Staff Paper Series

Staff Paper P96-8 May 1996

UNITED STATES AND CANADIAN AGRICULTURAL TRADE, TRANSPORTATION AND COMPETITION -- POST NAFTA

Proceedings of a Symposium Sponsored by NC-179, "Agricultural and Rural Transportation Systems," held in Minneapolis, Minnesota
October 6-7, 1995

Proceedings compiled by
Jerry Fruin and Allan Mussell

Department of Applied Economics

University of Minnesota

College of Agricultural, Food, and Environmental Sciences

St. Paul, Minnesota 55108

UNITED STATES AND CANADIAN AGRICULTURAL TRADE, TRANSPORTATION AND COMPETITION -- POST NAFTA

Proceedings of a Symposium Sponsored by NC-179, "Agricultural and Rural Transportation Systems," held in Minneapolis, Minnesota
October 6-7, 1995

Proceedings compiled by
Jerry Fruin and Allan Mussell

Committee Members of NCR-179

Dale Anderson	University of Nebraska
Michael Babcock	Kansas State University
C. Phillip Baumel	Iowa State University
Jerry Fruin	University of Minnesota
Steve Fuller	Texas A&M University
Steven Hanson	Michigan State University
Robert Hauser	University of Illinois
T. Q. Hutchinson	USDA, Economic Research Service
Won Koo	North Dakota State University
Don Larson	Ohio State University
Jerry Norton	USDA, Agricultural Marketing Service

Administrative Advisor of NCR-179

Marc Johnson — Kansas State University

Staff Papers are published without formal review within the Department of Agricultural and Applied Economics.

Information on other titles in this series may be obtained from: Waite Library, University of Minnesota, Department of Agricultural and Applied Economics, 1994 Buford Avenue, 232 COB, St. Paul, MN 55108-6040, U.S.A.

TABLE OF CONTENTS

Foreword

International trade in grains and oilseeds is an issue of major importance both to the economies of the U.S. and Canada. An important determinant in international trade flows and competitiveness is the grain transportation system and related infrastructure. The international grain trade and the related transportation systems are changing rapidly. These changes derive from changes in the economic situations of trading partners, alterations to agricultural, trade, and transportation policy, and shifts in the structure of markets for grain and grain transportation. Understanding international competitiveness and future developments in agricultural trade requires an assimilation of these interrelated topics.

This topic has been a research area of the Regional Research Committee on Agricultural and Rural Transportation Systems, NCR-179, since its inception in 1993. NCR-179 has as its objectives the review and identification of research and data priorities in agricultural transportation, and the exchange of research and information in these areas. This proceedings reports the results of a symposium convened by NCR-179 on October 6 and 7th, 1995 in Minneapolis, Minnesota to address issues of agricultural transportation and trade.

The papers examine a variety of issues impacting the demand for transportation services for the movement of farm commodities in the U.S. and Canada, both domestically and internationally.

CHANGES IN GRAIN HANDLING AND TRANSPORTATION: A CANADIAN PERSPECTIVE

by Art G. Wilson*

Introduction

At the outset I would like to thank you for the opportunity to outline some of the recent changes in the grain handling and transportation system in Canada. Recent rhetoric from some American politicians suggests that they are not fully aware of the operation of the Canadian system or is it that the elections are coming up? We have the same problem with our politicians.

Jerry Fruin asked John Heads, Director of the Institute, to address you today. Unfortunately, John is in Eastern Canada on a project with respect to the St. Lawrence Seaway. He asked me to substitute for him. As you know substitutes tend to be an unknown quantity, particularly those who have officially withdrawn from the game yet endeavour to keep track of the score. Even keeping track of the score can be a full-time activity with all the changes occurring in the rules of the game in Canada.

Historically, the Canadian and American systems have diverged with respect to the degree of regulation imposed. The American tradition has been to emphasize freedom to compete whereas the Canadian position has been one of regulation designed to accomplish a degree of equity in the eyes of the producer. It is now recognized that much of this regulation has been self-defeating and is becoming increasingly burdensome given the opening up of world markets by trade agreements. It is the changes occurring in the system to which I wish refer to today. The thrust of these is to make the entire system more efficient, and competitive. Indeed, it can be said that more changes have been wrought during recent months than have occurred during previous decades.

Canada Transportation Act

Foremost amongst these changes has been the repeal of the Western Grain Transportation Act (WGTA) on August 1, 1995. Regulation with respect to the transport of grain is now contained in the new Canada Transportation Act. In lieu of the subsidy provided to the railways on the movement of grain, about $560 million in 1994/95, the federal government is providing a direct, one time acreage payment to producers totalling $1.2 billion with an additional $300 million provided to ease the pain of adjustment over a three year period. The acreage payment is being made to landlords to offset the attendant reduction in land values, though an accommodation is required with their tenants. The adjustment payment is being made over three years. Part is being used to offset the change in the pooling of Canadian Wheat Board (CWB) grains based on delivery to the export posts of Vancouver/Thunder Bay to Vancouver/Lower St. Lawrence to more closely reflect points of equivalent prices on export. The remainder of the adjustment payment will be dispersed for such purposes as road upgrading and assistance to the alfalfa pelleting industry.

The change to full cost rates to shippers for the movement of grain maybe expected to have several long-run effects. Among these, are increased trucking of grain; a reorientation of resource use with higher value crops being produced in the areas having the greatest increase in freight rates; increased livestock

***Art G. Wilson is a consultant. He was Director, Transport Institute, University of Manitoba.**

production, both in ranching and feeding enterprises; increase in value-added processing; and modificationof the grain handling system. The operations of the Canadian Wheat Board will also be affected. The new Canada Transportation Act has many features which are designed to increase the competitiveness in the transport of grain and/or other products. Only 20 days notice is required of a change in freight rates; joint tariffs may be requested by shippers and confidential contracts entered into. Competitive line rates are to be made available to shippers on request, these rates being established by formula, final offer arbitration. In addition, the common use of track will be encouraged when this may improve the efficiency and effectiveness of rail transport.

Two additional features of the Act are of specific interest to grain shippers in Western Canada. These are the provision for rail line abandonment and determination of the rate for grain. The abandonment procedure is much less complex than previously. Each railway is to publish a plan which indicates over a 3 year period whether it intends to sell, lease, transfer or discontinue operation of a particular line. If so, the line is to be advertised with potential purchasers having 60 days to make offers, with five additional months being allowed to reach an agreement with the railway. If no private sale is made, the line is made available to the federal, provincial and municipal governments at the net salvage value for a maximum of 45 days. If no agreement is forthcoming, the line may be abandoned; the maximum period from advertising to abandonment being approximately eight months. Furthermore, over a limited period the federal cabinet can order the abandonment of a grain dependent branchline.

Rates on grain are established by formula. The base maximum rate scale is that which applies during the current 1995-96 crop year as calculated under the WGTA, but without the appropriate inflationary adjustment. The maximum rate scale refers to the scale of rates per tonne which may be charged for the movement of grain over specified ranges of distance. The maximum rate scale will be adjusted in subsequent crop years by a multiplier based on a cost index formula taking into account the miles of branchline which have been discontinued. It should be noted that separate charges can be imposed for demurrage and storage of loaded cars with credit available for dispatch, all factors designed to improve efficiency. A complete review of the grain related features of the Act is to be conducted in 1999, with particular attention given to their effect on the efficiency of grain handling and transportation and on the sharing of the efficiency gains between shippers and the railways.

The maximum rate scale is distance related. Consequently, the previous parity between the cost of shipments from Calgary and Edmonton to Vancouver has been removed; the rate from Edmonton now exceeding that from Calgary by $3.03 per tonne. At the same time, rate parity for shipments from Edmonton to Vancouver and Edmonton to Prince Rupert has been eliminated, the later route being 184 miles longer than the former. This destroys parity between the two ports, although volume discounts by CN North America, absorption of $1.00 of the additional cost by the CWB and a lowered handling tariff by the Prince Rupert terminal have effectively restored parity of the two ports basis Edmonton shipments. This situation has some potential for influencing the movement of Canadian grains over U.S. lines and vice versa due to the relatively lower rate charged from Calgary to Vancouver over the CP rail line. It is worthy of note that where a delivery point is serviced by both railways the same rate is charged.

Since the maximum rate scale applies to both the main lines and the grain dependent branchlines, little incentive is offered producers to shift their deliveries from highly inefficient lines to other lines. Total railway revenues would also be reduced by abandonment of these lines. However, abandonment is expected to proceed at a relatively brisk pace in the future given the desire of the railways to improve their operational efficiency and by the actions of elevator companies in locating their new high throughput elevators on lines which carry a large volume of traffic. The latter will be influenced by the unit train car block discounts available. CN North American has expressed an interest in achieving short line efficiency on some lines by negotiating reduced wage rates and more flexible work rules with its unions. As a matter of interest, existing short lines have had their present structure of returns guaranteed to 1999.

Allocation of Rail Cars for Grain

Rail cars continue to be allocated by the Grain Transportation Office, a government body. Given that the government has expressed the desire to have this function performed by someone else and the reluctance of the trade to take responsibility, this function is expected to revert to the railways. While yet to be announced, the 15,000 railway cars owned by the federal and the respective provincial governments are expected to be transferred to the railways for a nominal price. No change is foreseen for the 4,000 cars owned or leased by the CWB as these could be used as a bargaining tool. While producers have expressed some interest in ownership of the cars, such ownership could detract from the efficiency of use, particularly if the railways become responsible for car allocation. Any additional cost imposed for these cars would have the effect of raising the maximum rate scale since their use is effectively at zero cost to the railways.

Freight Adjustment Factors

Over time the markets for Canadian grain have changed. While formerly prices received for export wheat were equated at Vancouver and Thunder Bay, these are now approximately equal at Vancouver and the Lower St. Lawrence ports. In addition, there is now a significant flow of malting barley and milling wheat into the United States. This has resulted in the CWB imposing freight adjustment factors which take into account the flow of grain and the prices received for wheat, durum, malting and feed barley upon export. These factors are combined with the freight rates to Thunder Bay or Vancouver, the lesser rate being deducted from the producer's return. Over the next three years the additional cost of moving wheat down the lakes is being reduced by the $300 million adjustment payment.

Sale of CN North America

The federal transport minister, the Hon. Doug Young, has announced that the railway assets of government owned CN North America are to be offered for sale and sold this fall. The attractiveness of such assets to potential buyers remains in doubt. Furthermore, the restrictions imposed, limited maximum shares of individual ownership (15 percent) and the location of the head office (Montreal) do not help salability of the railway even though a significant portion of the debt has been written off. The railway is replete with uneconomic lines continued for political purposes and a large number of high cost lines in relation to traffic branch lines. Users of the railway want it to become more competitive even though significant progress to that end has been made during recent years. Profitability has been impaired by losses in Eastern Canada where much of the potential traffic has shifted to trucks. It is doubtful if the sale will be accomplished on the announced terms. Saskatchewan Wheat Pool has expressed an interest on the basis of maintenance of rail competition. However, the cooperative is now having second thoughts.

Competitive Position of U.S. Routes

With shippers paying full-cost grain rates following the demise of the WGTA, the competitive position of alternative routes to export has been altered. Research done at the Transport Institute last year established that use of U.S. routes to export was dependent upon prevailing exchange rates, relaxation of institutional constraints on the movement of grain, as well as upon the extra distances of haul associated with these routes. In addition, Canadian rates for hauling grain over 1200 miles have fallen as the maximum rate scale has been rendered consistent on an incremental mileage basis. Nonetheless, for those producers located near the border, U.S. routes continue to be of interest. The competitiveness of the U.S. system would be significantly increased if Burlington Northern were to lower its grain rates in North Dakota and Montana to the average U.S. rates on grain as determined by analysis of the Waybill Sample. Even at the rates in effect in 1994, the cost of exporting canola from Winnipeg through the Gulf was nominally more attractive than through Canadian ports.

Trade

Trade is an issue in which Canadian grain producers have a vital interest. While GATT and NAFTA call for liberalized trade, controversy has arisen over the volume of grain exports to the U.S. With the truce period terminating last month, the border is theoretically free again but in practice a cloud remains over future trade in grain. The continuing stream of rhetoric we hear from cross border senators and representatives leads us to surmise they believe in trade being a one-way street. The difference in agricultural policy between our two countries lies at the heart of the issue. The Canada-United States Joint Commission on Grain dealt with some of the irritants in attempting to allay controversy and ensure equitable and liberalized trade. The recommendations in their preliminary report, which are particularly pertinent to our grain handling and transportation system, are as follows:

1. Both countries eliminate discretionary pricing practices, specifically,
   a. the United States eliminate or significantly reduce and ultimately eliminate its export subsidy programs.
   b. the CWB be placed at risk of profit or loss in the market place or conduct itself in an equivalent manner.
2. Domestic agriculture policies for the cereal sector be modified to remove trade distorting effects with relative levels of support not so imbalanced between the two countries as to create significant trade distortion.
3. Grain inspection authorities in both countries standardize their methods and develop a common basis for measurement.
4. Protein be determined on a dry matter basis and its value established in the market place.
5. Both countries offer to sell on the basis of specification.
6. Both countries pursue the long-term goal of providing reciprocal access to the other's grain infrastructure.

Essentially, the Commission proposes that a similar trade and marketing environment prevail in Canada and the U.S. Bilateral trade would then reflect comparative advantage and not be predicated upon inconsistent trade and marketing policies. Under such a situation, Canadian exports of cereal products could settle at less than 3 million tonnes annually while offsetting U.S. exports to Canada could be significant.

Canadian Wheat Board (CWB)

The recommendation with respect to the CWB needs some background. The CWB is responsible for the marketing of Board grains, that is, wheat and barley for export and for domestic human consumption. The future activities of the CWB are a matter of considerable debate, indeed the entire western grain marketing system will be studied by the Western Grain Marketing Panel formed by Agriculture Minister Ralph Goodale in July of this year.

Major attributes of the CWB include:

1. Operations are carried on in the provinces of Manitoba, Saskatchewan, Alberta and the Peace River Block of British Columbia.
2. Sales are conducted from a single desk. In other words, the CWB acts as a monopolist in the sale of wheat and barley for export and domestic human consumption. By such action discrimination between markets may be practiced.
3. Returns from sales are pooled by grain and grade with initial, interim, and final payments being made to producers.

4. Financial backing is provided by the Federal Government since the CWB is a crown corporation. This financial backing assists in the financing of sales and the covering of losses and also lowers borrowing costs. The Board may be asked to carry out government policy.
5. Operations are conducted in the interest of producers. The CWB can be successful only if the confidence of producers is maintained.

The benefits which occur to producers from the CWB may be summarized as follows:

1. Single desk selling allows the CWB to capture the price premiums available in some markets.
2. The volume marketed enables the spreading of overhead costs and the hiring of professional analysts to provide market information equal or superior to that available to competitors.
3. Risk is reduced through price pooling, initial payments being guaranteed by the federal government which is also responsible for any losses arising from credit sales.
4. The expenses of the CWB are said to be offset by the relatively lower borrowing costs arising from the government guarantees as compared to the costs experienced by others in the trade.
5. Actual trade information is provided along with regular pool return outlook.
6. New markets are developed to increase potential sales volumes.

The CWB in the current marketing environment may be said to be operating in an analogous manner to the USDA and exporters under the EEP in pricing to different markets. With respect to the lack of transparency in pricing, sales prices remain undisclosed by the CWB as do those of other international grain firms. There is no doubt such firms are aware of the CWB sales prices since they are often involved in the transaction process.

Producers have expressed concerns regarding the efficiency and fairness of certain CWB practices and its ability to exploit niche markets. The CWB has responded with assistance in designing varieties for particular markets by modifying the payment system for protein to reflect more closely differences in the value of the grain, introduction of a contract delivery system which expedites movement toward "direct hits" at the ports, and electronic producer accounting. The CWB remains under pressure from some producers to publish more timely pool return outlooks, to shorten the period between the initial and final payment for the grain, to provide forward pricing options, to engage in market arbitrage, to create a capital base which will allow operation without the need for government involvement, to purchase grain stored on the farm and to make storage and incentive payments on the grain contracted. The CWB is now the defendant in a producer action in the Federal court, the contending producers holding that the regulatory functions of the CWB should be divorced from the marketing function and removed from its jurisdiction.

<u>Impact of Quality Control in Canadian Grain upon Transport Requirements</u>

Canadian requirements for cleaning, grading and inspection of grain have a considerable effect on the movement of grain for export. Indeed these act as constraints on movement through the United States. U.S. grain is not subject to the same degree of cleaning, nor do U.S. terminals have equivalent cleaning facilities, as those in Canadian terminals.

If Canadian grain moves to export through U.S. transportation routes, special arrangements have to be made with the Canadian Grain Commission with respect to segregation, cleaning and inspection procedures. The Canadian quality requirements complicate the use of U.S. channels to export. Nevertheless, this situation may change in the future as recommended by the Joint Commission. Indeed, the Joint Commission recommended that grading and inspection procedures in Canada and the U.S. be made more compatible. Other related recommendations were reciprocal inspection systems, inspection on a cost recovery basis, sampling procedures negotiated between buyers and sellers, and that registered and nonregistered U.S. and Canadian varieties be handled and transported by the Canadian system in a manner which ensure varietal integrity.

The Canadian grading system tends to emphasize quality, uniqueness and cleanliness in wheat, brewing quality in malting barley, and oil quality and content in oil seeds. These factors have a significant impact on the demand for Canadian grain in the domestic and international markets. Quality in wheat is of greatest importance in markets not receiving export subsidies or other forms of assistance while those markets under a state trading system are less likely to be sensitive to quality and more sensitive to price.

One of the quality attributes of wheat is cleanliness for which Canada is notable. While this factor has a positive effect on sales of Canadian wheat, the net benefit remains a moot point, with U.S. research implying that a higher cleanliness standard would entail a net cost in terms of all sales of U.S. wheat. Quality in grain has been intensively studied and the measurement of quality subject to intensive review, particularly in Canada. Grading may be considered a first step in the measurement of quality, this being the segregation of heterogenous material into a series of grades which reflect quality characteristics of significance to users. The primary objective of grading is to obtain the maximum net returns from the market. This is only achieved when the user is able to communicate with the producer or seller as to the quality of grain which is considered most desirable for a particular purpose as evidenced by the selection process and the offering price.

