DOES INTERNATIONAL TRUMP DOMESTIC TRADE? THE SEED POTATO MARKET IN CANADA

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1. Background

The restructuring of domestic support to agriculture in many nations, while being in accordance to recent changes in WTO rules, has slowed trade liberalization and has made uncertain the success of the Doha Development Agenda (DDA) (Chuanmin and Guoqianq, 2007). Given the potential failure of the DDA for multilateral trade negotiations, Canada will likely turn more to strengthening bilateral and regional trade agreements (RTAs). Bilateral agreements and RTAs between the U.S. and other countries have been growing rapidly in recent years (Josling, 2007), partly because of the failures in the multilateral trade agreements. The successes of these agreements have been linked to the small number of countries and stakeholders involved in teh negotiations and the subsequent ease in complying with national policies and institutions (Volltrath, 2003). Such experiences suggest that bilateral agreements and RTAs with the U.S. and other countries provide the greatest potential in meeting the future trade interests of Canadian producers.

While bilateral free trade agreements such as CUSTA/NAFTA have made significant improvements in Canadian-U.S. agricultural trade, substantial tariff and non-tariff trade barriers still exist (Furtan and van Melle, 2004). In particular, recent changes in traceability and labelling requirements, and sanitary and phytosanitary regulations have created major barriers to trade (Vollrath, 2003). The recent BSE disease outbreak in Canada and the 9/11 terrorist attack in the U.S. highlight the increased focus paid to food health and safety issues, terrorism, and their relationship to agricultural trade. For some agricultural imports, the U.S. Bioterrorism Act (BTA) includes technical and quality standards, administrative standards such as food traceability, and requirements on

packaging and labelling (Wieck et al., 2005). These recent events are partly responsible for increasing demands by the U.S. for country of origin labelling and increased health and safety testing on food and other raw materials entering the country.

The recent changes in U.S. policy suggest that exports of Canadian agricultural products to the U.S. are threatened despite strong trade relations between the two countries. In general, it is important that access to U.S. market be maintained, since market access enhances economic opportunities for Canadian producers. It can appear, then, that the preservation of the U.S. market is always in the interests of Canada. This assumption is supported in part by the economic gains for Canadian producers through free trade agreements. It is generally accepted by economists that free trade within North America has improved productivity and increased growth in the Canadian agricultural sector (Vollrath and Hallahan, 2006; Sparling and Caswell, 2006; Vollrath, 2003). In this context, it appears acceptable to incur some added costs resulting from technical trade barriers, such as requirements on packaging and labelling.

In some instances incurring added production costs may not be justified, especially if the requirements of the international market will raise the cost of domestic or inter-provincial trade. For Canada, the added cost to domestic trade is an important consideration. Recent trade data show that the value of domestic agricultural exports in Canada is greater than the value of international agriculture exports, averaging $24.4 billion and $22.9 billion respectively, from 1997 to 2003 (Statistics Canada, 2007a). Furthermore, domestic agricultural trade is responsible for approximately 12% of total domestic export value, while agriculture's share of international export value is only 6%

(Statistics Canada, 2007a). These findings suggest that for Canadian agriculture domestic trade is equally and perhaps more important than international trade.

Because of the need to consider domestic trade issues in Canada, new trade agreements require analysis designed to measure the costs and benefits associated with compliance to foreign trade requirements. For U.S.-Canadian trade, analysis is needed that compares the economic consequences of compliance to trade restrictions and the non-compliance cases that would result in the loss of the U.S. market. While it is clear that maintaining free market access without technical barriers maximizes the net returns in the system, it may not be the case for all agricultural commodities, especially in cases where maintenance of trade comes with increased costs. The economic problem is thus a choice between two scenarios: to comply with U.S. requirements or abandon the U.S. market. At a national level, either choice will have implications on the distribution of economic and farming activities, growth within the agricultural sector, and the viability of agricultural enterprises.

