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International Agricultural Trade
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U.S. IMPORTS OF CANADIAN WHEAT: ESTIMATING THE EFFECT OF THE U.S. EXPORT ENHANCEMENT PROGRAM

by

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U.S. Imports of Canadian Wheat: Estimating the Effect of the U.S. Export Enhancement Program. By Stephen L. Haley. Commercial Agriculture Division, Economic Research Service, U.S. Department of Agriculture.

Abstract

It is hypothesized that the U.S. Export Enhancement Program (EEP) has had a role in increased U.S. imports of Canadian wheat. Using a set of world wheat models that differentiate wheat according to class and source, several conclusions concerning the role of EEP are reached. Over the period 1986-1993, EEP has been accountable for 40 to 48 percent of the yearly growth in U.S. imports of Canadian wheat. EEP subsidies in 1991/92 to China and Brazil caused significant diversion of Canadian wheat that would have been destined for those markets instead to the U.S. market. Further, it is argued that a quota on imports is not likely to have price-enhancing effects for U.S. wheat.

Keywords: Canada, export enhancement program, wheat

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U.S. Imports of Canadian Wheat: Estimating the Effect of the U.S. Export Enhancement Program

Ever since the implementation of the United States - Canada Free Trade Agreement (FTA), increasing yearly U.S. imports of Canadian wheat have been a major concern of U.S. wheat interests. In July 1994 International Trade Commission (ITC) commissioners decided that the wheat imports were affecting the U.S. wheat price and income support program's costs and markets. They recommended restricting wheat imports through either an import quota, tariff-rate quota, or tariffs. After negotiations, the Canadians agreed to limit exports through the Canadian Wheat Board (CWB) to the United States to 1.5 million metric tons (mmt) for one year starting 12 September 1994, and to the formation of a joint commission on grains to examine grain marketing and support systems in each country.

There has been no widely agreed upon explanation as to why U.S. imports of Canadian wheat have been trending upward. Secretive export pricing practices of the CWB and the Western Grain Transportation Act rail subsidies have been suspected as factors. Less suspected, at least among U.S. wheat interests, has been the role played by U.S. wheat export subsidies, especially Export Enhancement Program (EEP) bonuses made to assist the sales of U.S. wheat in world markets.

There are two aspects to the way that the EEP has affected Canada. Both act to widen wheat price differentials between U.S. and Canadian wheats, leading to increased U.S. purchases of Canadian wheat. The first is related to the way that the CWB sets the price at which it acquires wheat from producers. This mechanism is described below. The second is the focus of this report. It emphasizes that the United States and Canada compete in both domestic and foreign markets. A program that shifts U.S. wheat to foreign markets increases domestic acquisition costs while at the same time displacing Canadian wheat from foreign markets. Given close geographical proximity, increased shipments to the United States might be reasonably expected.

Several issues could influence the magnitude of this effect, however. The first is the degree to which the United States has targeted EEP bonuses. Subsidizing sales to markets shared with Canada would have a displacement potential. The second is the degree to which Canadian wheat substitutes for U.S wheat, both domestically and internationally. The greater is the substitutability internationally, the more likely it that U.S. wheat has had a displacement effect. Also, the greater is the substitutability domestically, the more likely it is that U.S. flour millers could substitute Canadian wheat for a more costly U.S. product.

This paper investigates the role of the EEP in accounting for

increased U.S. imports of Canadian wheat. It uses a set of world wheat models that explicitly incorporate product differentiation among wheat classes and source countries. These models were constructed based on information on major import markets gathered as part of the Grain Quality surveys conducted by the Economic Research Service (ERS) of the U.S. Department of Agriculture (USDA). These models were constructed covering the July-June crop years from July 1986 through June 1993. The EEP has been an actively used program throughout this period. The models allow for targeting of EEP bonuses to specific importers, and allows consideration of the EEP as an in-kind subsidy program.

Three specific questions are addressed:

- What percentage of the growth of U.S. wheat imports from Canada could be reasonably attributed to the EEP over this 1986-1993 period?

- In what years was the EEP particularly important in accounting for increased Canadian wheat imports? Why?

- Given actual levels and targeting of EEP bonuses, what would have been the effect in 1992/93 (the most recent period covered by one of the models) of restricting Canadian imports to levels of 1989/90? Specifically, would U.S. prices have been significantly different than what they were if restrictions had been in place? What would have been the implication for the costs of the U.S. wheat price and income support program, upon which the recent ITC decision was based?

This paper is organized as follows. The next section looks more closely at U.S. wheat import trends and how the EEP may affect the CWB's acquisition cost of wheat from producers. The following section describes the modeling approach used for the analysis. The last sections answer the questions posed above. A short summary follows.

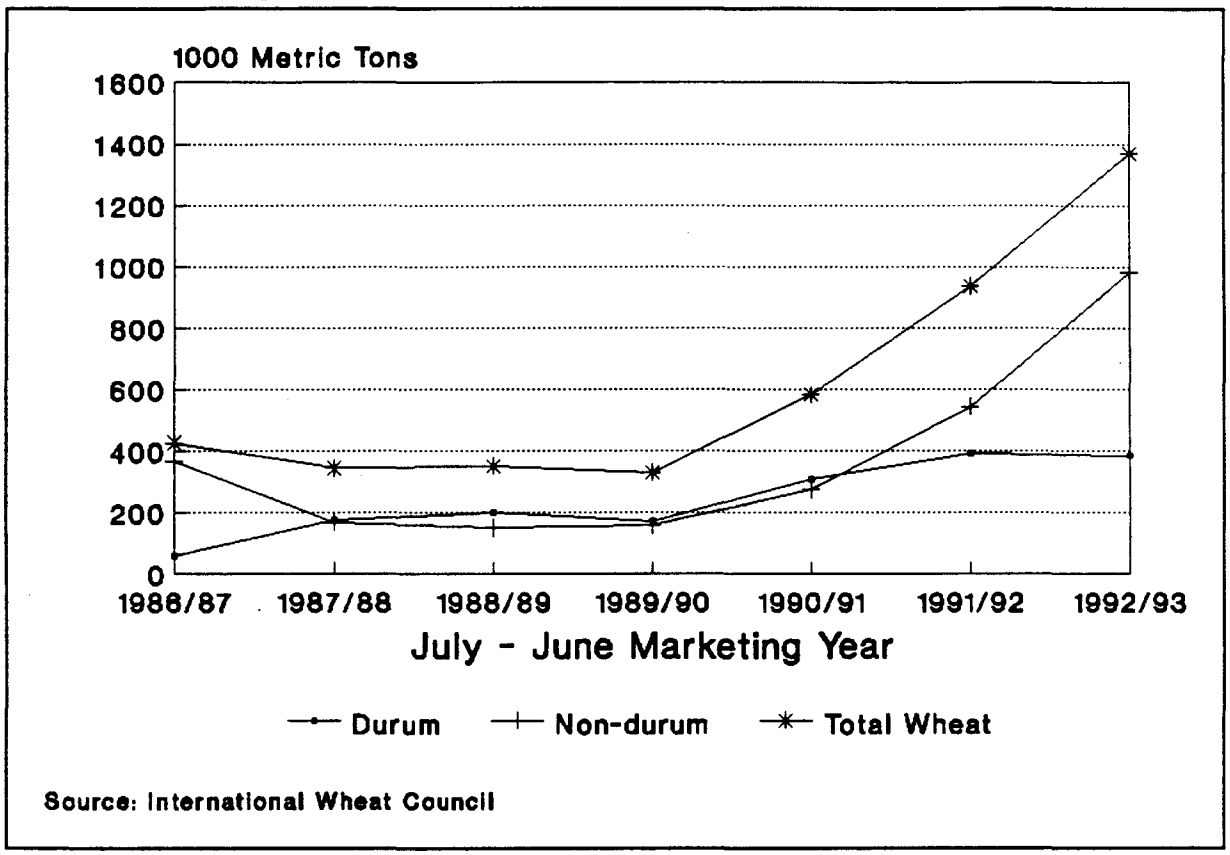
U.S. Wheat Import Trends and CWB Pricing Mechanisms

The wheat dispute between the United States and Canada is based on the less-than-transparent wheat pricing policies of the Canadian Wheat Board (CWB) and Canada's Western Grain Transportation Act (WGTA) rail transport subsidy. The CWB has sole authority for international and intraprovincial trade of Canadian wheat from the western provinces. The CWB sets producer payments, regulate deliveries through quotas and contracts, and organizes wheat handling and transportation. Based on anecdotal evidence, and aided by the fact that the CWB does not publish prices for individual sales, U.S. wheat producers and traders have maintained the CWB

subsidizes wheat exports to the determent of U.S. wheat sales, both domestically and internationally.

