Center for Agricultural Policy and Trade Studies
North Dakota State University

AGRICULTURAL POLICY BRIEF

No. 9 August 2005

Economic Analysis of the Free Trade of Agricultural Chemicals Between the United States and Canada

*Richard Taylor, Won W. Koo, and Jeremy Mattson**

Canadian and U.S. agricultural chemical markets are segregated by regulation. Chemicals registered and sold for use in one country cannot legally be used in the other, even if their chemical formulation is identical to that of a product that is registered and sold in the other country. Generally, when arbitrage between consumers in the two markets is not possible, the seller can set different prices in different markets. This behavior is known as third-degree price discrimination (DeSerpa). Third-degree price discrimination occurs even though there are no differences in the firm costs of supplying each market. The seller exploits differences in own-price demand elasticities to maximize profits.

Smith and Johnson (2005) conducted a survey in 2004 of chemical retailers in southern Alberta and northern Montana to obtain directly comparable retail prices for identical or very similar chemicals. They made price comparisons for 13 agricultural chemicals and found that the average prices for seven chemicals were statistically significantly higher in northern Montana. Five of the chemicals were more expensive in Southern Alberta, while the average price for the remaining chemical was not significantly different between markets. The size of the price difference was large for many of the chemicals. The researchers found Puma was about 29 percent more expensive in Montana than in Canada, and four other chemicals were 20-26 percent more expensive in the state. Meanwhile, Ally XP was 61 percent more expensive in Alberta than in the United States, and three other chemicals were about 20-28 percent more expensive in Alberta. Smith and Johnson reasoned that while differences in dealer costs could result in price differences, the differences would be applied to all chemicals. The finding that some chemicals are higher priced in Canada while others are higher priced in the United States suggests third-order price discrimination. The researchers concluded that economically and statistically significant price differences are generally associated with market power and differences in elasticities of demand. Own-price elasticity may differ because of different crop mixes or because the availability of approved substitutes may differ between the countries.

Taylor and Koo (2001) estimated the total additional cost paid by North Dakota producers for higher-priced agricultural herbicides. Like Smith and Johnson, they found that while some chemicals were priced higher in the United States, others were priced higher in Canada. In general, more chemicals were priced higher in the United States, and the price disadvantage for U.S. producers in some cases was significant according to the study. If U.S. prices were lowered to match Canadian prices, Taylor and Koo (2001) found that the savings for North Dakota producers would be $24 million annually, with the largest impact on hard red spring wheat producers

**Research Scientist, Professor and Director, and Research Assistant, respectively, in the Center for Agricultural Policy and Trade Studies. This report was prepared for U.S. Senator Byron Dorgan.*

($11.6 million). In an update to this study using 2002 data, Taylor and Koo (2003) found that the price differences still existed, even though they had narrowed somewhat. The price difference between the two countries was estimated to cost North Dakota producers over $20 million annually.

This study expands upon the previous studies by estimating the impact of agricultural chemical price differences for producers of durum wheat, spring wheat, winter wheat, barley, corn, soybeans, sunflowers, canola, dry beans, flax, and potatoes in 17 northern states, using updated price data.

Price Discrimination

Traditional economic theory states that the price of chemicals used in the farm sector is determined by supply and demand. Supply of a chemical is a function of the price of the chemical, prices of substitutes, the technique of production, taxes and subsidies, prices of other goods, and the number of sellers in the market. Demand for chemicals is a function of the price of the chemicals, price of substitutes, effectiveness of the chemicals, and price of crops. Price is determined by the intersection of the downward sloping demand curve and the upward sloping supply curve. Since the prices of herbicides vary between Canada and the United States, either one or both of the demand and/or supply curves are different. Figure 1 shows the direct effect of third-degree price discrimination. In the figure, the United States has a demand curve represented by D^{US} and Canada has a demand curve represented by D^{C}. It is assumed that the price elasticity of demand for chemicals in Canada is more elastic than that in the United States. The chemical companies who have some degree of monopoly power could maximize their revenue by segregating the two markets and charging a higher price (P_1) in the United States and a lower price (P_2) in Canada. They maximize their revenue by equating aggregate marginal revenue (MR^T) with their marginal cost (MC) as shown in Figure 1. Different supply curves will also change prices, but since most chemical companies are multi-nationals, the supply curves in the two countries should be similar except for costs involved in registration differences and the availability of competing products. Since the two markets are segregated, suppliers have the ability to set different prices to maximize their revenue.

