)			

Source: Study Results. a) Significance *90% ** 95% ***97.5% ****99% b) *90% ** 95% ***99%

Table 14: Cointegration between Peas Farm (Peas Farm (Pf)) and Peas Thunder Bay (Ptb), and Peas Europe (Pe), and Chicago Soybean Meal Futures. May 1988 – June 1996 (June 1989 – June 1995).

Crop Dependent Variable (Natural Logarithm)	Independent Variables (Natural Logarithm)	Coefficient n=97 (Coefficient Restricted Data n=72)	T-Test a (T-Test Restricted Data)	R2 DW	ADF Test b PP Test b	ADF & PP 10% 5% 1% C.V.
Peas Farm (Pf)	Feed Peas Thunder Bay (Ptb)	.99001 (1.0632)	39.514**** (16.222****)	.9436 (.7950)	-3.4720* (-3.5518*)	-3.45 -3.74 -4.29
	Freight Canadian (Fcdn)	-.047278 (-.01683)	-4.3675**** (-4.3675****)	1.846 (1.221)	-9.0084*** (-7.5017***)	
	Constant	.053825 (-.37953)	.41575 (-1.1008)			
Peas Farm (Pf)	Peas Europe (Pe)	1.1509 (1.0072)	27.747**** (10.828****)	.8939 (.6341)	-3.6988 (-3.2665)	-3.81 -4.10 -4.64
	Canadian $ Cash Cdac	1.5946 (1.3658)	17.858**** (9.6000****)	1.461 (.9509)	-7.3677*** (-5.477***)	
	Freight Total (Ftl)	-.061488 (-.061488)	-2.0803** (-2.3499***)			
	Constant	-1.0086 (-.14445)	-4.4603**** (-.29466)			
Peas Farm (Pf)	Soybean Meal Futures (Smf)	.64708 (.0317)	13.342**** (.3518)	.6548 (.0045)	-3.5737* (-2.7091)	-3.45 -3.74 -4.29
	Canadian $ Cash (Cdac)	.55116 (.0705)	4.3045**** (.54514)	.4697 (.3787)	-3.6402* (-2.9346)	
	Constant	1.5197 (4.7604)	5.8130**** (10.021****)			

Source: Study Results. a) Significance *90% ** 95% ***97.5% ****99% b) *90% ** 95% ***99%

Table 15: Selected Nutritional Contents, Selected Feed Components.

Panel 15.1

Crop Ingrediants

Ingredient	Dry Matter%	Crude Protein%	Crude Fat%	Crude Fibre%	Calcium %	Total Phos.%	Ash %	Ruminant Dig.Prot.%	By-Pass Prot.%
Barley	89	11.5	1.9	5	0.008	0.42	2.5	8.6	25
Canola meal	92	36	2.6	13.2	0.66	0.93	7.2	32	30
Corn	88	8.9	3.5	2.9	0.01	0.25	1.5	5.8	60
Oats	90	11	4	10.5	0.1	0.35	4	8.8	20
Peas	91	22	1	6	0.17	0.32	2.8	17	22
Soymeal	89.6	44	0.05	7	0.25	0.6	6	37.5	30
Wheat	88	13.5	1.9	3	0.05	0.41	2	10.9	25
Vicia Faba	89	25.7	1.4	8.2	0.14	0.54	6	21.6	N/A

Panel 15.2

Energy Analysis

Ingredient	ME(Kcal/kg) Poultry	Swine
Barley	2620	2870
Canola meal	1770	2700
Corn	3366	3168
Oats	2550	2668
Peas	2600	3200
Soymeal	2240	2825
Wheat	3086	3220
Vicia Faba	2370	

Panel 15.3

Amino Acid Content of Feed Ingredients

Ingredient	Lysine %
Barley	0.53
Canola meal	2.12
Corn	0.22
Oats	0.4
Peas	1.2
Soymeal	2.9
Wheat	0.4
Vicia Faba	1.52

Source: [Canadian International Grains Institute.,1993]

Table 16: Selected Nutrient Requirements, Swine.

Panel 1 Performance of Pigs Fed Peas as a Replacement for Soybean

% Soymeal Replaced					
	0	25	50	75	100
Daily Feed kg	2.16	2.07	2.09	2.22	2.11
Daily Gain	0.70	0.70	0.70	0.68	0.70
Feed/Gain	3.07	2.95	3.35	3.26	3.06

Source: [Gowans 1999]

Panel 2: Substitution of Peas and Canola Meal for Soymeal in Grower Pig (23-57 kg) Rations

Supplement	Daily Gain(g)	Intake(kg)	Feed Conversion
All-Soy	652	1.73	2.67
All-Canola	641	1.71	2.72
All-Peas	675	1.83	2.57
1/3 Peas, 2/3 Canola	644	1.68	2.71
2/3 Peas, 1/3 Canola	678	1.73	2.56

Source:[Gowans1999]

Table 17: Basis Calculation for Export Canadian Wheat, Years 1985/86 – 1994/95.

Costs of Moving Wheat from Farm to Export Position

Costs Year	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	Mean
Primary Elevation	6.09	6.27	6.27	6.98	7.26	7.94	8.26	8.01	7.56	7.78	7.68
Dockage Removal	1.67	1.67	1.67	1.84	2.05	2.3	2.41	2.66	3.11	3.11	2.50
Shrinkage	0.4	0.32	0.34	0.49	0.43	0.14	0.13	0.16	0.16	0.19	0.24
Carrying Charges (	4.05	2.49	2.3	3.42	4.95	4.07	2.1	2.78	2.29	1.79	3.06
Freight Rail	6.3	6.27	6.65	7.64	9.45	10.7	11.07	11.98	13.73	14.72	11.33
Marketing (3)	3.3	1.64	1.04	-0.03	1.39	2.65	0.61	1.39	2.11	2.31	1.49
Terminal Storage (	1.37	0.83	1	1.11	1.52	1	0.91	1.68	0.53	0.61	1.05
Fobbing											
St.Lawrence (4)	5.24	5.24	5.24	5.51	5.71	6.39	6.58	6.69	6.8	6.92	6.37
Pacific (5)	5.23	5.23	5.23	5.6	5.97	6.41	6.58	6.71	6.81	7.07	6.45
Lake Freight (6)	19.77	17.55	17.78	17.91	16.6	17.42	18.02	18.12	18.15	18.16	17.77
Transfer Storage	1.45	0.99	1.19	1.87	1.51	0.91	1.83	2.25	2.99	1.85	1.89
Fobbing (7)	2.4	2.27	2.15	2.04	2.07	2.18	2.23	2.27	2.27	2.27	2.19
Total St.Lawrence	52.04	45.54	45.63	48.78	52.94	55.7	54.15	57.99	59.7	59.71	55.57
Total Pacific	28.41	24.72	24.5	27.05	33.02	35.21	32.07	35.37	36.3	37.58	33.80

1) filed tariff for receiving, elevating and loading
2) Carrying charges on wheat stored in country elevators.
3) Includes interest, bank and other charges and Canadian Wheat Board administrative costs.
4) Thunder Bay fobbing charge, which includes elevation, outward weighing and inspection, terminal elevator receipt cancellation, lake shippers' charges, superintendence and forwarding brokerage charges.
5) Includes elevation, outward weighing and inspection, terminal elevator receipt cancellation, B.C. Shippers' charges, superintendence, wharfage and forwarding brokerage charges.
6) Includes lake freight, lake brokerage, cargo rates, insurance, St. Lawrence Seaway and Welland Canal tolls and inward elevation into into transfer elevator.
7) Includes outward elevation, outward inspection and weighing, superintendence, wharfage and forwarding brokerage charges.

Source: Canada Grains Council 96 p184

Table 18: Basis Calculation for Feed Pea Contract

BASIS FOR NEW FEED PEA CONTRACT		
	T. Bay	Vanc.
February Feed Pea Futures Price (Us $/t)	$212	$212
(Delivered Antwerp, Rotterdam, Amsterdam, Ghent)		
Ocean freight plus other costs (US $/t)	$40	$28
Feed Pea Price Canadian Port FOB (US $/t)	$172	$184
Feed Pea Price FOB (Cdn $/t based on 1.35 exch	$233	$249
Fobbing Cost (Cdn $/t)	$10	$10
Feed Pea Price Instore (Cdn $/t)	$223	$239
Elevator basis (excluding freight) (Cdn $/t)	$4	$4
Rail Freight Davidson T.Bay (Cdn $/t)	$28	NA
Rail Freight Davidson to Vancouver (Cdn$/t)	NA	$34
Elevator Deferred Contract (Dec.)	$190	$201

Source: [Growers' marketing services 1996]

Table 19: Basis for Export Feed Peas Modified from Canadian Wheat.

Nominal Canadian $, Yearly Averages	Modified for Peas, Clean, Loaded Rail Western Canada								
Costs Year	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	Avg.	% of St.Lawrence
Primary Elevation (1)	0	0	0	0	0	0	0	0	0
Dockage Removal	0	0	0	0	0	0	0	0	0
Shrinkage	0	0	0	0	0	0	0	0	0
Carrying Charges (2)	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
Freight Rail	7.64	9.45	10.7	11.07	11.98	13.73	14.72	11.327	0.279
	0	0	0	0	0	0	0	0	0
Marketing (3)	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
Terminal Storage (2)	1.11	1.52	1	0.91	1.68	0.53	0.61	1.051	0.026
Fobbing	0	0	0	0	0	0	0	0	0
St.Lawrence (4)	5.51	5.71	6.39	6.58	6.69	6.8	6.92	6.371	0.157
Pacific (5)	5.6	5.97	6.41	6.58	6.71	6.81	7.07	6.450	0
Lake Freight (6)	17.91	16.6	17.42	18.02	18.12	18.15	18.16	17.769	0.438
	0	0	0	0	0	0	0	0	0
Transfer Storage	1.87	1.51	0.91	1.83	2.25	2.99	1.85	1.887	0.046
Fobbing (7)	2.04	2.07	2.18	2.23	2.27	2.27	2.27	2.190	0.054
	0	0	0	0	0	0	0	0	0
Total St.Lawrence	36.08	36.86	38.6	40.64	42.99	44.47	44.53	40.596	
Total Pacific	14.35	16.94	18.11	18.56	20.37	21.07	22.4	18.829	

1) filed tariff for receiving, elevating and loading
2) Carrying charges on wheat stored in country elevators.
3) Includes interest, bank and other charges and Canadian Wheat Board administrative costs.
4) Thunder Bay fobbing charge, which includes elevation, outward weighing and inspection, terminal elevator receipt cancellation, lake shippers' charges, superintendence and forwarding brokerage charges.
5) Includes elevation, outward weighing and inspection, terminal elevator receipt cancellation, B.C. Shippers' charges, superintendence, wharfage and forwarding brokerage charges.
6) Includes lake freight, lake brokerage, cargo rates, insurance, St. Lawrence Seaway and Welland Canal tolls and inward elevation into into transfer elevator.
7) Includes outward elevation, outward inspection and weighing, superintendence, wharfage and forwarding brokerage charges.

Modified from:[Government of Canada, Canada Grains Council 1996, 184]

Table 20: Data Variables, Sources, Units, Missing Observations, and Conversion Factors to Metric Tonne.

DATA SOURCES

CROP	LOCATION MARKET	VARIABLE	SOURCE	CASH PRICE OR FUTURES NEAREST	ORIGINAL UNITS	OBSERVATIONS* MISSING, ADJACENT	TO $/M.T. CONVERSION FACTOR
PEAS	FARM	PF	STAT	CASH	CDN.$/M.T	0,0	NA
	THUNDER BAY	PTB	STAT	CASH	CDN.$/M.T	0,0	NA
	ROTTERDAM	PE	STAT	CASH	U.S.$/M.TON	0,0	NA
	ALBERTA	ABPC	AB.AG.	CASH	CDN.$/M.T	0,0	NA
	ACREAGE CDN.	PA	CGC		HA.	0,0	NA
	YIELD CDN.	PY	CGC		M.T./HA.	0,0	NA
	PRODUCTION CD	PP	CGC		M.T.	0,0	NA
WHEAT	ALBERTA	ABWC	AB.AG.	CASH	CDN.$/M.T	0,0	NA
	WINNIPEG	WWF	GLANCE	FUTURES	CDN.$/M.T	0,0	NA
	CHICAGO	WC	GLANCE	CASH	U.S.¢/BUS.	0,0	.36744
	CHICAGO	WF	GLANCE	FUTURES	U.S.¢/BUS.	0,0	.36744
BARLEY	ALBERTA	ABBC	AB.AG.	CASH	CDN.$/M.T	0,0	NA
OATS	ALBERTA	ABOC	AB.AG.	CASH	CDN.$/M.T	0,0	NA
	WINNIPEG	WOF	GLANCE	FUTURES	CDN.$/M.T	0,0	NA
	CHICAGO	OC	GLANCE	CASH	U.S.¢/BUS.	0,0	.68894
	CHICAGO	OF	GLANCE	FUTURES	U.S.¢/BUS.	0,0	.68894
CANOLA	ALBERTA	ABRSC	AB.AG.	CASH	CDN.$/M.T.	0,0	NA
	WINNIPEG	RSF	GLANCE	FUTURES	CDN.$/M.T	0,0	NA
CORN	CHICAGO	CC	GLANCE	CASH	U.S.¢/BUS.	0,0	.39368
	CHICAGO	CF	GLANCE	FUTURES	U.S.¢/BUS.	0,0	.39368
	U.S.GULF	CCX	WGS	CASH	U.S.$/M.TON	0,0	NA
	ROTTERDAM	CCE	WGS	CASH	U.S.$/M.TON	5,2	NA
SOYBEAN	CHICAGO	SC	GLANCE	CASH	U.S.¢/BUS.	0,0	.36744
	CHICAGO	SF	GLANCE	FUTURES	U.S.¢/BUS.	0,0	.36744
	ROTTERDAM	SOYEUC	WGS	CASH	U.S.$/M.TON	0,0	NA
SOYMEAL	CHICAGO	SMC	GLANCE	CASH	U.S.$/TON	0,0	1.10231
	CHICAGO	SMF	GLANCE	FUTURES	U.S.$/TON	0,0	1.10231
	ROTTERDAM	SME	FAS	CASH	U.S.$/M.T.	0,0	NA

Continued

	U.S.GULF	SMM	FAS	CASH	U.S.$/M.T.	0,0	NA
BEAN OIL	CHICAGO	BOC	GLANCE	CASH	U.S.¢/LB.	0,0	22.046
	CHICAGO	BOF	GLANCE	FUTURES	U.S.¢/LB.	0,0	22.046
FREIGHT	ALBERTA	FCDN	AB.AG.	CASH	CDN.$/M.T	0,0	NA
	GREAT LAKES	FGRLA	WGS	CASH	U.S.$/M.T.	48,13(23,6)**	NA
	ST. LAWRENCE	FSTLA	WGS	CASH	U.S.$/M.T.	25,13(2,2)**	NA
	U.S.GULF	FGULF	WGS	CASH	U.S.$/M.T.	25,13(0,0)**	NA
EXCHANGE	CDN.$CASH	CDAC	CANSIM	CASH	CDN.$/U.S.$	0,0	NA
	CDN.$FUTURES	CDF	GLANCE	FUTURES	U.S.$/CDN.$	0,0	NA
CPI	CANADIAN	CPIC	CANSIM	INDEX		0,0	NA
	U.S.	CPIU	CANSIM	INDEX		0,0	NA
INTEREST	U.S.FUTURES	TBF	GLANCE	FUTURES		0,0	NA
	CANADIAN CASH	CDTBC	CANSIM	CASH		0,0	NA

AB.AG ALBERTA AGRICULTURE
CANSIM GOVERNMENT OF CANADA
CGC CANADA GRAINS COUNCIL
FAS FOREIGN AGRICULTURE SERVICE; OILSEEDS AND PRODUCTS; USDA
GLANCE GLANCE MARKET DATA
STAT STAT PUBLISHING
WGS WORLD GRAIN STATISTICS, INTERNATIONAL GRAINS COUNCIL

97 observations. **Freight series initial 13 and final 12 observations are yearly averages. Great Lakes Freight has winter season closures. (,) is the missing observations after dropping initial and final missing observations.