Canada maintains a rigid system of varietal control, particularly for the different classes of wheat, which emphasize quality maintenance to a particular standard, for example, protein quality, with this made possible by field and end-use testing, industry recommendations and official registration. Control of quality within classes is maintained by the requirement for the visual distinguishability of varieties. This is substantially different from the system in the United States where intrinsic quality only becomes apparent through direct scientific measurement. As a result of the farm program, U.S. plant breeders tend to emphasize yield rather than quality in the development of varieties.

During recent years, an attempt has been made for Canada to tailor more closely to the needs of individual markets when developing varieties. While this has the potential of enhancing the aggregate value of Canadian grain upon sale, determination of the net benefit requires that the cost of such product differentiation in the production, handling and transportation processes be taken in to account. The uniqueness of Canadian grain requires that it be segregated from like grain from other sources during handling and transportation. This becomes an institutional restraint to using the U.S. handling and transportation system for exporting Canadian grain. As such, it tends to encourage the use of the domestic handling and transportation system, ultimately promoting use of Canadian ports at the Pacific Coast.

The change in transportation costs experienced by shippers as a result of the demise of the WGTA has a major impact on the relative competitiveness to users of the U.S. and Canadian handling and transportation systems. Joint access to each country's system could be advantageous to Canada, but this is by no means assured in the absence of cost reduction. Nonetheless, rail competition between the two countries will be encouraged as well as between their handling systems.

<u>Change in the Economics of Cleaning</u>

The cleanliness standard for Canadian grain is currently maintained by the removal of dockage at the terminal elevators, the standard for milling wheat being very restrictive. The return to the terminal elevator from cleaning, in addition to the cleaning tariff, is dependent upon the cost of the raw material (free at the point of origin), the freight rate from origin, and the cost of cleaning which is partly a function of volume and the market for the dockage removed. With the advent of full-cost freight rates, the cost of the raw material to the terminal has increased. This has reduced the net return received from dockage thereby changing the economics of cleaning at the terminals.

A different situation exists on the prairies. The high throughput primary elevator which replaces numerous smaller elevators as the handling system rationalizes can be made capable of cleaning to export standard. At the same time the volume handled can make the cleaning function economical. The expansion of livestock feeding on the prairies, encouraged by lower feed costs with the end of the WGTA, will also provide a ready market for dockage locally. The relative economics of the cleaning function, therefore, shifts from the terminal elevator to the high throughput primary elevator on the prairies. This can be expected to have an impact on the handling of grain at terminal elevators, particularly those at the Pacific Coast, these elevators essentially becoming transfer elevators. Elimination or reduction of the cleaning operation at the ports makes feasible the construction of new transfer facilities, while at the same time increasing the attractiveness of use of existing U.S. transfer facilities, particularly those on the Pacific Coast.

St. Lawrence Seaway

The growth of markets for Canadian grain on the Pacific Rim has had a major impact on the east/west flow of grain from the prairies. This has been accelerated by reductions in ocean freight rates and presently by the shift in the CBW pooling point from Thunder Bay to the Lower St. Lawrence. Previously, any additional costs arising from use of the eastern route were absorbed by the respective annual CWB pools. However, the cost of movement down the lakes is now factored into the aggregate cost of the eastern route; this is to be fully experienced by the 1998/99 crop years.

The decline in grain traffic has had a dramatic effect on use of the St. Lawrence Seaway. The Seaway on the Canadian side is dependent upon tolls revenue. While revenue exceeded operating costs in 1994-95, annual losses have been the norm. These losses have been in addition to capital and major maintenance costs and those related to the services of the Coast Guard. It has been recommended that operation of the Seaway be transferred to a private corporation, though such a change is by no means assured.

Due to revenue derived from the tolls, it is highly unlikely that tolls will be discontinued on the Canadian portion of the Seaway, notwithstanding the St. Lawrence Seaway Corporation proposal to discontinue tolls.

The impact of the change in direction of the grain flow is illustrated by the number of lake vessels involved in grain movement. While formerly the number exceeded 80, this has been reduced to about 25. Those with a vested interested in the Seaway route are attempting to regain traffic by reducing costs such as may be accomplished by formation of a shipping consortium.

Conclusion

I note that one of the representatives of Burlington Northern has stated that the Canadian system is in a state of flux. No doubt this view arises from a group of Saskatchewan producers attempting to negotiate a unit rate "to tweak the nose of the Canadian system." The thrust of the changes occurring is to render the system consistent with world trade requirements and make it more competitive. Privatization is being encouraged in an era of restricted government budgets. The expectation is that the policies of the U.S. and Canada will become more consistent and current trade irritants a thing of the past. The two systems will then become complementary and provide mutual benefits.

SOME THOUGHTS ON U.S. RAIL AND BARGE TRANSPORT, 1995-1996

by Allen A. Housh*

Last week, I made a trip to southeastern Minnesota for the last weekend of trout fishing followed by a visit to a farm I own in Howard County, Iowa. I spent an afternoon talking with my tenant as Friday's rain delayed corn harvest. It was a fascinating visit and I learned a lot about the dramatic changes going on in rural America. I mention this experience because I think it gives me some insight into how farmers are thinking and acting and how it may affect transportation in the future.

Farmers are selling grain--high prices for corn and soybeans are cleaning out the storage bins and new crop is pretty well sold even before harvest. This is quite a change from historic patterns where grain prices were at or below loan level at harvest time. What is going on? Why are we experiencing such a dramatic increase in the demand for U.S. agricultural commodities? Most important for today's agenda, what does it mean for U.S. rail and barge transportation in 1995-96?

My tenant has sold 40 bushels/acre of new crop soybeans on a scale up from $5.75 to $6.00. He has sold about half of his new crop corn on scale up from $2.30 to $2.50. The long-term outlook for prices of both soybeans and corn is bullish with a potential of $7.00 and even $8.00 possible for soybeans and $3.00 possible for corn. Significant demand rationing is necessary for this year's smaller crop.

As we look toward spring, it is highly unlikely that an annual set-aside will be in place for the 1996 crop. Acreage planted to corn should total over 81 million acres, with a trend yield of 126 bushels/acre production, for 9.4 billion bushels is projected for next fall's harvest. While that would be a 1.5 billion bushel increase over 1994 production, it would be only 200 million bushels larger than expected 1996-97 use.

What a difference a year makes. A year ago, U.S. corn exports were limping along just above 100 million bushels per month as China and South Africa were exporting 50 million bushels/month and as South Korea was importing 20 million bushels/month of feed wheat. The current export situation is much different. The United States is exporting 200 million bushels of corn each month. China and South Africa are no longer exporting corn--they are now importing it. South Korea is no longer importing feed wheat as tight world wheat fundamentals have curbed the wheat export subsidies that made it possible for wheat to compete with corn as a feed grain. Ethanol production grew by 17 percent during the past year. In summary, both export and domestic demand for corn increased significantly causing transportation costs to escalate.

During my years at Cargill, we always said that transportation was the largest commodity Cargill traded. Fluctuations in transportation prices created opportunities in lease car rates, and changes in barge, rail and freight rates had significant impacts on corporate earnings. The action of the barge freight market

---

***Allen A. Housh is a principal of Housh and Associates. He previously was Vice President of Transportation of Cargill, Inc.**

during the past year is a graphic illustration of the impact of increased demand for grain on the barge freight market.

Figure 1 reflects the 3-year, 5-year, and 10-year average freight market from St. Louis to the Gulf of Mexico for export as a percent of the 1975 tariff. This chart illustrates the seasonal nature of the barge markets with the highs occurring from the harvest period in September through November and the lows during the spring planting season when the farmers are in the field. The top line is the barge market in 1995, reflecting rates twice as high as the long-term average for the past 10 years. My earlier discussion of the increased demand explains the high rates. However, the huge crop of corn and soybeans produced in 1994 built the foundation for increased demand by pricing the supply competitively in the world market.

Rail rates experienced significant inflation in 1995 as the demand for rail cars set new records. For example, in Figure 2, we see carloadings of grain for the week of Sept. 16 totaled 31,879 cars--an increase of 26.5 percent from the corresponding week in 1994. This year, carloadings have been driven by the export market with grain inspections totaling 3.12 billion bushels through the week of Sept. 14 compared to 2.06 billion bushels for the comparable period in 1994. A 50 percent increase in grain exports can drive a 100 percent increase in the barge market. However, the rail rate increase has not been nearly as responsive.

As we look ahead to crop year 1995-96, we are projecting some significant changes in fundamentals. Total U.S. production of grain and soybeans is anticipated to fall 17 percent to 13.4 billion bushels. The region with the greatest decline in production is the upper Mississippi River, down 1.1 billion bushels to 3.6 billion bushels. The reduction in production will result in extremely tight ending stocks in 1996 for corn and wheat.

Meanwhile, major export sales for the current and next marketing year remain strong with 26 million tons currently on the books as compared with 18.5 million tons last year. U.S. exports of grain and soybeans are projected to increase 3 percent during the 1995-96 marketing year despite higher prices due to the tight world supplies of wheat and coarse grains. These projections result in the demand for rail-car loadings in 1995-96 about the same as 1994-95 with long-haul barge movements expanding by 1 million tons.

As we look to the turn of the century, there is reason to be optimistic about the demand for rail and barge transportation as shown in Figure 3. In contrast to the first half of the 1990s when world grain and oilseed volumes shrank, the last half of the 90s will include expanding trade. This will be beneficial to production agriculture in the United States where export markets are needed to support utilization of existing capacities. Supply/demand fundamentals outside the U.S. during the next 3-5 years are expected to warrant nearly full utilization of available U.S. cropland. This will make watching the development of the 1995 farm bill a very interesting experience.

It is particularly interesting that as we approach the last half of the 1990s, with expanding demand for all modes of transportation, we are experiencing unprecedented rationalization of both barge and rail systems. The Burlington Northern-Santa Fe are well on their way to consolidating staff with a recent announcement that some 800 clerical functions performed in Minneapolis and St. Paul will be handled in Topeka.

Meanwhile, the Union Pacific is busy laying out marketing strategies for handling the huge volume of corn that is originated on the CNW in Iowa and southern Minnesota. While the Southern Pacific is not very significant in grain origination, the addition of service to customers on the West Coast greatly enhances the power of the UP. Just this week, the Norfolk Southern announced a voluntary retirement program for employees over 55. Norfolk Southern is preparing for a potential merger with Conrail in the next year. If actions of the past year are an indication of the future, that seems a definite possibility.

What does all this rationalization mean to the shipping community? CHANGE. The small shipper will be forgotten. The barge shipper will have less leverage in their negotiations. Railroads will prosper by reducing costs and enhancing revenues.

Many of the same activities have occurred in the barge industry with Continental Grain recently selling its assets to ACBL, which is owned by CSX Corporation. The barge industry which has experienced many years of poor earnings is now reaping huge returns for its patience. Assets have appreciated significantly and it was a good time for Continental to "cash out."

Summary

In May of this year, participants in the 10-year Conversation Reserve Program for idling acres were given an opportunity for an early out. After having my Minnesota farm in the program for eight years, I decided to get back to farming. It is clear that more idled acres will be coming back into production to meet the growing demand for oilseeds and grain for the next five years. This is a positive development for all modes of transportation and for investors interested in investing in transportation companies. Those of us who are interested in the changes taking place in the transportation environment will have many opportunities to explain this unique situation.

