WORLD DURUM TRADE MODEL

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EXECUTIVE SUMMARY

Today's globalized marketing economy requires insight into the effects of domestic and international policy changes on the competitiveness of agricultural producers. It is important to understand that although the effects of individual policies cannot be identified, estimating compounded effects of these policies may provide valuable information for future domestic and foreign policy decisions.

The objective of this study was to assess the competitiveness of U.S. durum producers in supplying[1] durum by estimating production levels and trade flows under alternative trade scenarios. A mathematical programming model was used to compare production levels and distribution patterns for the durum market under protectionist and liberalized market environments. Production levels and export market share over recent years indicate there has been a shift in the competitiveness of major durum exporters.

The EEC has significantly increased its competitiveness over recent years, capturing export market share from both the U.S. and Canada. Although Canada has been able to maintain a relatively stable presence in the world durum export market, it has been unsuccessful in competing with the U.S. Export Enhancement and EEC Export Refund programs. To compensate for the losses in the world durum market, Canadian marketing efforts have been concentrated on selling durum to buyers in the U.S. milling industry. U.S. producers have lost market share to Canada in the domestic markets and in export market sales to the EEC over recent years, indicating that U.S. producers are losing competitiveness relative to other major durum exporters.

The net result of removing current trade barriers includes increased production by the United States and Canada and decreased production by the EEC. Canada gains a competitive advantage

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[1]Under the U.S.-Canadian Free Trade Agreement there is a direct farm to elevator shipments, but this study concentrates on shipments to domestic milling and export positions.

relative to the U.S. and the EEC in the durum export market. The United States gains a competitive advantage relative to Canada in supplying durum for U.S. mills. U.S. producers in northwestern and east central North Dakota and Montana, and Canadian producers in central Saskatchewan maintain production levels across all trade scenarios, implying producers in these regions have a competitive advantage in supplying durum. This competitive advantage is based on relatively low production and transportation costs.

The results of this study indicate that increased EEC exports have had a negative affect on the ability of U.S. and Canadian producers to compete in the world durum market. The U.S. is able to continue to compete with the EEC in the export market, via its EEP program, but has lost a competitive advantage in its domestic market. Canada has not provided the same level of support for exports, but has maintained a relatively stable market share by increasing sales to its nearest importer, the United States.

Canadian exports to U.S. mills varied across models to account for 0 to 40 percent of U.S. mill demand. The Canadian imports by U.S. mills increased when the WGTA payment was shifted from railroads to producers. The imports were eliminated when the effects of government programs, including EEP, ERP and WGTA were removed.

The future of the world durum market will depend on the continued use of the domestic and export support programs. Based on model results, a decision by the EEC to discontinue its dedication to the durum export market would significantly increase the competitiveness of Canada in the export market. Decreased export sales by the EEC under ERP and increased exports sales by Canada would increase the competitiveness of the United States in the world export market. Increased export sales by Canada would allow U.S. producers to increase competitiveness, relative to Canadian producers, in its domestic markets. Thus U.S. producers would supply additional bushels to U.S. mills.

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INTRODUCTION

U.S. agricultural producers are competing in a globalized market economy. Government policy changes of individual countries affect production levels and trade flows of commodities internationally. One commodity that has attracted special attention in the north central plains region is durum wheat. Although durum accounts for only about 5 percent of U.S. wheat exports, about one-third of the wheat produced in North Dakota is durum (USDA). Areas of Montana, Minnesota, and South Dakota are also committed to the production of durum. These four states combine to supply over 85 percent of U.S. durum. Implications of policy changes that influence production and distribution patterns of durum are important to producers in this region.

World trade of durum averaged about 4.9 million tons between 1987/88 and 1991/92 (USDA). The United States, Canada, and the European Economic Community (EEC) accounted

Table 1. World Durum Exports and Market Shares

	U.S.		Canada		EEC		Total
			- 1,000 metric tons -				
1983-84	1,470	37%	2,546	63%	80	2%	4,019
1984-85	1,410	41%	1,826	53%	110	3%	3,462
1985-86	1,445	43%	1,385	41%	500	15%	3,384
1986-87	2,236	53%	1,957	46%	90	2%	4,216
1987-88	1,691	31%	2,754	51%	950	17%	5,430
5-Yr Average	**1,650**	**41%**	**2,094**	**51%**	**346**	**8%**	**4,120**
1988-89	550	12%	2,003	44%	2,040	45%	4,571
1989-90	1,500	30%	2,838	57%	950	19%	4,996
1990-91	1,445	30%	3,224	67%	990	21%	4,780
1991-92	1,309	27%	2,727	57%	1,495	31%	4,765
1992-93	1,300	26%	2,400	48%	1,280	26%	4,981
5-Yr Average	**1,221**	**25%**	**2,638**	**55%**	**1,351**	**28%**	**4,819**
Change	**(429)**	**-16%**	**544**	**4%**	**1,005**	**20%**	**699**

Source: US, FAS; Canada, Canadian Grains Council; EEC, FAS & IWC for over 95 percent of the export supply. Historically, Canada has maintained a leadership position in the durum export market, supplying about half of the world exports. The United States has historically been the secondary supplier, and the EEC has been a residual supplier (Table 1).

There have been significant changes in comparing the market share and export levels of the durum market over the past decade. The level of trade increased over the past five years, compared to levels between 1983/84 and 1987/88, by about 700,000 metric tons, a 17 percent increase in volume. Within this larger market, the EEC has managed to increase exports by about 1 million metric tons annually, a 290 percent increase in export volumes. These increased exports translate to a 20 percent increase in market share. Canada has also increased volumes, but only captured an additional 4 percent of the export market. The United States, in contrast, has lost market share. U.S. durum exports declined by 430,000 metric tons, or 16 percent, between 1988/89 and 1992/93, compared to the average level over the previous five years.

Canada has maintained a high level of durum exports, excluding the drought years of 1985/86 and 1988/89 (Figure 1). Between 1982/83 and 1985/86 the U.S. level of exports remained relatively stable, then peaked in 1986/87. Durum exports have trended downward since the 1986/87 peak. The EEC, in contrast, established a trend of increasing durum export levels between 1986/87 and 1991/92. In making the domestic and international policy decisions that influence the competitiveness of producers in the world market, the EEC may have targeted the durum market. Durum is also a specialty commodity that does not have a mass producer or consumer base, such as corn. Therefore, intervention by other governments to protect export market share of durum may be limited. The EEC has used government policies in the form of producer subsidies and the Export Refund Program (ERP) to increase competitiveness of its durum producers in the world market.