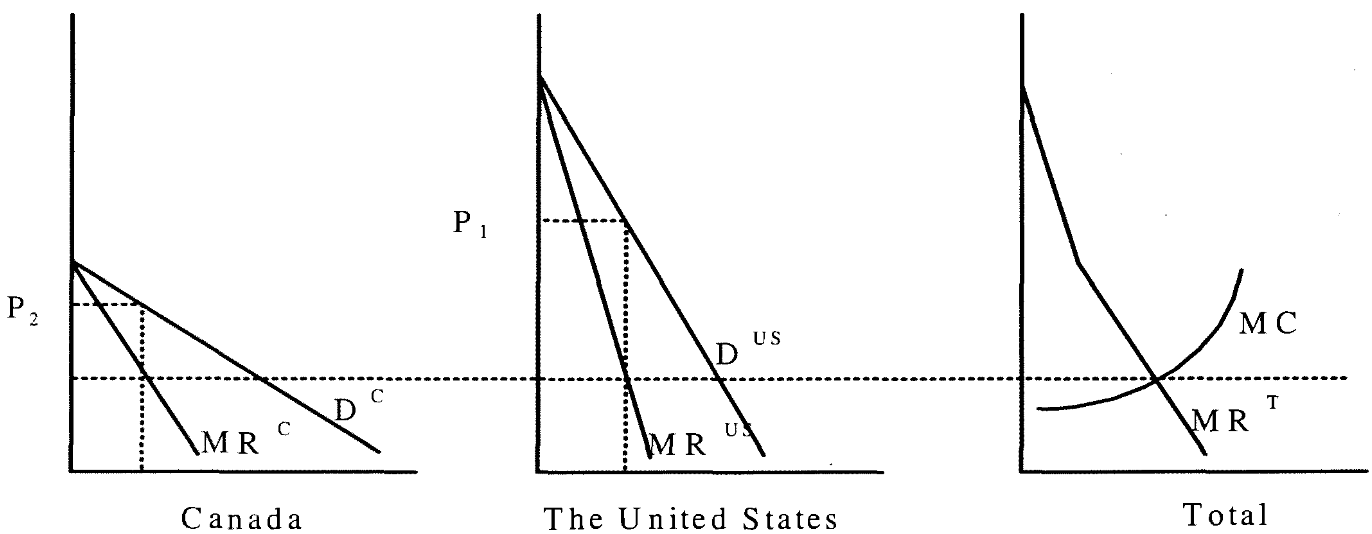

Figure 1.Third Degree Price Discrimination Between the U.S. and Canadian Agricultural Chemical Markets

Data

Price data for U.S. chemicals were obtained from the NDSU Extension Service and price data for Canadian chemicals came from the Saskatchewan Agriculture website. Usage data for corn, soybeans, potatoes, barley, durum wheat, spring wheat, and winter wheat for the 17 states were obtained from UDSA-NASS, and usage data for flax, canola, dry beans, and sunflowers came from "Pesticide Use and Pest Management Practices for Major Crops in North Dakota:2000." It was assumed that other states which produced these crops had similar chemical usage as North Dakota. The 2004 acreage of the eleven crops were obtained from USDA-ERS PS&D database. The U.S./Canada exchange rate for March 2005 (1.2096 C$ to 1 US$) was used to convert Canadian currency to U.S. dollar, and all rates and volumes were converted to U.S. measures.