Figure 1. Average Market Averages from St. Louis to the Gulf of Mexico

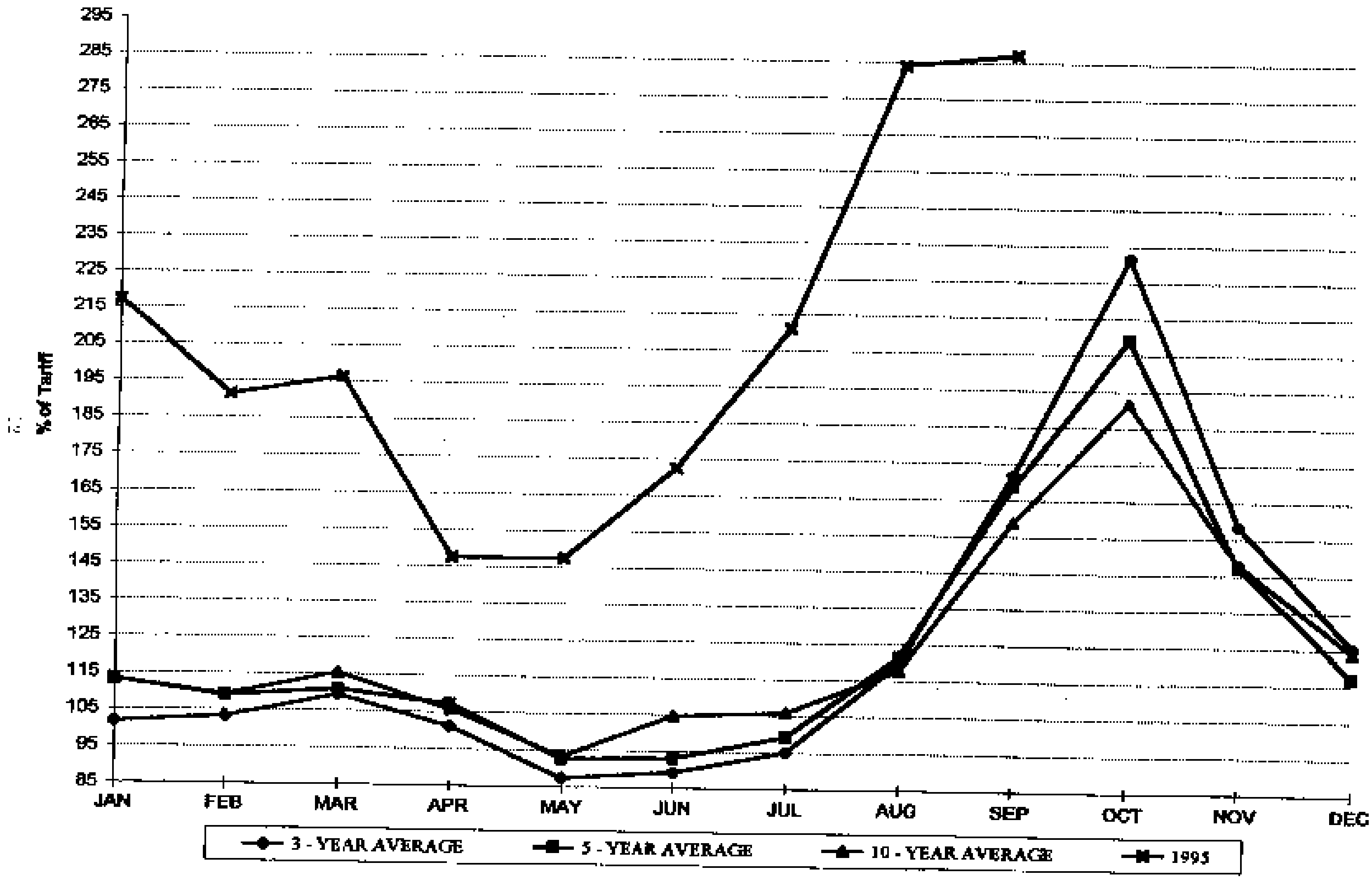


Figure 2. WEEKLY GRAIN RAIL CARLOADINGS 1995

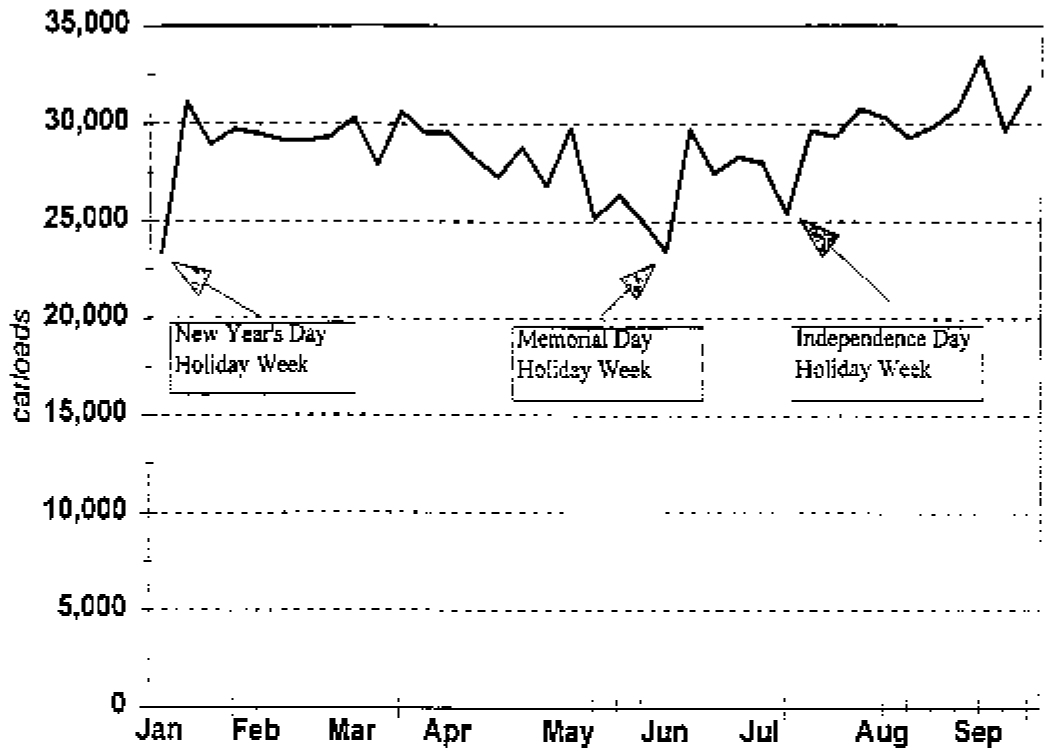
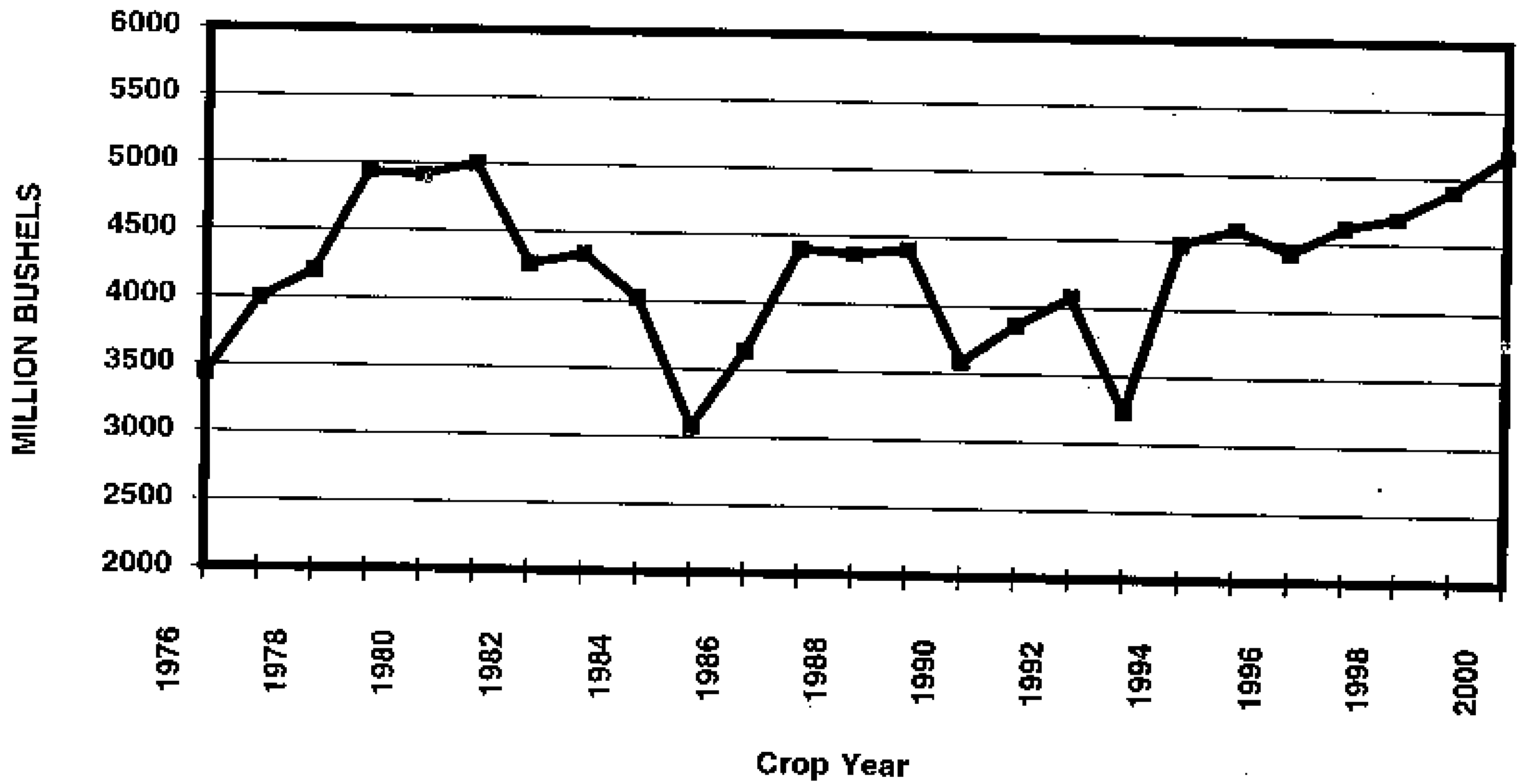


Figure 3.

US GRAIN AND SOYBEAN EXPORT INSPECTIONS



OCEAN FREIGHT

by Tom Medd*

Ocean freight on grain cargoes affects the value that U.S. producers obtain for their products since anywhere from 30 percent to 50 percent of their production is sold for export and subsequently moved via ocean going vessels. At the same time, ocean freight, its market direction, and how that market is determined is often misunderstood by some in the grain industry.

There are some unique factors that affect the provision of ocean freight services.

1. Vessels are in effect moving plant and equipment. As such they can be moved to the market that provides the best return on investment. To determine the rate of return on a vessel calculations are run on a daily or per diem basis.

2. Cost breakdown on a 50,000 ton Panamax vessel is as follows:

   a. Incurred fixed costs are about $2,000 per day whether the vessel works or lays up:

      1) Interest and finance: based on vessel cost of about $12 million for a vessel 12/13 years old and $24 million new.
      2) Lay up costs if taken out of service (minimum maintenance/security).

   b. The variable costs, about $4,000 to $4,500 per day, are comprised of:

      1) Maintenance and repair
      2) Crew costs which vary with nationality
      3) Operating insurance

   c. Voyage costs run about $8,000 per day and consist of:

      1) Fuel: daily usage 33 tons of fuel oil/2 tons of diesel. Bunker fuel at $100 per ton and diesel at $300 per ton equals fuel cost per day of about $3,900 per day.
      2) Port costs: line handlers, tugs, vessel agency fees, ships stores, local and discharge ports.

Note: Port costs vary with each port. At present a four day load in New Orleans is about $65,000. A four day discharge in Japan on the same vessel will cost about $150,000.

The basis for the above information for the daily cost of operating a 50/52,000 Long Ton Panama size vessel is about $14,000 per day.

***Tom Medd is Assistant Vice President of Marketing of Harvest States Cooperative.**

The reason that vessel costs and internal rates of return are based on daily calculation is that each voyage, including time spent loading and discharging, is different. Daily calculation, used as a common denominator, allows logical assessments of freight rates to be charged corresponding to the voyage in question and the total number of days it will take to complete the voyage.

The freight rate is composed of the days required to complete the voyage charter times per diem market values divided by tons shipped.

As an example, comparing a 50,000 ton cargo from the U.S. Gulf to Europe and from the U.S. Gulf to Japan, we would use the following rough figures:

Assume sailing time:

Europe 16 days at 310 knots per day/16 days in ballast back
Japan 30 days/30 days in ballast back
Per diem value of $14,000 per day
Panama Canal cost $85,000
Four day load/four day discharge
Port costs load/four days $65,000
Port costs Europe/four days $95,000
Port costs Japan/four days $150,000

U.S. Gulf Europe calculation:

32 days x $12,000 per day	$448,000
Four days load	65,000
Four days discharge	85,000
Total	$598,000

Divided by 50,000 tons equals $11.96 per Long Ton

U.S. Gulf Japan calculation:

60 days x $14,000 per day	$840,000
Four days load	65,000
Four days discharge	150,000
Panama charges	85,000
Total	$1,140,000

Divided by 50,000 tons equals $22.80 per Long Ton

While the rate to Japan is $22.80 per ton and the rate to Europe is $11.96 per ton, the return to the vessel is equal in both cases.

The above calculations are a simplistic analysis of how freight is calculated. There are numerous variables that an owner takes into consideration such as: a) shipping to areas during monsoon weather. Any rain time is for the account of the ship owner not the charter so an owner will budget for a certain amount of rain time depending on the time of the year, b) the owner may consider the value of back hauls from a destination to the load port as opposed to ballasting back with water in holds, 3) the cost of bunker fuel in various ports of the world also affect freight rates.

Grain freight is a relatively small part of the ocean freight world. Coal, steel, fertilizer, ore and merchandise comprise about 92 percent of world shipping cargoes with grain comprising only about 8 to 10 percent of world shipping. As such, grain rates are more or less dictated by other cargoes although grain rates do tend to have more volatility than major bulk cargoes and that situation can affect the price of grain to producers and consumers throughout the world.

Glossary of Ocean Freight

Charter and Charter Party: contract of affreightment between a vessel owner (or disponent owner) and a charterer (shipper). The charter party is the contract for the freight.

Disponent owner: simplistically a buyer of freight from an owner who then recharters the vessel to a shipper.

Three general types of vessel charters:

Long term time charter: vessel booking in which an ocean freight company charters a vessel for months or years to ship his own commodities or to resell freight to other shippers while operating the ship for a series of voyages.

Voyage time charter: vessel booking for a specific voyage whereby the charter books the vessel on a dollars per day rate and essentially operates the vessel with his own operations department, hopefully creating per ton rates cheaper than he could book on a voyage charter.

Voyage or trip charter: vessel booking for a specific voyage from origin to destination at a dollars per ton rate with specified load and discharge times allowed within the charter party.

CANADIAN RAIL SUBSIDIES AND CONTINENTAL BARLEY FLOWS: A SPATIAL ANALYSIS*

by D. Demcey Johnson
and William W. Wilson**

ABSTRACT

Rail subsidies provided under the Western Grain Transportation Act (WGTA) have been controversial within Canada and an issue in recent trade disputes with the United States. A detailed spatial equilibrium model of the North American barley market is used to assess the effects of WGTA subsidies. Simulation results indicate that elimination of these subsidies would induce a larger flow of barley from Canada to the United States.

I. INTRODUCTION

Under the Western Grain Transportation Act (WGTA), the Canadian Government pays railroads part of the cost of grain shipments from interior points to Vancouver (for export) and Thunder Bay. For budgetary reasons this has been a subject of longstanding controversy in Canada.[1] Change in this rate structure could have important implications for spatial flows within the North American barley market. U.S. barley production is concentrated in Northern states, contiguous to Canadian growing regions. The U.S. transportation and handling system is accessible to a significant portion of Canadian barley production--a fact that must be taken into account when considering the impacts of Canadian rail subsidies. In the 1993/94 marketing year, substantial quantities of Canadian barley moved across the border by truck for transshipping via U.S. elevators and railroads to U.S. destinations. From a Canadian perspective, these "prairie-border-crossing" flows represent an important logistical alternative, particularly in view of the higher cost of grain handling at Canadian elevators.

This paper presents results from a detailed spatial equilibrium model of the North American barley market. The analysis focuses on Canadian rail subsidies. In particular, we use model simulations to assess effects of removing these subsidies on North American barley trade flows. Results hinge on existence of alternative logistical channels for movement of Canadian barley into the U.S. marketing system, and arbitrage pressures in border regions.

The next section provides additional background on barley transportation and logistics, and on the competitive pressures (arising partly from U.S. trade and agricultural policies) that have induced increased sales of Canadian barley into the United States. The spatial model is outlined in the third section, and simulation results are presented in the fourth section. The paper concludes with a summary and discussion of implications.

---

*Reprinted by permission of the publishers of *The Logistics and Transportation Review*.

****Professor D. Demcey Johnson is Assistant Professor and William W. Wilson is Professor in the Department of Agricultural Economics, North Dakota State University, Fargo.**

II. BACKGROUND[2]

Canadian shippers pay only a portion of total rail costs for movements covered by the WGTA; the balance is paid directly by the Government to the railroads. Subsidy levels are adjusted annually, and a cap applies to total subsidy outlays. Subsidized rates apply to all rail movements of barley and malt from the Prairies to Vancouver (for offshore export) and Thunder Bay. Exports to the western United States do not qualify for subsidized rates; however, the rates do apply for shipments through Thunder Bay to the Midwest and eastern United States.

Proposals have been made to change this subsidy regime. At issue is the method of payment (MOP) for the Crow's Nest subsidy. Over a 4-year period, the subsidy would be converted into direct producer payments (*Milling and Baking News*, July 6, 1993, p. 45). While it is not yet known how this change in the MOP would be administered, the effect would be to raise direct shipping costs for Canadian shippers.

Figures 1 and 2 show components of barley transportation and handling costs for selected origins and destinations used in this study. The Government's share of the shipping cost is equal to the WGTA subsidy for Canadian origins. Comparisons of Canadian shipping costs, with and without the government share, show how changes in the MOP could affect shipping costs. Handling costs are also shown for both country and export elevators.

Excluding the government portion, the cost of shipping from Winnipeg to export position in Thunder Bay is less than the cost of shipping from Larimore, North Dakota to Duluth (Figure 1). However, the effect of the Canadian rail subsidy (19 c/bu) is partly offset by higher handling margins (33 c/bu total, including export elevation, versus 16 c/bu in the United States). A similar comparison is made for westbound shipments from Shelby, Montana and Lethbridge, Alberta to Pacific ports.

For shipments to Wisconsin malt plants, the value of Canadian rail subsidies is sizable (Figure 2). However, this advantage is dissipated by higher Canadian handling costs and the U.S. rail share of the total movement. The right-hand side of the figure shows costs of two movements from Lethbridge to the California feed market. The comparison shows that a prairie-border-crossing movement by truck costs less than a direct rail movement.

One of the largest feed deficit markets in North America is the U.S. West Coast. This market is traditionally served with Midwest corn and barley, both of which incur high freight costs. Allegations are made that this market could be competitively served from Canada, particularly Alberta, which is the primary barley production region in Canada (Magnusson and Lerohl). On the other hand, U.S. demand for malting barley is concentrated in the Midwest, where most malt plant capacity is located. Canada produces substantial quantities of malting quality barley--especially 2-rowed varieties, which are in more limited supply in the United States.

Opportunities for North American barley trade have inspired much debate in Canada. Recent studies have reached sharply different conclusions about whether the Canadian Wheat Board (CWB) has been underselling (in volume) barley into the U.S. market, and whether the Board should retain control over Canadian exports.[3] A major liberalization of barley marketing was implemented in August, 1993. The move toward a "Continental Barley Market" allowed Canadian producers or traders to sell their barley directly to U.S. buyers directly, bypassing the CWB (which retained control over offshore sales).

This was reversed through a September 1993 court decision after an estimated .5 to 1 mmt of Canadian barley had been contracted for sale to U.S. buyers.[4]

That such a large volume was contracted in the space of several weeks is indicative of the pressures to sell Canadian barley to the United States. This is partly due to the U.S. Export Enhancement Program (EEP), which has subsidized the sale of U.S. barley to offshore markets since the mid-1980s. To the extent that EEP has raised U.S. domestic prices while depressing offshore prices, it has provided an extra inducement for cross-border flows.

III. OVERVIEW OF THE SPATIAL MODEL

A mathematical programming model was developed to analyze North American barley flows. The United States and Canada are divided into different producing and consuming regions; to these are added export markets for barley and malt. The objective is to maximize the sum of producer and consumer surplus in feed barley markets less the cost of satisfying fixed regional demands for malt. This formulation treats malt demand as completely inelastic, while allowing feed barley prices and quantities fed (by region) to vary. By design, conditions of competitive spatial equilibrium are satisfied in the model solution.

The model analyzes barley flows within a marketing year and with fixed supplies. For each barley-producing region, available supplies are based on average annual production (acres times yield) during 1989-92. The model does not incorporate storage activities; all barley demand is for current use, either for feed or malt production. Figure 3 provides a description of the disposition of barley and malt in the model. Barley is shipped from producing regions to feed demand regions, including export markets. Malting barley is shipped to malt plants where, subject to capacity constraints, it is converted into malt for reshipment to malt demand regions (i.e., North American breweries and offshore malt plants).

<u>Barley Supply and Demand</u>. Barley supplies include four distinct types: feed barley (varieties not suitable for malting), 6-rowed white malting; 6-rowed blue malting, and 2-rowed malting. For each producing region, supplies are divided among the four types based on recent production history and quality factors. Quality differences are important because demand requirements vary across brewers, as discussed below.

Feed barley demand functions were synthesized from an optimization model at the state and province-level. Specifically, we used a least-cost feed model developed by Johnson and Varghese, which combines diet formulations for several classes of livestock in a single linear-programming problem. Using 1992 livestock inventories as scaling factors, the least-cost feed model was adapted for individual states and provinces. Synthetic demand schedules were derived by varying the barley price, holding other prices constant, and solving for barley quantity. These demand schedules were linearized for insertion in the spatial model. Impacts of the Alberta *Crow Benefit Offset Program* and the Saskatchewan *Feed Grain Market Adjustment Program* were captured by imputing a subsidy of US $7.9/mt (in the base case) for feed use within these provinces.

Actual barley use and trade flows are not available on a regional basis. For purposes of base-case simulations, the model was calibrated to be consistent with the level of cross-border flows observed in

1993/94. Specifically, we adjusted the intercepts on Canadian feed demand schedules so that the model reproduced the 1993/94 level of U.S. net imports.

Demand schedules for offshore markets (EEP and non-EEP) are based on econometric estimates. Both the United States and Canada export from their Pacific ports: Portland and Vancouver, respectively. EEP subsidies ($32/mt in the base case) apply to U.S. export shipments. Canada's export price to the non-EEP market is constrained to be no greater than the Portland price. This mimics strategic pricing by the CWB in its offshore sales.

There are 19 malt plant locations in North America with different capacity constraints. Vertical integration constraints are imposed at selected locations, reflecting brewer-owned malt plants. Malt demand regions are identified with states or provinces with significant beer production; there are also two export markets. For each malt demand region, quality requirements (percentages of 6-rowed white, blue, and 2-rowed malt) reflect market shares of major brewers with known variety requirements.

Transport and Handling Costs. Transport and handling costs are based on recent truck and rail rates, and handling margins at U.S. and Canadian elevators. For individual origins and destinations, several alternative movements were identified (e.g., truck, rail, or combination); least-cost movements were identified and incorporated in the analysis.

Barley Shipping Rates and Costs: An important feature of barley spatial flows are what we refer to as prairie-border-crossing trade. Some barley trade currently flows across prairie borders, and anticipated changes could result in greater flows through this network. In this study we allow for prairie-border-crossing trade explicitly as an alternative flow. Inclusion of handling costs in each country, as well as direct shipment to U.S. shipping stations (implicitly, transshipment points) provides a more realistic explanation of the spatial competitive environment that has emerged.

Shipment alternatives from prairie shipping points are illustrated in Figure 4. Table 1 defines cost components used in this study and specifies those included in alternative movements. C_c and C_e are Canadian country and export elevation costs respectively, U_c and U_e are the same for U.S. elevators. An *Administrative charge*, A_F is applied for all shipments direct from Canadian farms to U.S. shipping points. This is intended to reflect merchandising charges under the *ex-farm-truck* program introduced in early 1993. Specifically, this fee is charged by accredited exporters to execute these transactions. Trucking is allowed directly from Canadian farms to U.S. shipping points, T_{FU}; and from Canadian elevators to U.S. destinations, T_{AD2}. The shipper portion of rail rates from Canadian origins is defined as R^s and the assumed compensatory rate level is R^c. Gathering rates for U.S movements are defined as R^{USg} and the proportional rail rate for eastern U.S. shipments is R^{USp}. Direct point-to-point rates are represented by R^{US}.