The potential for import barriers on Canadian seed potatoes provides an empirical example that highlights the domestic verses international trade issue. The Canadian seed potato market has come under increasing scrutiny by the U.S. and is an example of an industry facing additional restrictions to maintain access to the U.S. market. This increased focus results from three disease outbreaks in the last twenty years: 1) the Potato Virus Y Necrosis (PVYn) outbreak in Prince Edward Island (PEI) between 1989-92; the potato wart outbreak in PEI in 2000; and 3) the golden nematode outbreak in Quebec in 2006. All of these disease outbreaks resulted in a temporary ban on seed product entering the U.S. and a strengthening of import requirements for seed potatoes after the bans were

lifted. These import requirements were relaxed when the disease outbreaks were contained, but the U.S. seems to be leaning towards making them permanent (e.g. Parliament of Canada, 2001). These increased requirements include: 1) province of origin labelling (POOL) that will require more costly tracing systems than those currently in place; and 2) a ban on bulk shipments with a maximum package weight of fifty pounds (e.g. Canadian Broadcasting Corporation, 2004).

The increased costs of compliance with the U.S. requirements will impose additional tracing and packaging (T&P) costs on seed potato producers in Canada, which will not only affect bilateral trade with the U.S. but also domestic trade within Canada. Because effective traceability systems must be in place for the sale of seed potatoes to all buyers, additional requirements will result in more T&P costs for all seed producers in Canada. Therefore, it is not clear if the preservation of the U.S. market for seed potatoes is worth the increased cost to domestic trade within Canada. The purpose of this study is to assess these issues for the Canadian seed potato market. The objectives are to: (1) determine if the preservation of the U.S. market for seed potatoes is worth the increased cost of trading within Canada; (2) determine to what extent seed potato trade between Canada and the rest of world will offset the loss of the U.S. market; and (3) measure distributional effects for seed production within Canada arising from T&P costs and the loss of the U.S. market.

2. Model

The market impacts of increased T&P costs on the Canadian seed potato industry are estimated using a single commodity, partial equilibrium trade model for the North

American seed potato market. The partial equilibrium model is of the type pioneered by Samuelson (1952), and further developed by Takayama and Judge (1964) into a quadratic programming problem where the objective is to maximize the sum of all regions social welfare (W). Given linear supply and demand relationships with intercept terms α^s and α^d, and slope terms b^s and b^d,

$$P_i^s = \alpha_i^s + b_i^s Q_i^s \tag{1}$$

$$P_i^d = \alpha_i^d + b_i^d Q_i^d \tag{2}$$

for $i=1,2,\ldots k,$ and assuming linear import demand relationships for international markets with intercept term α^m and slope terms b^m,

$$P_j^m = \alpha_j^m + b_j^m Q_j^m \tag{3}$$

for $j = 1,2,\ldots l$.

Let $V = \text{diag}(b^s, b^d, b^m, 0)$, a diagonal matrix with slope terms from equations 1 to 3, and zeros for the remaining elements of the principle diagonal. Let $R = [-\alpha^s, \alpha^d, \alpha^m - c^m, -c^d]$, a vector with intercept terms from equations 1 and 2, the intercept terms from equation 3 minus the per unit transportation costs to ship to the international markets (c_m), and the per unit transportation costs to ship to domestic markets (c_d). Finally let $X = [Q^s, Q^d, Q^m, z]$, a vector of endogenously determined quantities supplied (Q^s) and demanded (Q^d), international exports (Q^m), and domestic trade flows (z). Given this specification, the optimal allocation of output can be achieved by maximizing

$$W = \frac{1}{2} X'VX + X'R \tag{4}$$

subject to the trade flow restrictions

$$Q_i^s = \sum_{j=1}^{k} z_{ij} + \sum_{j=1}^{l} Q_{ij}^m,$$

$$Q_i^d = \sum_{j=1}^{k} z_{ji}$$

where z_{ij} is the quantity supplied from region *i* to region *j*, and Q_{ij}^m is the quantity exported from region *i* to international market *j*.

For this study, the model consists of three Canadian regions; Atlantic (Nova Scotia, New Brunswick and PEI), Central (Quebec and Ontario), and Western (Manitoba, Saskatchewan, Alberta and British Columbia). Seed potatoes in any region can be sold on the local market, to other domestic markets, to the U.S., or to the rest of the world (ROW). Import demand functions for the U.S. and ROW markets, and supply and demand relationships for each Canadian region, are calculated from elasticity estimates, (see Appendix A for details on elasticity estimation).