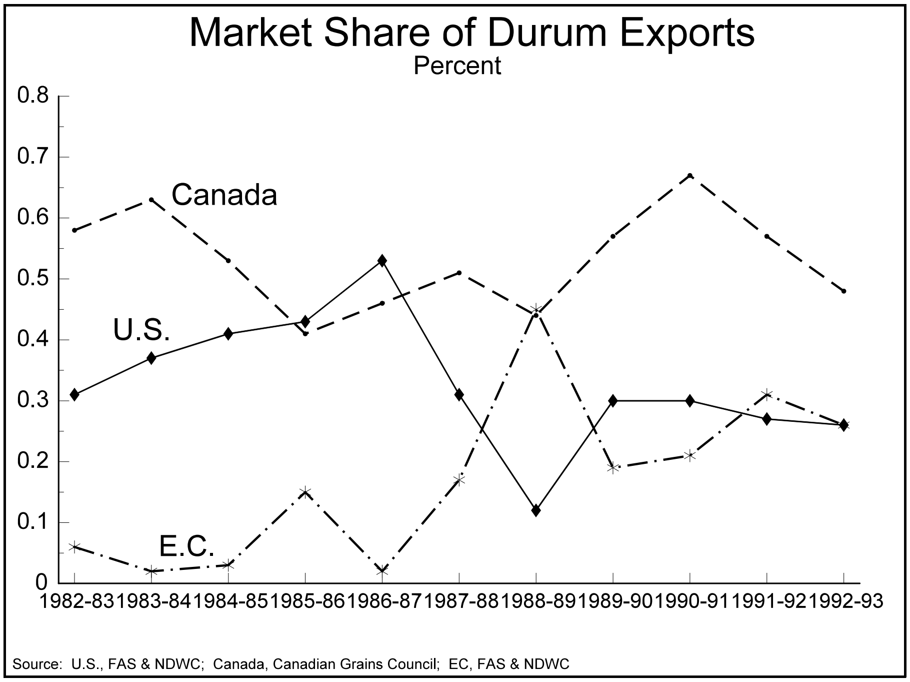

Figure 1. Market Share of Durum Exports

Canadian durum producers rely heavily on the export market, because a majority of the durum grown in Canada is sold to buyers outside its borders. Canada typically exports about 75 percent of its durum production. The United States houses a stronger domestic market, exporting only about 59 percent of its annual durum production. The EEC has the largest domestic durum market of the three major exporters, but the importance of the export market to the EEC has increased substantially over the past five years. Between 1985 and 1987 export markets were the destination for only about 5 percent of the EEC durum production. Since 1988 about 16 percent of the EEC durum produced annually has been sold in the export market. The implications of the EEC targeting a greater share of production for the export market may be important for U.S. producers because strong EEC production and export subsidy programs - that increase the competitiveness of its producers - apparently will remain in place.

Shifts in the importance of the export market as a destination for production of a commodity may signal that the competitiveness of a country has improved or deteriorated (Table 2). Canada's exports as a percent of production have ranged from 125 percent during the 1988 drought to a low of 43 percent during 1986, averaging 73 percent between 1985 and 1992. Between 1989 and 1992 durum exports, as a percent of production, for the United States have consistently lower than average export to production ratio over the eight-year period. The EEC surpassed its average export to production percentage between 1988 and 1992 for four out of five years. Defining the percentage of production used to satisfy export sales may signal changes among competitors, such as increased (decreased) domestic demand or adjustments in government policy. It is important to recognize these changes so production, marketing, and policy decisions account for new market influences.

Table 2. Durum Exports as a Percent of Production

	US	Canada	EEC
1985	47%	82%	5%
1986	69%	43%	4%
1987	78%	59%	7%
1988	92%	125%	21%
1989	41%	59%	22%
1990	44%	72%	13%
1991	49%	65%	11%
1992	50%	82%	15%
Average	59%	73%	12%

Source: *1992 World Grain Statistics*, IWC

The United States as a Canadian Export Market

The United States and Canada are both net exporters of agricultural products. Between 1982 and 1985 the United States exported an average 116 thousand tons of grains and oilseeds. Of these exports, less than 1 percent was delivered to Canadian receiving points. During the same period, the United States imported an average 321 thousand metric tons of grain and oilseeds, with 58 percent of these imports originating in Canada[2].

Between 1987 and 1990 the quantity of U.S. grain imports nearly tripled. The Canadian agricultural industry captured a larger share of the growing U.S. import market, and supply about 75 percent of U.S. grain and oilseed imports in 1990. By increasing its U.S. grain and oilseed market share by 17 percent, Canada expanded yearly sales to the U.S. by an average of 920,700 metric tons (74 percent) between 1987 and 1990[3].

Of interest to producers in the northern plains regions are the dramatic changes in the North American durum market over recent years. Canadian durum exports to the United States, that were virtually non-existent before the mid 1980s, have increased to over a million metric tons. Although Canada has maintained its market share in the world durum export market, it has done so by utilizing the United States as a major export destination.

Over recent years the importance of the U.S. as a market for Canadian exports has increased dramatically. Since 1986 durum imports have ranged from 304 thousand tons in 1989-90 to over a million tons in 1992-93. The significance of these tons as a portion of total Canadian durum exports has varied, reaching its peak in 1992/93 to account for 59 percent of total Canadian durum exports (Table 3).

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[2]United States Department of Agriculture, Personal Contact, 1992.

[3]USDA, 1992.

Table 3. Canadian Durum Exports to the US

	Canada Exports	Exports to US	% of Canadian Exports to US
	- 1,000 tons -		
1983-84	2,546	63	2%
1984-85	1,826	235	13%
1985-86	1,385	318	23%
1986-87	1,957	477	24%
1987-88	2,754	299	11%
1988-89	2,003	366	18%
1989-90	2,838	304	11%
1990-91	3,224	610	19%
1991-92	2,727	839	31%
1992-93	2,400	1,425	59%

Source: Canada, Canadian Grains Council

Effects of the ERP, EEP, and liberalized trade on the U.S./Canadian durum market are evident. The absolute level of Canadian durum exports has not changed significantly, but the end destination for exports has shifted dramatically to center on the U.S. Although effects of individual trade policies cannot be distinguished, the compounded effect appears to be the displacement of Canadian durum in the world market by both EEC and U.S. export promotion programs, and the displacement of U.S. domestic shipments by Canadian imports.

Base for Study

A global market for agricultural products encourages countries to become more efficient in producing and distributing commodities. Expanded trade zones increase the level of competition among exporters seeking to expand market share. Exporters gain market share by increasing competitiveness.

At an international level the three major sources of competitiveness are defined as comparative costs, exchange rates, and foreign and domestic policies (USDA-ERS, 1993). Comparative costs such as production and transportation costs, define the basis of being competitive. The relative costs depend on the human, capital and natural resource endowments, and technology available to individual nations. The comparative (relative) advantage a country has for producing and supplying a commodity defines the optimal production levels and trade flow patterns in the world because they are undistorted by government policy, exchange rates, or other external factors. In a liberalized trade environment the nation with relatively lower production and marketing costs, considering the opportunity costs and actual costs, should have a competitive advantage in supplying the commodity.

It is important to distinguish specialty crops within the agricultural market. Specialty crops have limited areas of production and little competition for end uses, so changes in government policies, exchange rates, and crop quality of individual countries can cause fluctuations in world prices and distribution. Durum is a specialty breed of hard wheat. It is characterized by its hard kernels, high protein and strong gluten. The primary use for durum is in milling of semolina, a main input for pasta manufacturers. High quality semolina is required to produce a superior pasta product that is uniform in color and does not break up during cooking.

The purpose of this study is to develop a model to identify possible competitive advantages and disadvantages that U.S. producers have for supplying durum, and estimate the effects that artificial barriers have on the competitiveness of major durum exporting countries, and thus the effects on production decisions and trade flows.

Past studies have assessed competitiveness under alternative trade policies. However, these studies have not addressed the concerns of durum producers (Haley 1986; Koo and Anderson 1989; Chowdhury, Ashok, and Heady 1979; Abbott, Paarlbery and Patterson 1988; Weiman and Hallam

1988; Koo and Cramer 1980; Gibson, Faimnow and Jeffery 1991). In a study by Golz, et al. (1991), the impacts of liberalized trade agreements and government policy changes were estimated for durum and semolina. The analysis in this report differs from the 1991 durum study because more specific production cost information was collected from U.S. and Canadian producing regions, more specific rail rate functions were utilized, and more attention is given to the U.S.-Canadian durum trade relationship. Because production and transportation costs provide a base for being competitive in the world market, improvement on these data may significantly impact model results. In addition, the focus of this study is to assess the competitiveness of U.S. producers relative to Canadian producers in alternative trade scenarios. The EEC producers are assumed to be insulated from world prices, implying the level of EEC production and export levels are determined mainly by internal government policy.

The objective of this study is to assess the competitiveness of the U.S. producers in producing, serving the domestic market, and exporting durum under alternative government policy environments. Specific objectives include:

(1) Estimating production levels and distribution patterns under alternative international policy scenarios,

(2) Assessing the competitiveness of major durum exporters in serving domestic and import markets under alternative government policy scenarios, and

(3) Examining the effects of government policy changes on the U.S./Canadian durum market.