Alternative transport and handling regimes for Canadian shipments were defined and are illustrated using this notation. The alternative most reflecting current and past marketing practices includes Min(T, R^1). This reflects the situation assuming the CWB controls exports via licenses and likely results in a lesser amount shipped to (via) the United States.

The *base case* solution uses elements in a shipping matrix for these origins as Min(T, R^1, TR). This routing allows for either direct rail, an all truck movement, or a truck/rail combination via U.S. shipping points. A different configuration of handling costs exists depending on the routing. In most cases, particularly for the central and northerly regions, R^1 is the optimal routing. However, TR applies in some southern origins, implying shipments by truck through the U.S. marketing system. Solutions using *compensatory rates* use elements defined as Min(T, R^2, TR). This allows for diversion of traffic from the Canadian handling and rail transport system to either an all truck movement, or a TR combination.

Interior Barley Trucking: The transport matrix allowed for shipment by either rail or trucks depending on relative rates and routings. Truck rates were developed in the United States from industry sources with treatment of backhauls to correspond with trade practices. Canadian trucking rates were derived from industry sources. Shipping rates were derived as $C = [(K_1 \cdot Q \cdot (D/K_2)) + (K_3 \cdot Q + K_4)]/Q$ where $K_1, ..., K_4$ are parameters used in truck rate formulas, Q is MT per load and D is the one-way distance. These rates were applied to all prairie-border-crossing movements and to intra-provincial movements. For movements within a province for feed-use, a distance of 50 miles was assumed.

Malt Shipping Rates: All intra-U.S. movements were assumed to be shipped by rail. Rail tariffs were used where they existed, primarily for movements on BN and CP/Soo. For others, rates were approximated in one of two ways. First, if a rate representative of that movement were shown in the 1991 Waybill Analysis, that rate was used. If not, rates were estimated using results of a regression analysis. Specifically, nonlinear regression equations were estimated for each of four inter-regional movements and used to derive rates for other possible movements.

Rates for intra-Canadian movements were similarly derived. For movements with published rates (mostly to Vancouver and Thunder Bay under WGTA), the published tariff was used. Intra-provincial movements from malt plants to breweries are mostly by truck, and the above formula was used with adjustments to account for the weight differential between malt and barley.

The model allows for inter-country movements of malt, which in practice is by rail. However, these rates either are under contract or are not available (i.e., because there are currently no movements to particular locations). For these movements, the estimated malt rate function for the contiguous U.S. region was used. The implicit assumption is that if a cross-border malt movement occurs it would involve rail costs similar to those of the contiguous U.S. region.

Mathematical Specification of the Model. Formally, the model is specified as a quadratic programming problem. Let X_{ijk} denote a shipment ('000 mt) from producing region i to feed demand region j. The index k denotes barley type. There are four barley types: feed, 6-rowed white malting, 6-rowed blue malting, and 2-rowed malting. The four types are perfect substitutes in feed demand; however, only malting types are shipped to malt plants. For notational convenience, we use the index h to refer to the subset of malting types. Shipments from producing regions to malt plants ('000 mt) are denoted Y_{imh}, where m identifies the malt plant location. Shipments of malt ('000 mt) to beer production regions are denoted Z_{mnh}, where n identifies the malt destination and h the malt type. The objective function is defined:

$$W = \sum_j \int_0^{Q_j} (\alpha_j - \beta_j Q_j) dQ_j - \sum_i \sum_j \sum_k X_{ijk} Tx_{ij} - \sum_i \sum_m \sum_h Y_{imh} Ty_{im} - \sum_m \sum_n \sum_h Z_{mnh} Tz_{mn}$$

where Q_j is total barley feed use in region j;

$$Q_j = \sum_i \sum_k X_{ijk} \qquad \forall j$$

α_j and β_j are regional feed demand parameters; and Tx_{ij}, Ty_{im}, and Tz_{mn} are transportation cost parameters ($/mt). The latter include freight costs and handling margins, and applicable import tariffs and export subsidies. Because barley supplies are fixed, total producer and consumer surplus is represented by the area under regional demand schedules less transportation. The objective function (1) is maximized subject to constraints on regional feed use, barley supplies, malt plant capacities, brewer ownership of selected malt plants, and malt requirements in beer production regions.

Producer prices are computed as a weighted average of the shadow prices associated with supply constraints in barley producing regions. There are no malt prices in the model other than the shadow prices associated with demand constraints at different points in the marketing system. These reflect the opportunity cost of malting barley (i.e., in terms of its alternative feed use) in addition to transportation and handling costs.

IV. RESULTS

Base-Case Simulations. Our base-case assumptions reflect a marketing regime in Canada similar to that which would have evolved under the Continental Barley Market proposal. Specifically, we assume: 1) quantitative restrictions do not apply to cross-border flows of barley or malt; 2) Canada does not regulate imports through the granting of permits; 3) current U.S. tariffs apply to imports of barley and malt from Canada; 4) Canadian rail rates reflect current Crow subsidies; and 5) cross-border truck/rail shipments are allowed to U.S. barley destinations.

Under base-case assumptions, the model projects 1.6 mmt of Canadian barley exports to the United States, including 1.0 mmt of feed barley (Table 2). This is approximately the level observed in 1993/94. Canada's total feed use is similar to levels observed in recent years. Canada also exports about .6 mmt of malting barley to the United States. Two-row malting barley accounts for over 90 percent of these malting barley exports.

Average producer prices are higher in the United States than in Canada. U.S. producer prices are $1.81/bushel (averaged over all U.S. producing regions and barley types), while Canadian producer prices are $1.58/bushel. Among other factors, this difference reflects the proximity of U.S. producing regions to high-priced feed markets and malting capacity.

Results confirm the importance of west-coast feed markets. California, Arizona and Nevada represent the highest-priced feed barley markets due to transportation costs and expensive feed substitutes. U.S. prices are lowest in Midwestern barley-producing states. Prices in the prairie provinces are the lowest of all regions. This is consistent with recent observations.

California represents the largest feed demand region, with barley feed use of 1.8 mmt. However, Canada supplies only 2% of California's barley feed use. The northwestern states (Oregon, Washington and Idaho), which account for an additional 1.8 mmt of feed barley demand, are supplied extensively (53%) by Canada. In total, Canada captures 29% of the U.S. feed barley market.

Canada's share of the U.S. malting barley market is 21% in the base case. Canadian exports of malting barley to the U.S. west coast are particularly large. The U.S. Midwest, where most U.S. malting capacity is located, is principally served by U.S. producing regions.

Regional flows provide an interesting perspective on the U.S. EEP program. Under base-case assumptions, subsidized U.S. export shipments originate largely in western Montana, Washington, Oregon, and Idaho. Feed markets in these states receive substantial inflows of barley from adjoining regions, including southern Alberta. This highlights the fungible aspect of barley supplies. The model does not allow Canadian barley to qualify for U.S. export subsidies; however, grain exported under EEP can be replaced in U.S. markets by imports from Canada.

Impact of Compensatory Rail Rates. Proposals have been made to change the method of payment for the Crow Benefit. Existing subsidies, paid by the Government to the railroads, would be converted into direct payments to producers over the course of four years. For purposes of model simulations, rates for applicable Canadian rail movements are adjusted by the full amount of the Crow Benefit. With fully compensatory rates, shippers would pay the total cost of shipping, including the portion previously paid by the Canadian Government. In addition, for purposes of these simulations the implicit subsidy associated with the Alberta and Saskatchewan provincial programs were excluded. Changes in the subsidy regime effectively raises the shipping rate to Vancouver (for off-shore exports) and Thunder Bay (for eastern N. American destinations), making prairie border-crossing movements more attractive.

Simulation results indicate that compensatory rates widen the gap between U.S. and Canadian producer prices (Table 2). With unrestricted access to the U.S. market, Canada exports over 3 mmt of barley to the United States--about 29% of total Canadian production. Barley feed use increases in the United States, and decreases in Canada, relative to the base case. Canadian exports to offshore markets are reduced compared with the base case because of higher shipping costs to Vancouver.

Greater detail on the change in barley flows is shown in Figures 5 and 6. Most of the change occurs in feed barley flows. Shipments of Canadian barley to California increase by nearly .9 mmt, displacing barley of US origin; total feed use in the state increases to 2.1 mmt. Montana and Utah also experience large new inflows of Canadian barley for feed use (.3 mmt in each case). Total malting barley shipments to the U.S. increase by a modest amount.

To gain additional perspective on the effects of alternative rate structures, additional simulations were conducted. The U.S. import tariff for barley (currently $1/mt) was raised by increments under both sets of transportation assumptions (Figure 7). Results suggest that under the current rail subsidy regime, a U.S. tariff of approximately $25 per metric ton would be necessary to curtail imports from Canada. However, with compensatory rail rates in Canada, U.S. tariffs must be higher to achieve the same result. This reinforces the point that compensatory rail rates have the effect of widening cross-border price differences, inducing (absent trade restrictions) a larger volume of U.S. imports from Canada.

V. SUMMARY AND DISCUSSION

The Canadian Government provides an important indirect benefit to grain producers though transportation subsidies. Rail shipments to Vancouver (for offshore export) and Thunder Bay (for eastern destinations) are subsidized; this has the effect of raising producer prices in the Prairie Provinces. Changes in this subsidy regime would have important implications on the direction of barley trade flows within North America. This mechanism has also become a focal point of ongoing trade disputes between Canada and the United States. For unrelated reasons, the Canadian Government has proposed changes in the method-of-payment of the Crow's Nest subsidy. Existing subsidies would be converted into direct producer payments over the course of four years. This would raise the cost of Canadian rail shipments to Vancouver and Thunder Bay and make alternative logistical channels (i.e., cross-border truck shipments) more attractive.

A mathematical programming model was developed to analyze North American barley flows. The model was used to identify optimal trade flows under conditions of liberalized barley trade in Canada as advocated by proponents of the Continental Barley Market. Two different transportation regimes were considered: the current rail rate structure (base case); and compensatory rates in Canada. In each case barley was allowed to be shipped by truck to U.S. shipping points.

In the base case, the United States imports about 1.6 mmt of Canadian barley. This includes 1.0 mmt of feed barley, sold primarily in West Coast markets. With compensatory rail rates in Canada, the equilibrium trade volume increases to 3.0 mmt; average producer prices are lowered in both countries compared with the base case. The primary change in flows would be increased shipments of Canadian barley to the California feed market.

These results suggest that criticisms of Canadian rail subsidies by the U.S. Government and producers are ill-advised. Elimination of Canadian rail subsidies would in fact increase the equilibrium shipment levels from Canada to the U.S. Higher shipper costs would depress barley prices in Canadian producing regions, the effect being to induce larger flows of Canadian barley into the United States. Much of the increased movement involves shipment via truck to U.S. shipping points for rail shipment beyond.

The analysis should be qualified in several ways. Reduction of producer prices in Canada is likely to induce a supply response--an effect not captured in our model. Further, the transportation rates used in our analysis reflect the current competitive regime. Undoubtedly, railroads will have to re-evaluate their rate structures, including the total shipping costs (i.e., handling plus shipping) of competitive movements, if and when these changes in WGTA are introduced.

TABLE 1

ELEMENTS OF SHIPPING COSTS FOR EXPORTS FROM CANADIAN ORIGINS
TO U.S. AND THIRD COUNTRIES

	U.S. Shipments		
Movement	East	West	Third Countries
T: All Truck	C_c+T_{AD2}	C_c+T_{AD2}	$C_c+T_{AD2}+C_e$
R^1: Rail (Rail Subsidized)	$C_c+R^s+R^{USp}$	C_c+R^c	$C_c+R^s+C_e$
TR: Truck/Rail	$A_F+T_{FU}+U_c+R^{USg}+R^{USp}$	$A_F+T_{FU}+U_c+R^{USw}$	$A_F+T_{FU}+U_c+R^{USw}+U_e$
R^2: Rail (Shipper Subsidized)	$C_c+R^c+R^{USp}$	C_c+R^c	$C_c+R^c+C_e$

TABLE 2

SIMULATION RESULTS

Variable	Base Case United States	Base Case Canada	Compensatory Rail United States	Compensatory Rail Canada
Bilateral Exports, '000 mt				
Feed barley	0	1,028	0	2,443
Malting barley	93	573	116	596
All barley	93	1,600	116	3,039
Malt	0	188	0	188
Offshore feed exports, '000 mt				
Subsidized markets	1,919	0	1,845	0
Nonsubsidized markets	0	2,741	614	1,511
Domestic Use, '000 mt				
Feed use	5,558	5,275	6,436	5,088
Malting use	2,759	871	2,759	871
Average Producer Price, All Barley				
U.S. $/mt	83.24	72.55	82.91	68.07
U.S. $/bu	1.81	1.58	1.80	1.48

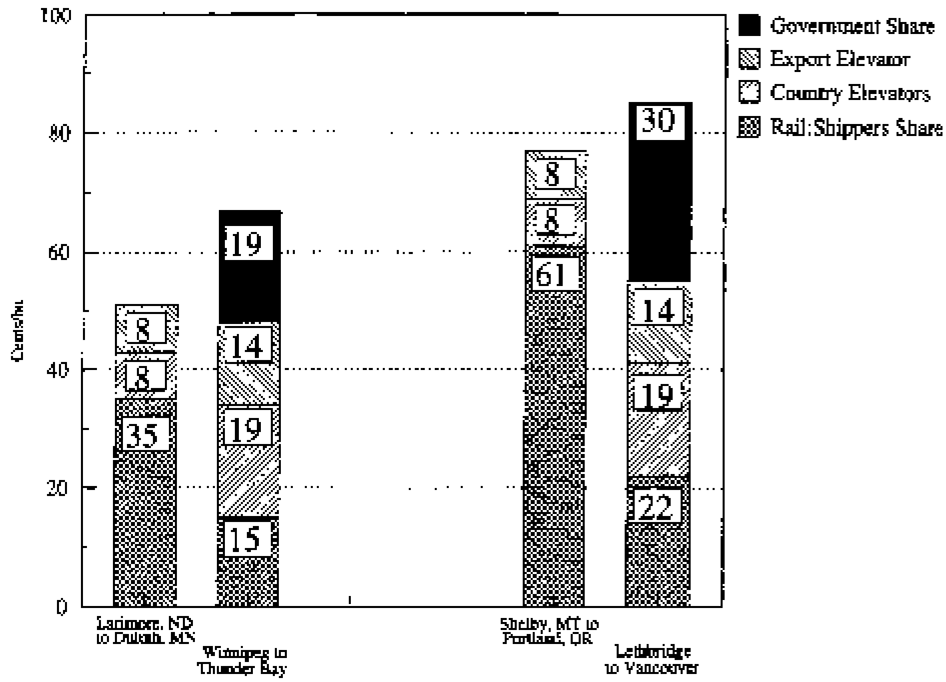


Figure 1. Grain Handling and Transport Cost Comparison for Third Country Export (U.S. cents/bu)

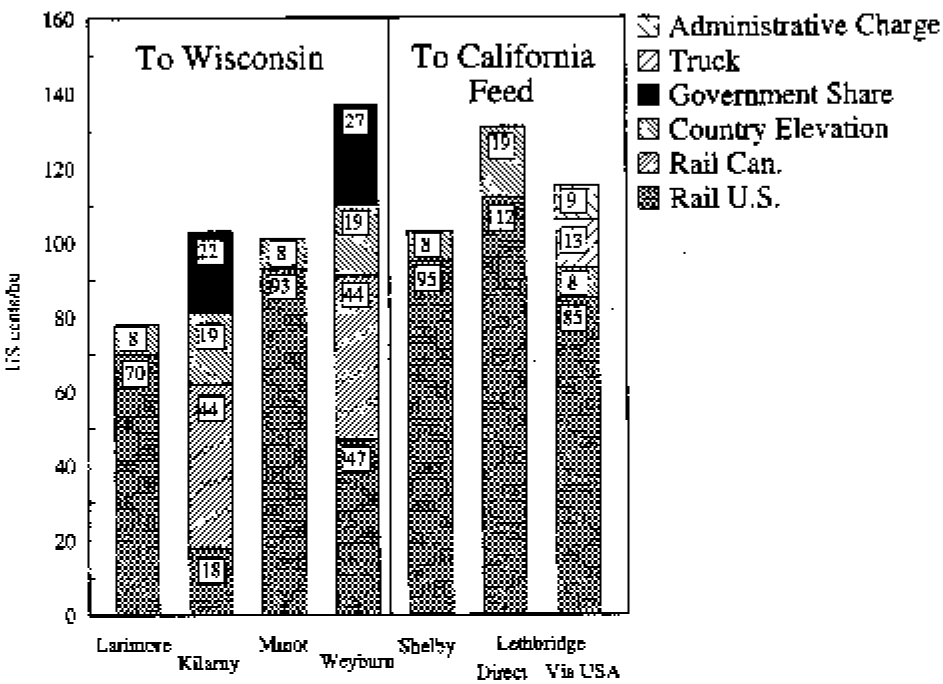
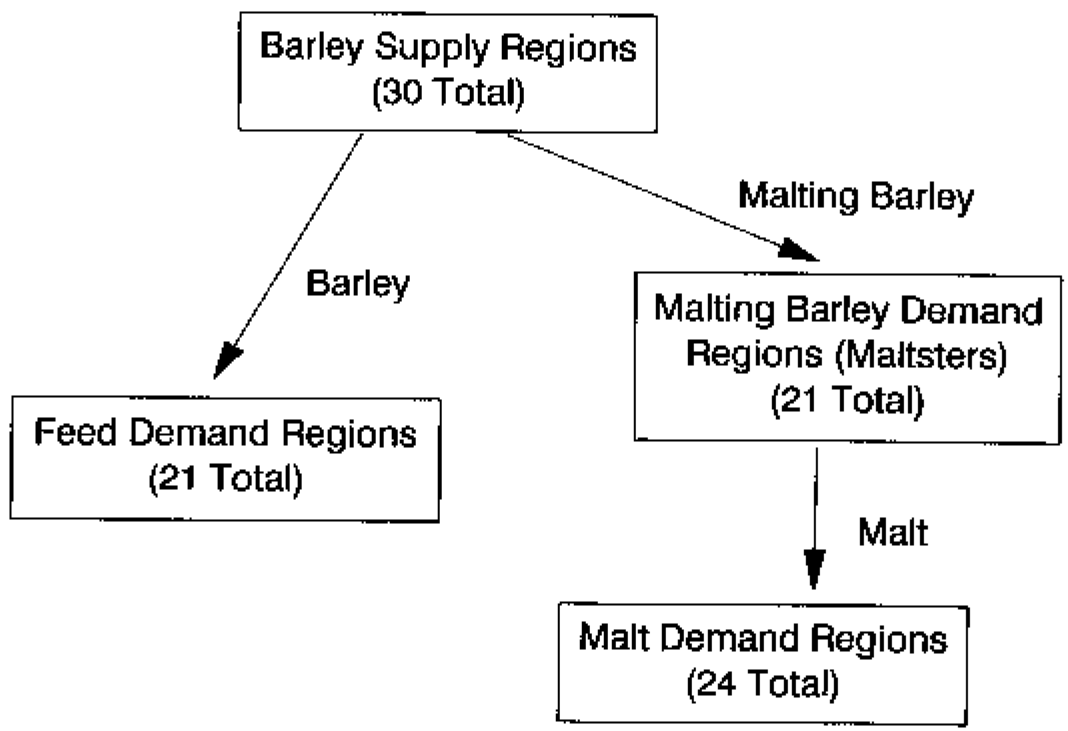