The focus of the dispute more recently has been the growth of Canadian wheat exports to the United States, especially since the implementation of FTA. Figure 1 shows U.S. wheat imports broken out between durum and non-durum wheats from Canada from July 1986 through June 1993. Total wheat imports have trended upward about

Figure 1
U.S. Wheat Imports From Canada



Source: International Wheat Council

150 thousand metric tons per year over this period. The growth in durum has been very steady at 54 thousand metric tons, while the growth of non-durum has been larger - 97 thousand metric tons - but has grown especially large only since 1990.

One way the EEP can affect the incentive to import Canadian wheat is through the way CWB bases its acquisition payment made to producers for wheat. CWB pegs its initial payment to producers at world wheat prices that incorporate the effect of export subsidies. This amount per unit is about 80 percent of the world price, with minor adjustments made for handling expenses. This payment constitutes the CWB wheat acquisition price.

The CWB goal is to price the grain sufficiently low so that proceeds from CWB sales will cover the sum of the initial payments to producers. If the CWB runs a deficit, the Canadian federal government must make reimbursement to cover it. In effect, this federal expenditure is an export subsidy.

An effective EEP will introduce a price wedge separating the U.S. domestic price from the world price. According to the mechanism described above, the Canadian producer price will be much lower than the comparable U.S. producer price. Additionally, geographical proximity implies that transport costs from Canada to the United States are likely lower than costs to most other export markets. These two factors imply that large price differentials likely exist that would make the purchase of Canadian wheat by U.S. flour millers attractive.

Although this explanation seems plausible, its effect has not been systematically quantified. The remainder of this paper presents an analysis that quantifies the effect of EEP. Although the CWB's pricing procedure is not explicitly modeled, a modeling mechanism that approximates its effect is used.

Modeling Approach

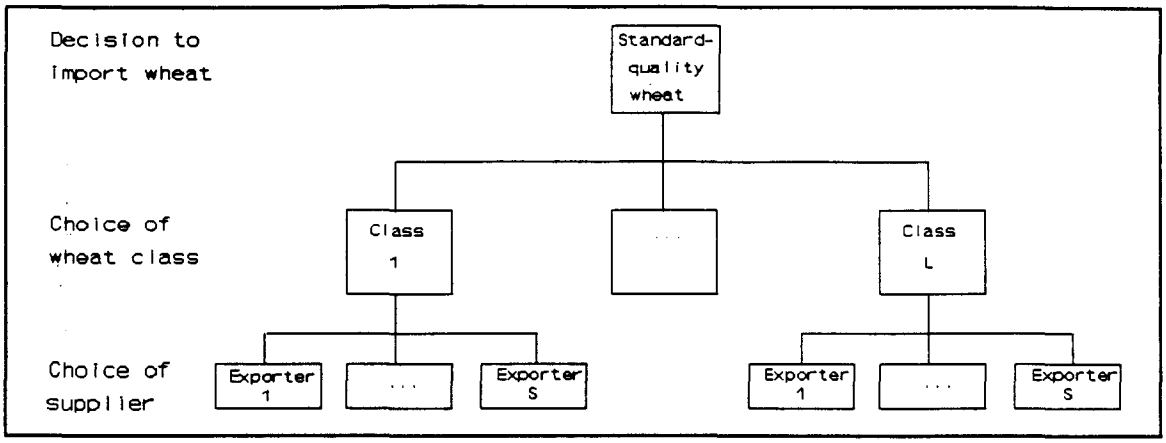
Previous world wheat models, with few exceptions (Hjort, 1988), analyze the competition among exporters facing a market of homogenous quality. Even the Armington assumptions differentiate a product by its country of origin, with no explicit recognition that quality requirements are not necessarily related to supply sources. The model constructed for this analysis recognizes that competitiveness among exporters is largely determined by the end-use requirements of wheat product demand and the policy structure of the importing country.

Three-Stage Theory of Wheat Import Demand

Wheat import demand is modeled as a three-stage decision process (fig.2). In the first stage, the importer determines how much wheat needs to be imported to satisfy domestic end-use demand for wheat. This wheat is referred to as "standard-quality wheat" and possesses characteristics particular to each importing country's needs. For the next two stages, some level of substitution among wheat classes and suppliers is assumed to occur. This substitution allows aggregation across characteristics to obtain a quality standard that can satisfy imports of different classes from different suppliers of wheat. The importing agent can thereby determine what classes of wheat will satisfy excess demands, given rates of substitution between "standard-quality wheat" and imported wheat.

In the second stage, the importer determines what class(es) of

Figure 2
Three-stage demand for wheat



wheat will optimally satisfy wheat import demand which is determined in the first stage. The goal of the importer is to minimize the costs of fulfilling the aggregate demand for wheat. This goal holds for both private and State traders. The solution to the cost minimization problem shows the mix of wheats that will satisfy demand for wheat-quality characteristics. In the third stage, the importer determines from which supplier to purchase the class of wheat identified in the second stage. Factors that influence supplier-specific quality characteristics are potentially many, but in particular they include spatial/timing characteristics; political and trade ties; and policy goals, including supply assurance and diversification objectives.

Making the Model Operational

The world wheat model was built in the Static World Policy Simulation (SWOPSIM) modeling framework, modified to incorporate the three-stage wheat import demand structure. SWOPSIM is a static, partial equilibrium, nonspatial modeling framework (Roningen, Sullivan, and Dixit, 1991). Supply and demand are functions of own- and cross-prices. Trade is the difference between domestic supply and demand. Domestic incentive prices depend on the level of consumer and producer support and on world prices denominated in local currency. Price transmission elasticities regulate the extent to which domestic prices change when world prices change. World markets clear when net trade of a commodity across all regions sums to zero.

Because the SWOPSIM structure assumes product homogeneity, the framework must be modified to make the modeling framework consistent with the theory of differentiated wheat demand. Seven types of wheat are in the model. Six of the wheats are identified with the country-source of production: the United States, Canada, the EC, Australia, Argentina, and Saudi Arabia. The seventh type is a generic wheat category comprising wheat produced elsewhere.

Armington's methodology is employed to calculate own- and cross-price elasticities for the wheat types, according to the procedures described in table 1. Necessary elements for setting the demand elasticity parameters are an own-price elasticity of demand for standard-quality wheat (stage 1), elasticities of substitution corresponding to wheat classes (σ, stage 2) and to wheat suppliers of particular classes (σ_i, stage 3), and consumption and/or import shares.

The first-stage demand elasticities, along with supply and price transmission elasticities, are shown in table 2. These elasticities are based on those used in ERS's trade liberalization studies (Sullivan and others, 1992; and Sullivan, 1990).

The elasticities of substitution were inferred from a review of the Grain Quality surveys. The countries included in the study were chosen on the basis of their share of purchases on the world wheat market (58 percent of 1992 imports and 63 percent of U.S. sales), and to yield a representative view of worldwide demand for wheat. These countries are separated out in table 2.

Table 3 shows how wheat is classified in each of the countries, the between-class substitution elasticities, the principal suppliers within wheat classes, and the within-class substitution elasticities. For most countries in the model, the between-class elasticities are estimated to be low (usually about 0.50), while the between-supplier elasticities tend to be higher (usually about 3.00). For the countries and regions not surveyed, historical wheat import and consumption patterns are used to construct the wheat class categories (table 4). An appendix to this report (available from the author) details wheat import demand in each of the importing countries or regions, implications for U.S. wheat competitiveness, and selection of parameter values.

Modeling the Export Enhancement Program

Over the July-June marketing years 1986/87 through 1992/93, more than $3.7 billion was expended on the EEP. Figure 3 shows the distribution of expenditures over the 7-year time frame. Figure 3 reveals that the highest yearly expenditures occurred in 1987/88 and 1991/92. Expenditures dipped during the middle years of 1988/89 and 1989/90 due to tighter worldwide wheat supply conditions.