Table 21: Panel 1; Comparison of Data, Peas Farm (Peas Farm (Pf)) and Alberta Peas Cash (Abpc). Panel 2; Comparison of Data, Soybean Meal Export (Smm) and Soybean Meal Cash (Sc).Panel 3 Comparison of Data, Peas Farm Weekly (Peas Farm (Pf)) and Peas Farm Monthly (Peas Farm (Pf)).

Panel 1 — Pea Farm (Pf) to Alberta Pea Cash (Abpc) — WEEKLY DATA — NOMINAL CDN.$

DATA CHECK

NAME	N	MEAN	ST.DEV	VARIANCE	MINIMUM	MAXIMUM	COEF.OF.VAR.	ANOVA(F)	BART
Pf	383	167.48	16.011	256.36	134.11	224.13	0.0956	37.606*	24.668*
Abpc	342	159.07	20.807	432.95	128.60	238.84	0.1308		

Panel 2 — Soybean Meal Export (Smm) to Soybean Meal Cash (Smc) — MONTHLY DATA — NOMINAL US $

DATA CHECK

NAME	N	MEAN	ST. DEV	VARIANCE	MINIMUM	MAXIMUM	COEF.OF.VAR.	ANOVA(F)	BART
Smm	97	206.88	34.298	1176.3	154.00	317.00	0.1658	0.004534	0.006507
Smc	97	206.55	34.016	1157.1	152.34	319.67	0.1647		

Panel 3 — Pea Farm (Pf)(Weekly) to Pea Farm (Pf)(Monthly) — WEEKLY TO MONTHLY — NOMINAL CDN.$

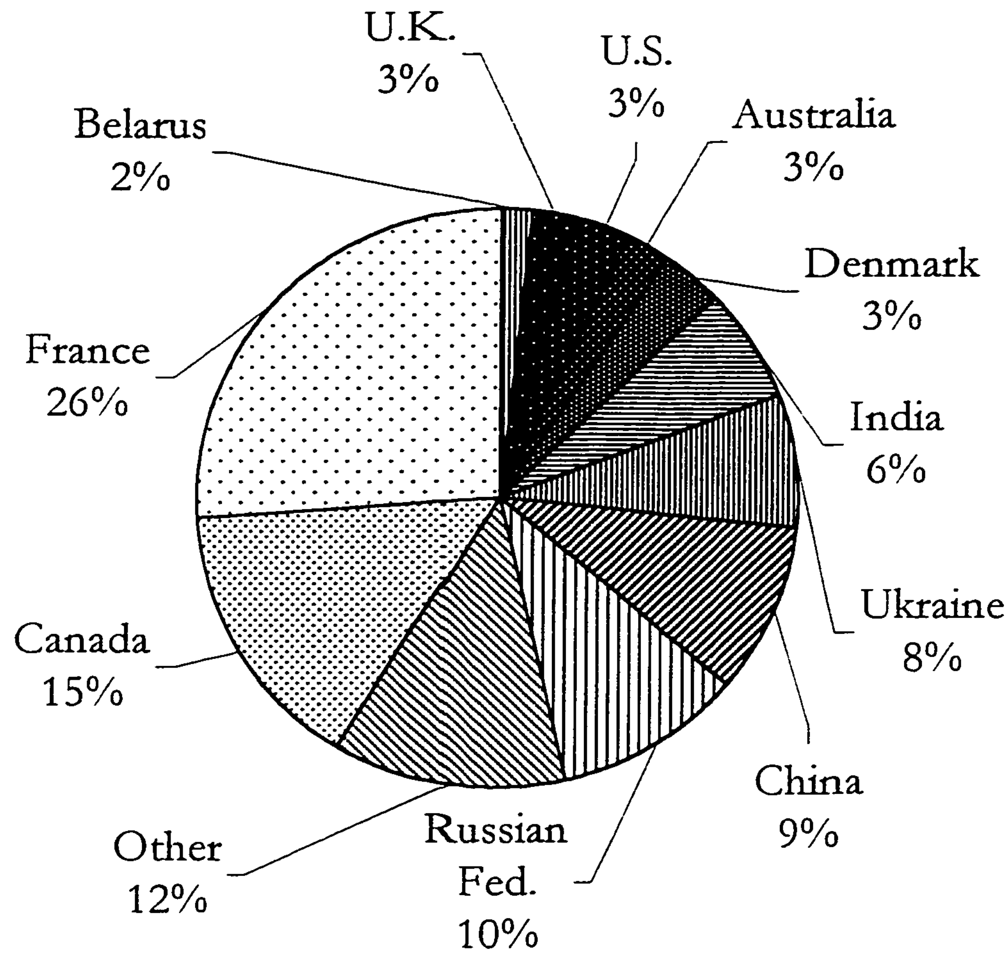
DATA CHECK

NAME	N	MEAN	ST.DEV.	VARIANCE	MIN.	MAX.	C.VAR
PF(W)	383	167.48	16.011	265.36	134.11	224.13	0.0956
PF(M)	97	172.5	21.665	469.36	137.79	238.83	0.1256

Source: Study Results

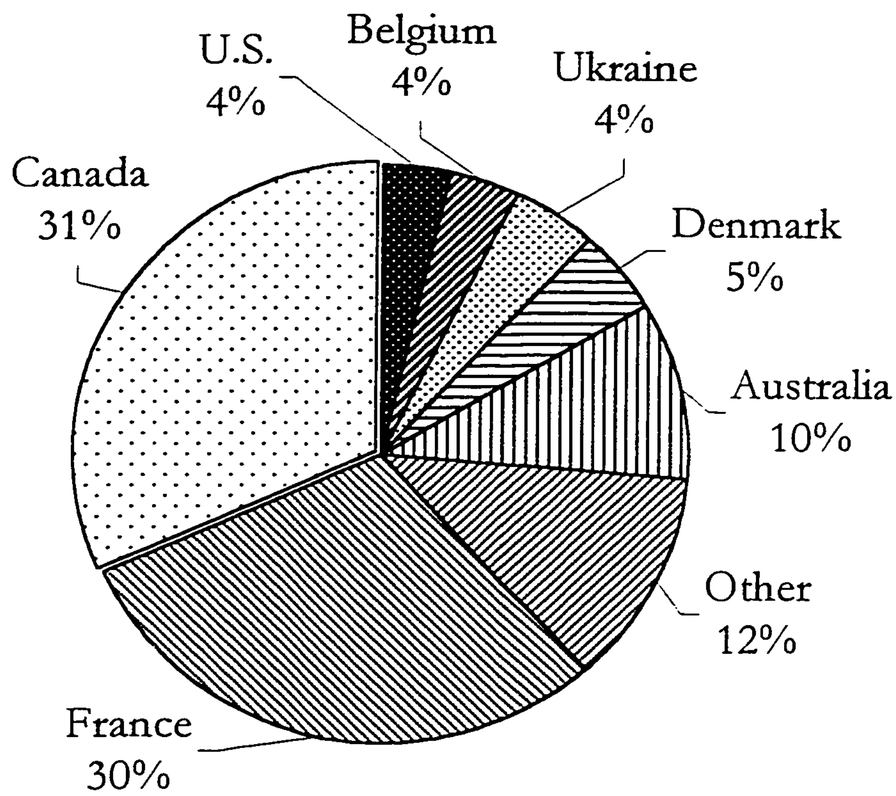
FIGURES

Figure 1: World Dry Pea Production, by Major Countries, 1997



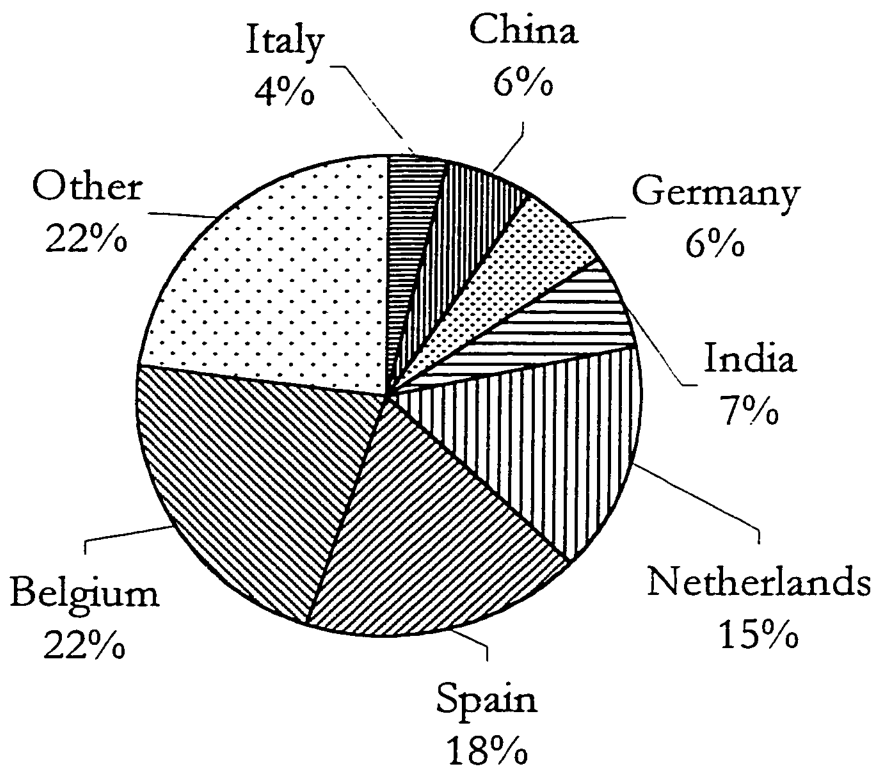
Source: Data Food and Agriculture Organization,1998,
http:\\fao.org/8080

Figure 2: Dry Pea Exports, World, byMajor Countries, 1997.



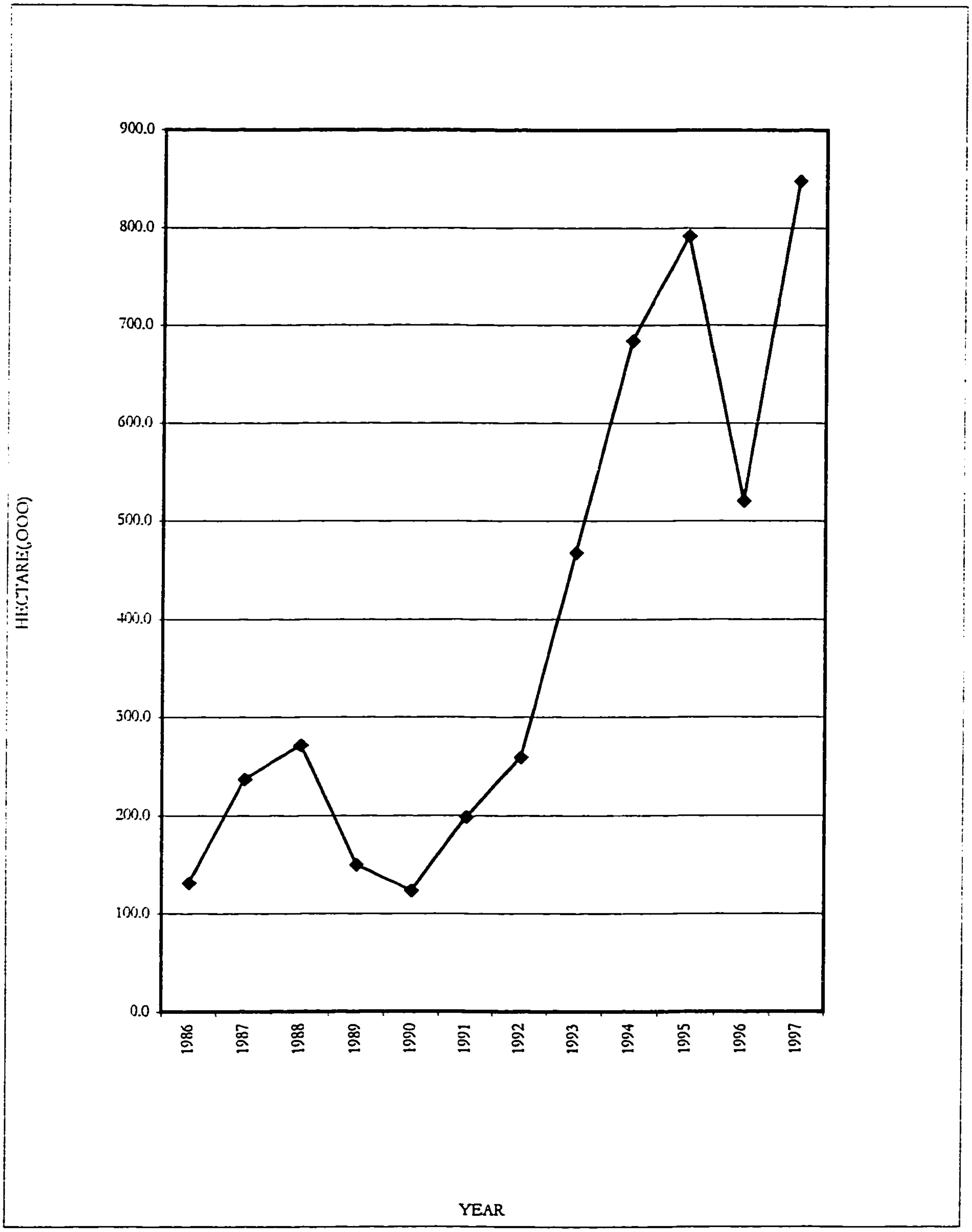
Source: Data from Food and Agriculture Organization, 1998,
http://apps.fao:8080/

Figure 3: Dry Pea Importers, World, by Major Countries, 1997.



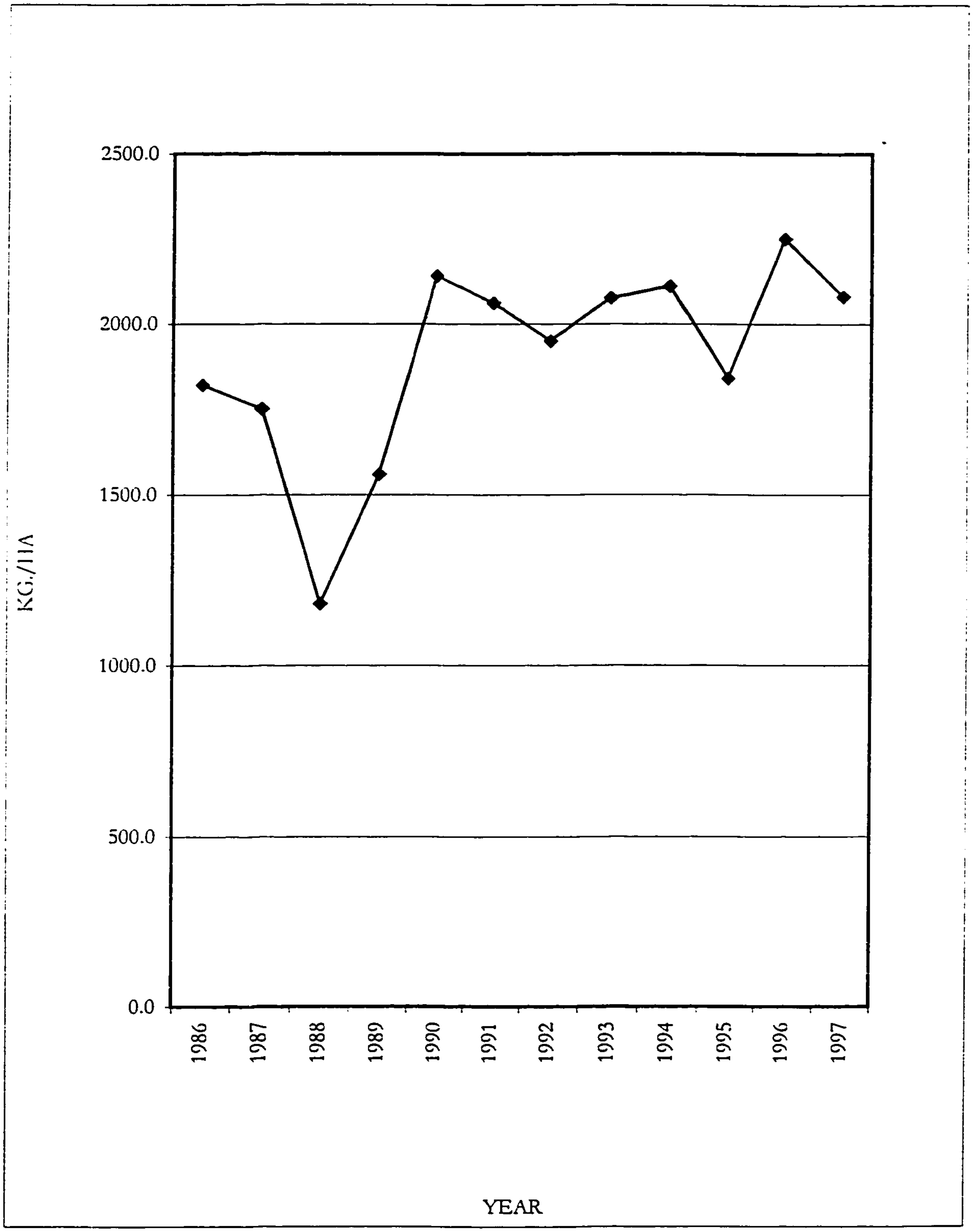
Source: Data from Food and Agriculture Organization, 1998
http://apps.fao:8080/

Figure 4: Area Planted, Dry Peas, Canada, by Years,1986-1997.