Results

Table 1 shows the area applied, total chemical costs in 17 states under the current system, total chemical costs under free trade, differences in chemical costs between the U.S. and Canada, and potential per acre savings if producers could purchase the lower priced Canadian chemicals. The following assumptions were made: 1) the price of chemicals in both the United States and Canada would not change, and 2) producers would choose lower priced chemicals under a free trade scenario. Iowa, Illinois, and Minnesota have the highest chemical use. Their aggregate spending on chemicals are $519 million, $493 million, and $347 million, respectively. Producers in North Dakota, Minnesota, Iowa, and Illinois could save $41 million, $23 million, $22 million, and $21 million annually, respectively, if lower priced Canadian chemicals were available to them. Montana could have a potential cost savings of $2.67 per acre, followed by North Dakota at $2.38 per acre, Idaho at $1.90 per acre, and Wisconsin at $1.69 per acre. The total savings across the 17 states for 11 crops could be $178 million or $1.26 per acre.

Table 1. Chemical Cost Savings With Free Trade of Agricultural Chemicals, by State

	Area Applied (1,000 acres)	US Cost ($1,000)	Free Trade Cost ($1,000)	Difference ($1,000)	Per Acre Savings ($/acre)
Idaho	2,595	45,189	40,266	4,923	1.90
Illinois	22,625	493,281	471,949	21,333	0.94
Indiana	11,703	205,826	194,368	11,458	0.98
Iowa	22,928	519,531	497,737	21,794	0.95
Maine	64	685	685	0	0.00
Michigan	5,107	86,787	82,601	4,186	0.82
Minnesota	16,918	347,121	324,091	23,030	1.37
Montana	6,584	139,845	122,280	17,565	2.67
New York	1,318	25,954	24,665	1,288	0.98
North Dakota	18,160	303,709	262,590	41,119	2.38
Ohio	8,729	156,308	149,844	6,464	0.74
Oregon	1,358	31,123	29,941	1,182	0.87
South Dakota	2,489	43,768	42,096	1,672	0.81
Pennsylvania	12,152	169,015	159,122	9,893	0.81
Washington	4,540	64,325	59,362	4,963	1.09
Wisconsin	3,968	142,685	135,990	6,695	1.69
Wyoming	275	3,085	2,777	308	1.12
Total	141,512	2,778,236	2,600,363	177,873	1.26

Table 2 shows the same information by crop. Chemical usage is the largest for corn ($1.62 billion), followed by soybeans ($557 million), spring wheat ($269 million), and winter wheat ($144 million). The largest total savings would be $74 million for corn, followed by $61 million for spring wheat, and $16 million for soybeans. Per acre saving would be $4.45 for spring wheat, $2.46 for barley, $1.32 for winter wheat, and $1.31 for corn.

Table 2. Chemical Cost Savings With Free Trade of Agricultural Chemicals, by Crop

	Area (1,000 acres)	U.S. Cost ($1,000)	Free Trade Cost ($1,000)	Difference ($1,000)	Per Acre ($/acre)
Corn	56,158	1,623,994	1,550,272	73,722	1.31
Soybeans	49,555	557,801	541,419	16,382	0.33
Spring Wheat	13,727	269,943	208,859	61,084	4.45
Winter Wheat	10,805	144,426	130,156	14,270	1.32
Barley	4,038	83,126	73,209	9,917	2.46
Durum Wheat	2,521	41,340	40,662	678	0.27
Sunflowers	1,375	10,432	10,432	0	0.00
Dry Beans	1,059	18,384	18,384	0	0.00
Potatoes	936	17,660	17,135	524	0.56
Canola	815	6,346	5,478	868	1.06
Flax	523	4,785	4,356	429	0.82
Total	141,512	2,778,237	2,600,363	177,873	1.26