The EEP is a subsidy program targeted to specific importers. Table 5 presents the yearly average unit subsidy amounts that importers in the model received. Until November 1991, EEP subsidies were given to exporters in the form of commodity certificates that could either be sold or exchanged for commodities owned by the Commodity Credit Corporation (CCC). This operation, called an in-kind subsidy program, presents analytical problems. Although export volume

Table 1 -- Three-stage demand for wheat

Stage 1: Decision to import wheat

Define: η = Demand elasticity for standard-quality wheat

Stage 2: Choice of wheat class

Define:
- σ = Elasticity of substitution between wheat classes
- η_{ii} = Own-price demand elasticity of class i wheat
- η_{ih} = Cross-price demand elasticity of class i wheat, with respect to class h wheat
- S_h = Expenditure share of class h wheat imports

Own-price demand elasticity of class i wheat:

$$\eta_{ii} = -(1-S_i)*\sigma + S_i*\eta$$

Cross-price demand elasticity of class i wheat:

$$\eta_{ih} = S_h*(\sigma + \eta)$$

Stage 3: Choice of supplier

Define:
- σ_i = Elasticity of substitution between suppliers of class i wheat
- $\eta_{i,jj}$ = Own-price demand elasticity of class i wheat from exporter j
- $\eta_{i,jm}$ = Cross-price demand elasticity of class i wheat from exporter j, with respect to exporter m
- $S_{i,m}$ = Expenditure share of class i wheat imports from supplier m

$$\eta_{i,jj} = -(1-S_{i,j})*\sigma_i + S_{i,j}*\eta_{ii}$$

$$\eta_{i,jm} = S_{i,m}*(\sigma_i + \eta_{ii})$$

$$\eta_{i,jm} = S_{h,m}*\eta_{ih} \text{ where } h \neq i$$

Table 2 -- Supply, demand, and price transmission elasticities

Item	Own-price supply elasticity	Own-price demand elasticity	Price transmission
Exporters:			
United States	0.60	-0.25	1.00
Canada	0.50	-0.43	0.85
EC	0.50	-0.37	0.15
Australia	0.90	-0.35	0.80
Argentina	0.60	-0.20	0.80
Saudi Arabia	0.30	-0.31	0.30
Surveyed importers:			
Venezuela	-	-0.28	1.00
Brazil	0.38	-0.20	0.30
Italy	0.50	-0.20	0.15
Former Soviet Union	0.23	-0.24	0.14
Morocco	0.30	-0.20	0.60
Tunisia	0.30	-0.20	0.60
Ghana	-	-0.30	0.40
Togo	-	-0.30	0.40
Egypt	0.30	-0.31	0.35
Yemen	0.30	-0.30	0.60
Pakistan	0.40	-0.30	0.25
Sri Lanka	-	-0.30	0.25
Japan	0.52	-0.10	0.40
Korea	-	-0.36	0.50
Taiwan	-	-0.33	0.30
China	0.15	-0.30	0.15
The Philippines	-	-0.30	0.50
Indonesia	-	-0.30	0.25
Other importers:			
Mexico, Central America	0.55	-0.26	0.50
Other South America	0.38	-0.30	0.70
Other Western Europe	0.80	-0.25	0.15
Eastern Europe	0.25	-0.28	0.40
Other North Africa	0.30	-0.20	0.60
Other Sub-Saharan Africa	0.50	-0.30	0.40
Other Near East	0.30	-0.30	0.60
Other Far East	0.40	-0.30	0.60
Rest of World	-	-0.30	0.70

- = Not applicable.

Table 3 -- Elasticities of substitution: Surveyed importers

Importer	Wheat class	Between-class substitution elasticity	Suppliers[1]	Within-class substitution elasticity
Venezuela	Hard	0.5	US-CN	3.0
	Soft		US-AR-EC-SA	3.0
Brazil	Preferred	0.5	DM-AR	1.0
	Hard		CN-US	3.0
Italy	EC	0.5	DM-Other EC	-
	Hard		US-CN-SA	3.0
	Durum		CN-US	0.5
Former Soviet Union	Generic	-	DM-US-CN-EC-AR-AU	3.0
Morocco	Durum	1.0	DM	-
	Common		DM-Foreign	3.0
			Foreign:US-EC-CN	4.0
Tunisia	Durum	0.5	DM-EC-US-CN	4.0
	Common		US-EC-DM	4.0
Ghana	Hard	0.5	CN-US	4.0
	Soft		EC	-
Togo	Hard	1.0	US-CN	2.0
	Soft		EC	-
Egypt	Domestic	3.0	DM	-
	Foreign		AU-Other	-
	Australian	0.5	AU	-
	Other		US-EC-SA-CN	3.0
Yemen	Generic	_	AU-EC-US-DM-CN	4.0
Pakistan	Domestic	0.5	DM	-
	Foreign		US-AU-EC-CN-SA	3.0
Sri Lanka	Hard	0.5	US-SA-CN	3.0
	Soft		US-EC-AU-AR	3.0
Japan	High Quality	0.5	US-CN-AU	1.0
	Low Quality		DM-AU	1.0
Korea	Food	0.5	US-AU-CN	1.0
	Feed		CN-EC-SA-AR	1.0
Taiwan	Hard	0.5	US-CN	1.0
	Soft		US	-
China	High Protein	0.5	CN-US-AU-AR-SA	3.0
	Low Protein		DM-US-EC	3.0
The Philippines	Hard	0.5	US-CN	3.0
	Soft		US-EC-AU-SA	3.0
Indonesia	Hard	0.5	CN-AR-SA-US	3.0
	Soft		AU-EC-US	3.0

- = Not applicable.

[1] Supplier codes: US- United States; CN- Canada; EC- European Community; AU- Australia; AR- Argentina; SA- Saudi Arabia; DM- Domestic.

Table 4 -- Elasticities of substitution: Other importers

Importer	Wheat class	Between-class substitution elasticity	Suppliers[1]	Within-class substitution elasticity
United States	Durum	0.5	US-CN	4.0
	Non-Durum			
	Hard	1.0	Winter-Spring	2.0
			Spring: US-CN	4.0
	Soft		US	-
European Community	Soft	0.5	EC	-
	Hard		US-CN-SA	3.0
Mexico, Central America	Hard	0.5	US-CN	3.0
	Soft		EC-US-AR-DM	3.0
Other South America	High Protein	0.5	US-CN	3.0
	Low Protein		DM-AR-US-EC	3.0
Other Western Europe	Soft	0.5	DM-EC	-
	Hard		US-CN-SA	3.0
Eastern Europe	Soft	0.5	DM-EC	-
	Hard		US-CN-SA	3.0
Other North Africa	Durum	0.5	DM-CN-US-EC	4.0
	Common		EC-US-DM-CN	4.0
Other Sub-Saharan Africa	Domestic	3.0	DM	-
	Hard		US-CN-SA	4.0
	Soft		EC	-
Other Near East	Domestic	3.0	DM-SA	-
	Foreign			
	Australian	1.0	AU	-
	Other		EC-US-CN-AR	4.0
Other Far East	Hard	0.5	AU-US-CN-SA	3.0
	Soft		EC-US	3.0
Rest of World	Generic	-	US-EC-AU-SA-DM	3.0

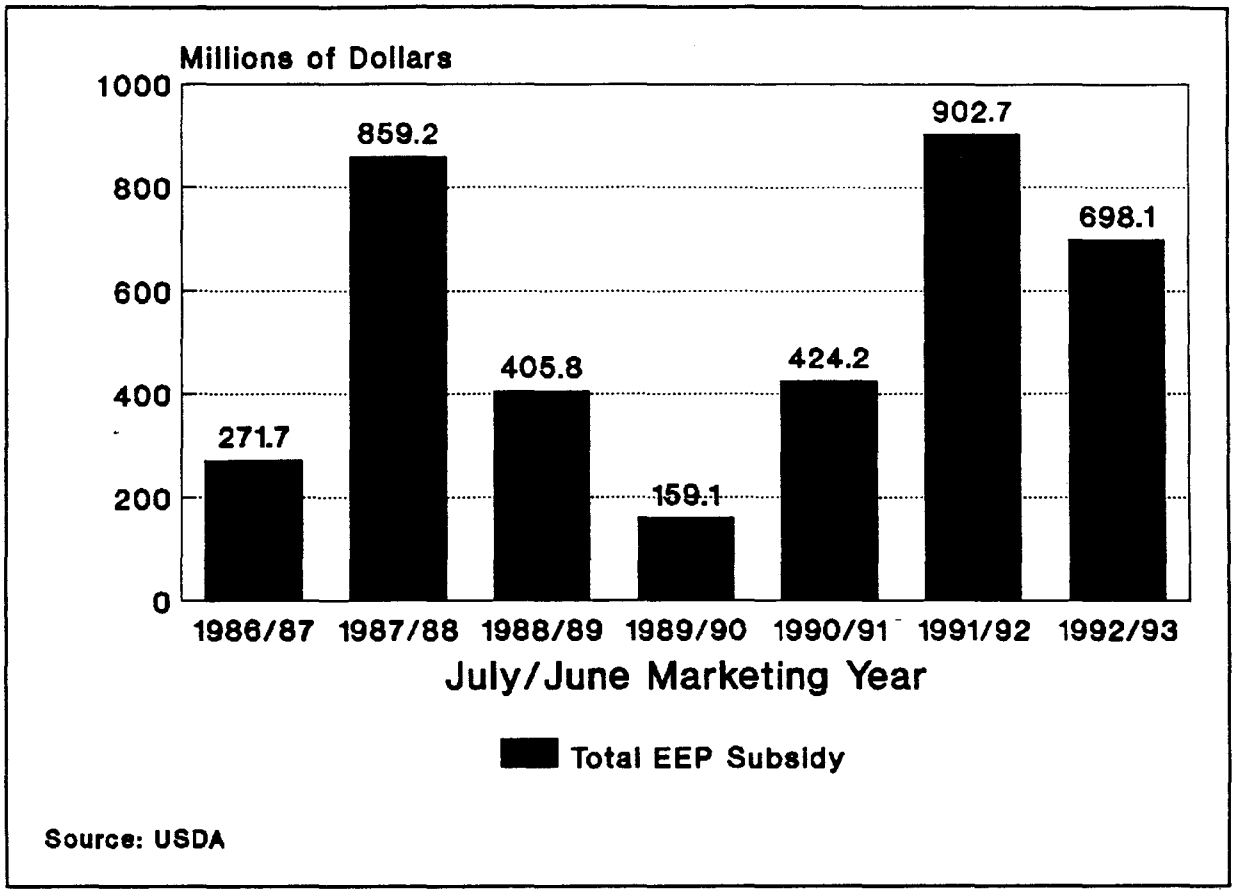
- = Not applicable.
[1] Supplier Codes: US- United States; CN- Canada; EC- European Community; AU- Australia; AR- Argentina; SA- Saudi Arabia; DM- Domestic.