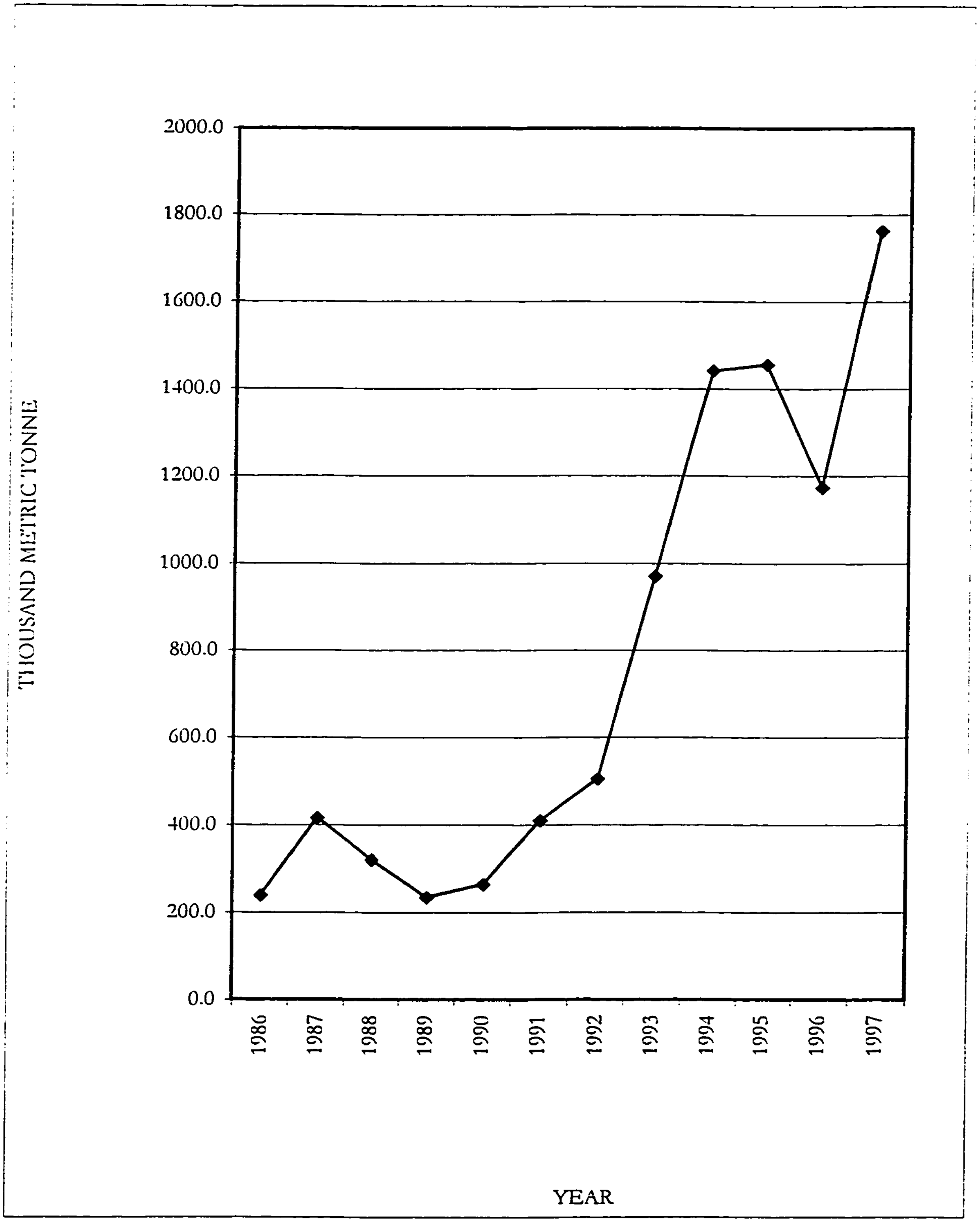
Source: Data from Food and Agriculture Organization, 1998,
http://apps.fao:8080/

Figure 5: Average Dry Pea Yield, by Years, Canada, 1986 - 1997.



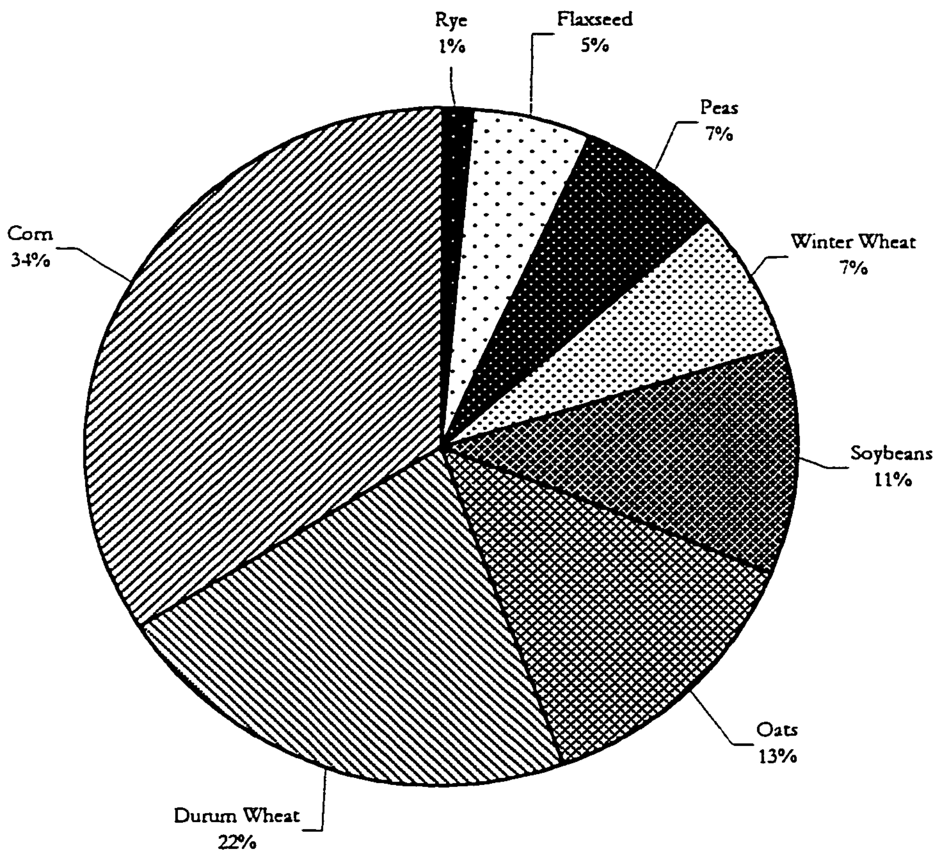
Source: Data from Food and Agriculture Organization, 1998,
http://apps.fao:8080/

Figure 6: Total Dry Pea Production, Canada, by Years, 1986 - 1997.



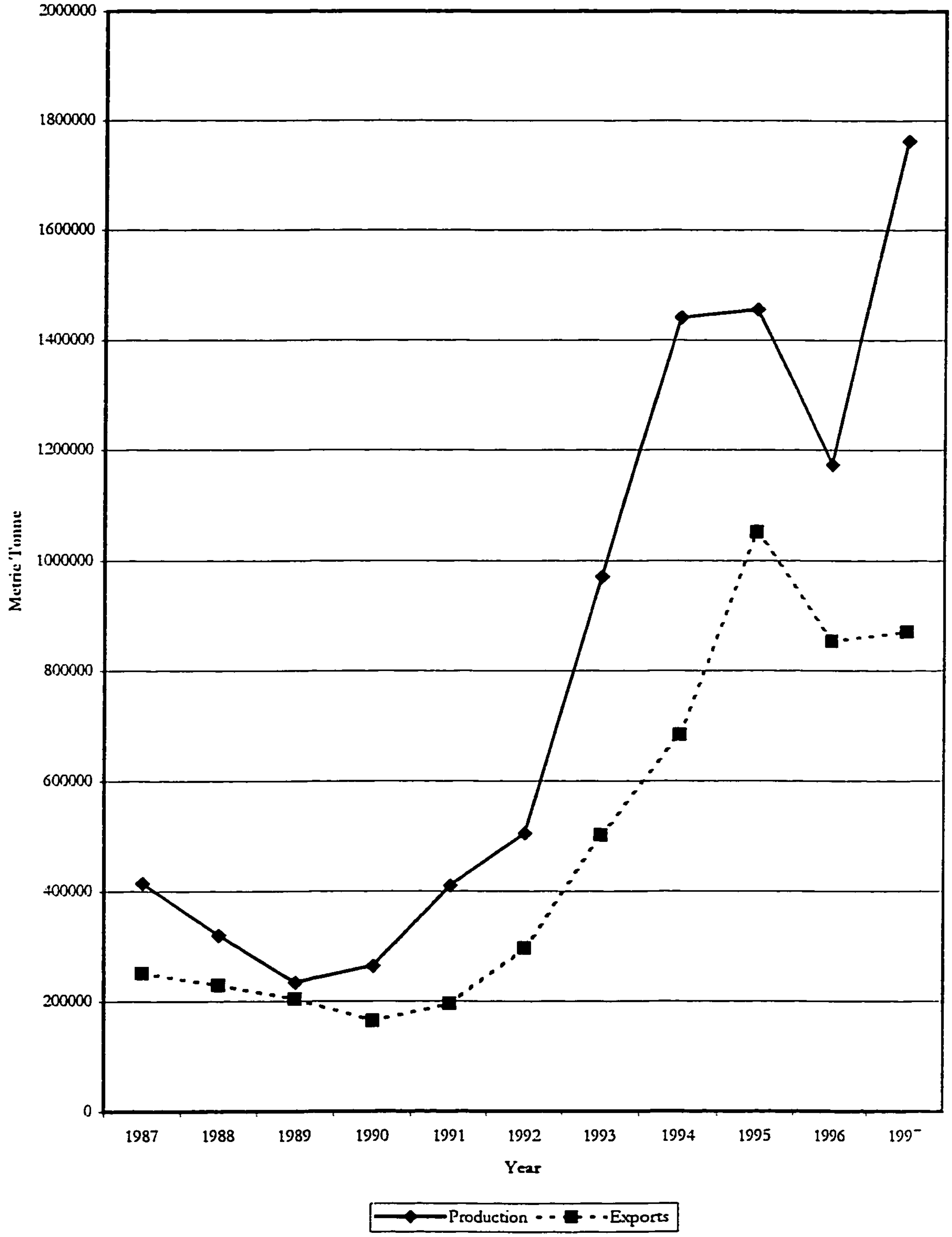
Source: Data from Food and Agriculture Organization, 1998,
http://apps.fao:8080/

Figure 7: Percentage of Crop Area Harvested of Selected Crops, Canada, 1995.



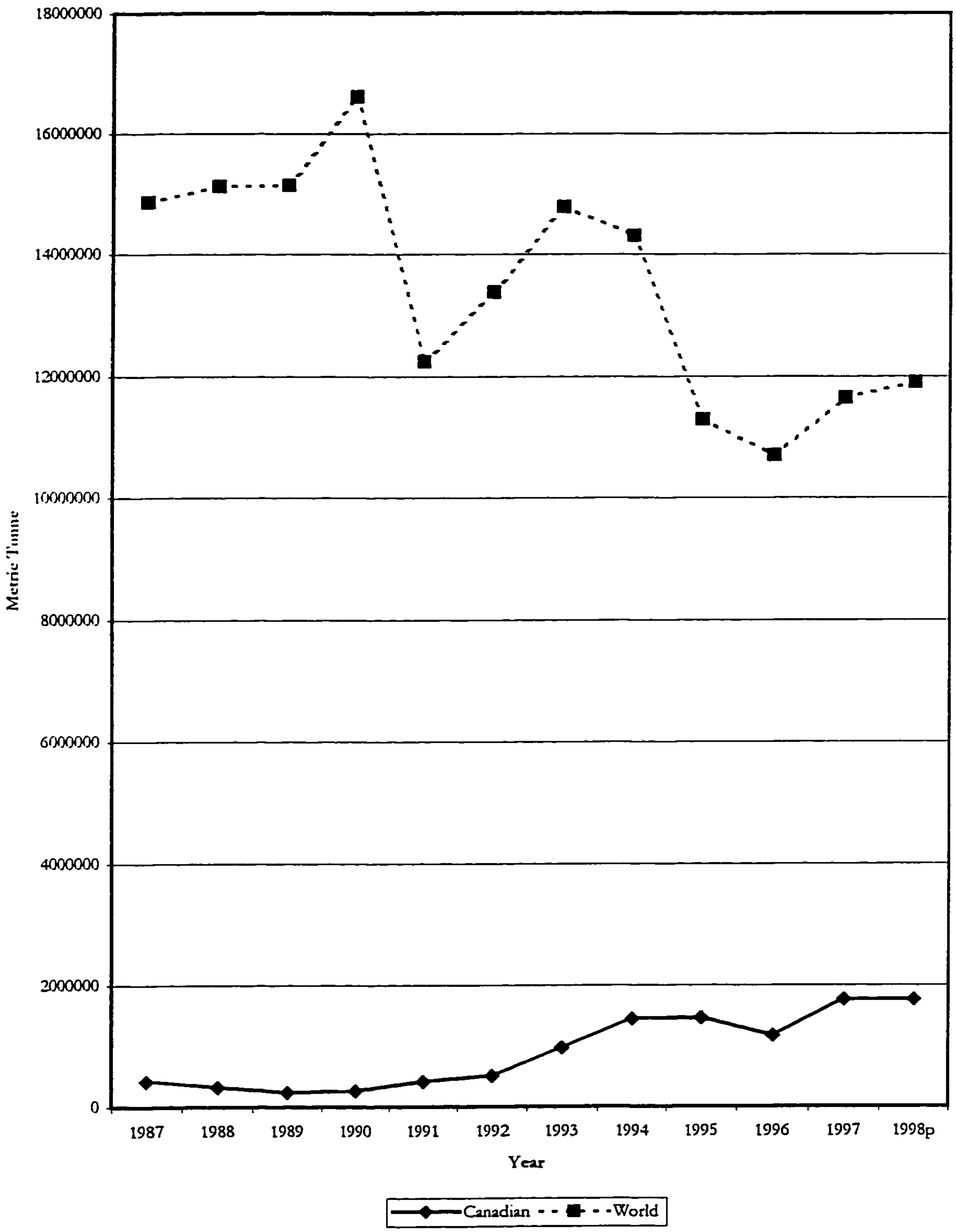
Source:Government of Canada, Canada Grains Council, Statistical Handbook 1996.

Figure 8: Production and Export Quantities, Dry Peas, Canada, 1987-1997.