Figure 2. Grain Handling and Transport Cost Comparison for U.S. Destinations (U.S. cents/bu)

Figure 3. Barley and Malt Flows in the Model



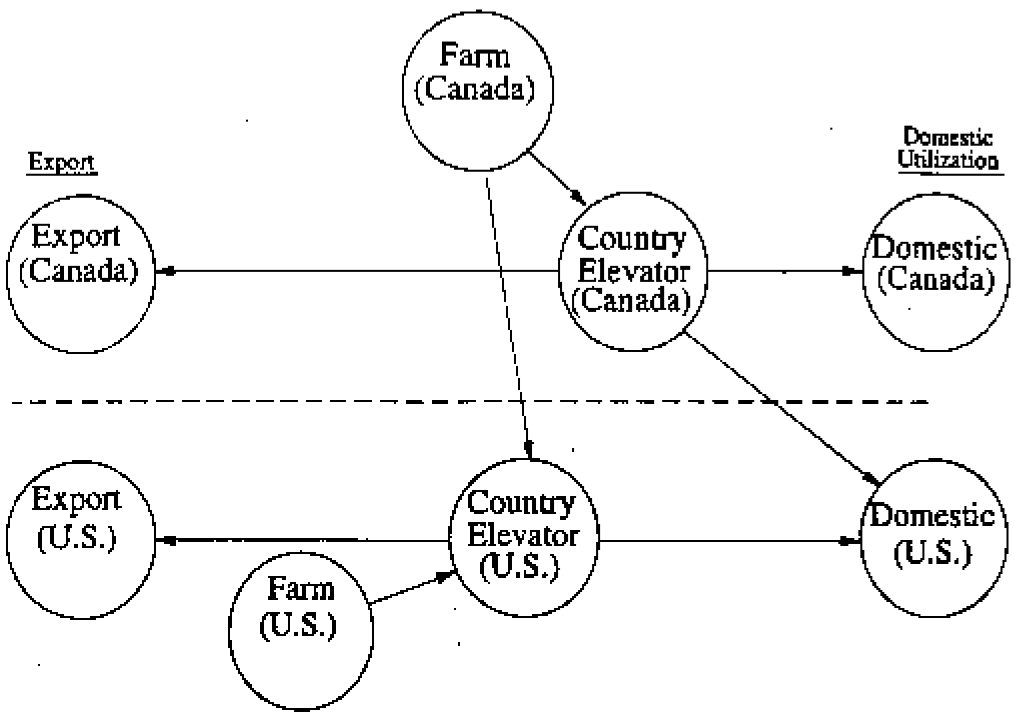


Figure 4. Alternative Shipping Routes from Farm Origins

Figure 5. U.S. Imports of Canadian Feed Barley by Region

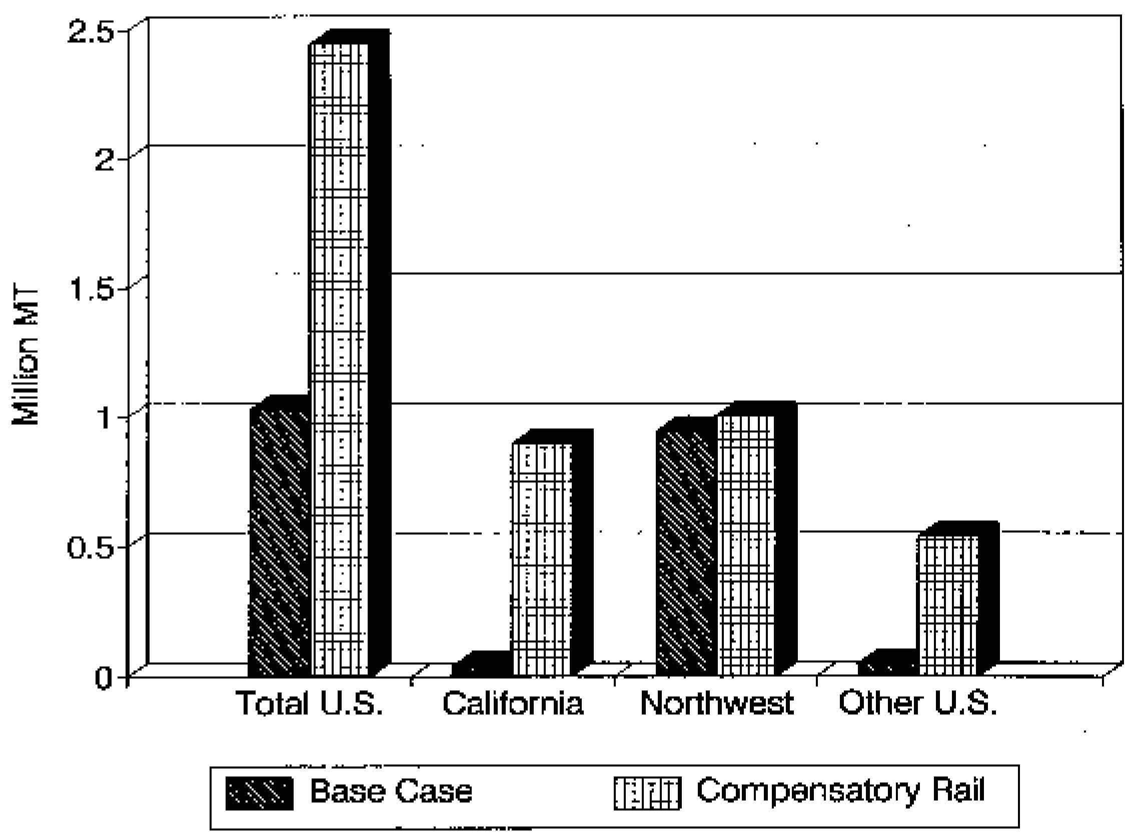
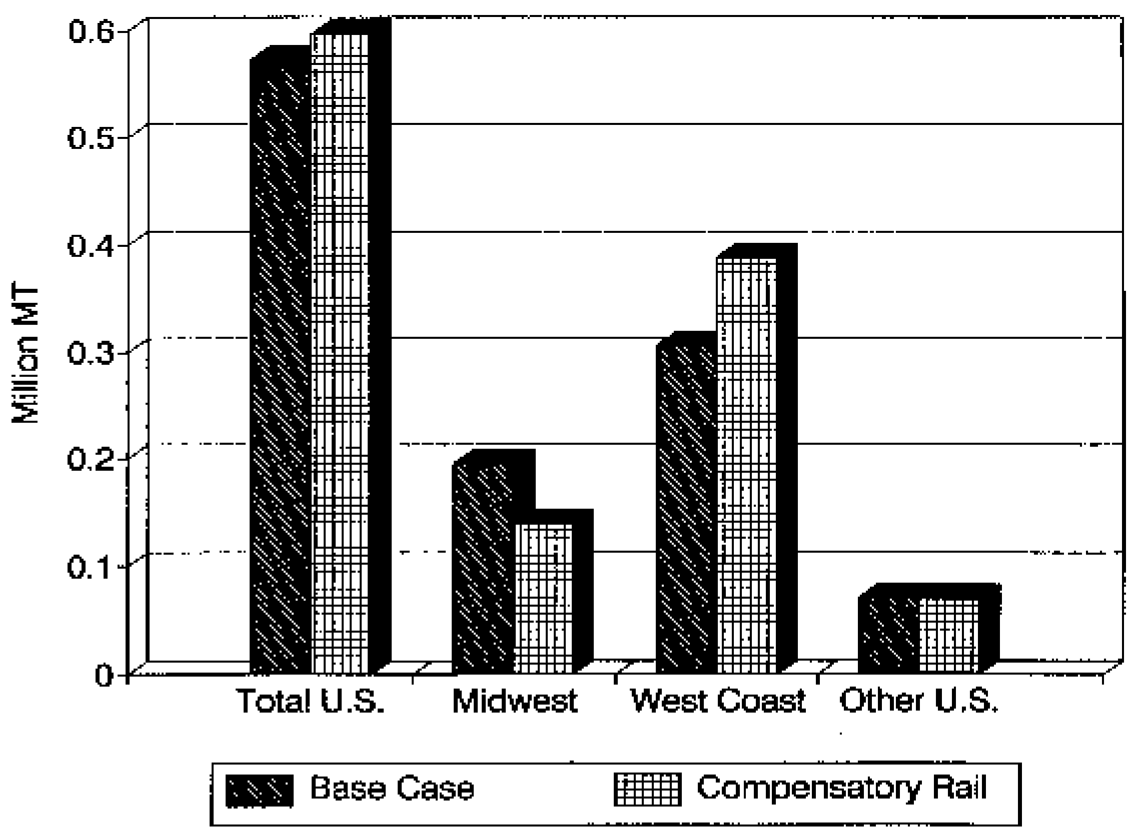


Figure 6. U.S. Imports of Canadian Malting Barley by Region



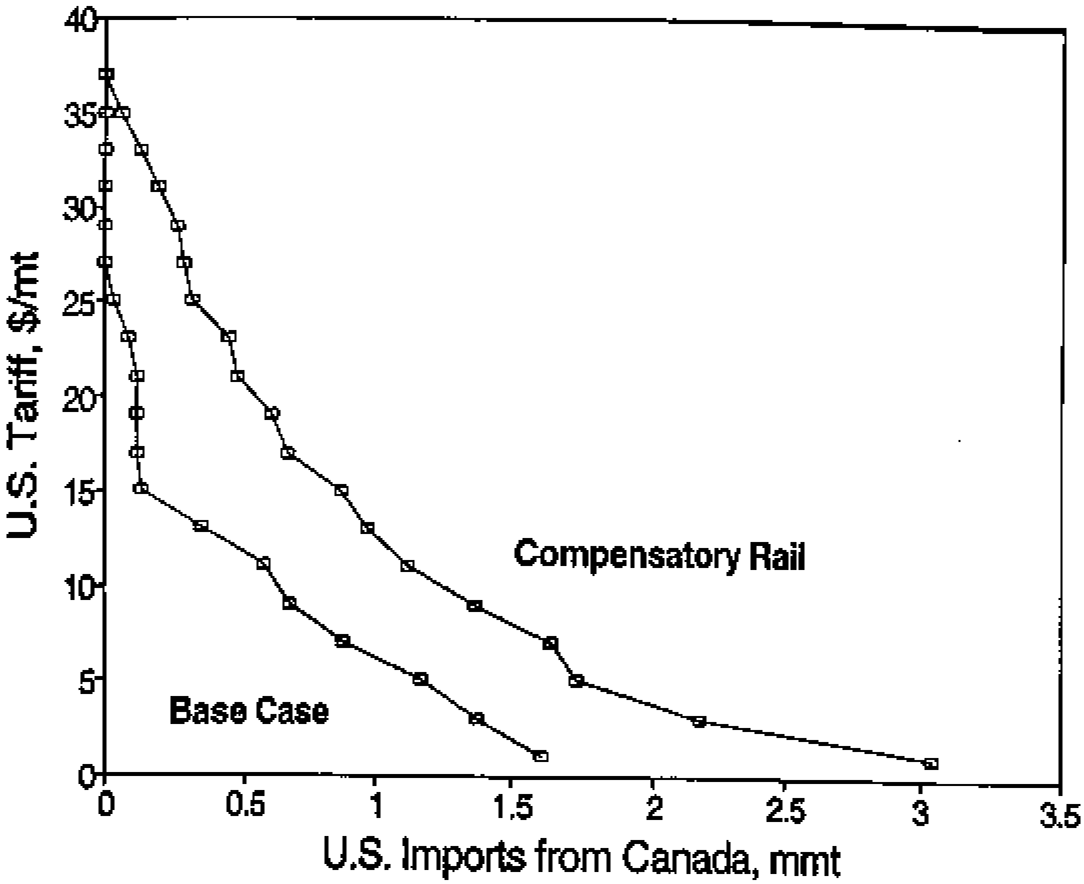


Figure 7. U.S. Tariffs and Barley Imports

REFERENCES

Agriculture Canada. (1992). *Grains and Oilseeds: Regulatory Review.* September. Ottawa.

Brooks, H. (1993). "First, Let's Assume We Have a Can Opener: An Analysis of the Economics of a Single North American Barley Market." *Canadian Journal of Agricultural Economics.* 41(3):271-281.

Canadian Wheat Board. (Dec. 1992 revised). *Performance of a Single Desk Marketing Organization in the North American Barley Market.* Winnipeg.

Carter, C. (March 31, 1993). *An Economic Analysis of a Single North American Barley Market.* Report submitted to the Associate Deputy Minister, Grains and Oilseeds Branch, Agriculture Canada. Davis, California.

Gray, R., A. Ulrich, and A. Schmitz. (1993). "A Continental Barley Market: Where Are the Gains?" *Canadian Journal of Agricultural Economics* 41(3):257-270.

Johnson, D. and B. Varghese. (August 1993). "Estimating Regional Demand for Feed Barley: A Linear Programming Approach." Agricultural Economics Report No. 303, Dept. of Agricultural Economics, North Dakota State University. Fargo.

Johnson, D. and W. Wilson. (February 1994). "North American Barley Trade and Competition." Agricultural Economics Report No. 314, Department of Agricultural Economics, North Dakota State University, Fargo.

Magnusson, G., and M. Lerohl. (1991). "Alternative Alberta Barley Trade Scenarios With the Northwest United States." Project Report, Department of Rural Economy, University of Alberta.

Schmitz, A., R. Gray, and A. Ulrich. (April 1993). *A Continental Barley Market: Where are the Gains?* Agricultural Economics Department, University of Saskatchewan.

Veeman, M. (1993). "A Comment on the Continental Barley Market Debate." *Canadian Journal of Agricultural Economics* 41(3) 1993:238-287.

ENDNOTES

1. WGTA subsidies recently became a focal point of bilateral trade tensions with the United States. U.S. grain producers argued for protection against Canadian imports, claiming that rail subsidies (among other factors) provide Canadian grain with an unfair competitive advantage.

2. Additional background information on the North American barley market and consuming industries, as well as additional analysis, is contained in Johnson and Wilson.

3. See Carter; Gray et al.; Brooks; and Veeman.

4. Milling and Baking News, September 28, 1993, p. 61.

MARITIME SHIPPING ISSUES AND U.S. AGRICULTURAL EXPORTS

by James R. Jones

Introduction

The importance of agricultural exports to United States agriculture and our position in the international economy has been recognized at least since the 1970s. Consequently maritime shipping issues as they relate to U.S. agricultural trade have received the attention of agricultural economists on several occasions (e.g., Jones, Qu, Casavant & Koo, 1995; Casavant & Wilson, 1991; Makus & Fuller, 1987; Jones, Casavant & Kim, 1986; Binkley, 1983; Binkley and Harrer, 1981; Sharp & McDonald, 1971). At the same time the international maritime community follows U.S. and world agricultural trade trends closely since grains in particular rank along with coal, iron ore, and steel as one of the industry's most important dry bulk cargoes (Drewry, 1986).

Several issues involving U.S. maritime shipping are receiving the attention of Congressional personages representing agricultural constituencies. Senator Grassley of Iowa has called for a slate of getting rid of the Jones Act, eliminating shipping conferences' antitrust immunity to set rates, ending all shipbuilding subsidies and stopping cargo preference (Journal of Commerce, December 13, 1994). Representative Walter Jones of North Carolina and other legislators are joining the ranks of critics of current maritime policies. This paper will survey current issues associated with cargo preference and other maritime support measures and maritime deregulation and liberalization that currently have overlapping policy ramifications regarding maritime shipping policy and U.S. agricultural exports.

The orientation taken in this paper perhaps needs no explanation before an audience of fellow economists, but if it is read by a lay person (particularly one who advocates agriculture as a goal in its own right) a word of clarification about the usage of competitiveness needs to be made. Tweeten distinguishes between *comparative advantage, competitive advantage,* and *competitiveness* (p. 27). Comparative advantage strictly speaking is defined in a context of an ideal trading environment with no policy distortions. Competitive advantage applies to the actual world with all its imperfections. In this paper using, social cost/benefit terminology, a nation pursuing its competitive advantage should expand production to expand exports assuming its domestic and foreign factor costs (direct and indirect) are less than the export price at the border. Competitiveness as viewed by the layman refers simply to expanding market share, often with little regard to direct factor costs subsidized by taxpayers and indirect social costs. Writing as an agricultural trade and marketing economist, my orientation will be towards competitive advantage. In this context a navigational improvement or other infrastructural or policy move that reduces the cost of transporting agricultural products will not necessarily be regarded as socially desirable simply because it may increase exports. It also needs to take into account, to the extent possible, the social costs relative to the revenue obtained from the export. Special cases with possible national defense implications will be addressed in the paper as well.