Table 5 -- Export Enhancement Enhancement bonuses for U.S. wheat: July-June marketing year

Country/Region	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93
	Dollars per metric ton						
Venezuela	--	--	--	--	--	1.29	13.78
Brazil	--	23.21	--	--	7.55	28.74	35.16
Mexico, Central America	--	12.18	10.84	2.53	1.95	4.84	1.99
Other South America	--	7.17	1.88	1.86	8.47	3.66	--
Other Western Europe	--	12.83	2.61	.28	45.17	36.47	36.00
Former Soviet Union	43.14	27.65	20.59	15.98	38.9	46.68	31.00
Eastern Europe	34.39	38.3	3.31	6.48	2.02	40.68	26.81
Morocco	40.93	30.44	18.47	15.14	41.98	42.11	35.34
Tunisia	24.32	33.43	--	5.65	45.71	41.02	35.50
Other North Africa	32.34	32.26	19.14	13.33	37.24	51.3	38.09
Ghana	40.21	34.82	22.06	16.88	44.07	55.95	35.01
Togo	40.21	34.82	22.06	16.88	44.07	55.95	35.01
Other Sub-Saharan Africa	7.15	9.41	8.41	16.57	5.75	55.95	29.52
Egypt	30.19	21.83	13.39	4.3	33.96	55.55	27.98
Yemen	--	8.98	21.42	9.94	20.24	30.89	34.38
Sri Lanka	33.69	31.62	11.86	7.33	35.38	44.97	27.03
Other Near East	15.16	12.27	9.64	3.64	15.2	7.62	16.98
China	34.25	35.42	20.38	5.15	27.32	43.47	40.00
Philippines	--	21.11	7.9	2.79	22.08	35.34	23.78
Other Far East	--	25.72	10.36	--	--	10.46	32.36

-- = None.
Source: Author's calculations for July - June marketing year, based on USDA data.

Figure 3
Export Enhancement Program for Wheat:
Yearly Subsidization, 1986/87-1992/93



clearly will expand, the effects on the domestic price are less certain. The stimulation of export demand (the "subsidy" effect) puts upward pressure on the domestic commodity price, while deliveries into the market out of CCC stocks (the "stock release" effect) depresses prices. Houck (1986) has shown that, for the case of a uniform export subsidy, the elasticity of export demand plays a determining role in which effect will dominate. If export demand is elastic (absolute value greater than unity), then the subsidy effect will dominate and the domestic wheat price should rise, all else constant.

An additional complication is introduced through the commodity certificate program. The certificates need not be redeemed for the commodity for whose export they were issued. Any commodity in CCC inventories can be redeemed. Therefore, if only a fraction of the certificates issued for wheat were redeemed for wheat, the program effect would begin to resemble more a cash subsidy, for which there is no domestic price ambiguity.

It is not possible to trace through the EEP certificates because certificates were also issued for in-kind payments of other

Government programs. However, personal contact with officials of the Agriculture Stabilization and Conservation Service (ASCS) in Kansas City indicates that of all certificates issued over the life of the commodity certificate program, 25 percent were redeemed for wheat. This proportion is incorporated in this analysis. When scenarios are run, the total amount of reduced EEP expenditures is calculated. This amount is divided by the domestic wheat price to yield the volume of EEP shipments. Twenty-five percent of this amount is assumed to have been originally released from CCC stocks to help finance the program subsidies. With the modeling of the program removal, this amount is withdrawn back into CCC stocks, thereby putting upward pressure on wheat prices when the program is removed.

Producer Responses

When evaluating the effects of the EEP, we assumed that the effects are incorporated in the base data used to initialize the model. Modeling the removal of the program identifies the effects of the EEP. EEP removal affects prices, consumption, stock levels, production, and therefore, trade.

How producers are assumed to adjust to changed prices is a problem stemming from the use of a static model for analyzing the effects for a specific year. Most planting decisions would have been made on the basis of expected prices rather than actual realized prices. Also, the supply elasticities from the SWOPSIM database are typically assumed to represent medium term (3-year) supply adjustments to changed prices. While one can formulate appropriate price expectation assumptions under which the medium-term elasticities are entirely appropriate for the analysis, that option is not fully exercised here. Rather, a range of results are reported. At one extreme, we assumed that there is no production response due to changed prices (supply elasticities set at zero). All adjustments come from changed consumption levels and changes in CCC stock levels. At the other extreme, producers are assumed to adjust fully within the current year to changed prices (supply elasticities set at levels in table 2). The true responses are assumed to be within the ranges presented. The distribution of "true" responses within the ranges could vary depending on whether an EEP was assumed to exist in the previous years.

Effect of the EEP on U.S. Wheat Imports

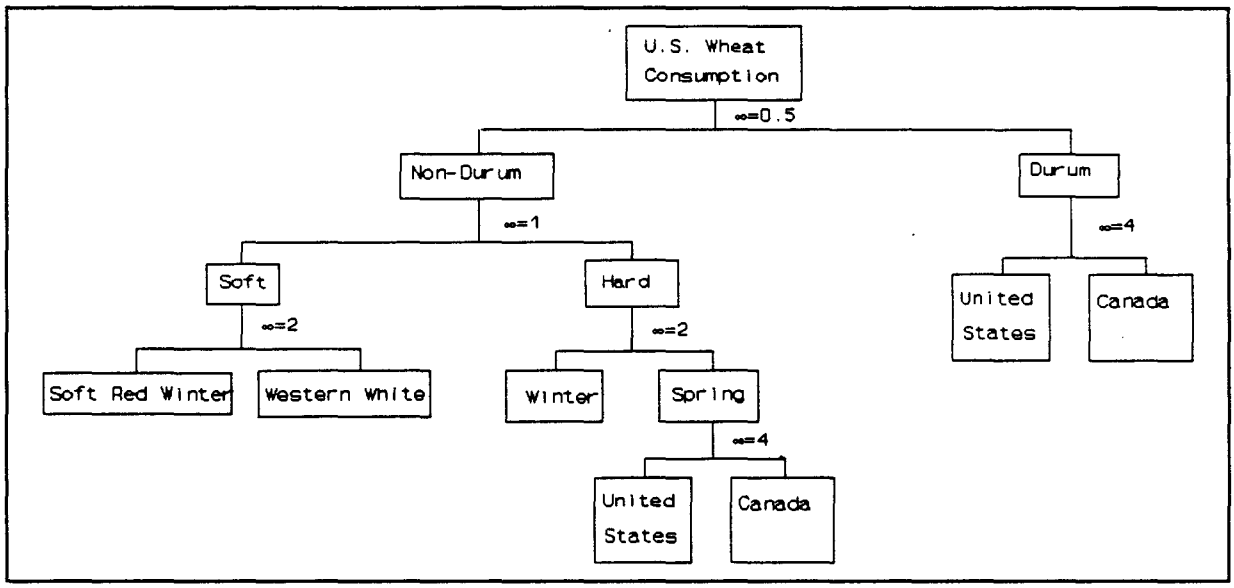
The subsidies shown in table 5 are assumed withdrawn from importers of U.S. wheat for each of the years 1986/87 through 1992/93. The effects of the withdrawals are analyzed through seven separate comparative static world wheat models, each having been constructed to capture relevant features of world wheat trade for each year for which analysis is intended. Details for a more comprehensive

evaluation of the EEP have been presented elsewhere (Haley, 1994). This analysis concentrates on the effect on U.S. wheat imports.