3. Data and Methods

The data used to estimate the demand and supply relationships, and to validate the model come from Statistics Canada and Agriculture and Agri-Food Canada (AAFC). Demand for seed potatoes for each Canadian region was derived from total certified seed acreage multiplied by an average seeding rate of 25 cwt/acre. Total certified seed acreage data is available from the AAFC online database InfoHort (AAFC, 2007). Domestic trade data for Canada are available from the Potato Market Review (AAFC, various years). Total potato acreage by province, and price indices used to estimate supply and demand elasticities are available from CANSIM (Statistics Canada, 2007b). T&P costs were estimated using studies on traceability costs for grain and fresh produce, adjusted for

potato production and packaging costs (e.g. Fonsah, 2006; and Wilson et al. 2005). Quantity and price data used to calibrate the model are given in Table 1.

Table 1. Average price and quantity data used to calibrate seed potato trade model

1997-2001 Average	Atlantic Canada	Central Canada	Western Canada
Market Price ($CAD/cwt)			
Local	10.88	11.18	13.02
U.S export	12.43	16.51	16.29
ROW export	28.78	17.48	27.17
Quantity Seed Potatoes (cwt)			
Local demand	3,324,028.6	2,064,254.9	2,750,863.2
Local supply	5,903,262.6	1,153,755.6	5,746,853.2
U.S. exports	897,297.2	18,342.2	1,822,663.1
ROW exports	357,482.4	3201.1	43,011.5

Sources: Statistics Canada, 2007b; AAFC, 2007

An important consideration in modelling seed potato trade is the quality differences for seed potatoes grown in different regions and the accurate simulation of trade flows. The data revealed that trade in seed potatoes existed even though the average price difference between regions was less than the approximate transportation cost. This suggests that quality differences exist between seed sold locally and the seed exported to other regions. Positive mathematical programming (Howitt, 1995) was used to calibrate both domestic and international trade flows to account for quality differences. Constraints were added to the model to force the international exports to the average amount for crop years 1997 to 2001. Domestic flows were constrained to the average across only crop years 1997 and 1998, since domestic trade data is not available past 1999. Transportation costs were adjusted by the shadow values of the trade flow constraints. This process can

approximate the premiums paid for seed potatoes and correct remaining errors made in approximating true transportation costs.

Increased T&P costs are included in the model through a shift in Canadian supply curves. To be effective, traceability systems must be in place for the sale of seed potatoes to local, domestic and international buyers and sellers. Therefore, additional traceability requirements will result in more costly T&P systems for all producers in Canada, not just those producing seed potatoes in any particular Province. Shifting the domestic supply curves reflects the added costs of traceability systems which will be incurred on all transactions of seed potatoes. Two increased T&P costs are analyzed: 1) a low cost estimate of $0.04/cwt; and 2) a high cost estimate of $0.76/cwt. From 2000 to 2006 the average price received for seed potatoes in Canada was approximately $12.00/cwt (Statistics Canada, 2007b). The two traceability systems therefore account for approximately 0.7% and 6.3% of the average market price, respectively.

The low tracing cost estimate of $0.04/cwt accounts for a rubber stamp that would need to be added to the package that identifies the Province of origin. Under this estimate, the one-step forward, one-step back paper tracing system currently in place would be maintained. The high cost estimate of $0.76/cwt includes the increased packaging cost plus the implementation of a bar code tracing system (e.g. EAN.UCC, 2003). Estimates of the costs of implementing this system are provided by Wilson et al. (2005). This system requires producers to implement an electronically based tracing system with additional scanning equipment and software. Excluded from this estimate is the radio frequency identification (RFID) tracing technology, which would add an additional $4.00/cwt to the T&P costs (Pape et al., 2003).

Of the two estimates, the high cost estimate seems most plausible. The one-step forward one-step back paper based system has been questioned as a system that does not respond quickly to disease outbreaks. In contrast, the bar code method is becoming the new standard for tracing systems.