Empirical Model

A static spatial equilibrium model is used to illustrate the production and distribution of durum in a world market. A mathematic programming model provides the framework for estimating the effects of political changes. The model's objective function is to minimize the sum of production costs across producing regions, transportation costs from producing regions to semolina mills, and transportation costs from producing regions to importing regions. Regional production, shipments to mills, the level of U.S. durum imports, shipments to ports, and shipments from export ports to import ports are endogenous variables.

Supply is defined by production in three exporting countries, the United States, Canada, and the EEC. In the United States, the major area of production is located in the north central states of North Dakota, South Dakota, Montana, and Minnesota. The remaining durum is produced in Arizona and the Imperial Valley in California. Durum production in the latter two states fluctuates widely year to year, because durum is viewed an alternative for second cropping irrigated cotton acres. The amount of durum produced varies depending on the relative prices of durum and other crops considered for the rotation.

The primary province for durum production in Canada is Saskatchewan. It accounts for about 90 percent of total Canadian durum production. The southeast region of Alberta and southwest region of Manitoba share in the production of additional bushels, contributing about 7 and 2 percent, respectively, of total Canadian durum production.

The EEC is defined as a single producing region because accurate data on the costs of production and transportation for individual countries are not available. Simplifying this model by defining these countries as one region, implies that there is cooperation among these countries under the Common Agricultural Policy, but does not limit the opportunities for analyzing the international impacts of policy changes.

Two demand markets included in the model are the domestic milling industry and the world import market. Domestic demand is equal to the durum required to maintain a semolina grind for

Table 4. Domestic Demand for Durum, Mill Location and 1993 Capacity in Cwts/Day

	Location	Capacity
1.	Pendleton, Or.	3,000
2.	Fresno, Ca.	6,000
3.	Great Falls, Mt.	4,000
4.	Ogden, Ut.	7,500
5.	Tolleson, Az.	6,000
6.	Cando, ND	8,000
7.	Carrington, ND	10,000
8.	Grand Forks, ND	13,000
9.	Omaha, Ne.	7,500
10.	Rush City, Mn.	9,000
11.	Minneapolis, Mn.	13,200
12.	Hastings, Mn.	25,000
13.	Superior, Wi.	13,700
14.	Excelsior Spring, Mo.	3,000
15.	St. Louis, Mo.	20,400
16.	Port Allen, La.	1,600
17.	Huron, Oh.	14,000
18.	Winchester, Va.	6,000
19.	Westport, NY	18,900
20.	Lethbridge, Alb.	3,900
21.	Saskatoon, Sask.	3,000
22.	Port Colborne, Ont.	6,700
23.	Montreal, Quebec	4,700

4.68 days per week[4] during the year for each durum mill in the U.S. and Canada. The EEC domestic demand is assumed to be satisfied by domestic production.

[4]U.S. durum mills average 4.68 days of milling per week during 1991 (World Grain, *Dynamic Growth in U.S. Durum Milling*. March 1993, p. 10.)

Import demand is defined as the average level of imports between 1990 and 1992 for eleven importing countries/regions. These eleven countries/regions accounted for over 85 percent of the world import demand over the three-year period.

Table 5. Imports of Durum, Average 1990-93

	Metric Tons
E. Europe	376,667
Poland	105,000
USSR	1,133,333
Cuba	43,333
Chile	55,000
Venezuela	213,333
India	250,000
Japan	140,000
Algeria	1,800,000
Libya	250,000
Tunisia	100,000

Assumptions used to develop the model:

1. Demand for durum by importing countries is inelastic.
2. Productivity of land within a producing region is uniform.
3. Durum is shipped from producing regions to mills by rail, utilizing an average 13-car train size in the United States.
4. Canadian transportation rates are equal to the U.S. single car rate. Because the Canadian rail and country elevator industries have not experienced the competition that encourages efficiencies in the network, this higher cost per ton mile is applied to shipments from Canadian producing regions to domestic mills and to export ports.

5. Durum is shipped from producing region to ports by rail, with the exception of the U.S. Gulf region that receives shipments by barge or rail. A 32-car train is utilized for the rail shipments to ports in the United States.
6. No storage or carryover is permitted at production regions or ports.
7. The U.S. is allowed to satisfy domestic mill demand through domestic production or by importing durum from Canadian producing regions.
8. EEC durum exports are insulated from changes in the world price.

The objective function of the model is defined as:

$$MIN\ Z = \sum_{p=1}^{P} + \sum_{p=1}^{P} \sum_{l=1}^{L} T_{pl} Q_{pl} + \sum_{p=1}^{P} \sum_{x=1}^{X} T_{px} Q_{px} + \sum_{x=1}^{X} \sum_{m=1}^{M} T_{xm} Q_{xm} \qquad \textbf{(1)}$$

where:

P	=	producing region
L	=	durum mill
X	=	export port
M	=	import port
T_{pl}	=	transportation rate per metric ton for shipping one ton of durum from producing region P to durum mill L
T_{px}	=	transportation rate per metric ton for shipping one ton of durum from producing region P to export port X
T_{xm}	=	transportation rate per metric ton for shipping one ton of durum from export port X to importing country M
Q_{pl}	=	metric tons of durum shipped from producing region P to durum mill L
Q_{px}	=	metric tons of durum shipped from producing region P to export port X
Q_{xm}	=	metric tons of durum shipped from export port X to importing country M.

The objective function is to minimize the cost for a summation of durum production and transportation activities that satisfy the domestic and import demand requirements within the constraints of the model. The first summation is the production cost function. The other summations represent costs of transporting the commodities (1) shipments from production regions to mills, (2) shipments from production regions to export ports, and (3) shipments from export ports to import ports.

Four linear constraints were placed on the model:

$$\sum_{x=1}^{X} Q_{px} = \sum_{m=1}^{M} Q_{xm} \tag{2}$$

$$A_i * Y_i \geq \sum_{p=1}^{P} \sum_{l=1}^{L} Q_{pl} + \sum_{p=1}^{P} \sum_{x=1}^{X} Q_{px} \tag{3}$$

$$D_m \leq \sum_{p=1}^{P} Q_{pm} \tag{4}$$

$$R_p \geq A_p \tag{5}$$

where:

R_p	=	arable acres available for durum production
A_p	=	acres utilized for durum production
Y_p	=	yield in metric tons per acre of durum produced.

Equation (2) is a second port clearing constraint that eliminates storage by equating export supply to import demand. Equation (3) eliminates storage at producing regions and prohibits excess demand by requiring regional production to be equal to or greater that the quantities shipped to domestic and export destinations. Equation (4) is a port clearing constraint that eliminates carryover at port destinations by requiring producing region shipments to export ports equal shipments required to satisfy import demand. Equation (5) is the land constraint. The number of arable acres available for production is greater than or equal to the number of acres utilized for durum production.

The rail rate function (Bitzan and Tolliver, 1992) was defined as:

$$\ln RATECTM = -2.7281 - 0.5223 \ln SHRT - 0.0838 \ln CARS + 0.1271 \ln HERF + 0.0467 \ln BDIST + 0.236\, EXPT$$

where:

RATECTM	=	revenue/cwt-mile
SHRT	=.	short-line distance
CARS	=	number of cars in shipment (13 cars for domestic shipments and 32 cars for export shipments)
HERF	=	Herfindahl-Hirschman Index, defined by the number of railroads in the CRD, to account for intramodal competition
BDIST	=	distance to barge facility to account for intermodal competition
EXPT	=	dummy for export shipment.