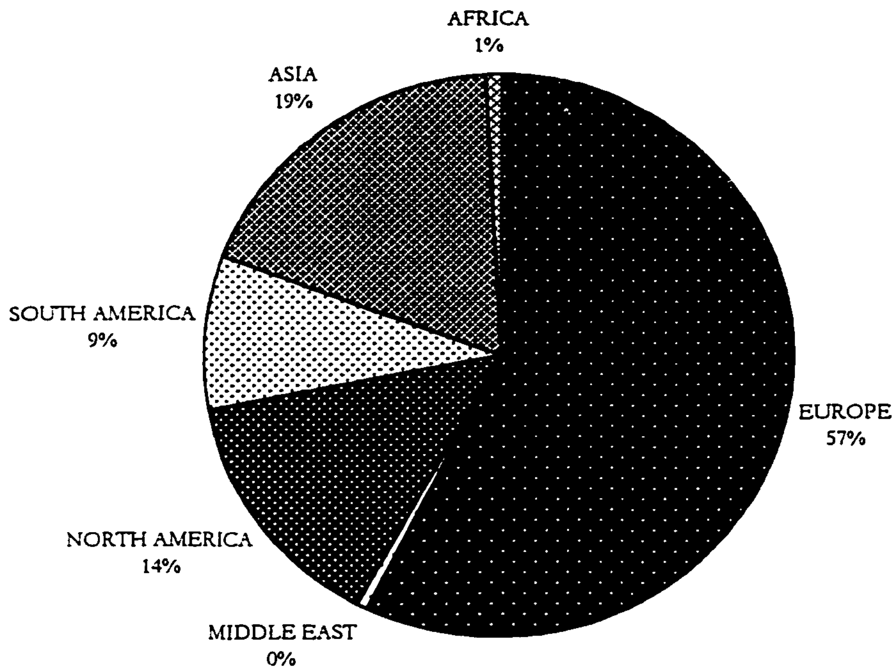
Source: Data from Food and Agriculture Organization, 1998,
http://apps.fao:8080/

Figure 9: Production of Feed Peas, World and Canada, 1987-1998.



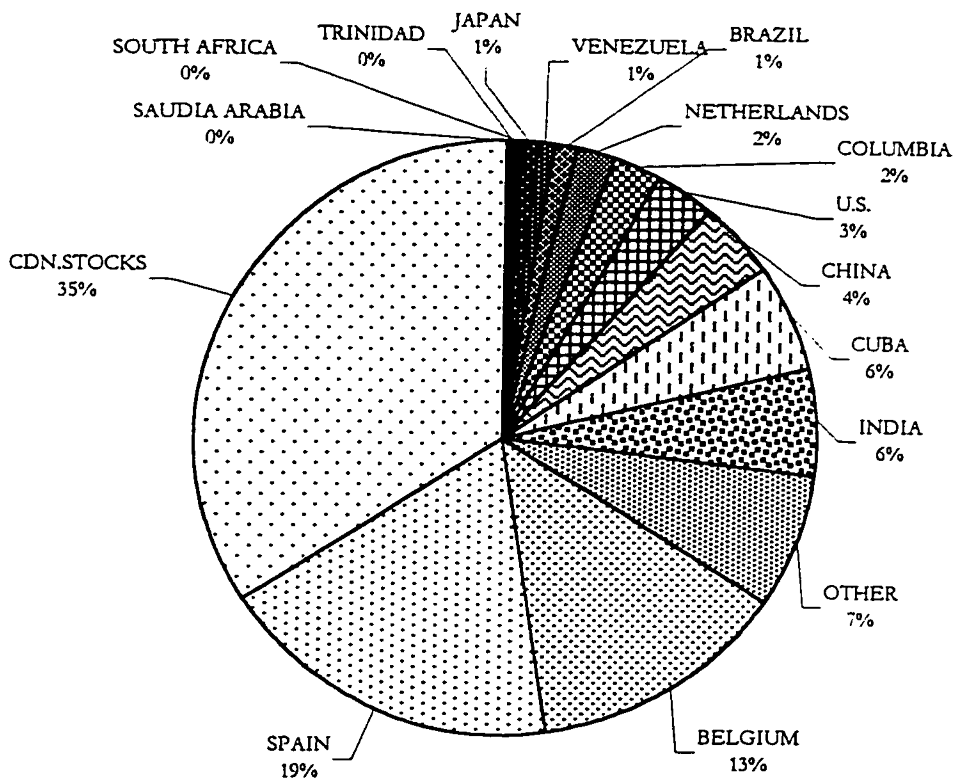
Source: Data from Food and Agriculture Organization, 1998, http://apps.fao:8080/

Figure 10: Major Export Markets for Peas, Canada, By Region of Destination, 1996/97.



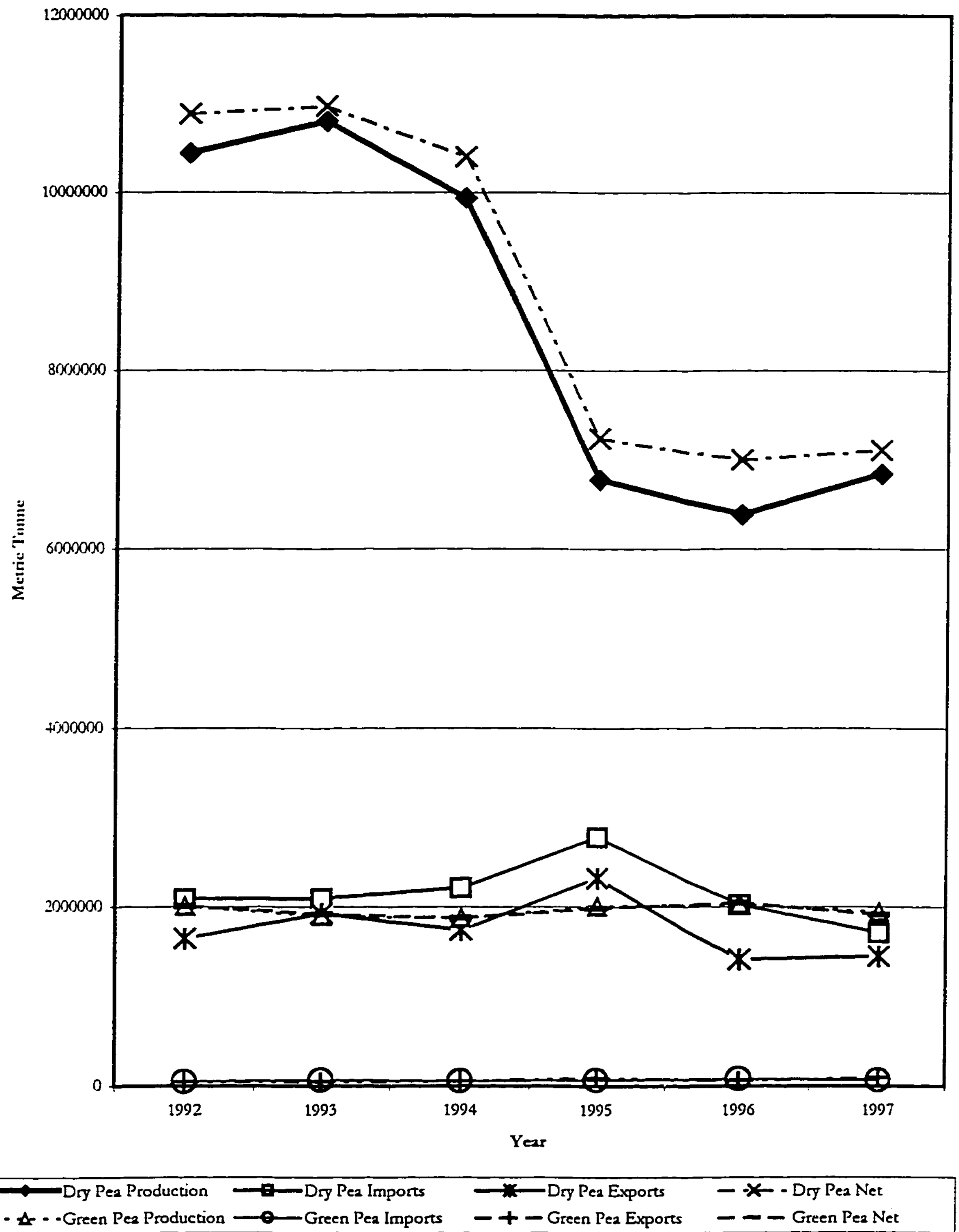
Source: Data from Alberta Conservation Tillage Society 1998 Agrifuture Farm Technology Expo Proceedings, 1998, 56.

Figure 11: Major Markets for Dry Peas, Canada, By Country of Destination, 1996/97.



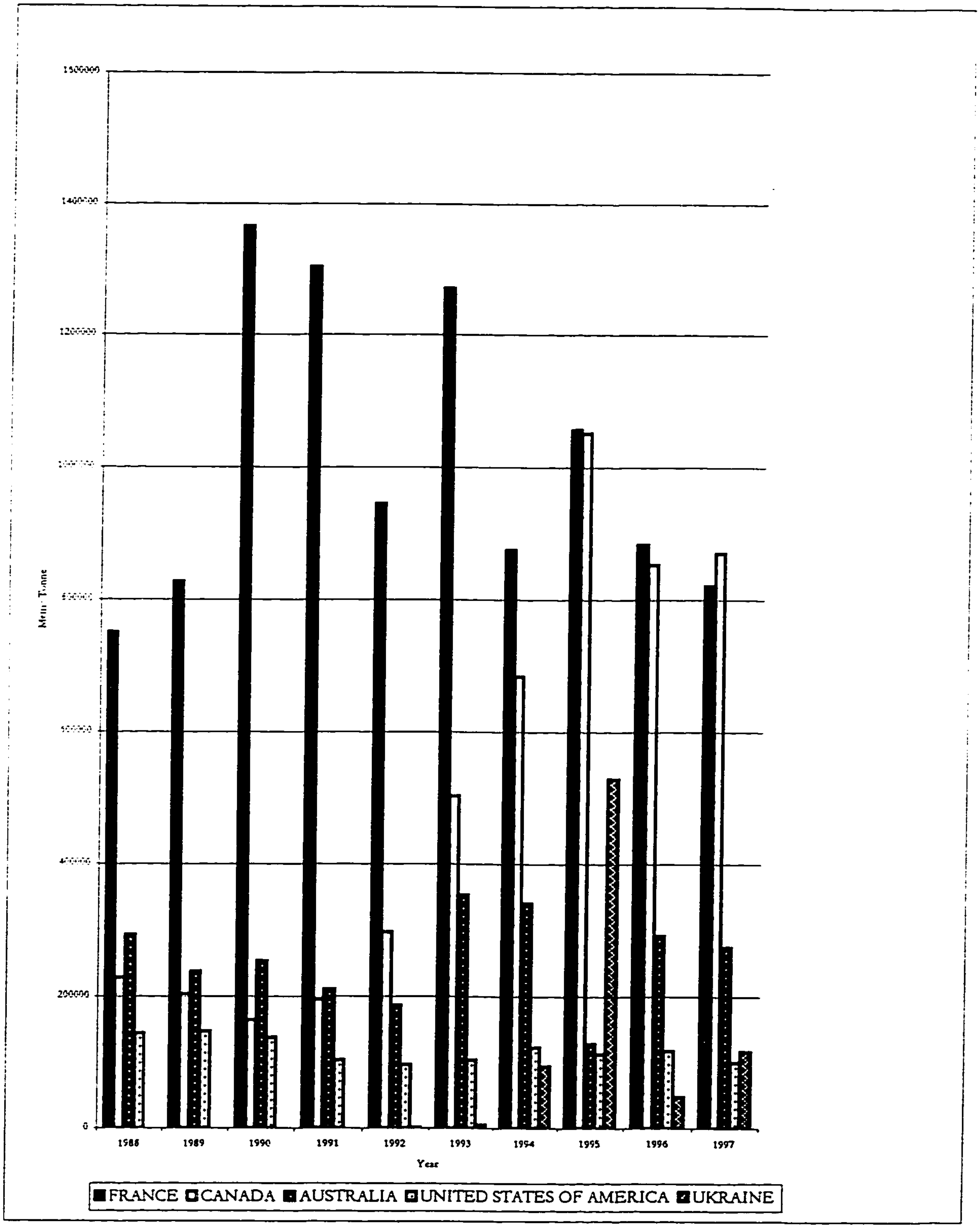
Source: Data from Alberta Conservation Tillage Society
1998 Agrifuture Farm Technology Expo Preceedings, 1998, 56

Figure 12: Pea Production, Imports, Exports, Net Supply, Europe, by Year, 1992 - 1997.



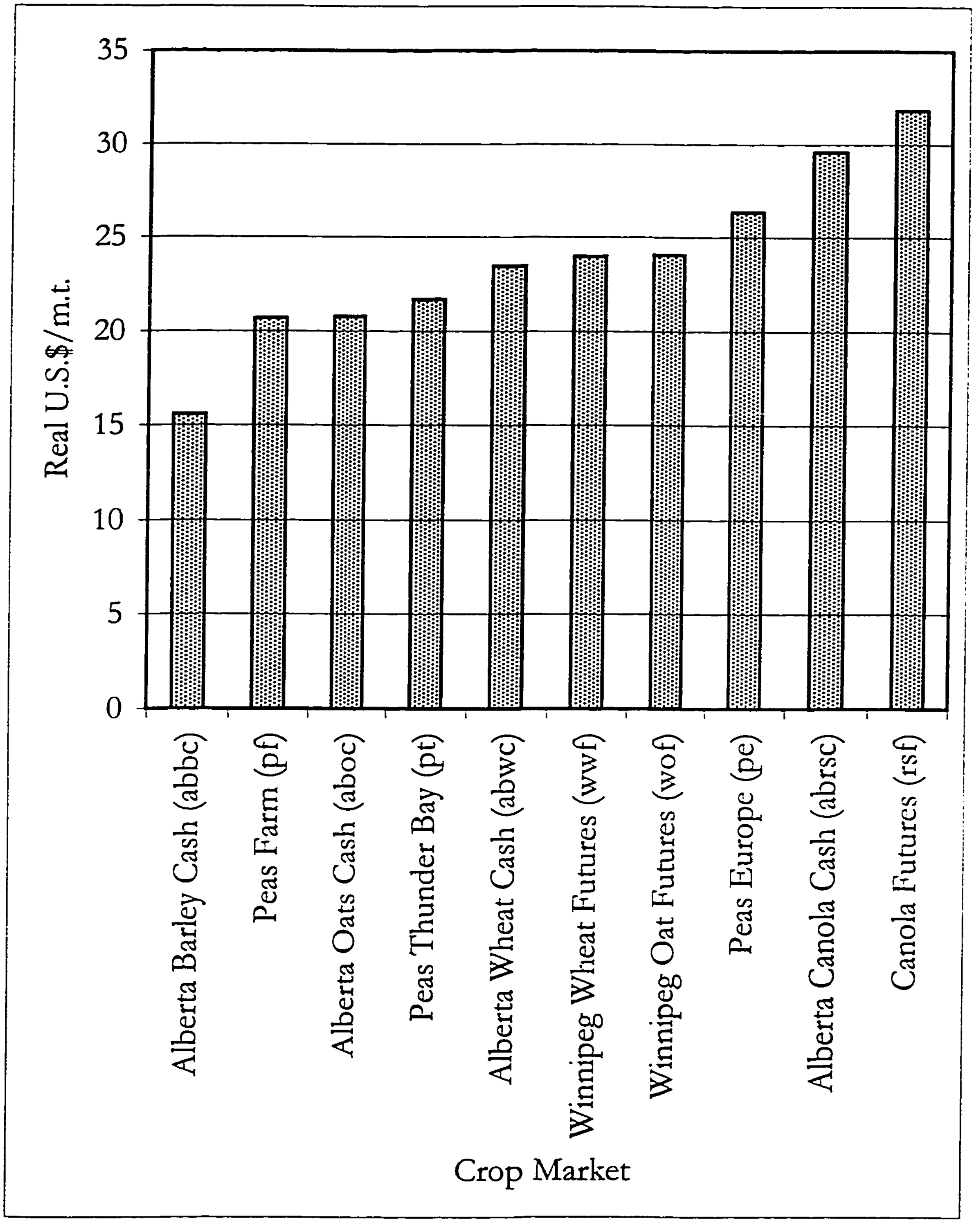
Source: Data from Food and Agriculture Organization, 1998,
http://apps.fao:8080/

Figure 13: Dry Pea Exporters, World, by Major Country, 1988 - 1997.