Table 3 shows the potential cost savings by chemical, and Table 4 shows the chemicals which are lower priced in the United States than in Canada. S-Metolachlor (Dual) is the most widely-used chemical in the 17 states, followed by 2,4-D and Dicamba (Banvel). 2,4-D and Dicamba are available from many different companies, and S-Metolachlor is manufactured by Syngenta. Other highly-used chemicals are Bromoxynil (Bronate), Clopyralid (Curtail, Stinger), and Chlorimuron-ethyl (Firstrate). The largest potential cost saving would be Bromoxynil ($43 million), followed by S-Metolachlor ($31 million), Clopyralid ($22 million), and Glufosinate-ammonium (Liberty) at $14 million. Many chemicals are priced lower in the United States than in Canada (Table 4).

Table 3. Chemical Cost Savings With Free Trade of Agricultural Chemicals, by Chemical

Ingredient	Common Name	Treated Area (1,000 acres)	U.S. Cost	Canada Cost	Total U.S.	Total Lowest	Savings
			-----$ per acre-----		---------------$1,000---------------		
Bromoxynil+MCPA	Bronate Advanced	7,755	8.40	5.24	83,483	40,714	42,769
S-Metolachlor	Dual	13,398	20.90	18.54	278,918	248,371	30,548
Clopyralid+MCPA	Curtail M	4,970	10.75	9.09	67,283	45,408	21,875
Glufosinate-ammonium	Liberty	2,069	14.80	8.12	31,763	17,426	14,337
2,4-D, Dimeth. salt	2,4-D	12,806	3.00	2.34	44,583	34,775	9,808
Dimethenamid-P	Outlook	3,424	20.00	17.20	68,480	58,893	9,587
Chlorimuron-methyl	Firstrate	3,322	15.00	6.95	43,022	34,014	9,008
Simazine	Princep	1,036	13.50	6.71	13,987	6,833	7,154
Fomesafen	Flexstar	1,323	9.00	6.44	13,190	9,438	3,752
Butoxy. 2,4-D ester	Weedone	942	6.00	5.75	8,047	5,416	2,632
Dicamba	Banvel	8,687	10.25	14.73	97,635	96,351	1,283
Acetic acid (2,4-D)	2,4-D	2,334	3.00	2.34	8,729	7,465	1,263
Flucarbazone-sodium	Everest	998	11.00	10.00	10,975	9,978	998
Fluazifop-P-butyl	Fusilade	426	10.55	8.73	4,489	3,715	774
Dicamba, Sodium salt	Celebrity +	2,436	17.50	14.98	29,279	28,521	758
Triallate	Fargo	391	12.50	11.12	4,892	4,352	540

Table 4. Chemicals Which Are Lower Priced in the United States

Ingredient	Common Name	Area Treated (1,000 acres)	U.S. Cost ($/acre)
Glyphosate diam salt	Glyhomax	61,653	6.30
Nicosulfuron	Accent	6,757	16.00
Rimsulfuron	Matrix	5,948	15.60
Thifensulfuron+tribenuron	Harmony Extra	5,453	3.60
Atrazine	Atrazine	36,440	1.90
Fenoxaprop	Puma	6,939	9.00
MCPA, sodium salt	MCPA	11,485	2.00
Clodinafop-propargil	Discover	2,461	13.60
Imazethapyr	Pursuit	2,459	9.70
Metsulfuron-methyl	Ally	2,505	2.20
Dicamba, Dimet. salt	Distinct	2,254	10.00
Fluroxypyr +2,4-D	Starane+Salvo	2,488	7.65
Trifluralin	Treflan	3,873	4.50
Tribenuron-methyl	Express	5,159	2.90
Imazamox	Raptor	1,054	11.95
Clethodim	Volunteer	1,105	8.55
Metribuzin	Metri	1,622	4.90
Ethalfluralin	Sonalan	846	9.75
Bentazon	Basagran	507	14.65
Triasulfuron	Rave	717	5.40
Sexthoxydim	Poast	650	8.15
Bentazon+sethoxydim	Rezult	306	18.40
Tralkoxydim	Achieve	346	12.25
EPTC	Eptam	247	16.50
Sulfosulfuron	Maverick	290	7.00
Imazamethabenz	Assert	192	10.65