4. Results

Tables 2 and 3 present the simulation results of the seed potato trade model. Three T&P cost estimates are examined; i) the low cost estimate of $0.04/cwt (column 2); ii) the high cost estimate of $0.76/cwt (column 4), and iii) an estimate of the traceability cost that would result in the same loss to the domestic market as a ban on U.S. seed potato trade (column 3). Column 3 is an estimate of the maximum Canadian seed potato producers and consumers would be willing to pay to preserve the U.S. seed potato market, assuming the distribution of benefits and costs among Canadian seed potato producers and consumers does not matter in such considerations. These results are compared against the case where there is a ban on U.S. trade in seed potatoes (column 5).

Market Impacts

Table 2 gives the market price and quantity impacts from the various trade scenarios. For the baseline results (see Appendix B), inter-provincial exports occur from the Atlantic region to both the Central and Western Canadian regions. Estimated trade flows from the Atlantic to the Central region were approximately twice the volume sold on the local market in the Atlantic, while only a small amount of seed potatoes flow from Atlantic to Western Canada. Baseline results show that Atlantic Canada exports the largest volume to the ROW, and that Western Canada is the largest exporter to the U.S.

The baseline results are consistent with the average price and quantities, from 1997 to 2001.

Estimated market impacts for both the high and low cost estimates show negative impacts on market quantity and positive effects on seed potato price. For the low cost estimate of $0.04/cwt, the market effects are in general small, reflecting the small increase in traceability cost. Results for this scenario show that a $0.04/cwt increase in T&P cost will result in a decrease in quantity supplied of 0.17% in Atlantic Canada, 0.13% in Central Canada, and 0.16% in Western Canada. A comparison of the supply impacts show that 90% of the losses in quantity supplied occur in Western and Atlantic Canada. Results further show that the $0.04/cwt increase in T&P cost will cause a decrease in quantity demanded of 0.08% in Atlantic Canada, 0.09% in Central Canada, and 0.07% in Western Canada. In addition, the impacts on Canadian seed potato demand are evenly distributed across regions. Results for the low cost scenario also show an increase in seed potato price of $0.03/cwt for all regions.

As expected, the model results show that domestic and international trade is negatively affected by additional T&P cost. For the low cost scenario the results show a decrease in exports from the Atlantic to Central Canada of 0.01%, and a decrease in Exports to Western Canada of 77.8%. Although most of the exports to the Western region are lost, exports to this region represent a relatively small amount of output from the Atlantic region. For U.S. exports, results show that a $0.04/cwt increase in T&P will reduce exports from Atlantic Canada by 0.47%, reduce exports from Central Canada by 0.35%, and reduce exports from Western Canada by 0.36%. However, in term of export volume almost all of the losses in U.S. exports occur for Western and Atlantic Canada.

For ROW exports, results from the low cost scenario show that the increase in T&P will reduce exports from Atlantic Canada by 0.2%, reduce exports from Central Canada by 0.33%, and reduce exports from Western Canada by 0.21%. The losses in export volume to the ROW are notably larger for Atlantic Canada.

In general, the market impacts resulting from the high cost scenario of $0.76/cwt are substantially larger in magnitude than the low cost scenario. Results for this scenario show that a $0.76/cwt increase in T&P cost will cause a decrease in quantity supplied of 3% for Atlantic Canada, 2.3% for Central Canada, and 3.2% for Western Canada. Similar to the low cost scenario, the supply impacts mostly occur for Western and Atlantic Canada. Results further show that the $0.76/cwt increase in T&P will cause a decrease in quantity demanded of approximately 1.7% for both Atlantic and Central Canada, and 1.2% in Western Canada. In addition, results for the low cost scenario show an increase in seed potato price of $0.53/cwt for Atlantic and Central Canada, and an increase in price of $0.49/cwt for Western Canada.

For the high cost scenario the results show that an increase in T&P cost of $0.76/cwt will decrease exports from Atlantic to Central Canada by 0.77%, and exports from the Atlantic to Western Canada will not occur. For U.S. exports, the high cost scenario results show that the increase in T&P will reduce exports from the Atlantic by 9.2%, reduce exports from Central Canada by 6.9%, and reduce exports from Western Canada by 6.5%. However, in term of export volume almost all of the losses in U.S. exports occur for Western and Atlantic Canada. For ROW exports, results for the high cost scenario show that the increase in T&P cost will reduce exports from the Atlantic by 4%, reduce exports from Central Canada by 6.6%, and reduce exports from Western

Canada by 3.9%. Similar to the low cost scenario, the losses in export volume to the ROW are notably larger for Atlantic Canada.