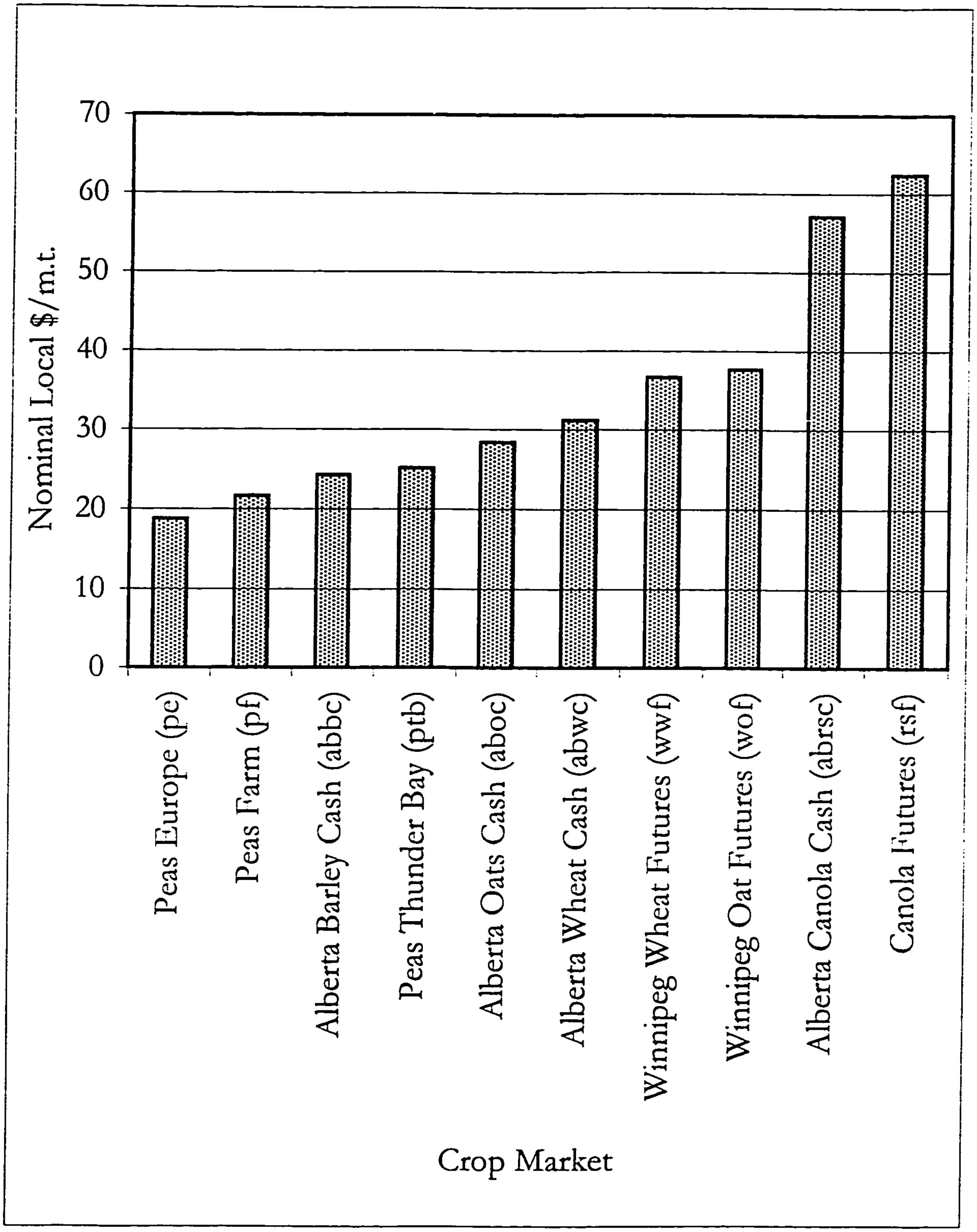
Source: Data from Food and Agriculture Organization, 1998,
http://apps.fao:8080/

Figure 14: Results, Standard Deviations, May 1988 to June 1996.



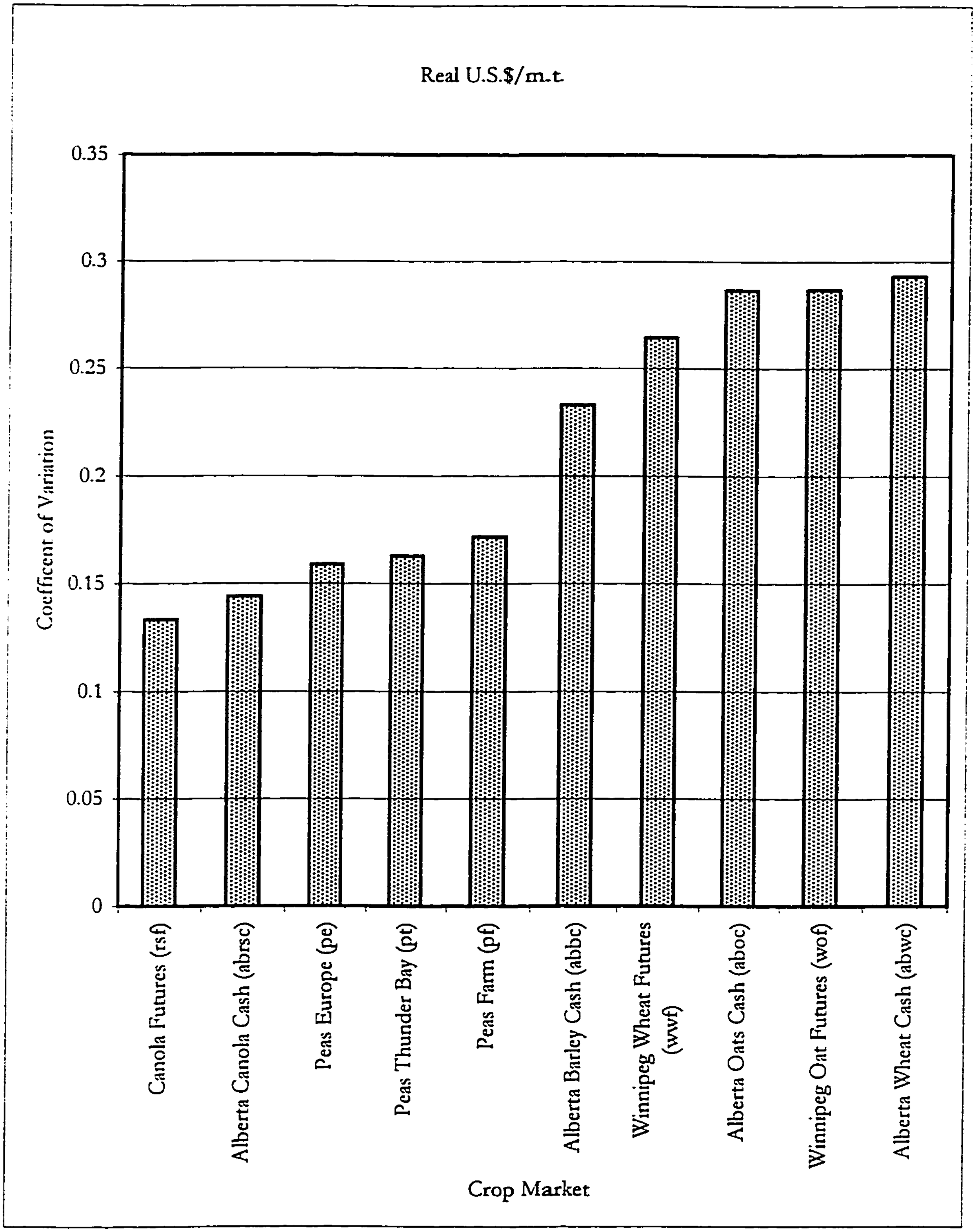
Source: Study Results

Figure 15: Results, Standard Deviations Nominal



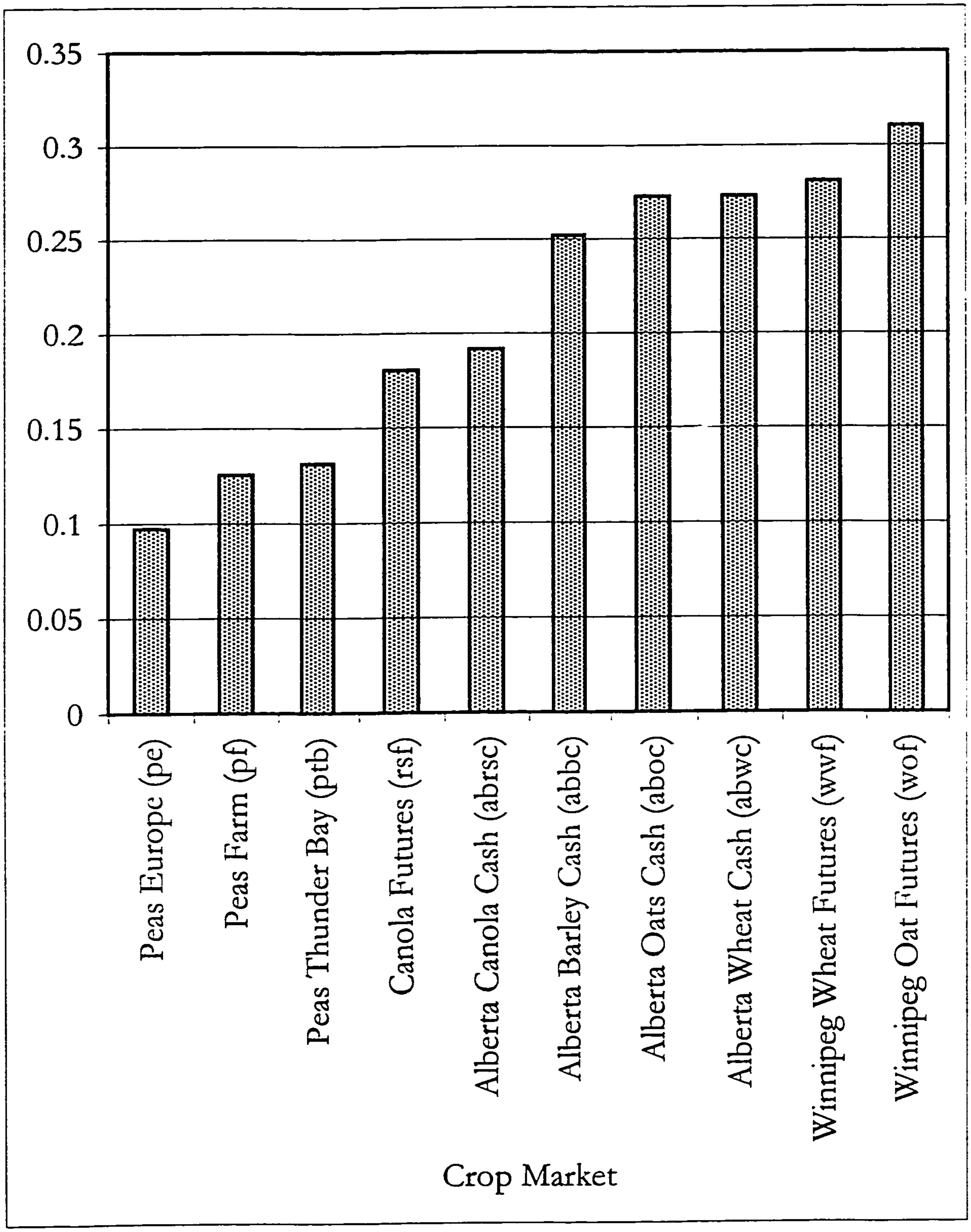
Source: Study Results

Figure 16: Results, Coefficients of Variation, May 1988 to June 1996.



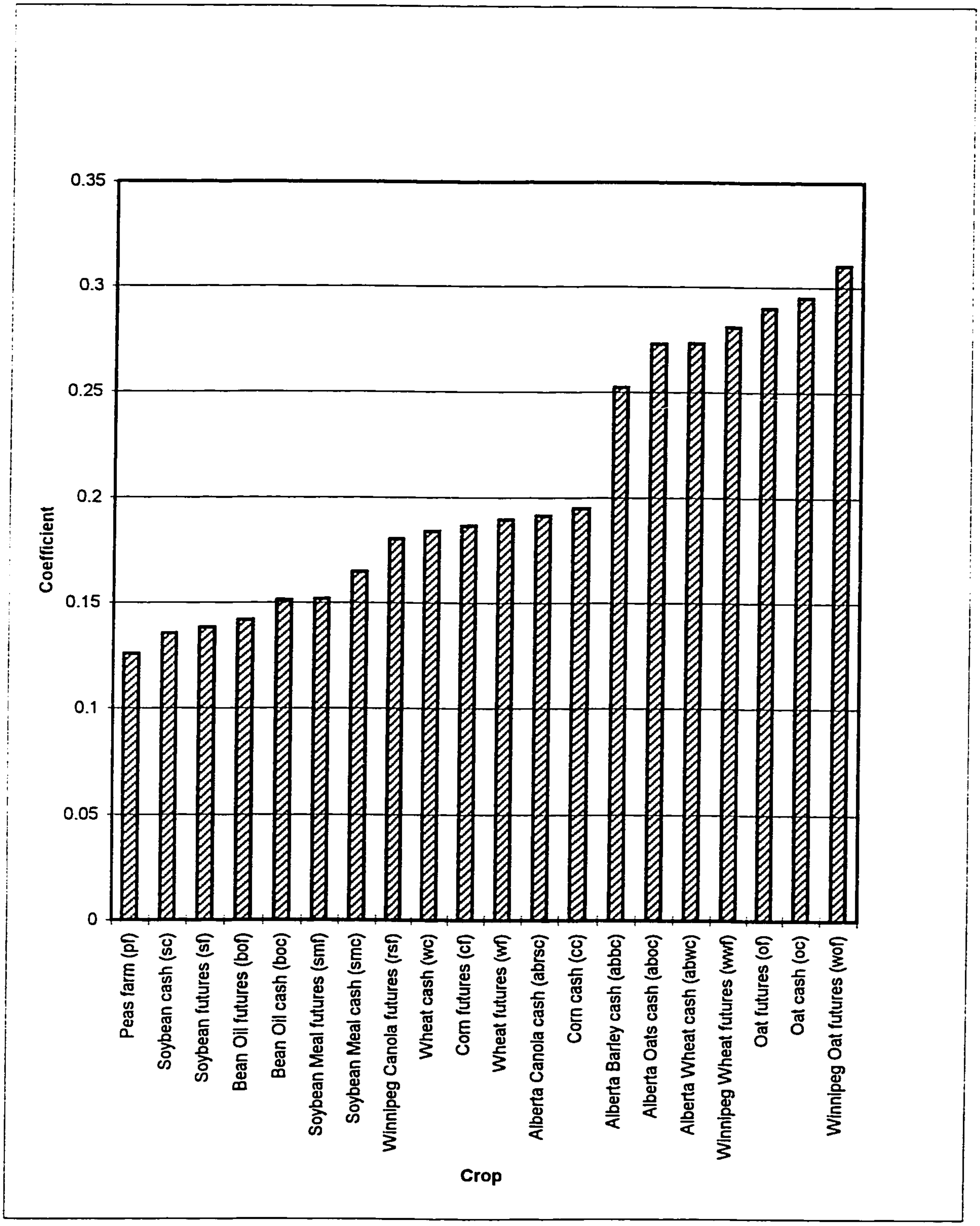
Source: Study Results

Figure 17: Results, Coefficient of Variation, Nominal May 1988 to June 1996.