The ocean freight rate was equal to:

*Rate per Nautical Ton Mile = 0.0001 * Distance from Export Port to Import Port.*

Alternative Scenarios

1. Model 1 is the Base Model; it reflects production and trade flows under current trade policies and transportation rates.
2. Model 2 is an estimate of the effects of a U.S. quota on durum imports.
3. Model 3 is an estimate of the effect of an increase in the EEC use of the ERP.
4. Model 4 is an estimate of the impact of eliminating increasing EEC use of the ERP, with the U.S. quota on durum imports in place.

5. Model 5 is an estimate of the effects of a change in the method of payment for the Canadian WGTA subsidy, shifting payment from railroads to producers.
6. Model 6 is an estimate of production levels and trade flows in a liberalized trade environment: EEP, WGTA and EEC subsidies are eliminated.

Data

To provide more specific production and trade flow estimates, each nation's durum production was defined among several individual producing regions. The U.S. durum producing area was divided into 20 producing regions. Five producing regions were defined across the Canadian prairie provinces. The EEC was defined as a source of export grain, but domestic demand and producing regions were not possible because data was not available.

Production costs are equal to the average variable cost required to produce one acre of durum. Variable costs are defined as the total economic cost minus land rent. Inclusion of land values may distort model results by introducing the effects government policies and economic conditions instead of representing the relative productivity of the land.

The U.S. producing regions are defined by state crop reporting district (CRD) boundaries (Figure 2). Within these CRDs the climate and soil are assumed to be homogeneous, so yield and production cost data is equal for each acre within a CRD. Production cost data were collected from University Extension offices and the yield and number of harvested acres were collected from Agricultural Statistics Agencies, in each state.

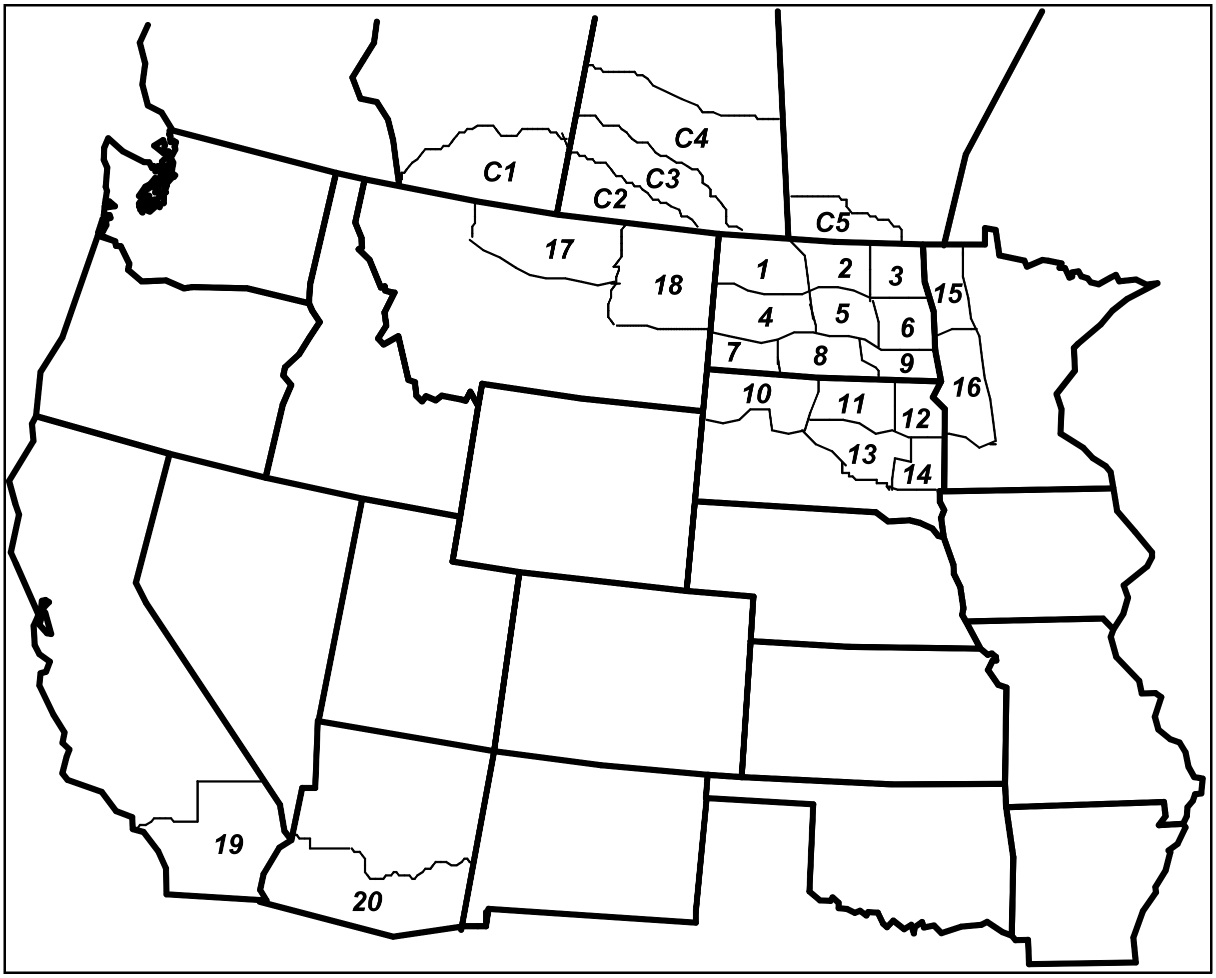

Figure 2. U.S. and Canadian Producing Regions

The Canadian production regions were defined by grouping provincial crop districts with similar soil types. The production cost and yield for each production region were estimated through a weighted average. The weighted average was defined by the average number of harvested acres, from 1990-1992, for each reporting district within the production region. The production costs were converted from Can$ to US$ using the 1992 exchange rate (IMF, 1993).

Table 6. Durum Production Costs and Harvested Acres

			1992	- 1990-92 Average -	
			PC/Ac	Bu/Ac	Harv Acres
P1	NW	ND	$55.61	33.6	938,000
P2	NC	ND	$66.54	33.8	569,300
P3	NE	ND	$69.16	36.1	603,700
P4	WC	ND	$62.48	31.1	244,300
P5	C	ND	$65.78	36.2	121,700
P6	EC	ND	$71.17	47.0	51,500
P7	SW	ND	$48.79	28.5	69,700
P8	SC	ND	$48.79	26.8	18,200
P9	SE	ND	$68.71	36.5	67,000
P10	NW	SD	$57.87	22.1	6,600
P11	NC	SD	$62.70	28.1	15,500
P12	NE	SD	$69.65	33.3	36,400
P13	C	SD	$64.03	28.0	2,500
P14	EC	SD	$68.50	26.5	2,000
P15	NW	MN	$57.23	47.9	22,500
P16	WC	MN	$55.94	43.9	7,500
P17	NC	MT	$61.81	24.0	22,100
P18	NE	MT	$61.81	33.0	166,300
P19	S	CA	$300.02	96.0	48,700
P20	S	AZ	$337.78	91.6	41,700
C1	SE	ALB	$73.34	30.3	107,571
C2	S	SASK	$58.01	30.7	941,680
C3	C	SASK	$62.20	33.4	390,769
C4	N	SASK	$70.23	32.6	144,660
C5	SW	MAN	$69.40	32.3	36,923
EEC			$177.12	42.6	891,460

The yield and number of harvested acres for the EEC was reported by the International Wheat Council (1993). The EEC yield was estimated through a weighted average, weighted by average number of harvested durum acres for each country in the EEC. The EEC production costs were obtained from Stanton (1986) and converted to 1992 price levels using an inflation index (IMF, 1993).

RESULTS

The model in this study is utilized to estimate how changes in government policy would affect the production and trade flows for durum. The Base Model reflects the actual trade environment for durum production and trade, including effects of the WGTA, EEP and ERP programs. The optimal solution for the Base Model is used as a base for identifying changes under alternative trade environments.