Modeling Assumptions

There are several modeling assumptions made that might affect the results in more than marginal ways. The first is the assumption of substitutability between U.S. and Canadian wheats in the U.S.

Figure 4
U.S. Wheat Consumption



market. As detailed in table 4, the model assumes a consumption structure and specific substitution elasticities between wheats. This structure, with initial substitution parameter values, is shown diagrammatically in figure 4. The parameter values have only been surmised as reasonable approximations: they have not been rigorously estimated. Also, the degree of substitutability may change from year-to-year due to, perhaps, weather-related events that cause differences in the intrinsic characteristics of the wheat. In order to assess the sensitivity of results to parameter values, the values have been increased 50 percent and model run to simulate removal of the EEP. Results are presented below that illustrate the contribution of the substitutability assumptions to the analysis.

A second assumption hypothesized as important to estimated outcomes is the degree to which the CWB has reacted to the EEP. As explained above, it is known that the CWB determines its initial acquisition price of wheat taking into account the EEP's effect on world wheat prices. The pricing story, however, is not complete because it is not known explicitly how the CWB uses export price discounts to

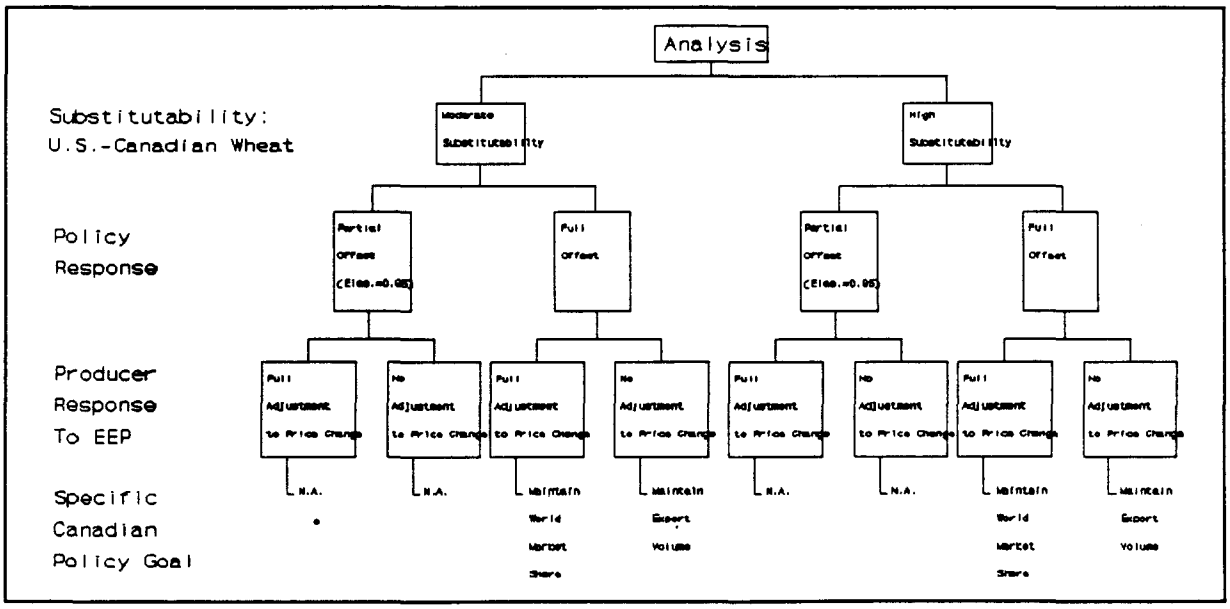
remain competitive in world markets.

In one version, the model is set so that most but not all of the change to the world price of Canadian wheat is transmitted back to the producer. In terms of model-mechanics, the "price transmission elasticity" set to 0.85 (table 2). Effectively, this specification means that it is assumed that the CWB passively absorbs 15 percent of changes in the world price.

In an alternative specification, it is assumed that the CWB uses export subsidies more aggressively. In the short-run, (that is, when producers are assumed not to respond to price changes, as explained above) it is assumed that the CWB uses uniform export subsidies to maintain export volume. In other words, the CWB completely offsets the effect of the EEP on the level of Canadian wheat exports. Export subsidies become a policy tool to maintain a set level of exports: if the level of exports was 10 mmt., it was because that was the level decided upon by the CWB. In the longer term (that is, when producers respond to price changes), it is assumed that uniform export subsidies are used to maintain Canadian world market share, relative to the other major wheat exporters of the United States, the European Union, Australia, Argentina, and Saudi Arabia.

Eight different versions of the model for each year (56, or 8 times 7, in all) are used to estimate the effect of the EEP on U.S. wheat imports from Canada. Rather than rely on point estimates of the effect, a range will be presented. Figure 5 summarizes the key differences between each of the versions.

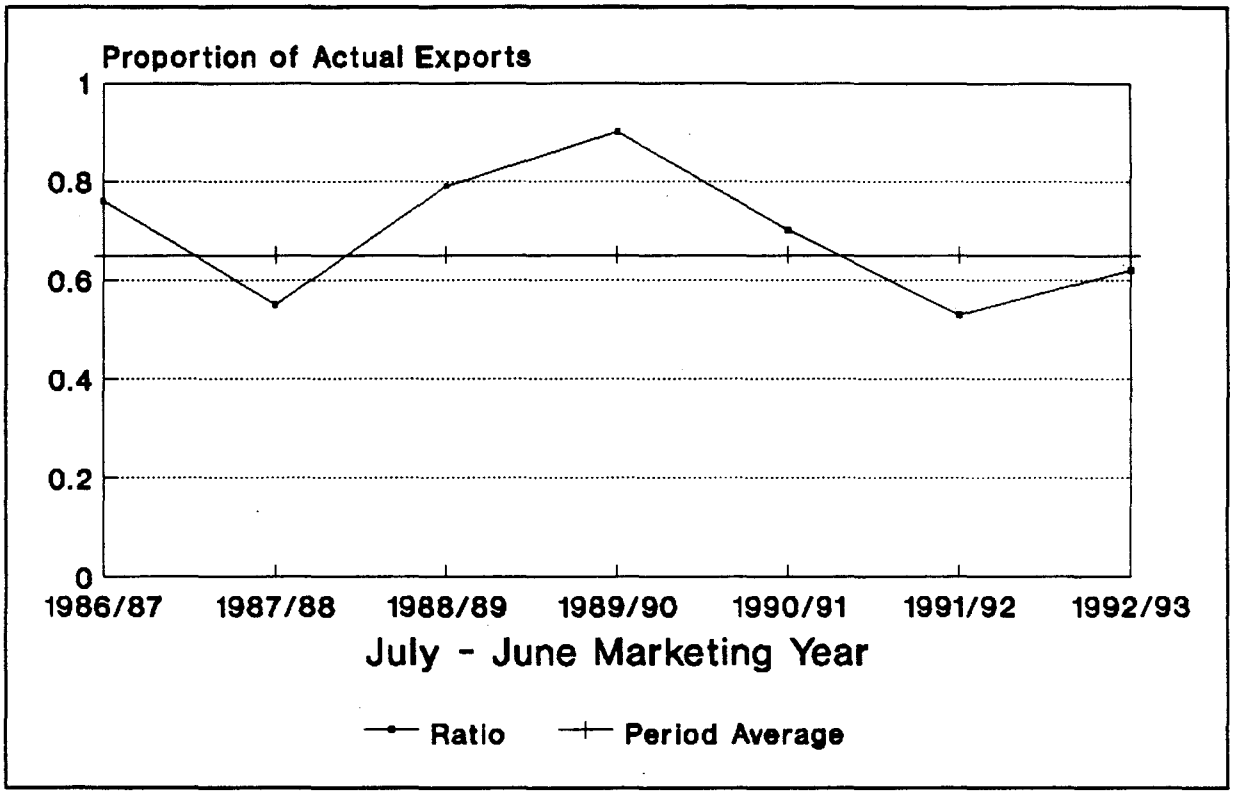
Figure 5 -- Modeling Assumptions



Effects of EEP on Wheat Import Levels

Table 6 shows model estimates of U.S. imports of Canadian wheat assuming the removal of the EEP, all else constant. Averaging across the 8 sets of modeling assumptions (substitutability, policy response, producer response), the results imply that total wheat imports from Canada for the entire time period would have been 35 percent less had there been no EEP. Results show that EEP probably had stronger relative effects in some years. Figure 6 shows yearly simulated import levels relative to the base. As might be expected,

Figure 6
Simulated Reduction in U.S. Wheat Imports Due to EEP Removal



the EEP's strongest effects occurred in 1987/88 and 1991/92, the years in which EEP expenditures were particularly high (fig. 3).