---

[*]James R. Jones is Professor in the Department of Agricultural Economics and Rural Sociology, University of Idaho.

Cargo Preference and U.S. Agricultural Exports

Cargo preference legislation impelling cargo to be carried in U.S. flag registered vessels is perceived to be one of the most pernicious measures restricting U.S. agricultural shippers in their choice of ships and depriving them of free and fair competition among suppliers of ocean transportation services. Cargo preference as mandated is intended to help maintain the U.S. merchant marine industry to assure that in time of war the United States would have a merchant marine fleet of its own to transport material and troops (Mendelowitz). There are several issues that arise in assessing the significance of such legislation. We look at the issue of its significance for the level and distribution (taxpayer versus producer or consumer) of agricultural export shipping costs, but the paper will also address the so-called national security issue as a rationale for cargo mandates reserving shipments for U.S. flagged carriers.

The current case where U.S. cargo preference provisions most affect U.S. agricultural exports is food aid shipments. In the Agricultural Trade Development and Assistance Act otherwise known as the Public Law 480 act of 1954, it was stipulated that 50% of government food aid be shipped on U.S. flag vessels. A provision in the Food Security Act of 1985 raised this percentage to 75%. This was a compromise to ward off a requirement that the 50% provision be extended to Export Enhancement Program shipments and other grain shipments receiving loan guarantees, etc.

Most of the food aid transported under cargo preference provisions is shipped as bulk cargo. During the period 1990-93, of the food aid transported in U.S. flag ships, 84% of the tonnage was bulk commodities such as wheat and corn shipped in bulk carriers and occasionally in ocean tug/barge tows, or tankers. The balance consisted of processed products such as cans of vegetable oil or bags of flour, rice, pulses, etc. shipped on liner vessels.

In the past cargo preference provisions were also tied to a third of U.S. grain shipments to the former Soviet Union. This was a part of the long term grain agreement of 1975. At a time when foreign flag carriers would lift grain from U.S. Gulf ports to Black Sea ports for about $8 per ton, the Soviets agreed to pay U.S. carriers $16 per ton. Since the long term grain agreement has expired this formula requiring a third of commercial grain exports be carried in U.S. flag vessels no longer applies. In a more recent announcement from the Secretary of Agriculture it was stated that cargo preference provisions cited above for food aid would apply to food aid shipments to the former Soviet Union (GAO, June 17, 1993). Thus cargo preference legislation, as it currently affects U.S. agricultural exports overseas, primarily involves only concessional food aid shipments.

Domestic waterborne movements of all cargoes are reserved for U.S. constructed, owned, and operated shallow draft and deep draft vessels. The Jones Act, or more accurately, the Merchant Marine Act of 1920, is a cabotage law requiring that waterborne commerce on domestic waterways and intercoastal U.S. transits be carried in vessels produced, owned and crewed in the U.S. It impacts U.S. agricultural exports through its effect on inland or intercoastal shipping costs rather than overseas ocean costs. One of the ways that the Jones Act does influence overseas rates is that it prevents foreign owned shipping lines from providing competitive feeder service between secondary U.S. ports and emerging "load center" ports which are forecast to increase their role as megacontainer vessels are introduced into major world fleets during the next few years.

Estimates of how much more expensive it is to ship grain in U.S. flag vessels as opposed to foreign flag registries range from 72% (Waters, 1985, p. 127) to more than twice as much according to U.S. General Accounting Office (GAO) estimates. The years of comparison are as important as the source in explaining variations in the estimated cost differential between foreign and domestic shipping rates. Foreign ocean freight rates are subject to volatile fluctuations much like commodity prices. On the other hand ocean freight differentials paid as subsidies to U.S. carriers are paid as the difference between estimated long term costs of operation and current market rates. The higher cost factor of domestic over foreign flag shipping cost as reported by GAO was a little under 100% in 1990 and 150% in 1992 because of variations in competitive world freight rates.

The U.S. Department of Agriculture pays the differential cost on the first 50 percent of tonnage shipped on U.S. vessels and the Maritime Administration pays the differential cost of the remaining 25%. Taxpayer funds that could be used for additional food aid shipments are diverted instead to U.S. maritime assistance. However, the burden on the agricultural community would be much more onerous if the legislation required using higher cost U.S. registered vessels on commercial shipments without provision for a taxpayer subsidy to cover that cost. The actual burden of current cargo protection legislation falls primarily upon U.S. taxpayers in the form of ocean freight differential subsidies to cover these extra costs.

The U.S. General Accounting Office, in a study released in 1994, found that cargo preference laws requiring a percentage of all government owned or controlled cargo be shipped in U.S. flag vessels cost the federal government about $3.5 billion over the previous five year period. The agency estimated this saved about 6000 seafaring jobs at an annualized cost of $116,000 per seaman. Over two thirds of this was Department of Defense expenditures, but about $1.13 billion was spent shipping U.S. agricultural products as food aid. The cost to the government for extra transportation charges on food aid shipments from 1991 to 1994 was about $600 million. In spite of this assistance GAO has noted that the number of U.S. merchant marine vessels and personnel have continued to decline

U.S. flag carriers hauled less than 5% of U.S. Grain export tonnage over the period 1990-93 (GAO, September, 1994). Approximately 18 bulkers have carried over 80% of this tonnage. While cargo preference in fact is a relatively small item in its present form, calls for more ambitious preference programs have been made so that scenarios for more stringent programs are very appropriate as research exercises. The United Nations Conference on Trade and Development has long advocated a program restricting 40 % of all liner cargo to domestic flag carriers and in the Manila conference a call to extend this to bulk cargoes was also made. The Boggs bill in the 1980s proposed mandating that ultimately 20% of all bulk cargoes trade be carried on U.S. vessels. A spatial equilibrium modeling exercise by Jones, Casavant, and Chong Kim (1986) estimated the proposal would increase the cost of shipping wheat from the West coast approximately 8 to 16 cents per bushel. In another study utilizing a similar model, assuming 40% of U.S. exports were carried in U.S. registered vessels, the Gulf price declined by 5.61%, and 17.19% if all exports were impelled to move in U.S. vessels with no ocean freight differential subsidy (Qu).

Aside from cargo preference forcing shippers to use higher cost vessels due to their being built in higher cost shipyards and/or crewed by higher cost crews, at least two other factors also increase the cost of shipping under cargo reservation. Because of delays in port waiting for the availability of a flag carrier, transit times are potentially longer for the shipper. In addition the possibilities for triangulation and backhauling are constricted when U.S. vessels have to be used (see E. G. Frankel, Inc., 1981). Flexible itineraries permitting the triangulation of vessel services are essential to efficiency in tramp bulk service trades. Cargo-preference measures rigidify geographically inefficient route structures and situations where ballast voyages can easily constitute half the total steaming time (Fleming, 1979, p. 257).

The U.S. flag merchant fleet has declined from over 5000 ships at the end of World War II, to less than 400 ocean going vessels of all types in the 1990s according to a recent (1994) General Accounting Office (GAO) report. Mariner employment has shrunk from an estimated 110,000 level in 1945 to 27,000 people filling less than half that number of actual seafaring positions. However these numbers mean very little when looking at the role of U.S. flagged carriers in the U.S. security framework. First modern ships deployed today are more productive and larger and employ much smaller crews than at the end of World War II. During Operation Desert Shield/Storm, seven Department of Defense (DOD) owned sealift vessels provided the same carrying capacity as 116 of the breakbulk vessels employed during World War II (GAO/NSIAD-94-177 Strategic Sealift). Moreover, all seven of these vessels were of the Roll on/Roll off variety that are not used to carry U.S. grain and agricultural exports. The bulk vessels that carry agricultural products are over 25 years in average age, and the U.S. Department of Defense has testified to GAO that they frankly view the vessels as having no significant role in the country's defense requirements (GAO, September, 1994, p. 42.).

To the extent that the national security of the country is reinforced by maintaining a fleet of flag vessels, the argument could be made that this objective could be more equitably met by using construction and/or operating differential subsidies financed by general tax revenues. However the situation as it exists is not that simple. At this point in time all such programs are either phased out or in the process of being discontinued. So far neither the Administration nor maritime advocates in Congress have been able to find an acceptable package in a time of stringent budgetary restrictions that can gain passage to continue subsidizing operation or construction of U.S. vessels. A proposal initiated unsuccessfully by the Administration to employ a cargo tonnage tax would share some of the same features found objectionable in cargo sharing provisions.

In fairness to maritime interests, they point out a certain hypocrisy on the part of agricultural interests for objecting to their receiving assistance when even more taxpayer moneys are expended in various agricultural subsidy programs such as agricultural export enhancement payments. The case that exporting agricultural products at less than world market prices is motivated by national defense need considerations is so preposterous that this is not even purported as a rationale. The argument here is that foreigners do it so we must do it too. The maritime sector can certainly make the same argument.

Deregulation and the Maritime Reform Bill

Deregulation in the form of abolishing the Federal Maritime Commission (FMC) is a hot and tumultuous issue that may give rise to many future research issues. The Ocean Shipping Reform Act of 1995 approved by the House Transportation and Infrastructure Committee in August (*Journal of Commerce*) contains many controversial features. The term "deregulation" describes the bill in terms of it abolishing the FMC and ending public tariff filings by ocean carriers. However it leaves antitrust immunity in tack for ocean carrier conferences to collectively set rates. While initially calling for an end to rate filling for domestic carriers, the legislation requires foreign flag carriers to submit rate information to the Department of Transportation if they are suspected of offering rates that undercut domestic shipping lines. In its initial "controlled carrier" language so-called anti-predatory pricing by government controlled and conglomerate diversified shipping lines provisions placed foreign carriers under stricter rate and tariff scrutiny than domestic carriers. This has since been extended to foreign carriers as well to avoid the charge of discriminatory treatment. Now apparently the Transportation Department would be empowered to investigate rates of any carrier deemed to be predatory.

Industrial organization and trade oriented economists in our profession may find a rich research and education field of action as a result of this round of so-called deregulatory reform legislation as it unfolds. Regulatory reform legislation as described above could lead to a system of stronger closed conferences or cartels exempted from antitrust laws, or it could be perceived as so outrageously stacked in favor of such cartel activity as to generate a subsequent call for an end of such immunity.

Liberalization of Maritime Policy

The granting of maritime supports and other protective measures that distort international competitiveness is perhaps as widely practiced in maritime transportation as in the agricultural sectors of most nations. Protectionism in international shipping policies comprises many forms including operating and construction subsidies to domestic vessels and operators, special tax depreciation alternatives, cabotage laws and legislation favoring nationally flagged vessels, and a host of other instruments.

Some progress in the direction of liberalization and restraining further trade distorting activities in maritime shipping is argued to have occurred under the recent Uruguay Round of GATT negotiations. The Uruguay Round broadened the scope of GATT to include services under a legal framework of the General Agreement on Trade in Services (GATS) which has inherited the main features of GATT regarding the process of liberalization of services (Organization for Economic Cooperation and Development). An assessment regarding how well the negotiators performed by the Institute for International Trade (Schott, 1994) gave services the same B+ rating as was given to the overall accord and to the agricultural sector in particular. Unfortunately progress on liberalizing maritime transport services which fall within this broad category received an I (Incomplete).

Although general negotiations under the Uruguay round were initiated in September, 1986, discussions on maritime transport issues did not commence until 1990, the year that negotiators were initially to finalize the agreement. Largely because of EC recalcitrance on agricultural sector issues, the negotiations dragged on a further three years to December of 1993 and the agreement was signed in April of 1994 by the major negotiating partners including the U.S.. Commitments for international transportation liberalization were not completed and the latest deadline for commitments in this sector were delayed to June, 1996. Moreover, MFC obligation for this sector is abolished during this negotiation period.

In spite of the U.S. position that we favor trade liberalization in general, our government demonstrated little enthusiasm for inclusion of our national shipping laws in the Uruguay GATT negotiations. The Jones Act has become one of the points of contention in the international negotiations. The European Union negotiators' stance is that the Jones Act is an indirect subsidy to shipbuilding interests in the U.S.. Our unwillingness to negotiate has been alleged to be one of the reasons no agreement was reached on shipbuilding subsidies in the Uruguay negotiations. To increase their leverage, European negotiators are insisting that we be willing to put such maritime issues as the Jones Act on the table parallel to negotiations on telecommunications market access liberalization in Europe (JOC, October 6, 1995, pp. 1a-1b). In the mean time our domestic maritime and shipbuilding interests argue for protection on the grounds that other countries are granting protection to their domestic shipbuilding interests and implore our government to impose penalties against other countries because of their subsidies. Does this sound like U.S. and Canadian or European agricultural trade war rhetoric?

Conclusion

U.S. Maritime shipping policy is in a crisis that arguably could threaten U.S. security in the future. Going in the direction of halting the decline of the U.S. fleet by even more restrictive cargo preference legislation could be very harmful to U.S. agricultural exports. Existing cargo preference legislation as it applies to U.S. food aid shipments, while more of an irritant than a major impediment to U.S. export volume and prices, has not averted the decline in the U.S. merchant marine. While a significant portion of this fleet would probably leave U.S. registry without such legislation, the bulk of U.S. vessels carrying such cargo is declared by the Department of Defense to be irrelevant to its needs. Baring a radical protectionist or nationalistic swing in U.S. policy, advocates of added cargo preference restrictions have probably met their Nemesis in agricultural and other sector opposition since they lack endorsement from the Defense establishment.

Economic efficiency and equity criteria would argue in favor of construction and operating subsidies funded from general revenues over cargo sharing as a way of protecting activities of the U.S. fleet that have legitimate national defense ramifications. However these subsidies were not renewed in the early 1980s and will phase out on all remaining U.S. vessels by 1998, at which time more vessels are expected to abandon the U.S. flag. The Clinton Administration attempted to subsidize the U.S. fleet by imposing a tonnage tax on shipments leaving and entering U.S. ports and harbors. This would have placed a National Defense burden on exports and imports, including U.S. agricultural exports, rather than spreading the costs among general revenue sources. The same legal objection that has threatened the Harbor Maintenance Fee program, namely that taxing exports is explicitly prohibited in the U.S. Constitution, could also become an issue. Also, to renew such subsidies would complicate reaching agreement with OECD negotiators to aim at terminating all shipping subsidies, a position that the Clinton Administration endorsed as an objective for the 1996 GATS negotiations. Given the trade ramifications of subsidizing a U.S. merchant fleet it seems that moving responsibility for providing U.S. shipping needs for defense purposes might best be transferred from MARAD to the Department of Defense.

One interesting policy compromise would be to eliminate cargo preference requirements on food aid shipments and simultaneously cut back agricultural export subsidy outlays by an equivalent amount. If the funds currently used to subsidize the shipments carried in U.S. vessels were directed toward additional food aid shipments, Export Enhancements payments could be cut back equivalently with a washout effect on U.S. agricultural shipments. Or the savings could be added to budgetary cuts currently being sought by both the Congress and the Administration. Another option would be to simultaneously reduce U.S. budgetary outlays for EEP and directly transfer the funds used to subsidize shipments in U.S. vessels to the Department of Defense to provide for more ready reserve vessels specifically designed to meet defense needs. This could be a revenue neutral and trade neutral way of dealing with assuring a fleet to meet U.S. security needs.

References

Binkley, James K. "Marketing Costs and Instability in International Grain Trade: *American Journal of Agricultural Economics.* Vol. 65, No. 1, February, 1983, pp. 57-64.

Binkley, James K. "Major Determinants of Ocean Freight Rates for Grains: An Econometric Analysis" *American Journal of Agricultural Economics.* February, 1981, pp. 47-57.

Casavant, Kenneth and Wesley W. Wilson. "Shipper Perspectives of the Shipper Act of 1984". *Transportation Quarterly*. Vol. 45, No. 1, January, 1991.

Drewry Shipping Consultants, Ltd. *Seaborne Trade & Transportation; Volume 3, Grain.* May 1986.

Fleming, D.K. "The Role of the Federal Government in U.S. Marine Transportation." *Maritime Policy and Management: International Journal of Shipping and Port Research.* London: Taylor & Francis Limited, 1979, Vol. 6, No. 4, 253-267.

Frankel, E.G., Inc. Impact of Cargo Sharing on U.S. Liner Trade with Countries in the Far East. For the Federal Maritime Commission. Volume II Liner Services and Operational Impacts of Cargo Sharing (September, 1981).

Jones, James, Lu Qu, Kenneth Casavant and Won Koo. "A Spatial Equilibrium Port Cargo Projection Model". *Maritime Policy & Management: International Journal of Port & Shipping Research.* Taylor & Francis Ltd. Vol. 22, No. 1, pp. 63-80.

Jones, James, Kenneth L. Casavant and Chong Kim. "Maritime Constraints and International Trade: Case Study of the Impact of Cargo Preference on U.S. Wheat Trade". *Research for Tomorrow's Transport Requirements: Proceedings of the World Conference on Transport Research* (Volume 1). Vancouver, British Columbia, Canada, May 1986, pp. 795-808.

Journal of Commerce. "EU Links Telecom, Maritime Negotiations". (October 6, 1995) pp. 1a-1b.

__________. "House Modifies Ship Bill". (October 2, 1995) pp. 1a, 10a.

__________. "Breaux: Action on Ship Bill Unlikely this Year-but House Backers Vow to Find Way to Win Passage". (September 13, 1995) pp. 1a, 10a.

__________. "Maritime Bill on a Fast Track". (August 7, 1995) p. 6a.

__________. "House Panel Passes Bill to Deregulate Shipping". (August 3, 1995) pp. 1a, 8a.

__________. "House Panel Votes Today on Bill Eliminating FMC". (August 2, 1995) pp. 1a-8a.

__________. "U.S. Hard Line Helped Doom Shipbuilding Talks". (March 22, 1994) pp. 1a, 10a.

_________. "Grassley to Renew Push Against Ship Subsidies". (December 13, 1994) pp. 1a, 2a.

__________. "U.S.-Flag Ships Double Cargo Costs, GAO Says". (December 12, 1994) pp. 1a, 2a.

Mendelowitz, Allan I. "PL 480 Title I Transportation Issues". United States General Accounting Office Testimony before the United States Senate, Committee on Agriculture Nutrition, and Forestry; November 7, 1989.