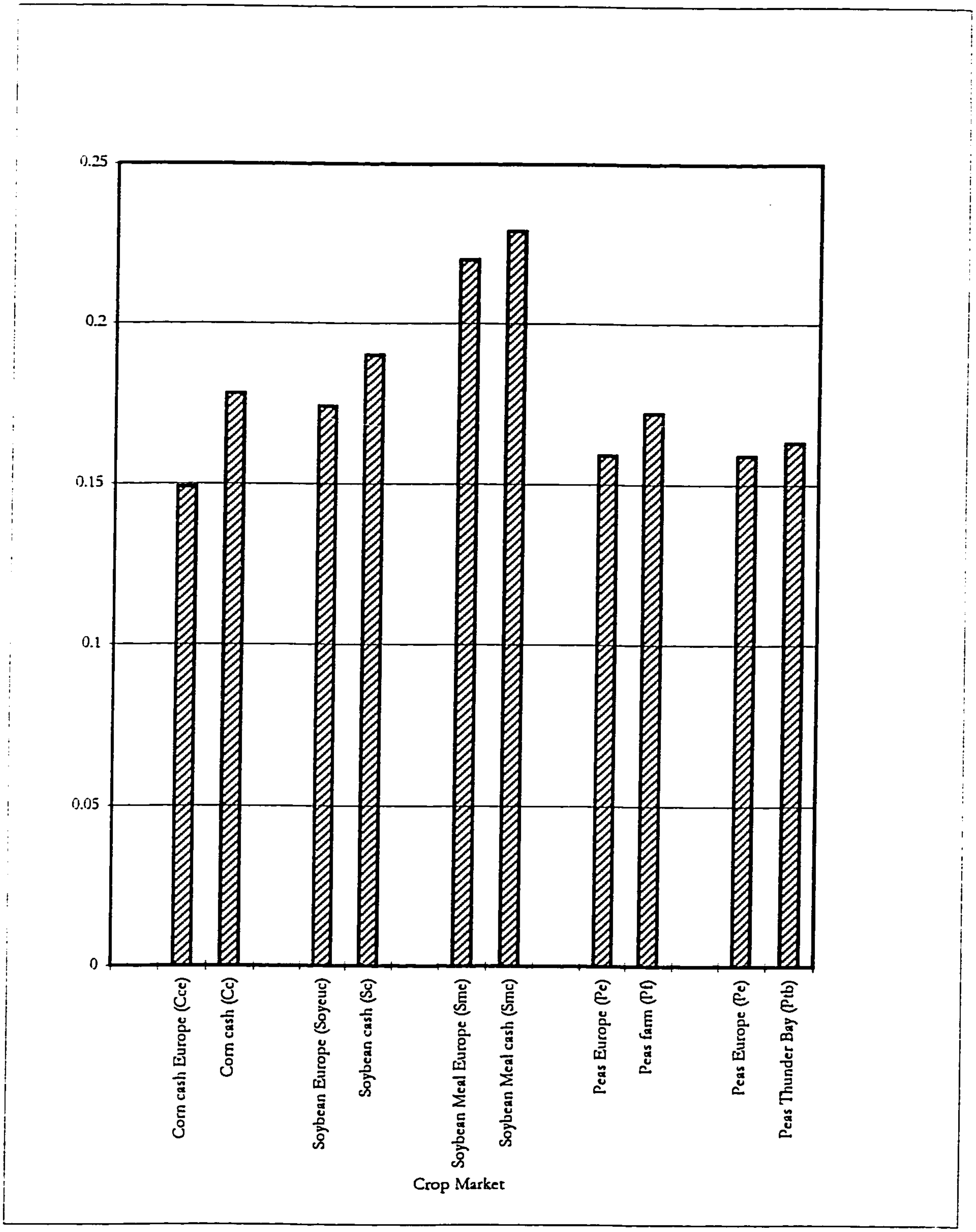
Source: Study Results

Figure 18: Coefficient of Variation of North American Prices, May 1988 - June 1996 (Nominal Local $/m.t.)



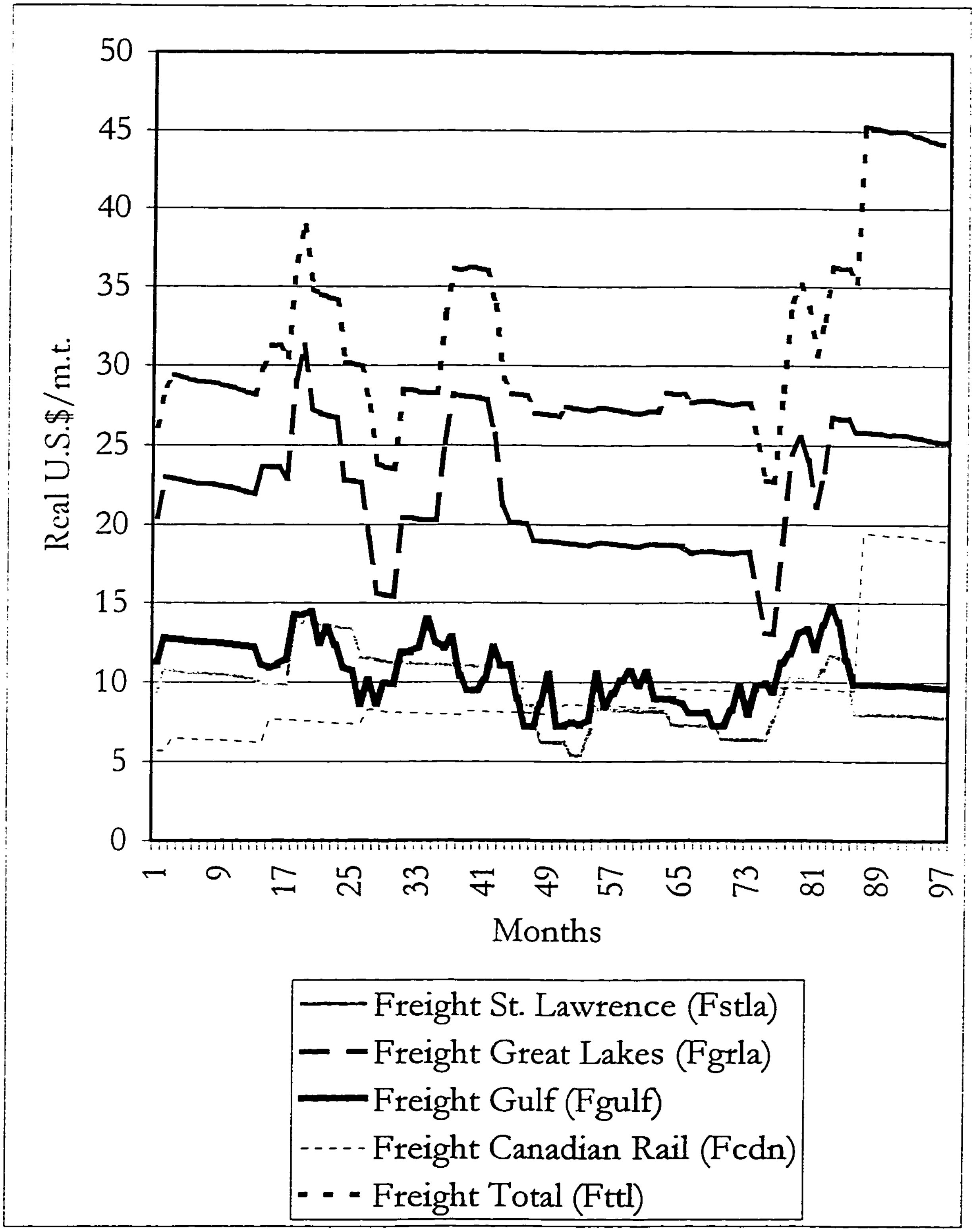
Source: Study Results

Figure 19: Comparison of Coefficient of Variation of North American and European Prices, May 1988 - June 1996 (Real U.S. $/mt.)



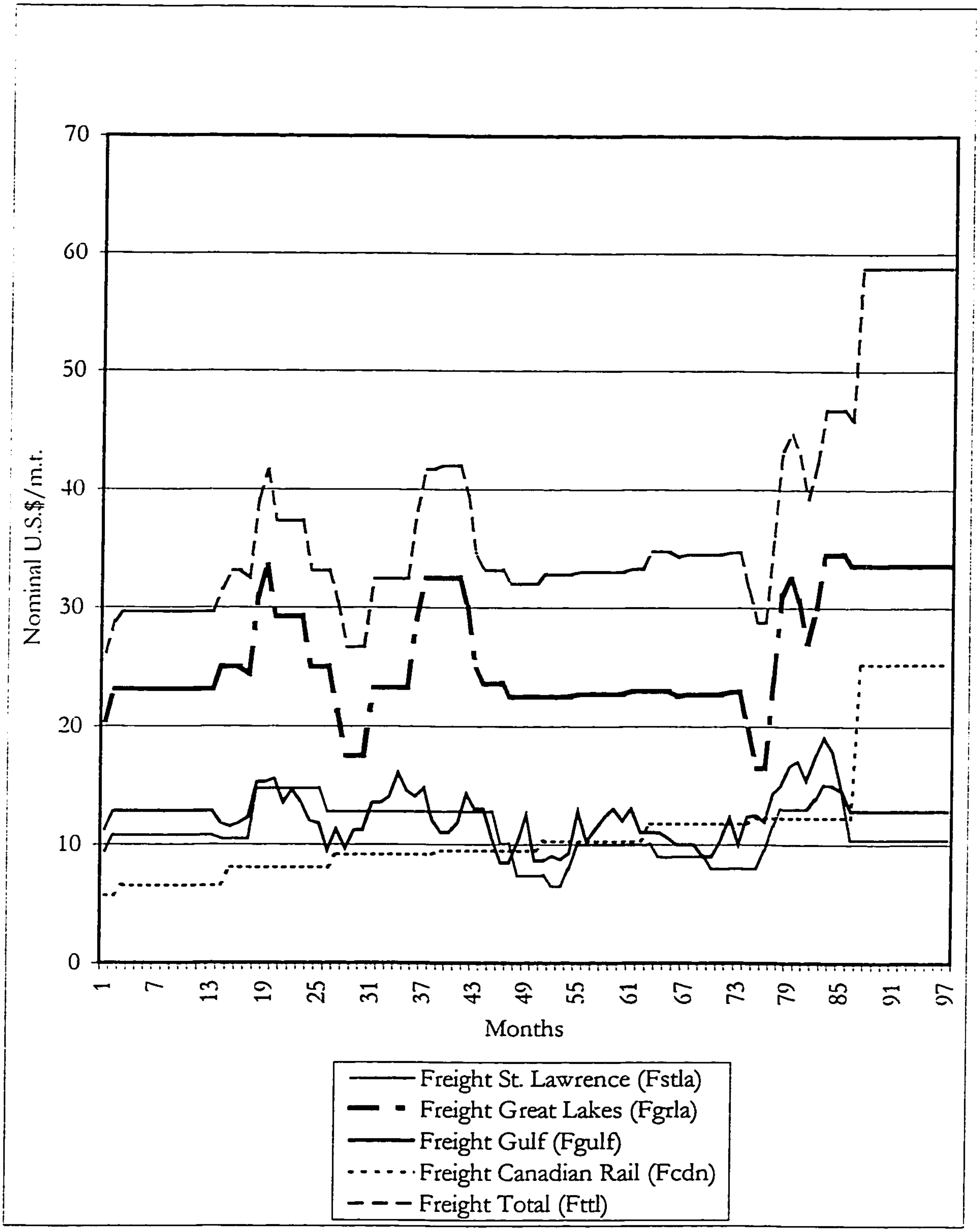
Source: Study Results

Figure 20: Selected Ocean and Rail Freight Rates for Grains from North America to Europe, May 1988 - June 1996.(Real U.S.$/m.t.)



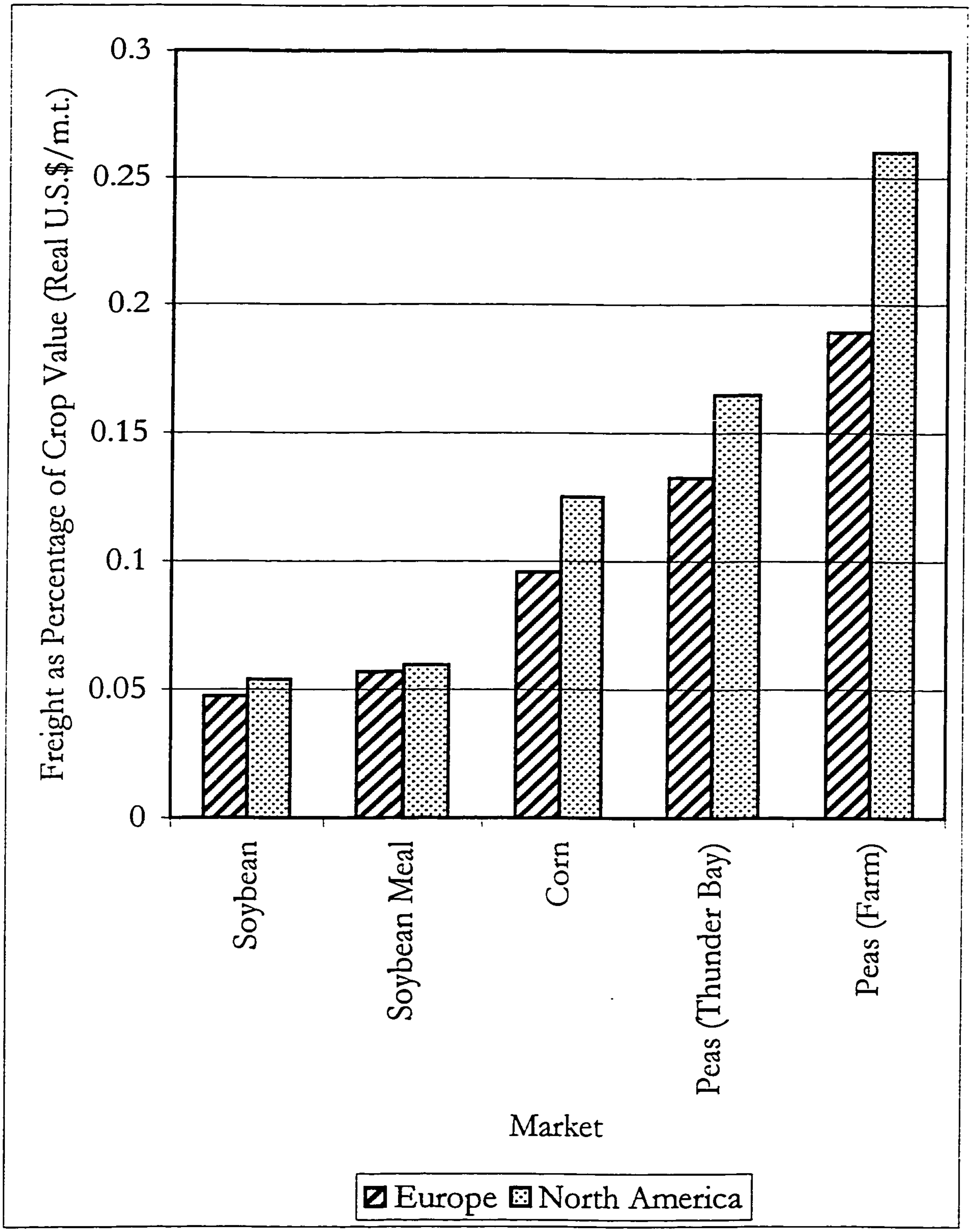
Source: Data from World Grain Statistics,
International Grains Council, Various.

Figure 21: Selected Ocean and Rail Freight Rates for Grains from North America to Europe, May 1988 - June 1996 (Nominal Local $/m.t.)