The chemical pricing structure in the United States and Canada has changed during the past few years. Several chemicals which were lower priced in Canada in 2001 are now similar or higher priced today. They include, Imazamethabenz (Assert), Atrazine, Bentazon (Basagran), Rimsulfuron (Basis), Cyanazine (Bladex), EPTC (Eptam), Sethoxydim (Poast), and Ethalfluralin (Sonalan). The price differences for some chemicals have widened since 2001; they are Banvel, Bromoxynil, and 2,4-D. The price differences have also narrowed for several chemicals, including S-Metolachlor (Dual), Triallate (Fargo), Glufosinate-ammonium (Liberty), and Clopyralid (Stinger).

Summary

The total per acre savings, if lower priced chemicals were available to U.S. producers, would be $1.26 per acre for the 17 states and 11 crops. The total savings across 141 million acres would be $178 million if U.S. producers were able to purchase lower priced agricultural chemicals from Canada and the prices of chemicals in both countries remained unchanged. North Dakota producers would save $41 million, followed by Minnesota ($23 million), Iowa ($22 million), and Illinois ($21 million). The largest per acre savings would be in Montana, $2.67 per acre, followed by North Dakota and Idaho. The largest potential per acre savings by crop is for spring wheat, followed by barley. Based on findings in this study, we strongly recommend free trade of agricultural chemicals between the United States and Canada.

References

Deserpa, Allan. *Microeconoic Theory: Issues and Applications*. 2nd edition. Allyn and Bacon Inc., Boston. 1988.

Glogoza, Phillip, Marcia McMullen, Richard Zollinger, Andrew Thostenson, Thomas DeJong, William Meyer, Nick Schauer, and Jeff Olson. "Pesticide Use and Pest Management Practices for Major Crops in North Dakota:2000. NDSU Extension Service. Fargo, ND. October 2002.

North Dakota State University Extension Service. "Crop Production Guide:2005." No.15. North Dakota Agricultural Experiment Station, Fargo, ND.

Saskatchewan Agriculture and Food website. www.agr.gov.sk.ca/docs/crops/cropprotguide 2005herbicide.pdf. Accessed July 25, 2005.

Smith, Vincent H., and James B. Johnson. "Agricultural Chemical Prices in Canada and the United States: A Case Study of Alberta and Montana," Agricultural Marketing Policy Paper No. 4. Agricultural Marketing Policy Center, Montana State University. December 2004.

Smith, Vincent H., and James B. Johnson. "Environmental Regulation, Market Power, and Price Discrimination in the Agricultural Chemical Industry." Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Providence, Rhode Island, July 24-27, 2005. May 9, 2005.

Taylor, Richard D., and Won W. Koo. "United States and Canadian Agricultural Herbicide Costs: Impacts on North Dakota Farmers." Agribusiness and Applied Economics Report No.456. North Plains Trade Research Center. North Dakota State University. May 2001.

Taylor, Richard D., and James A. Gray. "United States and Canadian Agricultural Herbicide Costs:2003 Update." Agricultural Policy Brief No.2, Center for Agricultural Policy and Trade Studies, Department of Agribusiness and Applied Economics, North Dakota State University, September 2003.

United States Department of Agriculture. PS&D database, website. Accessed July 25, 2005.

United States Department of Agriculture, NASS. "Agricultural Chemical Usage, 2004 Field Crops Summary." May 2005.

United States Department of Agriculture, NASS. "Agricultural Chemical Usage, 2003 Field Crops Summary." May 2004.

North Dakota State University
Dept. of Agribusiness & Applied Economics
P.O. Box 5636
Fargo, ND 58105-5636