As expected, EEP as an explainer of increased imports varies proportionally with assumptions about the degree of substitutability between the wheats, the level of Canadian export subsidization, and inability of producers to respond to price changes in the short-term. The substitutability assumption seems to be most important. The differences in total import levels between cases where only the substitutability assumption is changed (1 and 5, 2 and 6, 3 and 7, 4 and 8) average 394 thousand metric tons, with little between-case variation.

Table 6 -- Estimates of U.S. Imports of Canadian Wheat

1,000 Metric Tons

Scenario:			Moderate Subst.				High Subst.		
		Partial Policy Resp.		Full Policy Resp.		Partial Policy Resp.		Full Policy Resp.	
Year	Base	Case 1: Full Prod. Resp. to Prices	Case 2: No Prod. Resp. to Prices	Case 3: Full Prod. Resp. to Prices	Case 4: No Prod. Resp. to Prices	Case 5: Full Prod. Resp. to Prices	Case 6: No Prod. Resp. to Prices	Case 7: Full Prod. Resp. to Prices	Case 8: No Prod. Resp. to Prices
1986/87	427	364	329	339	328	340	301	308	300
1987/88	345	230	194	196	193	192	175	152	174
1988/89	352	301	284	287	284	280	259	261	259
1989/90	331	309	301	309	301	300	288	288	288
1990/91	582	477	411	432	409	438	363	380	360
1991/92	936	624	531	529	526	515	416	401	410
1992/93	1369	1002	875	908	868	879	741	764	732
Total	4342	3307	2925	3000	2909	2944	2543	2554	2523

Outcomes with respect to the presumed Canadian policy response (partial or full) seem to depend on the assumption regarding producers' ability to respond to changed prices: average of 350 thousand metric tons assuming producers respond (cases 1 and 3, 5 and 7) but only 18 thousand metric tons otherwise (cases 2 and 4, 6 and 8). One interpretation would be that assumptions regarding the Canadian policy export response matter only over the medium or longer term.

Viewed from a different perspective, outcomes with respect to producers responses could be seen to depend on the policy assumption. In the partial policy response cases (1 and 2, 5 and 6), the differences average 392 thousand metric tons. In the full policy response cases (3 and 4, 7 and 8), they are only 61 thousand metric tons. A conclusion might be that assumptions regarding producers' capacity to quickly respond to price changes matters mostly in the situation where policymakers do not actively counteract the effects of the EEP in world markets.

Modeling Assumptions and ANOVA

Regression results reported in Table 7 represent an attempt to highlight the contribution of the assumptions to the results. The interpretations are of the variety associated with ANOVA.[1] The independent variables are defined as in the table: a set of indicator variables (values of 0 or 1) depending on whether a particular assumption is being made. For instance, the variable AX is equal to 1 in the case of moderate substitutability, and to 0 for the high substitutability case. Indicator variables representing interaction effects are defined as well - for instance, ABX=1 if AX=1 and BX=1, 0 otherwise. These variables are regressed on the import levels predicted by the model. There are 56 observations - 7 years times 8 cases. The import levels are centered about the mean for each case in order to negate differences attributable to the time dimension.

A number of equations have been estimated (although only two are shown here). The first objective was to test for interactions between assumptions to see whether they combine to influence modeling results in statistically significant ways. In no case could any significant interactions be discerned. From equations shown in the table, the joint hypothesis that none of the possible interactions are statistically significant cannot be rejected: F-statistic equals 0.24.

Equation 2 shows the direct effects of the assumptions. Of the direct-effect coefficients, the substitution coefficient is the

---

[1]See Neter and Wasserman (1974), parts 3 and 4. The regression approach described here is explained in detail in their section 16.3

Table 7 -- Effects of Assumptions on Modeling Outcomes: Results from ANOVA Analysis

Definitions:

Z - Predicted import levels*
AX - Substitution index: Moderate = 1; High = 0;
BX - Policy index: Partial = 1; Full = 0;
CX - Producer response index: Full = 1; None = 0;
**(*)X - Interaction indices, where * = A,B,or C

Equation 1
Dependent variable: Z

Valid cases:	56	Missing cases:	0
Total SS:	412580.5000	Degrees of freedom:	48
R-squared:	0.1490	Rbar-squared:	0.0249
Residual SS:	351091.1429	Std error of est:	85.5243
F(7,48):	1.2009	Probability of F:	0.3205
		Log-Likelihood:	-324.2771

Var	Coeff	Std. Error	t-Stat	P-Value
C	390.4286	32.3251	12.0782	0.0000
AX	47.4286	45.7146	1.0375	0.3047
BX	2.0000	45.7146	0.0437	0.9653
CX	0.5714	45.7146	0.0125	0.9901
ABX	-0.2857	64.6503	-0.0044	0.9965
ACX	11.7143	64.6503	0.1812	0.8570
BCX	49.8571	64.6503	0.7712	0.4444
ABCX	-12.0000	91.4293	-0.1312	0.8961

Equation 2
Dependent variable: Z

Valid cases:	56	Missing cases:	0
Total SS:	412580.5000	Degrees of freedom:	52
R-squared:	0.1318	Rbar-squared:	0.0817
Residual SS:	358201.7857	Std error of est:	82.9970
F(3,52):	2.6314	Probability of F:	0.0597
		Log-Likelihood:	-324.8386

Var	Coeff	Std. Error	t-Stat	P-Value
C	378.1071	22.1819	17.0458	0.0000
AX	50.1429	22.1819	2.2605	0.0280
BX	23.7857	22.1819	1.0723	0.2885
CX	28.3571	22.1819	1.2784	0.2068

* To obtain Z, predicted import levels from table 6 were centered about their respective column averages in order to minimize distortions due to variation across time.

largest and only one which is statistically significant. This result implies that the substitutability assumption is the most crucial for modeling purposes.

Analysis of Import Trend

Table 8 presents another way to examine the effect of the EEP on wheat imports. For the base and for the cases corresponding to each alternative set of assumptions, a simple time trend equation is estimated. The degree of variance explained by the simple trend estimate (the adjusted R-squared) is around 60 percent for most cases. In the table, the slope parameter shows the rate at which imports have been estimated to have been increasing over the time period. The actual growth is estimated at about 150 thousand metric tons per year.

The percentage reductions in the growth rate due to EEP removal are shown in the last table column. They range from 32 percent (moderate substitutability, partial policy response, full producer response) to 56 percent for opposite assumptions. From the analysis reported above, the substitution assumption is the most important. The average growth rate for the 4 cases corresponding to moderate substitutability is 91 thousand metric tons, a 40 percent reduction from the actual rate. The average growth rate for the higher substitutability cases is 73 thousand metric tons, a 48 percent reduction.

U.S. Imports of Canadian Wheat in 1991/92

As shown in figure 6, wheat imports in 1991/92 attributable to EEP effects were higher than the average. As there noted, EEP wheat volume and expenditure were high that year, suggesting a relationship with the U.S. wheat import level. However, it is hypothesized that a switch in the type of wheat demanded by importers that may accompany an increase in import demand may introduce an additional channel through which U.S. wheat imports could be affected by the EEP. This effect arises because the United States can supply several types of wheat to importers.

Further analysis of EEP targeting and levels of wheat demanded in Chinese and Brazilian markets from the United States and Canada illustrates the effect. Figure 7 shows the sum of Brazilian and Chinese wheat imports from Canada and the United States. In addition to the rise in overall wheat demand, the figure shows a reorientation from soft wheat to hard wheat in 1991/92. This switch is important because U.S. hard and Canadian wheats are close substitutes in both markets, meaning that EEP subsidies would have had a larger displacement effect with respect to the level of Canadian imports in those markets.