Five models are compared to Base Model. Variations in acreage employment, shadow prices, trade flows, and changes in export market share under alternative market scenarios are interpreted to estimate the effects that changes in government policy may have on the world durum market.

Competitiveness

Exporters achieve varying degrees of competitiveness in satisfying demand when government policy changes influence the trade environment. Competitiveness for producers is the ability to provide a more attractive product to buyers, using factors such as cost and quality to capture a share of the market. Quality and preferences are highly variable and difficult to model, so these factors are not considered in this study. Trade flows are based on the least cost combination of production and transportation costs that satisfy demand requirements within specified parameters.

Competitiveness is evaluated by two factors: utilization of available land and shadow prices. Land utilization is the portion of available acres in a producing regions that are employed. Shadow prices are proxies for the value of one additional acre of land within an individual producing regions. In addition the competitiveness of individual countries in satisfying export market demand is compared across the models.

Land Use

13.4 million acres are required to satisfy the US and Canadian domestic demand and world import demand in the Base Model (Table 7). The United States, Canada and the EEC employ 59, 83 and 100 percent, respectively, of available acres[5]. The regions within each country that utilize more than 25 percent of available acres have an advantage in producing or transporting durum to satisfy demand markets.

In the United States, the northwest, central, south central and southeastern North Dakota regions, as well as north central Minnesota, Montana, and Arizona, are competitive in producing durum. The southern and central regions of Saskatchewan are Canada's most competitive regions. The EEC utilizes all available acres in the Base Model.

When a U.S. quota is established to limit durum imports, U.S. land use increases 3 percent (292,260 acres), while Canadian land use decreases 10 percent (334,300 acres). EEC land use is unchanged. The quota allows northeastern, central, south central, and southeastern North Dakota to increase land use as these regions supply durum to domestic markets that were satisfied by Canadian durum imported from southern Saskatchewan in the Base Model.

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[5]EEC acres are established as constraint of the objective function for Models 1 through 5 because the production and export levels originating from this region are insulated from the direct affects of most international policy through domestic subsidy and export promotion programs.

An increase in the EEC utilization of its ERP has a negative impact on US production and a positive impact on Canadian production. The EEC increase in exports displaces Canadian shipments to international markets, thus Canada increases shipments to the U.S. Although U.S. durum export levels are unchanged compared to the Base Model, the Canadian producing regions have an advantage relative to central and southwestern North Dakota, and to north central Minnesota, in satisfying United States domestic durum requirements. Five of the six Canadian production regions maximize production when the EEC increases exports.

The effects of simultaneous policy changes including a U.S. quota on durum imports and an increase in EEC use of the ERP severely limit Canadian durum marketing opportunities (Model 4). Only 56 percent of available Canadian acres are utilized. This represents a 27 percent loss in acres compared to the Base Model. Only central Saskatchewan is able to maintain production levels achieved in the Base solution. The central Saskatchewan region is able to maintain production by contributing over 90 percent of the Canadian durum exports to the United States. The central, south central, and southeast regions of North Dakota again increase production as they satisfy demand from U.S. durum mill demand.

The proposed method of payment change that would shift the Canadian WGTA payment from railroads to producers dramatically increases the competitiveness of Canadian producers as illustrated by the utilization of almost all available Canadian durum production acres (Model 5). With this policy change U.S. producers utilize only half of the available acres, as Canadian producing regions increase shipments to U.S. mills.

Table 7 . Land Use for Alternative Trade Policy Scenarios

			Acre Limit	Model 1 Base	Model 2 US Quota	Model 3 EEC Ups ERP Use	Model 4 US Quota EEC ERP	Model 5 WGTA Shift	Model 6 Subsidies Eliminated
P1	NW	ND	1,876,000	100%	100%	68%	100%	100%	100%
P2	NC	ND	1,138,600	25%	25%	25%	25%	25%	25%
P3	NE	ND	1,207,400	25%	37%	25%	31%	25%	39%
P4	WC	ND	488,600	25%	25%	25%	25%	25%	25%
P5	C	ND	243,400	94%	100%	25%	100%	25%	100%
P6	EC	ND	103,000	100%	100%	100%	100%	100%	100%
P7	SW	ND	139,400	100%	100%	25%	100%	25%	100%
P8	SC	ND	36,400	25%	100%	25%	100%	25%	100%
P9	SE	SD	134,000	25%	100%	25%	100%	25%	100%
P10	NW	SD	13,200	25%	25%	25%	25%	25%	25%
P11	NC	SD	31,000	25%	25%	25%	25%	25%	25%
P12	NE	SD	72,800	25%	25%	25%	25%	25%	25%
P13	C	SD	5,000	25%	25%	25%	25%	25%	25%
P14	EC	SD	4,000	25%	25%	25%	25%	25%	25%
P15	NW	MN	45,000	100%	100%	100%	100%	100%	100%
P16	WC	MN	15,000	100%	100%	100%	100%	100%	100%
P17	NC	MT	44,200	25%	25%	25%	25%	25%	25%
P18	NE	MT	332,600	100%	100%	75%	100%	25%	100%
P19		CA	97,400	25%	25%	25%	25%	25%	25%
P20		AZ	83,400	25%	25%	25%	25%	25%	25%
% US Land Used				59%	63%	43%	62%	50%	64%
CP1		MAN	215,142	25%	25%	28%	25%	96%	25%
CP2	S	SASK	1,883,360	94%	76%	100%	48%	100%	100%
CP3	C	SASK	781,538	100%	100%	100%	100%	100%	100%
CP4	N	SASK	289,319	25%	25%	100%	25%	100%	71%
CP5		ONT	73,846	25%	25%	100.%	25%	100.%	25%
% of Canadian Land Used				83%	73%	95%	56%	100.%	91%
EEC Land Used			891,460	100%	100%	150%	150%	100%	50%
% of Total Land Used				68%	68%	65%	64%	69%	72%

The final policy scenario that is examined is the impact of free trade, estimating the impact of an international agreement to liberalize trade. This scenario provides the United States with its highest level of acreage utilization, 3,886 thousand acres or 64 percent of available acres. Canada also achieves a competitive advantage, relative to the Base Model, increasing land use to 2,942 thousand acres, or 91 percent of available acres. The EEC has a substantial decrease in acreage utilization as only the minimum level of acres, 445,730, are employed. This suggest that the ERP and domestic support policies are vital to the production and sale of durum for the EEC.

Shadow Prices

Another indicator of competitiveness is the shadow prices (RHS value) assigned to producing regions or across alternative market environments. The shadow price is equal to the amount that the objective function cost would have decreased if an additional acre of land would have been available within that producing region.

The shadow prices in the Base Model establish the value of an additional acre of land in the current market environment. Differing land values for varied producing regions in the Base Model are based on the resource endowments (e.g. acres), production costs, transportation costs, and the effect of government policies. For example, north central Montana has the highest shadow price at $27.48, so, if an additional acre of land was available in this region, the objective value (cost) would decrease by $27.48. Northeast Montana is second with $18.18. Both regions have limited acreage; accounting for less than 1 percent of U.S. available durum acres. The bushels from north central Montana are used to satisfy domestic mill demand in the western United States. Production originating from northeast Montana flows to the ports to satisfy export demand (Figure 3).

East central North Dakota has a shadow price of $17.05. Its limited bushels are important to the U.S. milling industry in Minnesota and Wisconsin. The northwest region of North Dakota, that accounts for about a third of U.S. durum acres is given a value of $4.65 in the Base Model. Durum produced in this region is primarily targeted for export through Duluth, but it is also important to the local milling industry.