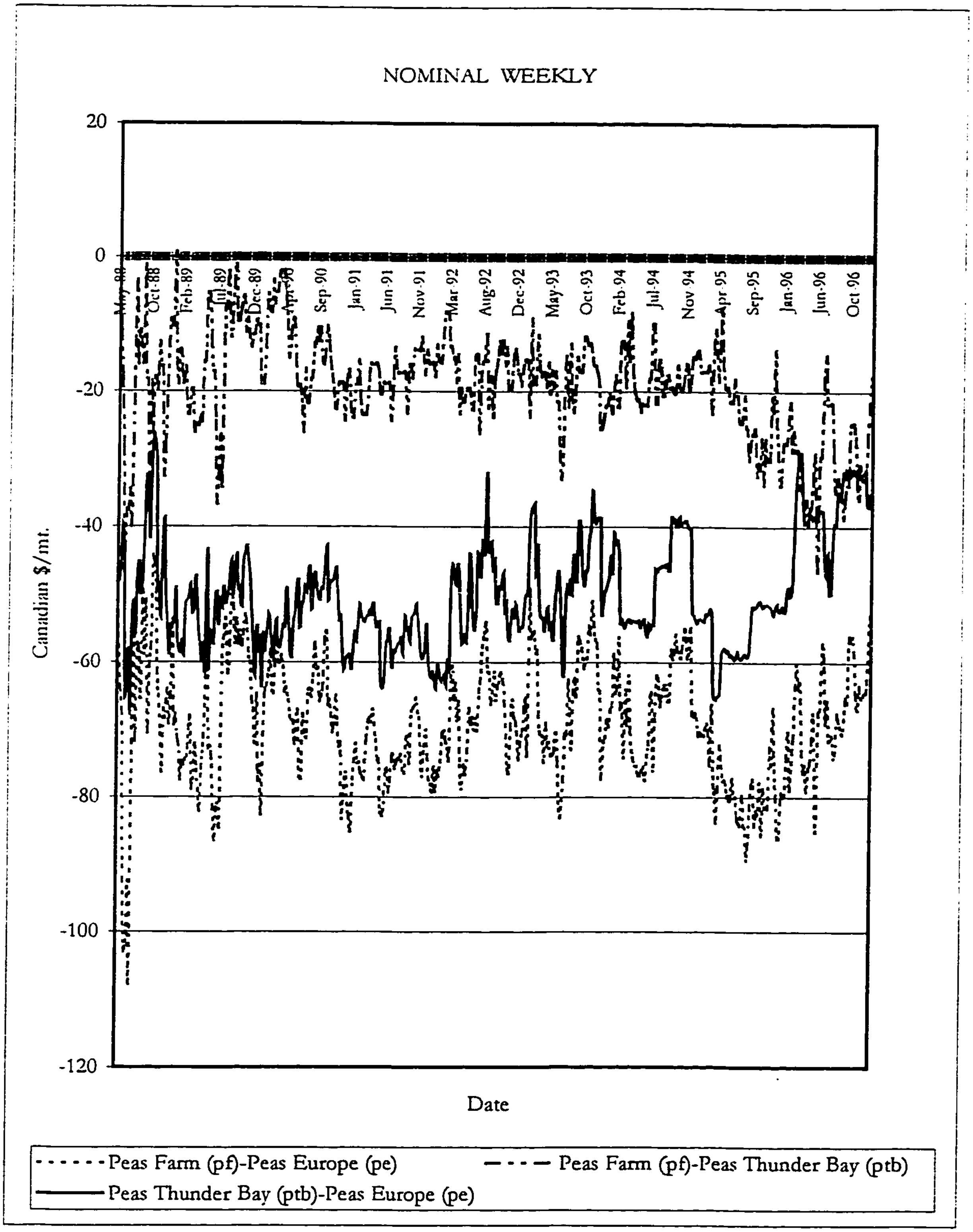
Source: Data from World Grain Statistics, International Grains Council, Various

Figure 22: Results, Freight as Percentage of Market Value, May 1988 to June 1996.



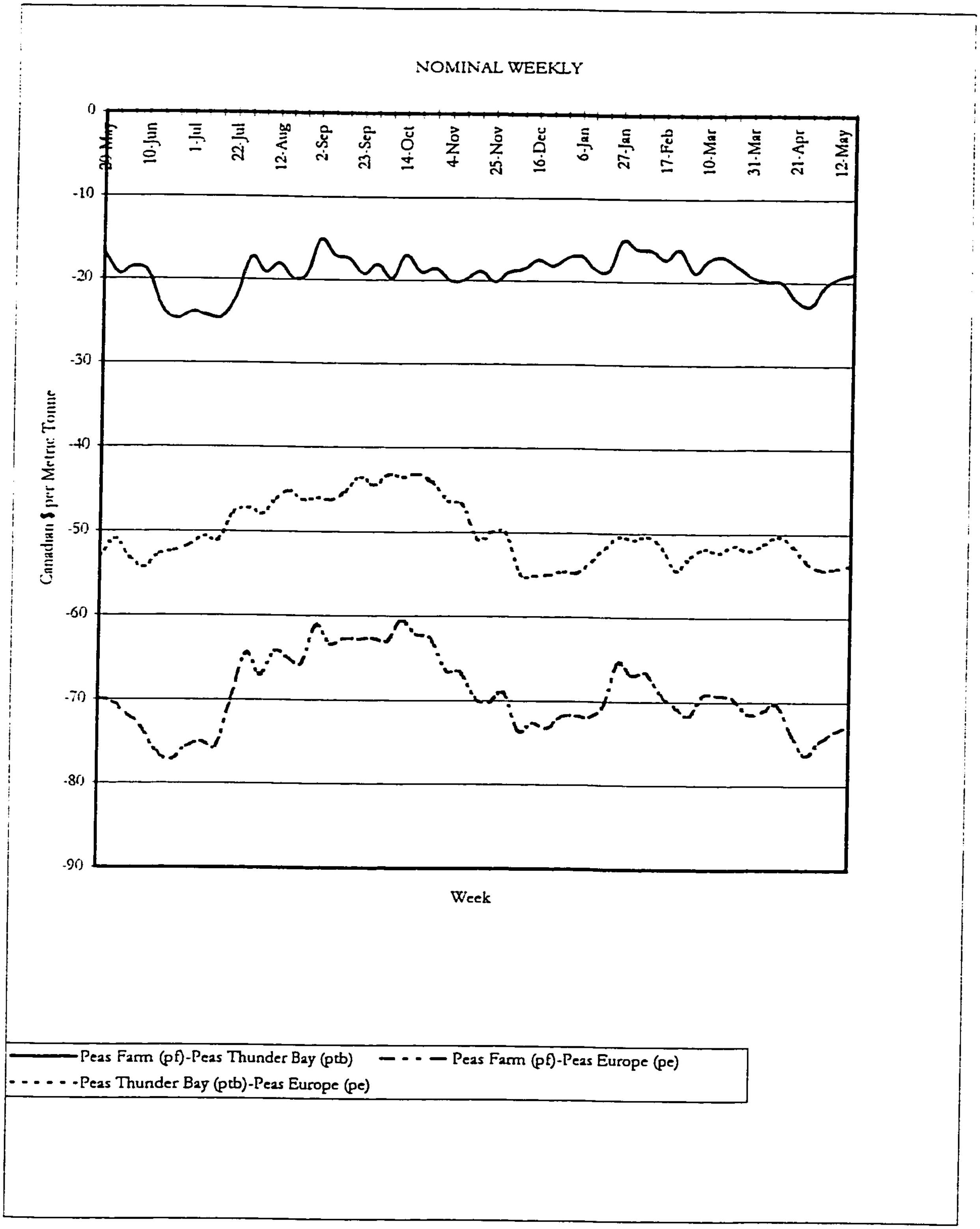
Source: Study Results

Figure 23: Feed Pea Basis, May 1988 to June 1996.



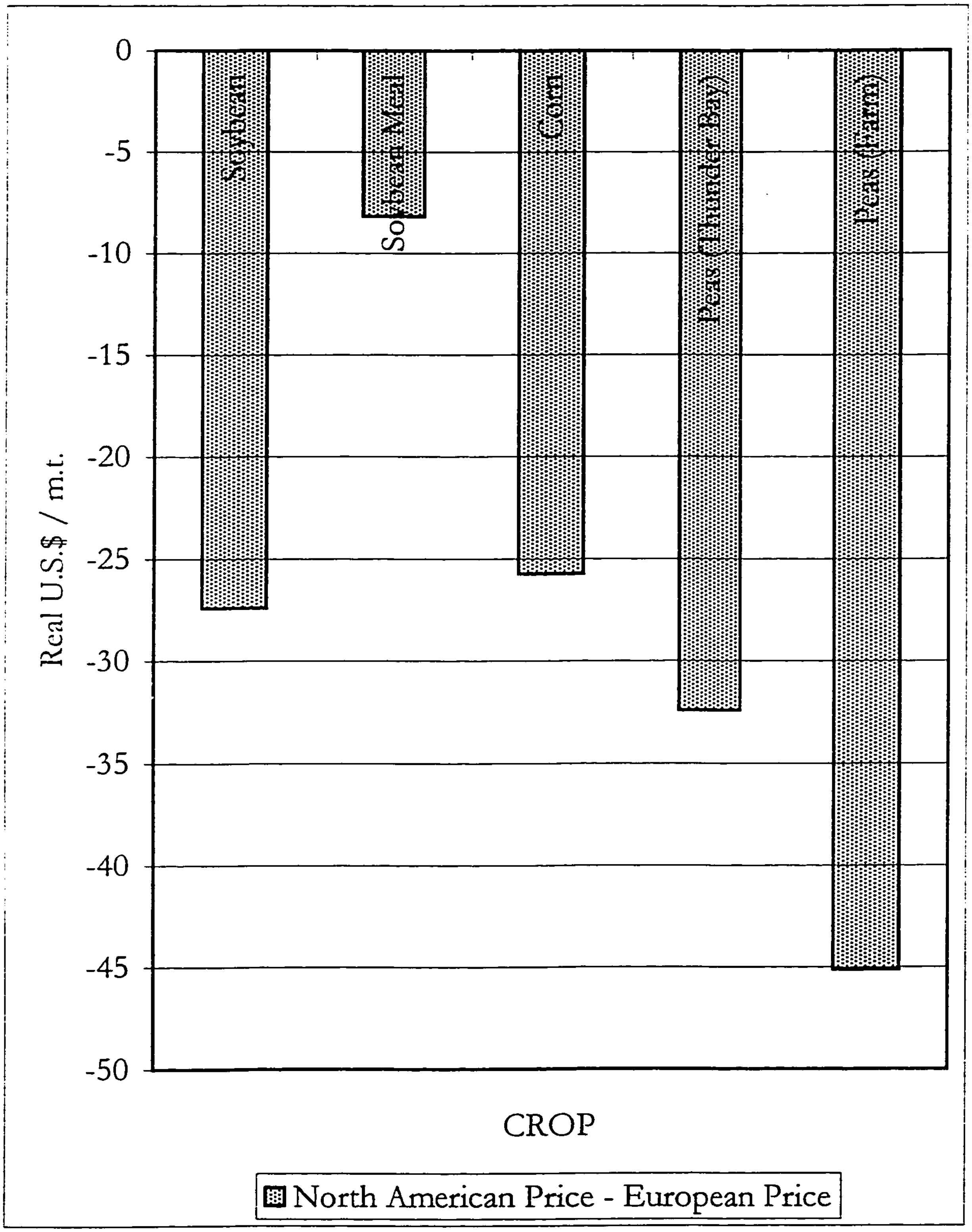
Source: Study Results

Figure 24: Average Weekly Basis, Feed Peas between Prairie Farm, Thunder Bay and Europe, May 1988 - June 1996 (Nominal Canadian $/mt.).



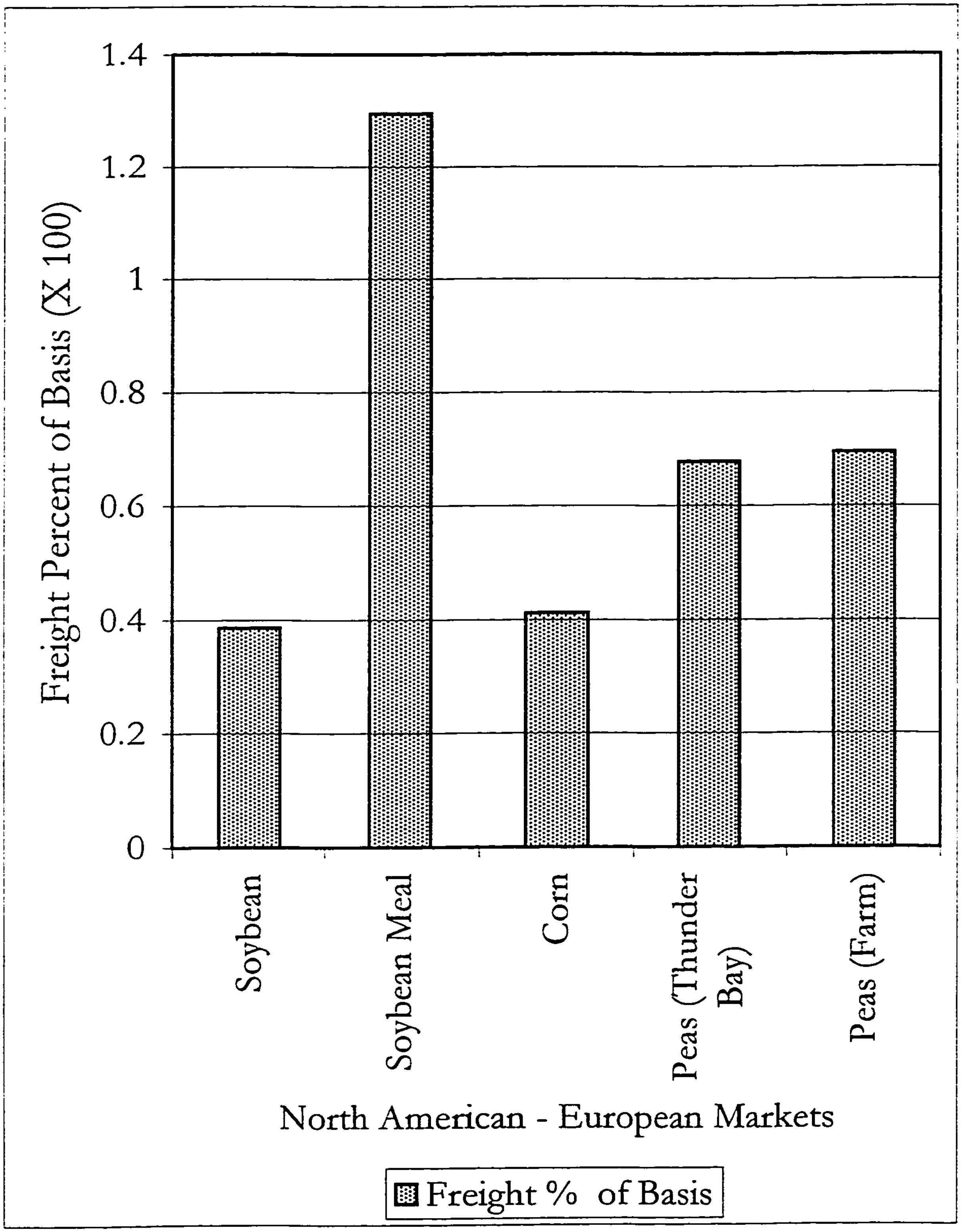
Source: Study Results

Figure 25: Results, Mean Basis Between North America and European Markets, May 1988 to June 1996.



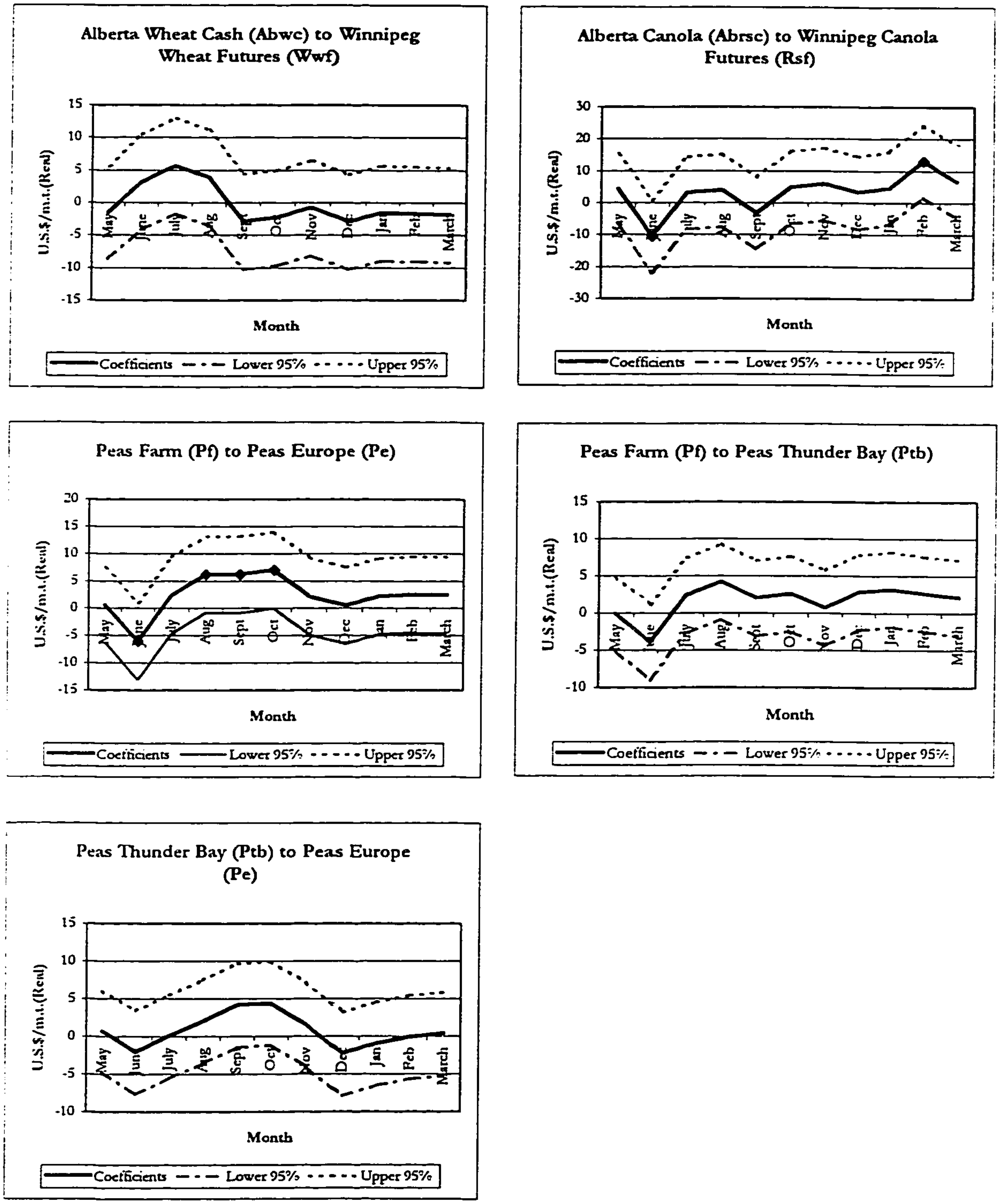
Source: Study Results

Figure 26: Results, Freight Percentage of Mean Basis Between North American and European Markets, May 1988 to June 1996.