Organization for Economic Cooperation and Development. *Maritime Transport 1993.* Paris: OECD Publications, March, 1995.

Schott, Jeffrey J. *The Uruguay Round: An Assessment.* Washington, DC: Institute for International Economics, November, 1994.

Sharp, John and Hugh McDonald. *The Impact of Vessel Size on an Optimal System of U.S. Grain Export Facilities.* Ohio Agricultural Research and Development Center Research Bulletin 1048, December, 1971.

Tweeten, Luther. *Agricultural Trade Principles and Policies*. Boulder: Westview Press Inc., 1992.

United States General Accounting Office. *Cargo Preference Requirements: Objectives Not Significantly Advanced When Used in U.S. Food Aid Programs.* Report to Congressional Requesters # GAO/GGD-94-215, September, 1994.

__________. *Strategic Sealift: Summary of Workshop on Crewing the Ready Reserve Force*. Report to the Administrator, U.S. Maritime Administration # GAO/NSIAD-94-177, June 1994.

__________. *Cargo Preference Requirements: Their Impact on U.S. Food Aid Programs and the U.S. Merchant Marine*. Report to the Chairman, Committee on Agriculture, House of Representatives # GAO/NSIAD-90-174, June, 1990

__________. *U.S. Food Aid Exports: The Role of Cargo Preference*. GAO/NSIAD-93-34, June, 1993.

Waters, Robert C. *Final Report: Evaluation of Maritime Protection Practices and Proposals and Proposals on U.S. Bulk Trades*. Department of Engineering Administration, The George Washington University/U.S. Department of Transportation Contract No. DTRS-5683-C-00002, December 27, 1985.

IMPACTS OF INCREASES IN FOOD DEMAND IN CHINA ON THE WORLD AGRICULTURAL SHIPPING INDUSTRY

by Won W. Koo*

China is the third largest country in the world, ranked after Russia and Canada, with about 960 million hectares. However, its arable land is limited to approximately 95.7 million hectares, representing 10 percent of its total land. Arable land per capita in China is about 0.08 hectare, lower than in the United States (0.72 hectare) (FAO).

China is well-known for its huge population. China's population has been growing at 1.5 percent annually for the last 10 years and was estimated to be about 1.18 billion in 1993. Although the Chinese government has made tremendous effort to control the population growth rate, China's population is expected to reach 1.3 billion by 2000. To feed its huge population, China has become one of the largest grain producers in the world. China's rice, wheat, corn, and soybean production was 178, 106, 103, and 20 million metric tons, respectively, in 1993 (Table 1). As shown in Table 1, Chinese agricultural production has increased substantially for the last 14 years.

China's economy is changing rapidly. After the economic reform of 1978, China has experienced dramatic economic growth. The country's GDP grew from 447 billion yuan in 1980 to 3,138 billion yuan in 1993 (Table 1). Between 1978 and 1993, the country's gross domestic product (GDP) increased almost fourfold with real annual growth rates averaging close to 10 percent. Recent growth rates have been even more dramatic. Between 1991 and 1992, GDP increased 12.8 percent, and between 1992 and 1993, GDP increased 13.4 percent (Table 1). During the same period, the total value of China's agricultural output increased at an average annual rate of 6.1 percent, and its grain output increased at an annual rate of 2.7 percent.

Externally, China is becoming a major player in international markets. In 1980, the value of China's foreign trade was only about $20.6 billion. However, that figure soared to about $196 billion by 1993. Its trade with neighboring countries grew even more rapidly than its overall foreign trade. From 1983 to 1991, China's overall foreign trade grew at about 15 percent annually while trade with its neighbors grew at about 20 percent annually (Tuan 1992).

In agricultural product trade, China is a major agricultural exporter, selling $15.3 billion in 1992, and is also one of the world's largest agricultural importers. Its agricultural imports, however, have been much smaller than its exports and are relatively small in relation to its total consumption (ERS/USDA).

Grain is the dominant agricultural product of China's agricultural sector. Grain production represents about 57 percent of China's total agricultural production value and covers 74.2 percent of its planted area (ERS/USDA). Since the 1978 economic reforms, Chinese grain production has increased rapidly. Its grain output reached 443 million metric tons in 1992, a 45 percent increase from 1978.

***Won W. Koo is Professor of Agricultural Economics at North Dakota State University.**

The rise in disposable income has caused Chinese people, especially its urban consumers, to demand a more diversified high quality diet. Per capita consumption of grain in urban areas fell from 134.76 kilograms in 1985 to 127.93 kilograms in 1991. Urban consumers substituted grain products with eggs, poultry, and red meat (pork and beef). In China's rural areas, the same trend also occurred. By 1991, per capita consumption of grain in rural areas fell from 257.45 kilograms in 1985 to 250.05 kilograms (Peng 1993). These changes are altering the demand structure for food: decreases in per capita consumption of grain, especially rice, and increases in demand for meat.

The objective of this study is to evaluate the impacts of increases in China's food consumption on world agriculture. Special attention is given to an evaluation of China's agricultural imports and exports under alternative scenarios in agricultural production technology and implications on the world agricultural shipping industry.

The Chinese government has used a Self-sufficiency Policy for grain products at the provincial and national levels since the 1950s. This policy emphasizes the minimization of inter-provincial grain trade and imports from other countries. This policy has not optimized grain production in terms of the principle of comparative advantage. Chinese agricultural scientists have indicated that grain yields could be increased substantially if agricultural production were specialized on the basis of regional endowments and technology (Zhou and Jiang, 1995).

China's economy is a mixture of central planning and relatively open markets. Like the rest of the economy, agriculture has a free market orientation although the government continues to strongly influence agricultural production.

Following the establishment of the People's Republic of China in 1949, the Chinese Communist Party launched a nationwide program of land reform. Its objective was to destroy the feudalism that existed and return the land to the farmers. Chinese leaders believed this was an essential condition for increasing grain production and developing China's industry (Chen 1991). The ultimate goal was to socialize agriculture and raise agricultural productivity, especially grain production (Lin and Koo 1990). After the land reforms were completed in the early 1950s, the central government promoted collectivization of agricultural production. This policy continued until 1977.

A significant change in Chinese agricultural policy started in 1978 after experiencing a period of stagnation and a fall in agricultural production. Key components of the new policy are the promotion of a production responsibility system and an increase in the procurement price of agricultural products. Under this system, an individual farmer manages the production on land assigned by a contract which regulates taxes and a quota sales obligation to the Chinese government. The government increased the quota procurement prices substantially in 1979 and further price adjustments took place in later years.

In 1985, for example, quota prices for grain exceeded their 1978 levels by 107 percent. In addition, the government gave bonuses for output surpassing quota deliveries. In 1979, farmers received price bonuses of 50 percent for grain deliveries beyond their contract quota level (Li and Weersink). The adoption of the production responsibility and price adjustment systems dramatically affected Chinese grain production.

Development of An Empirical Model

A spatial equilibrium model based on a mathematical programming algorithm was developed for this study. The reasons for using a spatial equilibrium model are as follows. Because China has had a centrally planning economy for the last several decades, the Chinese government set major agricultural commodity prices. In addition, both production and consumption have been allocated by the government. Econometric estimation of producers' and consumers' responses to prices based on a free market system, therefore, was not feasible.

The model used in this study focused on production and consumption of rice, wheat, corn, and soybeans in China and its trade relationships with other exporting and importing countries. Exporting countries included in the model are the United States, Canada, Argentina, Thailand, Vietnam, Australia, and the European Union (EU). Importing countries include Japan, Korea, Malaysia, and other importing regions grouped into two regions. China is divided into 30 producing regions and 30 consumption regions based on existing government administration divisions. The model identifies five ports in China: Dalian, Qingdao, Shanghai, Guangzhou, and Haikou.

In the model, China is allowed to trade rice, wheat, corn, and soybeans with other countries. Southeast Asian countries are allowed to import rice, corn, and soybeans from exporting countries and China. The production and consumption of rice, wheat, corn, and soybeans within China and trade of these commodities with other countries are optimized on the basis of land endowments, yields, and demand conditions.

This study assumed that the capital city of each province represents the point of production and consumption. Railroads are the mode of transportation used in moving grain from producing regions to consuming regions, and ocean vessels are used for ocean shipments.

The model used for this study is static. The objective function is to minimize the sum of production costs in China's producing regions, transportation costs from China's producing regions to its consuming regions, exporting costs from China to Asian importing countries, and importing costs from the major exporting countries to China and Asian importing regions. The objective function is optimized subject to a set of constraints associated with the resource endowments in each producing region, domestic and import demand, and physical capacity of shipping and handling facilities. Farming technology is incorporated into the crop yield activities in each producing region. Trade policies such as import quotas are included into the model by constraining import demand.

<u>Mathematical Model</u>

The objective function of the model is mathematically expressed as follows:

$$(1)\quad \text{MIN } Z = \sum_{c}\Big(\sum_{i}(PC_{ci}+G_{ci})A_{ci} + \sum_{i}\sum_{j} t_{cij}Q_{cij} + \sum_{i}\sum_{p}(t_{cip}+\pi_{cip})Q_{cip} +$$

$$\sum_{p}\sum_{m} t_{cpm}Q_{cpm} + \sum_{k}\sum_{p} t_{ckp}TQ_{ckp} + \sum_{k}\sum_{p} EP_{ckp}EQ_{ckp} + \sum_{k}\sum_{p} P_{ckp}Q_{ckp} +$$

$$\sum_{p}\sum_{j} t_{cpj}Q_{cpj} + \sum_{k}\sum_{m} P_{ckm}Q_{ckm} + \sum_{k}\sum_{m} t_{ckm}Q_{ckm}\Big)$$

where

c	=	index for commodities (rice, wheat, corn, soybeans)
i	=	index for producing regions in China
j	=	index for consuming regions in China
p	=	index for sea ports in China
k	=	index for exporting countries
m	=	index for importing countries
π	=	profit margin at export port in China
A	=	acreage planted for crop c in producing region i in China
PC	=	production cost of crop c in producing region i in China
G	=	production cost adjustment
Q	=	quantities of each commodity shipped from producing regions to consuming regions and ports or from ports to importing countries
EQ	=	quantities of each commodity exported with subsidy
TQ	=	total quantities of each commodity shipped into China with and without subsidy
t	=	transportation costs per metric ton in shipping from producing regions to consuming regions and ports or ports to importing countries

The first term in Equation 1 represents the total production cost of the four grain crops and export or import activities of the crops. The first summation in Equation 1 represents the production cost of each crop in each producing region. The production costs are calculated by multiplying production cost per hectare by total hectares in production. The following three summations indicate the total transportation and handling costs from the producing regions to consuming regions, from producing regions to export ports, and from export ports to importing countries. The next three summations represent the total import costs of the four crops from major exporting countries. The final two summations represent the total import costs of other Asian importing countries.

The objective function (Equation 1) is optimized subject to the following constraints:

(2) $\sum_{c} A_{ci} \leq L_i$

(3) $\sum_{i} Q_{cij} + \sum_{p} Q_{cpj} \geq D_{cj}$

(4) $\sum_{j} Q_{cij} + \sum_{p} Q_{cip} = \lambda_{ci} Y_{ci} A_{ci}$

(5) $\sum_{k} Q_{ckm} + \sum_{p} Q_{cpm} \geq ED_{cm}$

(6) $\sum_{c}\sum_{i} Q_{cip} \leq H_{p}$

(7) $\sum_{i}\sum_{p} Q_{cip} = \sum_{p}\sum_{m} Q_{cpm}$

(8) $\sum_{k} EQ_{ckp} + \sum_{k} Q_{ckp} = \sum_{j} Q_{cpj}$

(9) $\sum_{k}\sum_{p} EQ_{ckp} + \sum_{k}\sum_{p} Q_{ckp} = \sum_{k}\sum_{p} TQ_{ckp}$

(10) $\sum_{p} TQ_{ckp} + \sum_{m} Q_{ckm} \leq ES_{ck}$

where

L = total arable land available for crops in producing regions in China

λ = adjustment factor for farming technology

Y = crop yields in China

D = China's domestic demand for each commodity in each consuming region

ES = upper limit export supply at each exporting country

ED = import demand for each commodity in importing countries

EP = import cost for each commodity with export subsidy at each port

P = import cost for each commodity at each port

H = handling capacity at port p

Equation 2 represents land constraints, indicating that total land used for grain production in each producing region should be less than the total land available for the crop. Equation 3 represents domestic demand constraint for consumption in each consuming region in China. The equation indicates that the total amount of grain each individual consuming region receives from the grain producing regions in China and foreign exporting countries should be greater than or equal to the amount of grain needed in the region. Equation 4 indicates that the total quantities of grain produced in each producing region in China should be greater than or equal to the quantities shipped to domestic and foreign consuming regions. Equation 5 represents the import demand constraint for Asian importing countries. The equation indicates the quantities of each crop shipped from Chinese ports and other exporting countries' ports to the individual importing region should be greater than or equal to the total import demand for the crop in each importing region. Equation 6 represents the handling capacity constraint at each port in China, indicating that the quantities of grain handled at each port should be less than its processing capacity. Equations 7, 8, and 9 represent the inventory clearing conditions of exported and imported grain at each port. Equation 10 shows the total amount of grain shipped to each importing region should be less than or equal to the export supply at the exporting countries.

Base and Alternative Models

This study has one base and four alternative models to analyze the grain production and trade patterns. The models are stated as follows:

Model 1 is the base model incorporating existing production, transportation, importing, and exporting conditions under current agricultural and trade policies in China and other exporting and importing countries. The 1993 data are used for the base model.

Model 2 is the base model with the projected demand for rice, corn, wheat, and soybeans in 2004.

Model 3 is the base model with the projected demand for rice, wheat, corn, and soybeans in 2004 and 4 - 6 percent increase in crop yield over 10 years as a result of an advance in farming technology in China.

Model 4 is the base model with the projected demand for rice, wheat, corn, and soybeans in 2004 and 8 - 12 percent increases in crop yields over 10 years as a result of an advance in farming technology in China.

Model 5 is the base model with the predicted demand for rice, wheat, corn, and soybeans in 2004 and 12 - 16 percent increases in crop yields over 10 years as a result of an advance in farming technology in China.

The base model imposes a minimum production constraint at 50 percent of the current production level and a maximum constraint at 120 percent of the current production level in each producing region to examine marginal costs associated with the production constraints in each producing region. In each model, demand for and the supply of grain are assumed to be perfectly price inelastic.

Collection of Data

Data requirements for the model include production costs for crops, domestic transportation rates, ocean shipping rates, crop yields in each producing region, constraints on arable land, domestic demand quantities, import demand quantities and import cost, and export supply quantities.

Crop Production Cost and Yields

The production costs for rice, wheat, corn, and soybeans are variable costs of producing the crops on one hectare of land ($/hectare). The cost of land is not included in the analysis. Production costs were obtained from Economic Research Service publication Agricultural Statistics of the People's Republic of China and from China Rural Economy Statistics Year Book published by the China Statistics Bureau (CSB). The production costs of rice, wheat, corn, and soybeans are reported annually by the China Statistics Bureau at the provincial level up to 1990. The 1992 production costs of rice, wheat, corn, and soybeans have not been published. In this study, therefore, 1990 production costs data are adjusted to 1992 production costs by using the agricultural inputs price index.

Total available land for the production of rice, wheat, corn, and soybeans in each producing region was determined on the basis of the total 1992 planted hectares published by the China Statistics Bureau.

Yield data of rice, wheat, corn, and soybeans at each producing region were obtained from China Rural Statistical Year Book (CSB). A three year average of crop yields in each producing region, 1990-1992, was used in the model to represent yields of each producing region to avoid possible bias in measuring crop yields which could have resulted from extreme weather conditions.

Crop yields for the crops in 2004 are estimated in a double-log functional form with time series data from 1975 to 1993. In this estimation, crop yields are regressed against time trend. The predicted crop yields shown in Table 2. The base and model 2 use 1990 - 1992 average yields for rice, wheat, corn, and soybeans. Model 3 uses 50 percent of the predicted increase in yields, Model 4 uses the predicted increase in yields, and Model 5 uses 150 percent of the predicted yields.

Transportation Cost

Transportation costs were divided into two parts: 1) China inland transportation costs from producing regions to domestic consuming regions and 2) ocean transportation costs from exporting country's ports to importing country's ports by ocean vessels.

Most inland grain movements between provinces are by rail. In China, the railway system is state-owned with rail rates regulated by the central government. The policy is to discourage long distance shipping by rail because of the system's limited capacity. There are no detailed data on rail rates for long distance shipments in China. Therefore, a rail freight rate was developed using average rates from 12 railway administrations under the Ministry of Railways reported by Cook, Martland, and Feng (1994).

Specific ocean freight rates between China's ports and its trading partners are not available. An ocean freight rate function was developed using average shipping rates reported in World Grain Statistics (IWC 1992). These freight rates were regressed against ocean mileage using the double log function. The estimated ocean freight rate function is used to calculate ocean freight rates from grain exporting countries to Chinese ports.

Demand Data

China is divided into 30 regions for rice, wheat, corn and soybeans distribution. Per capita rice and wheat consumption data were collected from China Agricultural and Trade Report: China Situation and Outlook Series (ERS) and China Urban Family Expenditure Survey Data (CSB). The former reports the rural per capita consumption data, and the latter reports the urban per capita consumption data. Per capita consumption data were calculated by using the weighted average of the two data sets based on urban and rural population. Per capita consumption for corn and soybeans are available for only a few provinces. Therefore, average per capita consumption of corn and soybeans were calculated by dividing the total consumption by population. Provincial per capita data were obtained by adjusting the average consumption based on regional production, considering the production and consumption ratio provided by sample provincial data.

To project the demand for crops in 2004, China's domestic demand functions for rice, wheat, corn, and soybeans were estimated as a function of its GDP with annual time series data from 1981 to 1993. The per capita consumption data were obtained from The Production, Supply, and Distribution (PS&D) Database (ERS) and the GDP data were obtained from China Statistical Yearbook (CSB). The estimated models are used to estimate domestic consumption of rice, wheat, corn, and soybeans in 2004. In the model, only the income variable is considered because prices of rice, wheat, corn, and soybeans in China are controlled by the government and do not reflect demand and supply conditions. The WEFA group predictions of China's GDP growth rate were used to project grain demand for 2004.