Results for the non-compliance scenario (no U.S. seed potato trade) show varying market effects across Canadian regions in terms of magnitude and direction. Results for this scenario show that non-compliance will cause a decrease in quantity supplied of 11.7% in Atlantic Canada, 9% in Central Canada, and 34% in Western Canada. The market impact results therefore show that non-compliance will have the greatest effect in Western Canada. Results further show that non-compliance will cause an increase in quantity demanded of 2.7% in Atlantic Canada, 2.8% in Central Canada, and 7% in Western Canada. The market price for seed potatoes will decrease by $0.88/cwt in the Atlantic and Central Canada, and $2.78/cwt in Western Canada. These results therefore show that table stock and processing potato producers will benefit by the loss of the U.S. market for seed potato.

For the non-compliance scenario the results show that the loss in the U.S. market will greatly increase exports from Atlantic to Central Canada. Based on the results, exports to Central Canada will increase 23.3%. For ROW exports, results show that the U.S. ban will increase exports from the Atlantic by 6.6%, increase exports from Central Canada by 10.8%, and increase exports from Western Canada by 21.9%. In terms of volume, the increase in exports to the ROW is notably larger for Atlantic Canada.

Table 2. Estimated changes in trade flows resulting from increased tracing and packaging costs (millions of lbs.)

	Traceability and Packaging Cost							
	$0.04/cwt		$0.37/cwt		$0.76/cwt		No U.S. Trade	
Market Impact	Total Change	%	Total Change	%	Total Change	%	Total Change	%
Atlantic Canada								
Quantity Supplied	-0.91	-0.17	-7.79	-1.46	-16.02	-3.00	-62.57	-11.72
Quantity Demanded	-0.29	-0.08	-2.73	-0.80	-5.66	-1.66	9.32	2.74
U.S. Exports	-0.42	-0.47	-3.98	-4.43	-8.26	-9.20	-89.81	-100.00
ROW Exports	-0.07	-0.20	-0.69	-1.92	-1.42	-3.97	2.34	6.55
Central Canada Exports	-0.01	-0.01	-0.24	-0.35	-0.52	-0.77	15.73	23.34
Western Canada Exports	-0.12	-77.79	-0.15	-100.00	-0.15	-100.00	-0.15	-100.00
Market Price ($/cwt)	0.03	0.27	0.26	2.55	0.53	5.30	-0.88	-8.73
Central Canada								
Quantity Supplied	-0.17	-0.13	-1.48	-1.11	-3.05	-2.29	-11.90	-8.96
Quantity Demanded	-0.17	-0.09	-1.65	-0.83	-3.42	-1.73	5.63	2.84
U.S. Exports	-0.01	-0.35	-0.06	-3.34	-0.13	-6.93	-1.83	-100.00
ROW Exports	-0.001	-0.33	-0.01	-3.16	-0.02	-6.55	0.03	10.79
Market Price	0.03	0.22	0.26	2.07	0.53	4.29	-0.88	-7.06
Western Canada								
Quantity Supplied	-0.74	-0.16	-7.40	-1.56	-15.42	-3.25	-160.70	-33.89
Quantity Demanded	-0.20	-0.07	-1.75	-0.61	-3.61	-1.25	20.36	7.07
U.S. Exports	-0.65	-0.36	-5.72	-3.14	-11.80	-6.48	-182.16	-100.00
ROW Exports	-0.01	-0.21	-0.08	-1.88	-0.17	-3.88	0.94	21.92
Market Price	0.03	0.24	0.24	2.12	0.49	4.37	-2.78	-24.66

Notes: cwt = hundredweight (100 lbs, = 45.45 kg). Baseline model prices and quantities are an average of crop years 1997 to 2001.