Table 8. Shadow Prices for Alternative Market Scenarios

			Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
			Base	**US Quota**	**EEC Ups ERP Use**	**US Quota EEC ERP**	**WGTA Shift**	**No Subsidies**
P1	NW	ND	$4.65	$6.83	$4.80	$18.00	$24.46	$17.93
P2	NC	ND				$47.00		
P3	NE	ND						
P4	WC	ND						
P5	C	ND		$2.80	$0.30	$3.76		$3.66
P6	EC	ND	$17.05	$20.67	$17.43	$21.92	$8.36	$21.78
P7	SW	ND	$0.62	$3.08	$1.55	$3.84		$5.51
P8	SC	ND		$1.13		$1.84		$2.15
P9	SE	SD		$2.51		$3.47		$3.36
P10	NW	SD						
P11	NC	SD						
P12	NE	SD						
P13	C	SD						
P14	EC	SD						
P15	NC	MT	$27.49	$34.00	$27.49	$35.27	$16.57	$38.09
P16	NE	MT	$18.18	$20.92	$19.54	$22.32	$9.36	$23.09
P17	NW	MN						
P18	WC	MN	$0.76	$2.82	$0.83	$3.64		$3.64
P19		CA						
P20		AZ						
CP1		MA						
CP2	S	SASK					$13.00	
CP3	C	SA	$1.03	$0.73	$0.89	$0.71	$14.52	$4.43
CP4	N	SASK					$7.63	$7.17
CP5		ON					$7.74	

A shadow price value of $0.76 is attached to east central Minnesota and of $0.62 to southwest North Dakota in the Base Model. Production from southwest North Dakota and a portion from east central Minnesota are transported to mills in southern Minnesota. Additional bushels from east central Minnesota flow to mills in the midland region of the United States.

The single shadow price value in Canada is attached to the producing region in central Saskatchewan. This region accounts for about a third (29 percent) of the available Canadian durum acres. Production from this region is important to U.S. mills in the west, Canadian mills outside the Prairie Provinces, and export markets served through Thunder Bay and the St. Lawrence Seaway.

The shadow prices for U.S. producing regions increase when the effects of a U.S. quota on durum imports is estimated (Model 2). In addition, the central, southeast and south central producing regions in North Dakota receive shadow price values of $2.80, $2.51 and $1.31 as these bushels replace Canadian shipments to U.S. mills. The shadow price for the region in central Saskatchewan decreases as shipments to U.S. mills are limited.

An increase in EEC use of its ERP negatively impacts the value of production in Canada and has a positive effect on U.S. shadow prices as U.S. exports are displaced in the world market. U.S. production that was previously used to satisfy export demand is shifted to the domestic market where its value is higher in the model because no government interference influences the shadow prices (Model 3).

The effects of simultaneous government policy changes in the U.S. and the EEC increases shadow prices substantially for U.S. regions (Model 4). U.S. regions are logically assigned their highest values as Canadian exports are limited to the U.S. by a quota and displaced in other markets by shipments under EEP and ERP programs.

Increased shadow price values for each Canadian region, that result from a change in the method of distributing the WGTA payment, suggest that the competitiveness of Canadian producers would be positively affected by the proposed change. The shadow price values for U.S. regions decline, with the exception of those for northwest North Dakota. The production originating in northwest North Dakota is committed solely to the export market in this model, as producers in this region supply all of the durum exported by the U.S. The northwest region of North Dakota is the single region that is able to maintain its competitiveness relative to Canadian producing regions when the competitiveness of Canadian producers is enhanced through a change in the method of payment under the WGTA (Model 5).

In the final policy scenario, an international liberalization of trade policies, the shadow price values increase for both the U.S. and Canadian producing regions. The elimination of subsidies gives Canada an advantage in supplying durum to import markets, relative to the EEC. Although U.S. exports decline, the U.S. is able to increase the value of its production by satisfying 100 percent of its domestic demand. When the international markets are not distorted by government subsidies, Canada has an advantage relative to the United States and the EEC in supplying durum for the world import market. The United States is able to gain a competitive advantage in serving its domestic mills, as factor including production and transportation costs and land resources allow U.S. production to displace the flow of Canadian durum south to U.S. mills (Figure 4).

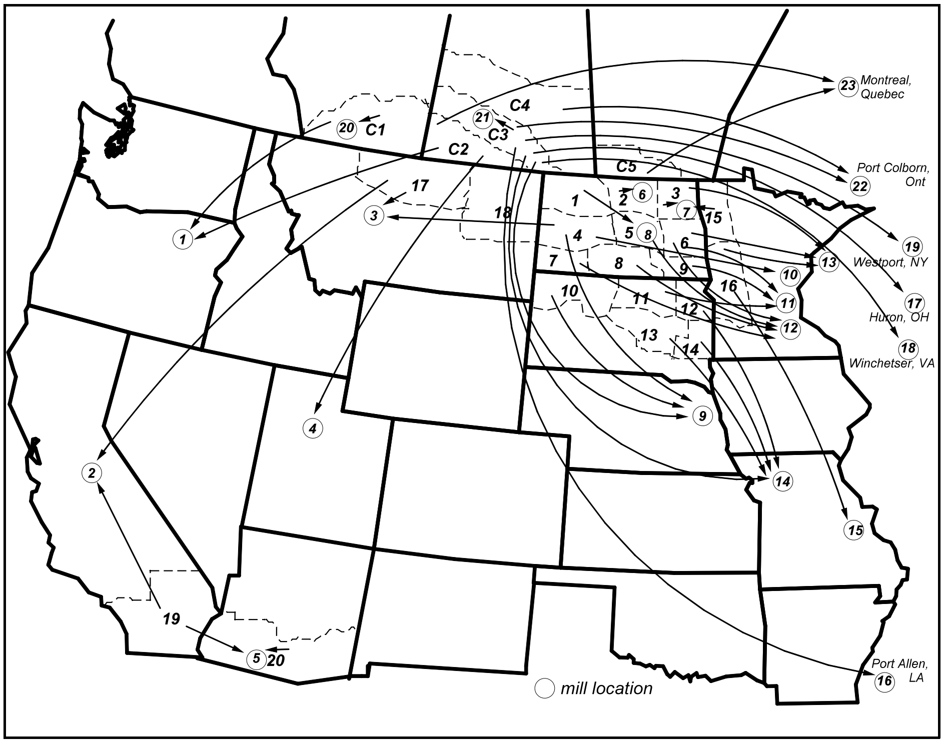

Figure 3. Base Model Trade Flows

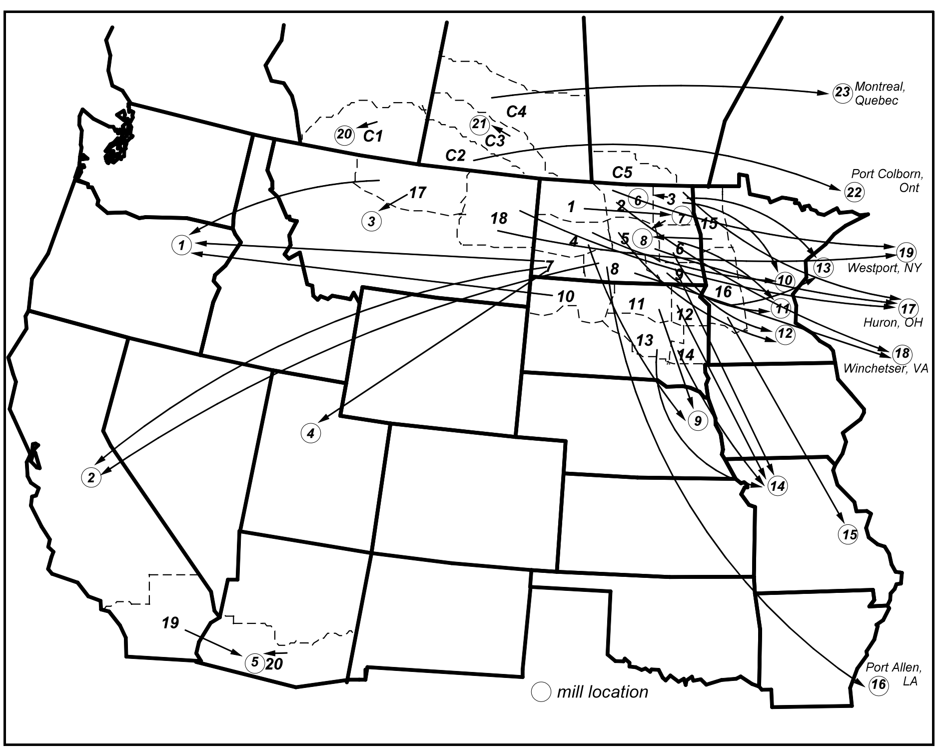

Figure 4. Free Trade Model Flows

Export Market Share

The competitiveness of the major exporting countries in supplying durum for the world export market can be assessed based on export market share. Shifts in market share relative to the Base Model indicate an increase or decrease in the ability of a country to compete under the alternative market environments, defined by alternative government policy scenarios. The ability of exporting nations to maintain market share is indicator of the competitive advantage a country may have in producing and transporting a commodity.