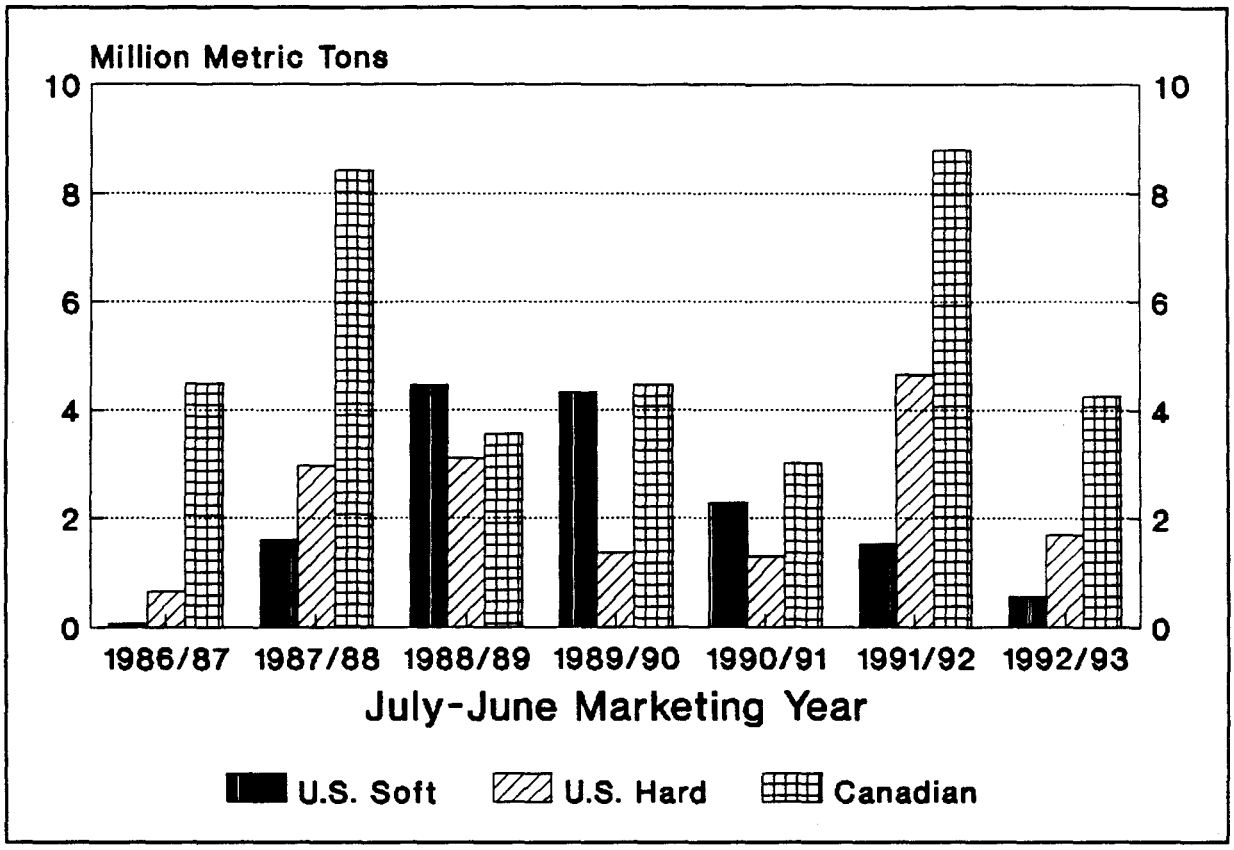
Three modeling experiments were performed. In the first, EEP

Table 8 -- Regression Results

Scenario	Parameter Estimates: Constant*	Slope	Adjusted R2	Percent Reduction in Slope Coefficient from Base
Base	14.86 (240.44)	151.36 (34.55)	62.7	-
Moderate Substitutability				
Partial Canadian Policy Response:				
Full Producer Response	61.29 (163.86)	102.79 (30.97)	62.5	32%
No Producer Response	69.43 (140.68)	87.11 (26.59)	61.9	42%
Full Canadian Policy Response:				
Full Producer Response	68.86 (148.30)	89.93 (28.03)	60.8	41%
No Producer Response	71.14 (139.26)	86.11 (26.32)	61.8	43%
High Substitutability				
Partial Canadian Policy Response:				
Full Producer Response	74.71 (143.58)	86.46 (27.13)	60.4	43%
No Producer Response	91.00 (119.65)	68.07 (22.61)	57.3	55%
Full Canadian Policy Response:				
Full Producer Response	81.29 (130.66)	70.89 (24.69)	54.7	53%
No Producer Response	93.43 (118.07)	66.75 (22.31)	57.0	56%

* Standard error of coefficient estimate in parenthesis below coefficient.

Figure 7
U.S. - Canadian Competition in the Chinese and Brazilian Wheat Markets



subsidies to the Chinese and Brazilians are reduced to zero, but EEP subsidies to all other subsidy recipients are increased to leave the total EEP expenditure constant. The result is referred to as the "pure target effect." In the second, EEP subsidies to China and Brazil are reduced to zero and EEP expenditure is reduced by that amount. This result is called the "mixed target effect." In the third, all EEP subsidies are removed. This result is called the "total effect." Results are shown in table 9. In addition to 1991/92, results for 1992/93 are shown in order to provide a contrast.

The "pure target" case for 1991/92 predicts a reduction of U.S. imports of Canadian wheat of 139 thousand metric tons, or 45 percent of the "total effect" of 312 thousand metric tons. The "mixed target" case is 177 thousand metric tons, or 57 percent of the "total." As a contrast, 1992/93 Chinese and Brazilian demand is much lower although the ratio of demand between hard and soft wheat is similar. Corresponding percentages are: 27 percent for the "pure" effect and 34 percent for the "mixed."

Table 9 -- Targeted EEP Subsidies and U.S. Wheat Imports

Terms: Pure Target Effect -- Eliminate EEP subsidies to China and Brazil, but do not reduce overall EEP expenditure level.

Mixed Target Effect -- Eliminate EEP subsidies to China and Brazil, and reduce EEP expenditure level by an amount equal to the targeted subsidies.

Total Effect -- Elimination of EEP subsidies to all importers of U.S. wheat.

Results Below Report in Units of 1000 Metric Tons

	Reduction in U.S. Exports to China and Brazil	Expansion of Canadian Exports to China and Brazil	Reduction in U.S. Wheat Imports from Canada
1991/92			
Pure Target Effect	3238	2928	139
Mixed Target Effect	3134	2785	177
Total Effect	2677	2184	312
1992/93			
Pure Target Effect	1286	1131	99
Mixed Target Effect	1271	1103	126
Total Effect	1101	832	367

These experiments imply that competition of similar wheats in shared markets can cause a displacement effect independent of the level of aggregate EEP spending.

Effect of a Quota

In July 1994 the ITC decided that high levels of imported Canadian wheat had materially interfered with the operations of the U.S. wheat income and price support program. Canada subsequently agreed to restrict wheat shipments to the United States.[2] Most of the ITC concern centered on a hypothesized wheat price decrease due to the presence of excessive supplies of imported wheat. Lower-than-

[2]Up to 300 thousand metric tons of durum wheat and up to 1,050 thousand metric tons of other wheat can enter the United States at the tariff rate set under the terms of the North American Free Trade Agreement (NAFTA). For durum imports between 300 and 450 thousand metric tons, the tariff rate is $23 per ton. For additional imports of durum (above 450 thousand) and other wheat (above 1,050 thousand), the tariff rate is $50 per ton. For additional details, see USDA Press release no. 0727.94.

justified wheat prices caused a widening of the deficiency payment rate and therefore cost U.S. taxpayers millions of dollars in additional payments to U.S. wheat producers.[3]

Theoretical Expectations

If the United States were to restrict imports of Canadian wheat, a proportion of that wheat would surely find its way to other markets served by Canada. Because the United States and Canada compete in an interconnected world market for wheat, it is likely that the Canadian wheat would displace U.S. wheat in third markets. This effect, by itself, would depress U.S. wheat prices. The dual of this international displacement is the expanded sales opportunities for U.S. producers in the U.S. domestic market. These sales would lead to price increases for U.S. wheats. The overall effect on U.S. wheat prices would therefore depend on the relative sizes of these two effects.