Welfare Impacts

In order to accurately reflect the economic impacts of the various trade scenarios, welfare measure were calculated based on the trade model results. Welfare measures include changes in consumer surplus, producer surplus, and total welfare resulting from the three T&P cost estimates, and from a ban on U.S. trade. The welfare changes are relative to the baseline situation of no additional traceability requirements for Canadian producers. These economic measures are presented in Table 3 for the three Canadian regions, as well as for the U.S. and the ROW. For the U.S. and the ROW, the social welfare measure represents the gains from trade with all of Canada.

For the low cost estimate of $0.04/cwt, the welfare effects are generally small, reflecting the small increase in traceability cost. Results for this scenario show that a $0.04/cwt increase in T&P cost will decrease both producer and consumer surplus in Canada. In general the results show that losses in consumer surplus will be slightly larger in magnitude than producer surplus. The $0.04/cwt increase in T&P will result in a decrease in social welfare of 0.21% in Atlantic Canada, 0.19% in Central Canada, and 0.18% in Western Canada. In terms of value, the welfare losses in Western and Atlantic Canada are twice that of Central Canada.

Results from the low cost scenario show the added T&P cost will decrease Canadian social welfare by $370,000 or 0.2%. Compared to the no U.S. trade results, the estimated impacts of the low T&P cost on the seed potato market welfare justify preservation of trade in seed potato with the U.S. This figure is approximately one-tenth of the $3.4 million Canada would lose if imports of seed potatoes into the U.S. were banned due to non-compliance. In addition, the distribution of losses across Canadian

regions is fairly even, which may improve the acceptability of this scenario at the provincial level. Furthermore, the U.S. reduction in social welfare is relatively small, indicating that this scenario is economically feasible and thus a credible U.S. policy scenario.

The magnitude of welfare losses from the high cost T&P system are much higher than the low cost system. Similar to the low cost scenario, results for the high cost estimate of $0.76/cwt show that the increase in T&P cost will decrease both producer and consumer surplus in all Canadian regions. In general, the results show that losses in consumer will be larger in magnitude than the loss in producer surplus. In particular, the loss in consumer surplus in Central Canada is over three times larger than the loss in producer surplus. The $0.76/cwt increase in T&P will cause a decrease in social welfare of 4% in Atlantic Canada, 3.6% in Central Canada, and 3.5% in Western Canada. Similar to the low cost scenario, the loss in welfare in Central Canada is approximately half of the loss occurring in both Western and Atlantic Canada.

The traceability cost of $0.76/cwt is estimated to decrease Canadian social welfare by $7 million or 3.7% from the baseline scenario. Compared to the no U.S. trade results, the estimated impacts of the high T&P cost on the seed potato market welfare do not justify preservation of trade in seed potato with the U.S. The $3.4 million Canada would lose if imports of seed potatoes into the U.S. were banned due to non-compliance is half of the amount lost if the high cost tractability system was in place. This finding suggests that Canada should consider non-compliance to potential U.S. POOL regulations if the traceability costs are equal to or above the high cost estimate, but compliance may be the best option so long as compliance costs are low. Using total Canadian social

welfare impacts as the sole criteria, it is estimated that $0.37/cwt is the maximum additional traceability cost that farmers should be willing to pay in order to preserve the U.S. market. This estimate indicates that the costs of electronically based tracing systems need to be reduced in half before compliance to additional trade standards become economically feasible.

The conclusion that compliance may not be in the best interest to Canada under high compliance costs should be tempered by regional distributional considerations. The economic consequence from non-compliance varies greatly across Canadian regions. Proportionally large decreases in producer surplus will occur if there is a U.S. trade ban. Producer surplus will decrease in Atlantic Canada by 22.1%, decrease in Central Canada by 17.1%, and decrease in Western Canada by 56.3%. However, due to increases in consumer surplus the welfare losses will be largely mitigated. In Atlantic Canada, results show that non-compliance will decrease social welfare in the Atlantic by 1.8% and in Western Canada by 3.5%. In Central Canada the rise in consumer surplus is greater than the decline in producer surplus, generating an increase in social welfare for the region of 1.8%. The results therefore show that the U.S. trade ban will have significant distributional effects. Unless effective methods can be enacted whereby gainers compensate losers, it is likely that the overall small change in welfare caused by non-compliance may not be evenly distributed across regions within Canada. Given the overall economic losses in Western Canada and Atlantic Canada, along with the gains in Central Canada, a non-compliance policy may not be feasible because of distributional considerations.