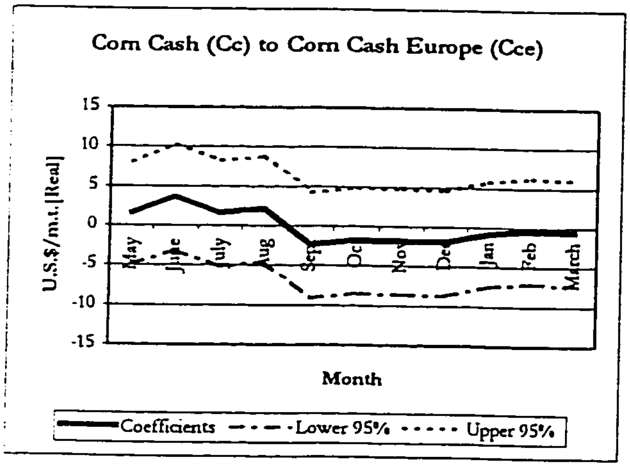
Source: Study Results

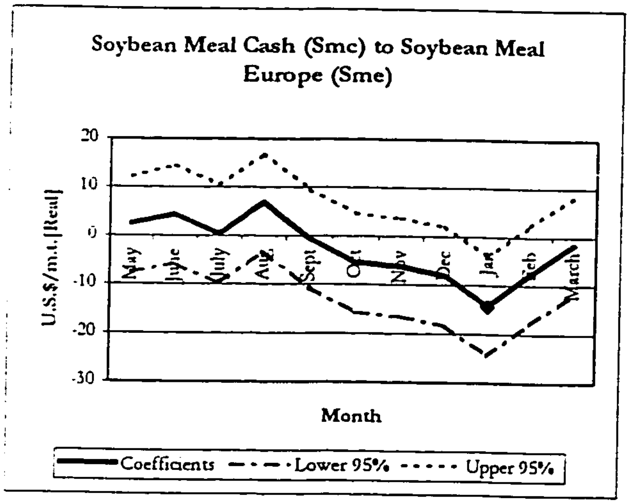
Figure 27: Seasonality, Selected Canadian Crops, May 1988 - June 1996 (Real U.S.$)

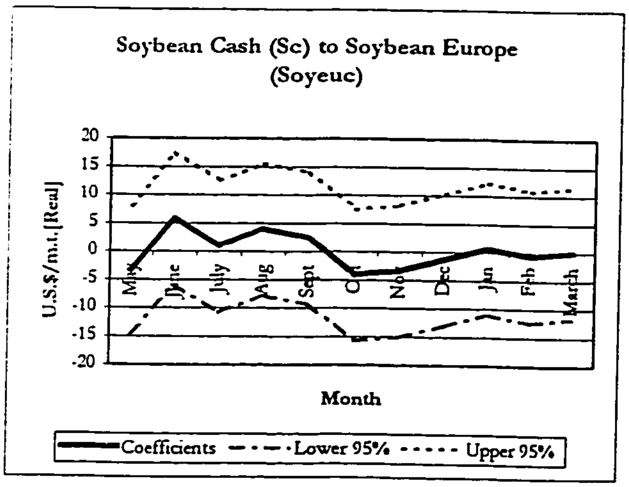


Source: Study Results

Figure 28: Seasonality, Selected U.S. Crops, May 1988 - June 1996 (Real U.S.$)

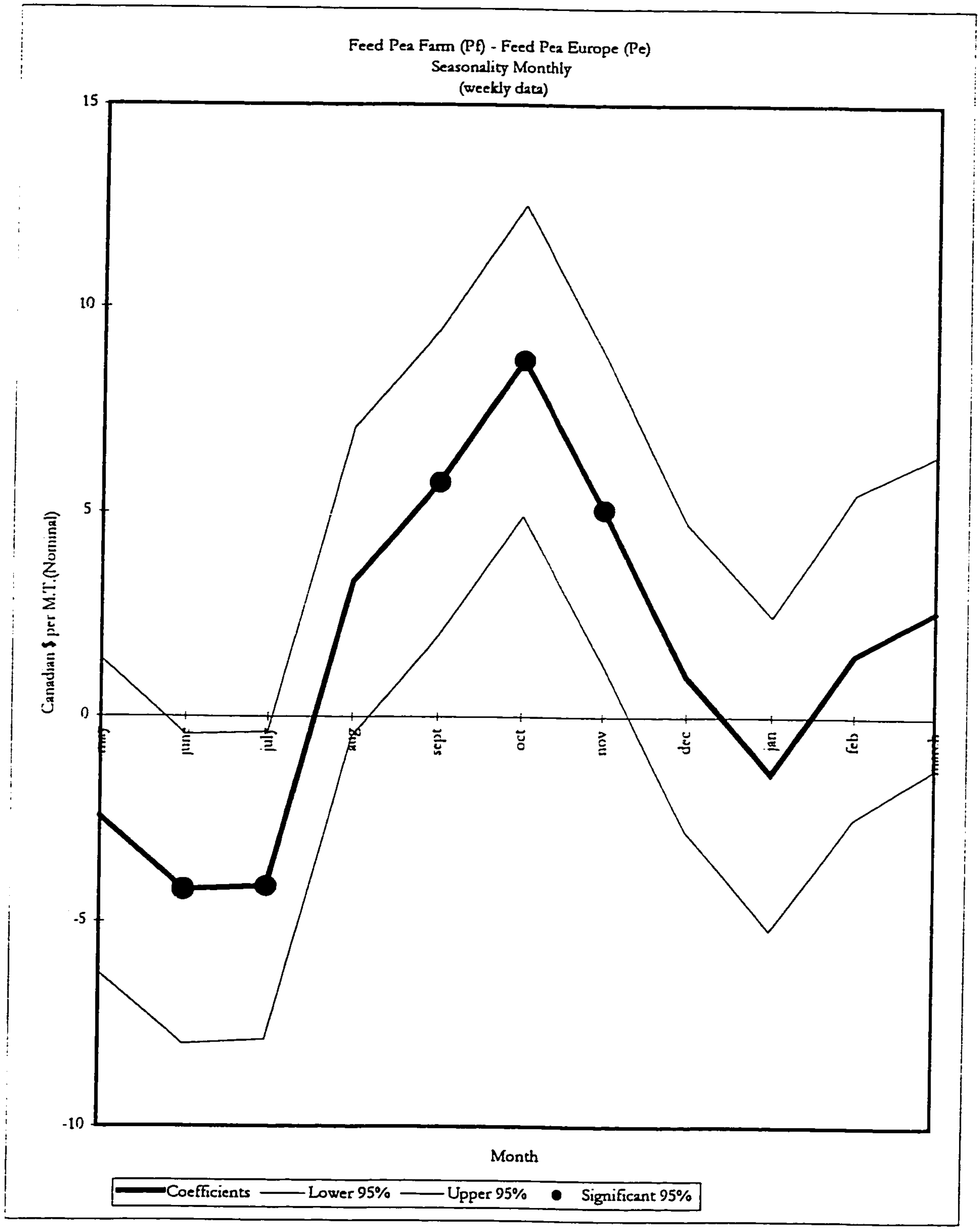






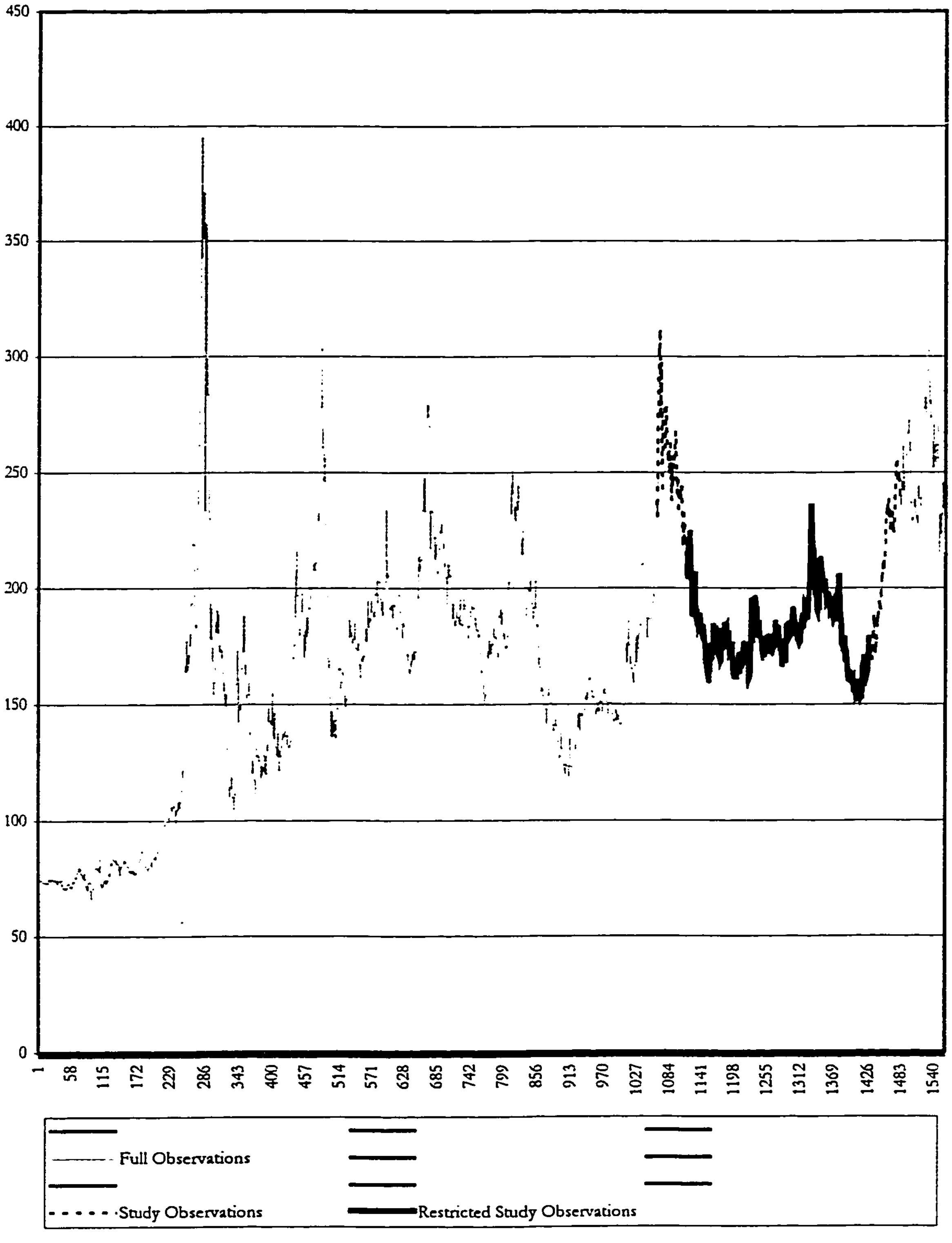
Source: Study Results

Figure 29: Results, Feed Pea Seasonality



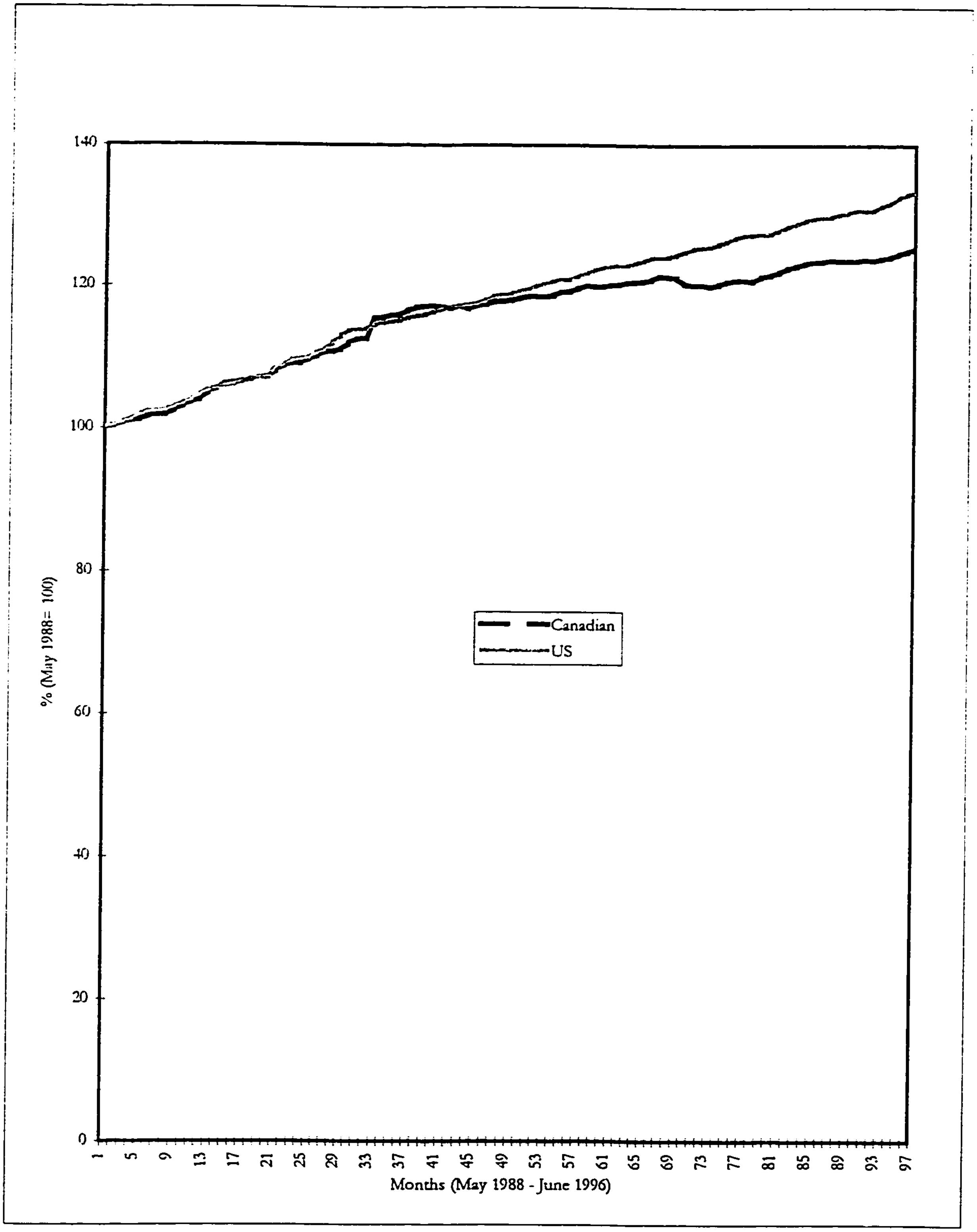
Source: Study Results

Figure 30: Full, Study Period, and Restricted Observations, Soybean Meal Futures, 1968-1998 (Nominal U.S.$/short ton)



Source: Data form Glance Market Data Services Inc., 1998

Figure 31: Consumer Price Index,Canada and United States, May 1988 - June 1996.



Source: Data from Cansim Data Base,
Government of Canada