The estimated demand model for rice indicates that the per capita consumption of rice has a decreasing trend, indicating that as income goes up, consumers tend to substitute products such as meat, milk, and eggs. Other demand models indicate that wheat, corn, and soybeans have an increasing trend, indicating that as income goes up, consumers tend to consume more of these products. The predicted demand for rice, wheat, corn, and soybeans are shown in Table 3.

Trade Data

FOB prices of rice, wheat, corn, and soybeans at selected ports in exporting countries were obtained from World Grain Statistics (IWC) and Commodity Statistics Bulletin (ABARE). The prices used in the model are average prices from 1990 to 1992. Wheat prices include the export subsidies used by the United States and the EU. Handling costs at export ports and import ports are assumed to be 5 percent of FOB price. Major importing countries are China, D.P.R. Korea, the Republic of Korea, Japan, Malaysia, Hongkong, Singapore, Thailand, Sri Lanka, Indonesia, and Russia, and several parts of the former Soviet Union. Some of these importing countries are aggregated into several regions according to their geographic location.

Importing countries' demand quantities were calculated using a three-year average of imports, except for Japan's and Korea's rice import data. The import data were collected from ERS Asia and Pacific Rim Situation and Outlook Series which reports the potential demand for grain under the Uruguay Round GATT Agreement.

Results

Results obtained from the model 1 (base) are compared with those obtained from alternative scenarios. Results are presented by crops.

Rice

Rice production is 128.98 million metric tons and the total planted area is 31,990 thousand hectares in the base model. Rice production is concentrated in the southern provinces, including Zhejiang, Anhui, Hubei, Hunan, Jiangxi, Guangdong, Guangxi, and Sichuan. The production pattern in the base model is similar to actual rice production in China.

Rice consumption is 127 million metric tons in the base model, indicating that domestic rice production is larger than domestic consumption. In the base model China exports 1.97 million metric tons of rice to its neighboring countries.

When China decreases its rice consumption as a result of increases in per capita income in 2004, while maintaining the same level of farming technology as the 1993 level in Model 2, rice production and planted area decline compared to the base model. China exports 1.91 million metric tons of rice to its neighboring countries and also imports 2.96 million metric tons from major exporting countries. This implies that China could be the net rice importer in 2004. Since transportation costs of shipping rice from southern provinces to deficit regions in China are inefficient and also expensive, it is more economical if major rice producing provinces in the southern region export rice, while deficit provinces in the northern region import rice.

When rice yields are assumed to increase by 4 percent, 8 percent, and 12 percent in Models 3, 4, and 5, respectively, with the same level of rice consumption as that in Model 2, rice production increases compared to Model 2, while planted area declines. China's rice imports decline in Models 3,4, and 5, compared to Model 2, but are larger than its rice exports, indicating that China would be a major rice importing country in 2004. Its net rice import in Model 2 is approximately six percent of the total rice trade in the world market in 1994 and three percent in Model 5.

Wheat

China's wheat production is 98,653 thousand metric tons, and planted area is 30.1 million hectares in the base model. Twelve provinces produce almost 90 percent of China's wheat in the base model. Nine wheat-producing provinces are located in northern China. China produces only soft wheat. Major wheat producing provinces are Heilongjiang, Shandong, Hebei, Henan, Shaanxi, Gansu, Nei Monggol, Xinjiang, Jiangsu, Anhui, Hubei, and Sichuan.

Domestic demand is 109.12 million metric tons, which is much larger than domestic production in the base model. China imports 10.47 million tons of wheat from major exporting countries, including the United States and Canada. China has been one of the largest wheat- importing countries for the last decade.

When China's wheat consumption increases 35 percent from 109.12 million metric tons to 146.86 million metric tons with the same level of farming technology as the 1993 level in Model 2, wheat production and planted area in Model 2 are similar to those in the base model. As a result, China increases its wheat import to 47.87 million metric tons, which is about 48 percent of its domestic production and about 32 percent of domestic consumption. Most imports come from the United States, Canada, and Australia.

When wheat yields increase by 5, 10, and 15 percent in Models 3, 4, and 5, respectively, wheat production and planted area increase as well. As a result, China's wheat imports decrease substantially compared to those in the base model, but imports in Model 5 are larger than those in the base model. Its wheat import in Model 2 is approximately 43 percent of the total wheat traded in the world market in 1994, but 15 percent in Model 5.

Corn

China is one of the largest corn-producing countries in the world. China's corn production is 100.58 million metric tons, and planted area is 21.96 million hectares in the base model. Corn is mainly produced in seven northern provinces and two southern provinces, which produce about 84 percent of corn produced in the country. Major corn-producing provinces are Heilongjiang, Liaoning, Jilin, Shandong, Hebei, Henan, Sichuan, and Yunnan.

Domestic demand for corn is 86 million metric tons in the base model, indicating that China is a corn exporter. China exports 21,819 thousand metric tons of corn to its neighboring countries, including Korea and Japan, and also imports 7.24 million metric tons. Because of high transportation costs in shipping corn from surplus regions in the northern China to deficit regions in southern China, the northern provinces export their surplus corn to the neighboring countries, while the southern provinces import corn from exporting countries, including the United States.

When Chinese corn consumption increases about 55 percent from 85,999 thousand metric tons to 133,698 thousand metric tons in Model 2, Corn production and planted area increase substantially. However, domestic production is not large enough to meed domestic demand in Model 2. China's corn import increases from 7,24 million metric tons in the base model to 29.7 million metric tons in Model 2. China imports most corn from the United States.

When corn yields are increased by 5.5 percent, 11 percent, and 16.5 percent in Models 3, 4, and 5, respectively, corn production increases accordingly, but planted area declines. China's corn imports are 27.93 million metric tons in Model 3, 22.76 million metric tons in Model 4, and 18.17 million metric tons in Model 5. This implies that China will a major corn importing country in 2004. Its corn import in Model 2 is approximately 43.4 percent of the total corn traded in the world market in 1994 and 26.6 percent in Model 5.

Soybeans

China is the third largest soybean producer in the world. China's soybean production is 8.5 million metric tons, and planted area is 5.89 million hectares in the base model. Soybeans are mainly produced in six northern provinces, including Heilongjiang province that produces about 30 percent of soybeans produced in China. Other main soybean- producing provinces are Jilin, Shandong, Hebei, Henan, Nei Monggol, and Anhui.

Domestic soybeans demand is 10.15 million metric tons in the base model, indicating that China is a net importer of soybeans in the base model. China imports 1.65 million metric tons of soybeans in the model, and most of the imports come from the United States.

When domestic demand is increased 50 percent from 10.15 million metric tons to 15.29 thousand metric tons in Model 2, domestic soybean production decreases, resulting in an increase in imports. As soybeans yields increase 5%, 10%, and 15%, in Models 3, 4, and 5, respectively, domestic production and imports increase accordingly. This implies that China could be a major soybean importer in the world. Its soybeans import in Model 2 is approximately 23.0 percent of the total soybeans traded in the world market in 1994 and 19 percent in model 5.

All Crops

China is one of the largest agricultural producing countries in the world. The country produces 337 million metric tons of major crops (rice, wheat, corn, and soybeans) and the total planted area is about 90 million hectares in the base model. China exports 4.44 million metric tons of grains, mainly rice and corn, in the base model. However, when the predicted demand for the crops on the basis of expected economic growth in 2004 is incorporated into the model (Model 2), China becomes a major grain importing country. As crop yields are increased in Model 3, 4, 5, China's agricultural imports decline, but would be over 20 percent of the total grains and soybeans traded in the world market in 1994.

Trade Flows of Agricultural Products

As shown in Table 4, China imports rice from Viet Nam and Thailand in Models 2 through 5 mainly because transportation costs between China and these countries are lower than those between the United States and China. On the other hand, China imports the total amount of corn and soybeans from the United States mainly because of lower shipping costs from the United States to China than those from Argentina to China. China imports about 30 percent of its import of wheat from the United States, 42 percent from Canada, 15 percent from the EU, 8 percent from Australia, and 1.4 percent from Argentina. This is mainly because China imports hard wheat which is produced in the United States and Canada. This implies that increases in China's agricultural consumption will increase U.S. agricultural exports more than other countries' exports.

One concern is whether the United States has enough grain handling capacity to meet China's import demand. The United States may experience rail car shortage problem when China begins to import corn, soybeans, and wheat needed to satisfy its increased domestic demand. Another concern is whether China has enough grain handling capacity at its ports and for inland shipments. Chinese railroads are operating at full capacity and ports are already congested with in- and out-bound traffics.

Conclusions

China's food consumption will increase as a result of expected rapid economic growth. Although China increases its agricultural productivities through improving farming practices, its domestic production of agricultural commodities are not large enough to meet domestic demand in the near future.

China exports rice and corn to its neighboring countries. China, however, will become a major importer of rice, wheat, corn, and soybeans in the near future. Increases in China's grain and soybeans imports will increase U.S. exports to China substantially and affect the world agricultural economy. There will be a substantial increase in agricultural production in major exporting countries and increases in prices of agricultural commodities. China will import rice from its neighboring countries, but corn and soybeans from the United States. China will import wheat mainly from the United States, Canada, and Australia. Increases in China's imports will also affect grain shipping and handling industries. Unless the industries increase their capacities, they would not be able to handle the total amount of grains imported from major exporting countries.

Table 1. GDP, per capita GDP, agricultural output, and total trade values in China

	Unit	1980[1]	1993[2]
GDP	Yuan (billion)	447	3138
	U.S. dollars (billion)	298	545
GDP (per capita)	Yuan	570	2665
	U.S. dollars	380	463
Ag. Output	Yuan (billion)	145	661
	U.S. dollars (billion)	96.667	115
Crops			
Rice	million MT	140	178
Wheat	million MT	55	106
Corn	million MT	63	103
Soybeans	million MT	8	20
Trade			
Exports	Yuan (billion)	27.12	529
	U.S. dollars (billion)	18.08	92
Imports	Yuan (billion)	29.88	599
	U.S. dollars (billion)	19.91	104

[1] 1980, 1.5 Yuan = $1 U.S. dollar.

[2] 1993, 5.76 Yuan = $1 U.S. dollar.

Table 2. The actual and predicted yields for rice, wheat, corn and soybeans

Crop	1993	2004	% increase
	--------tons/ha---------		
Rice	5.84	6.32	8.0
Wheat	3.39	3.82	10.3
Corn	4.49	4.98	11.1
Soybeans	1.54	1.70	10.0

Table 3. The actual and predicted demand for rice, wheat, corn and soybeans

Crop	1993	2004	% increase
	----1,000 metric tons----		
Rice	127,001	126,942	-0.04
Wheat	109,118	146,856	34.58
Corn	85,999	133,698	55.46
Soybeans	10,149	15,289	50.06

Table 4. Production, consumption, exports, and imports of each crop under the base and alternative model

	Area Planted	Production	Consumption	Export	Import	% of Net Import to World Trade
--------------------------------1,000 metric tons---------------------------------						
Rice						
Model 1	31,990	128,975	127,001	1,974	0	--
Model 2	31,322	125,894	126,942	1,911	2,959	5.94
Model 3	30,077	126,082	126,942	1,912	2,771	4.87
Model 4	29,052	126,271	126,942	1,912	2,582	3.80
Model 5	27,969	126,459	126,942	1,912	2,394	2.73
Wheat						
Model 1	30,096	98,653	109,118	0	10,465	9.52
Model 2	30,042	98,985	146,856	0	47,871	43.54
Model 3	31,571	110,284	146,856	0	36,572	33.27
Model 4	32,534	120,117	146,856	0	26,739	24.32
Model 5	33,610	129,854	146,856	0	17,002	15.46
Corn						
Model 1	21,959	100,580	85,999	21,819	7,238	--
Model 2	23,018	104,000	133,698	0	29,697	43.45
Model 3	22,111	105,766	133,698	0	27,932	40.86
Model 4	21,933	110,937	133,698	0	22,760	33.30
Model 5	21,746	115,532	133,698	0	18,165	26.58
Soybean						
Model 1	5,891	8,497	10,149	0	1,652	5.08
Model 2	5,461	7,789	15,289	0	7,500	23.04
Model 3	5,490	8,230	15,289	0	7,059	21.69
Model 4	5,369	8,401	15,289	0	6,888	21.16
Model 5	5,628	9,135	15,289	0	6,154	18.91

Table 5. China's Agricultural Imports by Sources

	U.S.	Canada	Australia	Argentina	EU	Others
	------------------------------------1,000 MT					--
<u>Rice</u>						
Model 1	0	0	0	0	0	0
Model 2	0	0	0	0	0	2,959
Model 3	0	0	0	0	0	2,771
Model 4	0	0	0	0	0	2,582
Model 5	0	0	0	0	0	2,394
<u>Wheat</u>						
Model 1	3,131	4,770	989	0	1,575	0
Model 2	14,648	20,249	4,021	670	7,276	0
Model 3	11,191	15,469	3,072	512	5,559	0
Model 4	8,182	11,310	2,246	374	4,064	0
Model 5	5,202	7,191	1,428	234	2,584	0
<u>Corn</u>						
Model 1	7,238	0	0	0	0	0
Model 2	29,607	0	0	0	0	0
Model 3	27,932	0	0	0	0	0
Model 4	22,760	0	0	0	0	0
Model 5	18,165	0	0	0	0	0
<u>Soybeans</u>						
Model 1	1,652	0	0	0	0	0
Model 2	7,500	0	0	0	0	0
Model 3	7,059	0	0	0	0	0
Model 4	6,888	0	0	0	0	0
Model 5	6,154	0	0	0	0	0

References

Agricultural Yearbook Editing Committee. *China Agricultural*, various issues. Beijing, China.

Australian Bureau of Agricultural and Resource Economics. *Commodity Statistics Bulletin.* Various issues, 1986-1994.

Chen, Liang Yu. *Chinese Grain Economy and Policy.* C.A.B. International, 1991.

China Statistics Bureau. *China Rural Economy Statistics Yearbook 1993.* Beijing, 1993.

China Statistics Bureau. *China Statistical Yearbook 1992.* Beijing, 1992.

China State Statistics Bureau. *China Urban Family Expenditure Survey Data.* Beijing, 1992.

Commerce Ministry. *China Commerce Yearbook 1992.* Beijing, 1992.

Cook, P.D., C.D. Martland, and C.L. Feng. "China Railway Performance Modeling." *Journal of the Transportation Research Forum* 34(1994):1-15.

Crook, F.W., W. Lin, and H. Colby. "Determinants of Wheat Import Demand." Economic Research Service, U.S. Department of Agriculture. Report No. AGES 9329, 1993.

Economic Research Service. *Agricultural Statistics of the People's Republic of China 1949-1990.* U.S. Department of Agriculture, 1994.

Economic Research Service. "Asia and Pacific Rim Situation and Outlook Series." U.S. Department of Agriculture. Report No. WRS-94-6, 1994.

Economic Research Service. "China Agricultural and Trade Report: Situation and Outlook Series." Various issues, U.S. Department of Agriculture.

Food and Agricultural Organization, Production Yearbook, FAO Statistical Series No. 104. Rome, Italy, 1991.

Food and Agricultural Policy Research Institute. *FAPRI 1995 U.S. Agricultural Outlook.* Staff Report #1-95, Iowa State University and University of Missouri-Columbia, 1995.

Foreign Agricultural Service. *The Production, Supply, and Distribution (PS&D) Database.* United States Department of Agriculture, 1994

Halbrendt, C. and C. Gempesaw II. "A Policy Analysis of China's Wheat Economy." *American Journal of Agricultural Economics* 72(1990):268-78.

Halbrendt, C.K., S.H. Webb, and R.L. Aull-Hyde. "A Multi-commodity Spatial Equilibrium Approach to Analyze Infrastructural Reform in China's Crop Sector." *Journal of the Transportation Research Forum* 34(1994):47-57.

Hearn, D.H., C.K. Halbrendt, C.M. Gempesaw II, and S.H. Webb. "An Analysis of Transport Improvements in China's Corn Sector: A Hybrid Spatial Equilibrium Approach." *Journal of the Transportation Research Forum* 31(1990):154-66.

International Wheat Council. *World Grain Statistics*. London. Various issues, 1991-1994.

Johnson, D.G. "Does China Have a Grain Problem?" *China Economic Review* 5(1994):1-14.

Koo, W.W., and J. Fruin. "Methodology and Data System for Study of Transportation." *North Central Regional Research Publication* 179(1994):21-32.

Lardy, N.R. *Foreign Trade and Economic Reform in China, 1978-1990*. University of Cambridge, 1992.

Li, Jianguany and A. Weersink. "The Historical Development of Chinese Agriculture: A Policy Review." Working Paper W.P. 94113, University of Guelph, 1994.

Lin, Jinding and Won W. Koo. "Economic Development in the Agricultural and Industrial Sectors in the People's Republic of China." Agricultural Economics Report No. 263, 1990.

Peng, Liquan. *Report of Food Consumption of Chinese Farmer*, Rural Investigation, Beijing, 1993.

Tierney, W. I. "Wheat Export Enhancement Program." *Quarterly Wheat Outlook*, Kansas State University, 1994.

Tuan, Francis. "China's Trade with Neighboring Countries Since the Early 1980's." Economic Research Service, U.S. Department of Agriculture. No. RS-92-3, 1992.

U.S. Defense Mapping Agency. *Distances Between Ports.* Washington D.C., 1985.

Webb, S. H. and W. H. Colby. "China's Agricultural Marketing System in the 1980's." Economic Research Service, U.S. Department of Agriculture, No. RS-92-3, 1992.

Wu, Shou. "Interprovincial Circulation of Grain and Wholesale Markets in China." *North Central Regional Research Publication* 179(1994):1-11.

Xu, G.H. and L.J. Peel. *The Agriculture of China*. Oxford University Press, 1991.

Zhou, C.Q. and G.C., Jiang. "China Can Solve Its Grain Demand Problem in the Future." *People's Daily* April 5, 1995.