Table 3. Estimated Welfare Impacts of Increased Tracing and Packaging Costs (Millions of Canadian Dollars)

	Traceability and Packaging Cost							
	$0.04/cwt		$0.37/cwt		$0.76/cwt		No U.S. Trade	
Welfare Change	Total Change	%	Total Change	%	Total Change	%	Total Change	%
Atlantic Canada								
Consumer Surplus	-0.09	-0.17	-0.87	-1.59	-1.81	-3.29	3.04	5.55
Producer Surplus	-0.07	-0.34	-0.58	-2.89	-1.19	-5.91	-4.43	-22.06
Social Welfare	-0.16	-0.21	-1.46	-1.94	-2.99	-3.99	-1.38	-1.85
Central Canada								
Consumer Surplus	-0.05	-0.18	-0.51	-1.66	-1.05	-3.42	1.77	5.77
Producer Surplus	-0.02	-0.26	-0.14	-2.22	-0.30	-4.53	-1.12	-17.11
Social Welfare	-0.07	-0.19	-0.65	-1.75	-1.35	-3.62	0.65	1.75
Western Canada								
Consumer Surplus	-0.08	-0.14	-0.69	-1.21	-1.41	-2.49	8.29	14.65
Producer Surplus	-0.06	-0.31	-0.60	-3.10	-1.25	-6.40	-10.96	-56.30
Social Welfare	-0.14	-0.18	-1.29	-1.69	-2.66	-3.49	-2.66	-3.50
Total Canada								
Consumer Surplus	-0.22	-0.16	-2.07	-1.46	-4.27	-3.00	13.10	9.22
Producer Surplus	-0.15	-0.32	-1.33	-2.88	-2.73	-5.92	-16.50	-35.83
Social Welfare	-0.37	-0.20	-3.40	-1.80	-6.99	-3.72	-3.40	-1.80
U.S.								
Social Welfare	-0.07	-0.77	-0.66	-6.86	-1.34	-13.91	-9.61	-100.00
ROW								
Social Welfare	-0.01	-0.41	-0.10	-3.80	-0.21	-7.80	0.46	17.13

Notes: cwt = hundredweight (100 lbs, = 45.45 kgs) . Baseline model prices and quantities are an average of crop years 1997 to 2001. All figures are expressed in millions of $CDN.

The results for the non-compliance scenario also show that the value of trade with the ROW does not increase substantially an enough in the non-compliance case to offset the loss of the U.S. market. The findings highlight that the U.S. is by far the largest international market for Canadian seed potatoes, and an important market for producers in Western Canada. Finally, it is estimated that a ban on seed potatoes entering the U.S. would result in a net loss to the U.S. of $9.61 million. This loss is incurred by U.S. non-seed potato producers who will no longer be able to buy high quality Canadian seed potatoes. Furthermore, the losses to the U.S. producers are approximately threefold the losses incurred by Canadian producers. It may not be in the U.S. potato producers' interest to force compliance on Canadian seed potato producers; and hence the U.S. position may not be credible. However, the interests of U.S. potato producers may be outweighed by those of U.S. seed potato producers who would gain as a result of an import ban.

5. Conclusions

Bilateral agreements and RTAs with the U.S. and neighbouring countries provide the greatest potential in meeting the trade interests of Canadian producers, however, even with more integrated markets, exports of Canadian agricultural products to the U.S. are always threatened by protectionist interests. Recent trade concerns have led in part to the increased demand by the U.S. for country of origin labelling and increased health and safety testing on food and other raw materials entering the country. Policy decisions over compliance to U.S. trade requirements should be considerate of the costs and benefits

associated with compliance to additional U.S. trade restrictions, because of potential impacts on domestic trade within Canada.