The competitiveness of the United States, Canada, and the EEC in satisfying demand of major durum importers varies as government policies are changed. The Base Model solution that incorporates current government policies shows that Canada, the United States and the EEC control 41, 39 and 20 percent, respectively, of the world durum export market (Table 9).

Table 9. Export Market Share

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
			EEC Ups	US Quota	WGTA	No
	Base	US Quota	ERP Use	EEC ERP	Shift	Subsidies
US	39%	39%	38%	37%	32%	35%
Canada	41%	39%	32%	30%	48%	53%
EEC	20%	22%	30%	33%	19%	12%
Total MT	5,152,427	4,666,669	5,228,207	4,666,666	5,344,530	4,466,663

Canada satisfies import demand from Russia and the FSU, Cuba, Chile, Japan and the United States. The United States controls exports to Poland, Algeria, and Tunisia. The EEC supplies durum import requirements for eastern Europe, India, and Libya. In addition Canada and the EEC both ship durum to Venezuela (Table 10).

Total shipments originating from the exporting nations for the Base Model solution are 2,113,330 metric tons from Canada, 2,005,000 metric tons from the United States, and 1,034,097 metric tons from the EEC. The U.S. targets sales to import countries by applying subsidies through EEP, thus gaining competitiveness in serving individual countries. The EEC utilizes its ERP in establishing a competitive advantage in the world market. Canadian competitiveness is enhanced through subsidies under the WGTA.

Canada gains its largest market share in the liberalized trade environment (Model 6), controlling 53 percent of the world durum export market. With liberalized trade, Canada increases market share 23 percent compared to the Base Model, capturing market share from both the United States and the EEC. Canadian export market share is at its lowest when the effects of U.S. quota and an increase in the EEC's use of the ERP are estimated (Model 4). Both Canada and the U.S. lose export market share to the EEC in this scenario.

The United States has its largest export market share, 39 percent, under current market conditions. The United States captures its smallest market share when the Canadian WGTA payment is shifted from railroads to producers. Market share declines 18 percent compared to the Base Model as the competitiveness of U.S. producers is diminished relative to Canadian producers. The United States is able to maintain a rather consistent share in the durum export market across the models, evidence that U.S. producers are competitive in the current market environment as well as in a liberalized trade environment.

The largest market share for the EEC is under the scenario that includes a U.S. quota coupled with an increase in the EEC export refund program. Under this scenario the EEC increases market share 65 percent compared to the Base Model, to supply a third of the world durum exports.

Table 10. Exports of Durum for Model Alternatives

	Exporting Country		
	US	**Canada**	**EEC**
		Base Model	
E Europe			376,667
Poland	105,000		
Russia		1,133,333	
Cuba		43,333	
Chile		55,000	
Venezuela		55,903	157,430
India			250,000
Japan		140,000	
Algeria	1,800,000		
Libya			250,000
Tunisia	100,000		
United States		685,761	
		WGTA Shift (Model 5)	
E Europe			376,667
Poland			105,000
Russia		1,133,330	
Cuba		43,333	
Chile		55,000	
Venezuela		213,333	
India			250,000
Japan		140,000	
Algeria	1,725,920	74,080	
Libya		47,573	202,430
Tunisia			100,000
United States		877,883	
		No Subsidies (Model 6)	
E Europe			376,667
Poland			105,000
Russia		1,133,333	
Cuba		43,333	
Chile	55,000		
Venezuela	213,333		
India		214,620	35,380
Japan		140,000	
Algeria	1,097,000	703,000	
Libya	250,000		
Tunisia		100,000	
United States		0	

Market share declines 60 percent to 12 percent under in the liberalized trade environment. These significant losses in market share in the liberalized trade environment indicate that the competitiveness of the EEC in the world durum export market is influenced substantially by government policies.

U.S. Durum Imports from Canada

The impact of Canadian imports on U.S. production can be observed for the various trade scenarios by analyzing changes in the absolute levels of durum shipments and in the significance of the shipments as a portion of the Canadian durum export activity.

In the Base Model solution, Canadian durum shipments to U.S. mills equal 685,761 metric tons, accounting for 33 percent of the total Canadian exports (Model 1).

When a U.S. quota of 200,000 metric tons is established to limit durum imports, Canadian and U.S. export levels decline. The decline in Canadian exports is attributed to a U.S. quota. The decrease in the level of U.S. exports results as more U.S. production is

Table 11. Share of Canadian Exports Shipped to U.S. Mills

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Base	**US Quota**	**EEC Ups ERP Use**	**US Quota EEC ERP**	**WGTA Shift**	**No Subsidies**
Canada Exports	2,113,330	1,832,572	1,672,061	1,389,609	2,584,533	2,389,284
Can Exports To US Mills	685,761	200,000	761,538	200,000	877,883	0
US Mill Demand - % Can Exports	32%	11%	46%	14%	34%	0%
Can Imports - % US Mill Demand	33%	10%	36%	10%	42%	0%

required to satisfy domestic demand. Marginal bushels produced for export are supplied at a higher cost, and are not as competitive in the world market, relative to Canadian production.

The result of an increase by the EEC in its application of the ERP is a decrease in the flow of Canadian durum to U.S. mills compared to the Base Model. Canadian sales to U.S. mills decline by 21 percent (441,269 metric tons). As the EEC serves the USSR and Japan (markets previously satisfied with Canadian durum), fewer bushels are required to satisfy export demand outside North America, making additional bushels available at a lower marginal cost. This shift in export market share increases the competitiveness of Canada in the U.S. market, enabling Canada to increase exports to the U.S. by 11 percent compared to the Base Model.

When the WGTA payment is shifted from railroads to producers, Canadian exports to the U.S. are at their highest level among the model solutions. Exports totalling 877,883 metric tons are shipped from Canadian producing regions to U.S. mills, to account for 42 percent of annual U.S. mill demand. This level is 192 thousand metric ton, or a 28 percent increase from the amount of U.S. imports in the Base Model. The shift in the WGTA payment provides Canadian producers with a significant competitive advantage, relative to many U.S. producers, in supplying durum for U.S. mills (Model 5).

In the free trade environment, the Canadian exports to the U.S. are eliminated. This shift of exports from U.S. mills to other importing countries suggests that U.S. producers are very competitive in supplying durum for domestic markets. Also, this implies that subsidies that include the ERP, EEP, and WGTA distort production decisions and trade flows contribute to a market environment that encourages the flow of durum from Canadian producing regions to U.S. mills. The acknowledgement of the effects of the world market on durum production in North America may be vital to understanding the economics of production decisions and trade flows.

SUMMARY

In today's globalized marketing economy it is increasingly important to understand how domestic and international policy changes affect the competitiveness of agricultural producers. Recent bilateral and multilateral trade agreements and the implementation of export promotion programs continue to impact agricultural production decisions and trade flows.