Figure 8 -
Effect of Quota on U.S. Wheat

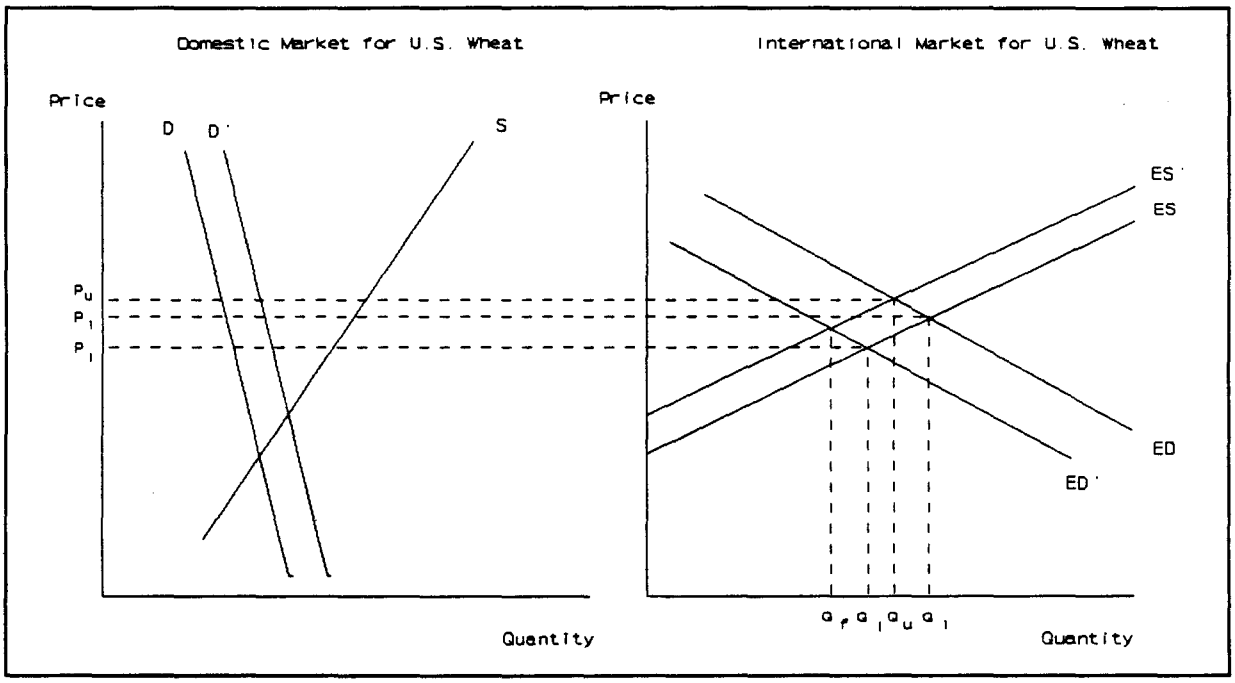


Figure 8 illustrates the effects. The left panel shows the domestic supply and demand schedules (S and D, respectively) for U.S. wheat as a functions of the U.S. price. The right panel shows the international market for U.S. wheat. Larger quantities of wheat

[3]The EEP was not taken into account in the ITC's decision on material interference because the EEP is not part of the U.S. wheat program.

supplied than what is demanded domestically are shown as the U.S. excess supply (ES) schedule. Initial equilibrium exports (Q_i) and price (P_i) are shown where excess demand for U.S. wheat, represented as the ED schedule, meets excess supply.

The direct effect of the quota on wheat imports from Canada is shown as an increase in demand for U.S. wheat (movement of D to D' in the left panel) and, correspondingly, reduced excess supply available for the international market (ES to ES'). Export levels decrease from Q_i to Q_u, and the export price increases to P_u in order to ration export demand. Canadian wheat displaced from the U.S. market would presumably find its way to alternative markets. If U.S. and Canadian wheats were not substitutable internationally, these direct effects would be the final ones.

If U.S. and Canadian wheats were substitutable internationally, Canadian wheat displaced from the United States would in turn displace U.S. wheat from international markets. In the right panel, the excess demand for U.S. wheat would shift leftward to ED'. The magnitude of the shift would depend on the magnitude of the substitutability. A high degree of substitutability is shown in the panel: ED shifts sufficiently leftward to more than offset the initial upward price movement: the price decreases below the initial equilibrium price as exports decrease to Q_f. The lower price limit would be at P_l where no domestic substitutability (and hence no leftward movement of ES) is assumed.

Estimate of Quota Effect

The models already used in this paper for analysis can be used for an examination of this issue. The analysis is assumed to cover the medium-term: producers are assumed to adjust to predicted price changes. For this particular experiment, the model for the 1992/93 year is used because it is the latest year capable of being analyzed. The specific scenario is one in which imports are restricted to 1989/90 levels. As can be seen in table 6, actual imports for 1992/93 were 1,369 thousand metric tons, and were 331 thousand metric tons in 1989/90. The implied reduction, therefore, is 1,038 thousand metric tons.

Three Canadian policy responses are modeled. The first is the partial adjustment to world prices, as used above. The second and third have the Canadians using explicit uniform export subsidies. In the second, the goal is to maintain 1992/93 export market share relative to the other major wheat exporters. In the third, the goal is to maintain export volume at constant levels. Results on export volumes and prices are shown in table 10.

Predicted decreases in U.S. export volumes are fairly small:

Table 10 -- Price and Trade Effects of U.S. Quota on Canadian Wheat

Cases -- Canadian Policy Response to U.S. Quota:

(i) none
(ii) increase subsidy to maintain world market share
(iii) increase subsidy to maintain export volume

Change in:	Case (i)	Case (ii)	Case (iii)
		1000 MT	
Canadian Export Vol.	-353 (-1.85%)	-74 (-0.39%)	0
U.S. Export Vol.	-117 (-0.32%)	-163 (-0.44%)	-175 (-0.47%)
		Dollars/MT	
Canadian Export Price	-3.82 (-2.11%)	-5.30 (-2.93%)	-5.69 (-3.15%)
U.S. Export Price	-0.69 (-0.53%)	-0.95 (-0.74%)	-1.05 (-0.85%)

between 0.3 and 0.5 percent. Corresponding U.S. export price decreases range between $0.69 and $1.04 per metric ton. With the U.S. price transmission elasticity set to one, domestic producer and consumer prices are assumed to change by these same amounts.

Because the U.S. wheat price decreases, the implication is that restriction of Canadian imports would serve to increase wheat program costs rather than decrease them. This result is directly contrary to the basis upon which the recent ITC ruling was made, that is, that increased Canadian imports have increased the cost of U.S. wheat program by lowering the prices of U.S. wheat upon which deficiency payments are calculated.

Alternative Approach

It is possible to generate results that could support the ITC decision. The mechanism is based on the assumption that Canadian imports forced the diversion of U.S. wheat away from its highest-valued domestic use into less-desirable export markets. In order to obtain a U.S. price increase resulting from the import restriction, it must be assumed that Canadian wheat withdrawn from the United

States does not to enter into alternate marketing channels; that is, it is effectively destroyed or perhaps used for feed. In terms of figure 8, ES shifts leftward to ES', but there is no change in ED.

As an experiment, U.S. production and consumption levels were exogenously set at the solution levels of case 1 above. The model was solved for export prices that would clear all markets. In these instances, the U.S. wheat prices would have to increase in order to reduce the level of excess demand for U.S. wheat in import markets to match the fixed level of excess supply. The necessary price increase was calculated to be $0.40 per metric ton. Therefore, if one were willing to accept the premise of this analysis (that is, no non-U.S. demand for the withdrawn wheat), then U.S. wheat program costs could have increased due to the imports.

Conclusions

Increasing yearly U.S. imports of Canadian wheat have been a major concern of U.S. wheat interests. Given the recent ITC ruling and trade negotiations with Canada, wheat imports will now be lower, for at least one year. This paper has presented analysis concerning the effect of EEP on the level of imports and the effect that a quota might have on U.S. wheat exports and prices. It uses a set of world wheat models that explicitly incorporate product differentiation among wheat classes and source countries.

Three sets of conclusions emerge from this analysis:

- Over the period 1986-1993, EEP has been accountable for 40 to 48 percent of the yearly growth in U.S. imports of Canadian wheat. The greater is the presumed substitutability between U.S. and Canadian wheat, the higher is the attribution of the growth to the EEP.

- The effect of the EEP was strong in the 1991/92 July-June crop year. In particular, EEP subsidies to China and Brazil caused significant diversion of Canadian wheat that would have been destined for those markets instead to the U.S. market.

- Restriction of U.S. imports of Canadian wheat to 1989/90 levels for the 1992/93 July-June crop year would not have had price-enhancing effects for U.S. wheat. On the contrary, diversion of the Canadian wheat to third countries would have had induced sales away from the United States, thereby causing U.S. wheat exports to decline and reducing the export price of U.S. wheat. If it is assumed that the Canadians increase their subsidies to maintain the same export volume, wheat prices in the United States are calculated to fall by at least $1 per metric ton (or 2.7 cents per bushel). An implication is that wheat imports from Canada have not had a deleterious effect on

the operation of U.S. wheat income and price support program.

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