Since the mid 1980s changes in durum production levels and trade flows have received special attention from U.S. producers in the north central plains region. North Dakota, Montana, Minnesota and South Dakota producers supply over 85 percent of the annual U.S. durum bushels, so producers in this region are cognizant of changes in production levels and distribution patterns for durum .

In the international durum market the United States, Canada, and the EEC accounted for over 95 percent of annual export supply during the past decade. Canada has had the largest export share, controlling about 53 percent of the market. The United States has been second in the durum export market, averaging a 33 percent share. The EEC averaged a 13 percent share. Historically the EEC has been a residual supplier, accounting for 8 percent of the durum export market between 1983/84 and 1987/88. Over recent years the EEC has experienced a significant change in its durum export market share, developing into a competitive export supplier that averaged a 28 percent share between 1988/89 and 1992/93. This share reflects a 364 percent increase from the previous 5-year export market share average of 8 percent.

In addition to concerns about the globalized durum market, there have been adjustments in the North American durum market. Over recent years the United States has become a major destination for Canadian durum export sales. Canada exported virtually no durum to U.S. destinations prior the mid 1980s, but in 1992/93 durum sales to the U.S. totalled over a million metric tons. The bushels exported to U.S. destinations have accounted for an increasing share of total Canadian exports, equalling 59 percent of total Canadian exports for 1992/93. Changes in production levels and distribution of North American durum raise questions about the competitiveness of U.S. durum producers.

The effects of individual export promotion programs, trade liberalization agreements, and domestic support programs cannot be distinguished, but it is evident that there have been substantial changes in the world durum market over recent years. The objective of this study was to assess the competitiveness of U.S. durum producers in serving the domestic market and the world export market under alternative government policy scenarios. A static spatial equilibrium model was used to estimate production levels and trade flows for the durum market under alternative policy scenarios including a change in the Canadian WGTA method of payment, an increase in EEC use of ERP, and a U.S. quota on durum imports.

The Base Model reflects the actual trade environment for durum production and trade including effects of the WGTA, EEP, and ERP. The solution for the model was the basis for estimating impacts of changes in government policies. Variations in acreage employment, shadow prices, trade flows and export market share under alternative policy scenarios were interpreted to estimate the effects that changes in policy may have on the world durum market.

Competitiveness was evaluated by comparing land utilization and shadow prices of alternative models to the Base Model. In the Base Model solution the U.S., Canada, and the EEC employ 59, 83, and 100 percent of available acres. The northwest, central, south central and southeast regions of North Dakota, as well as north central Minnesota, Montana and Arizona are competitive in producing durum in the current policy environment. The south and central regions of Canada and the EEC are also competitive in the world durum market.

A U.S. quota allows several U.S. producing regions to increase production as the bushels produced in these regions are used to replace bushels previously imported from Canada. U.S.

production increases 4 percent while Canadian production declines 10 percent. U.S. export sales are unchanged as market gains are attributed to increased domestics sales.

When effects of an increase in the EEC's use of its ERP are estimated, the U.S. is at a competitive disadvantage, and land use declines 16 percent compared to the Base Model. Canada, in contrast, increases land use by 12 percent. Although the competitiveness of the U.S. in the world export market is unchanged, Canadian shipments to U.S. mills increase 14 percent as the increased ERP benefits displace Canadian exports outside North America. Canadian producers gain an advantage in serving U.S. mills as additional Canadian bushels are available at a lower marginal cost for competing in the North American market because of the competitive advantage the EEC gains in serving some of the Canadian export markets.

A simultaneous U.S. quota and an increase by the EEC in its application of the ERP result in the lowest level of Canadian land employment across the policy alternatives. The Canadian producing regions utilize 56 percent of available acres, compared to 83 percent in the Base solution. U.S. acre utilization increases 3 percent as U.S. producers limit Canadian sales to U.S. mills. Compared to EEC producers, the U.S. and Canadian producers are at a competitive disadvantage in serving the export market experiencing 2 percent (282,780 MT) and 11 percent (712,495 MT) declines in export market share, respectively.

The competitiveness of Canadian producers is increased significantly when the WGTA payment is shifted from railroads to producers. Canadian producers gain a competitive advantage, relative to U.S. producers, in supplying durum for both the U.S. mills and the world export market. Canadian exports to U.S. mills equal 877,883 metric tons, accounting for 42 percent of the annual mill consumption. Canadian export market share increases 7 percent as it serves markets previously satisfied by U.S. exports.

When government subsidies are eliminated to estimate optimal production levels and distribution patterns, the United States and Canada gain a competitive advantage relative to the EEC in the world durum market. The United States increases utilization of land by 5 percent and Canada has an 8 percent increase in land use, compared to the Base Model. A global liberalization of trade policies allows Canada to increase exports beyond North America. The U.S. gains a competitive advantage in serving its domestic mills, eliminating Canadian imports. Thus, when production levels and trade flows are not 'manipulated' through government policies, the United States and Canada both experience gains as the United States increases production to satisfy domestic demand and Canada increases production to serve world durum importers beyond North America.

Results of this study are a clear indication that the durum market is truly a global one. It is important for U.S. producers and policy markets to understand the implications of changes on international level. The cause/effect relationship of individual policies as they impact the world durum market cannot be defined. The compounded effects of individual government policy changes do, however, lend themselves to changes in production decisions and alterations in the distribution patterns on an international level.

REFERENCES

Agricultural and Trade Analysis Division, Economic Research Service, U.S. Department of Agriculture. *The Basic Elements of Agricultural Competitiveness. In Three Parts: Economics and Policy, Geography, and History.* Miscellaneous Publication Number 1510. March 1993.

Agriculture Canada. Manitoba. Personal Contact. 1993.

Agriculture Canada. Ontario. Personal Contact. 1993.

Bitzan, John and Denver Tolliver. *The Use of Geographic and Product Competition in Grain Rail Rate Regulation and Analysis.* Unpublished Report, Upper Great Plains Transportation Institute, North Dakota State University, 1992.

Canadian Grains Industry. *Statistical Handbook 1992.* Winnipeg, Manitoba.

Department of Agricultural Economics. *Crop Budgets.* Arizona Cooperative Extension, University of Arizona. 1993.

Imperial County Extension. *Guide Lines to Production Costs and Practices*. University of California, Cooperative Extension. 1991. Holtville, California.

International Monetary Fund. *International Financial Statistics Yearbook.* Various Years. Washington, D.C.

International Wheat Council, *1992 World Grain Statistics.*

Minnesota Extension Service. *Crop Budgets.* St. Paul, Minnesota.

Minnesota Extension Service. Personal Contact. 1993. St. Paul, Minnesota.

Montana Agricultural Statistics Service. *Montana Agricultural Statistics 1992.* 1993. Helena, Montana.

Montana Agricultural Statistics Service. Personal Contact. 1993.

Montana Soil Conservation Service. Personal Contact. Bozeman. 1993.

North Dakota Agricultural Statistics Service. *North Dakota Agricultural Statistics 1993*. 1993. Fargo, North Dakota.

North Dakota Cooperative Extension. *Estimated 1993 Costs Budgets*. North Dakota State University, Fargo.

Saskatchewan Agriculture and Food. *Cost of Producing Grain Crops in Saskatchewan 1993*. April, 1993.

South Dakota Agricultural Statistics Service. *South Dakota Agricultural Statistics 1992-93*. 1993. Sioux Falls, South Dakota.

South Dakota Cooperative Extension. *1993 Estimated Costs of Production for Spring Crops*. South Dakota State University, U.S. Department of Agriculture, Brookings.

Stanton, B.F. *Production Costs for Cereals in the European Community: Comparison with the Unit ed Stat es*. Agri cult ural Exp erim ent Stati on Rep

ort
No.
86-
2.
Cor
nell
Uni
versi
ty.
Mar
ch,
198
6.

Statistics Canada. Personal Contact. 1993.