For Canadian seed potatoes, the increased costs of compliance with the U.S. requirements will impose additional tracing and packaging costs on seed potato producers in Canada, which will not only affect bilateral trade with the U.S. but also domestic trade within Canada. The purpose of this study was to address these issues within the Canadian seed potato market. The results indicate that it may not be in Canada's interest to comply with increased import requirements suggested by the U.S.. Increased import requirements will affect both domestic as well as international trade. The loss of domestic production and trade resulting from the increased requirements is twice the loss that would result if this market were abandoned due to non-compliance. It may be in Canada's interests to abandon the U.S. market in order to preserve domestic trade. Furthermore, the results indicate that the U.S. may suffer from a ban on imports at least as much as Canada, so that the U.S. position may not be a credible threat. Canada produces a high quality seed potato that is not easily produced elsewhere. U.S. potato producers will suffer losses if they are no longer able to buy these high quality Canadian seed potatoes.

6. Literature Cited

Agriculture and Agri-Food Canada, 2007. *Infohort*. Available at: http://www3.agr.gc.ca/apps/infohort/index.cfm?action=dspPtDsc&lang=eng, Accessed on: September 4, 2007.

Agriculture and Agri-Food Canada, Various years. *Potato Market Review.* Agriculture Canada, Market Information Service, Ottawa. (discontinued in 1999)

Canadian Broadcasting Corporation. 2004. *Spud Scare*. Available at: http://www.cbc.ca/news/background/agriculture/spudscare.html. Accessed on: October 2, 2006.

Chuanmin, S., and C. Guoqiang. 2007. World agri-trade policy readjustment since the Uruguay round and the policy implications. *Outlook on Agriculture* 36(2): 87-92.

EAN.UCC. 2003. *About EAN International and the Uniform Code Council, Inc*. Available at: http://www.ean-ucc.org/home.htm. Accessed on: November 24, 2003.

Fonsah, E.G. 2006. Traceability: formulation and implementation of an economic efficient system in the fruit and vegetable industry. *Choices*. 21(4): 243-248.

Furtan, W.H., and B.M. van Melle. 2004. Canada's agricultural trade in North America: do national borders matter? *Review of agricultural economics* 26(3): 317-331

Greene, W.H. 2000. *Econometric Analysis*. 4th ed. Prentice-Hall, Inc. New Jersey.

Howitt, R.E. 1995. Positive mathematical programming. *American Journal of Agricultural Economics* 77: 329-342.

Josling, T. 2007. Multilateral and regional trade agreements: competing trade structures? *EuroChoices* 6(2): 26-27.

Pape W.R., B. Jorgenson, D.Larson and R. Boyle. 2003. Is traceability too expensive? *Food Traceability Report*. 3(1): 16-17.

Parliament of Canada. 2001. *Standing Committee On Agriculture And Agri-Food Evidence* [Recorded by Electronic Apparatus]. Tuesday, March 27, 2001. Available at: http://cmte.parl.gc.ca/cmte/committeepublication.aspx?sourceId=54593. Accessed on: September 3, 2007.

Samuelson, P.A. 1952. Spatial price equilibrium and linear programming. *The American Economic Review*. 42(1): 283-303.

Sparling, D.H., and J.A. Caswell. 2006. Risking market integration without regulatory integration: the case of NAFTA and BSE. *Review of Agricultural Economics* 28(2): 212-228.

Statistics Canada. 2007a. *CANSIM database*. Interprovincial and international trade flows at producer prices, annual (dollars). Data table 386-0002. Available at: http://cansim2.statcan.ca. Accessed on: August 16, 2007.

Statistics Canada. 2007b. *CANSIM database*. Data tables 001-0014, 002-0022, 328-0014, 328-0001. Available at: http://cansim2.statcan.ca. Accessed on: August 16, 2007.

Takayama, T., and G. Judge. 1964. Spatial equilibrium and quadratic programming. *Journal of Farm Economics*. 46(1): 67-93.

Vollrath, T.L. 2003. North American agricultural market integration and its impacts on the food and fibre system. Market and Trade Economics Division, Economic Research Services, U.S. Department of Agriculture, Information Bulletin No. 784.

Vollrath, T., and C. Hallahan. 2006. Testing the integration of U.S.-Canadian meat and livestock markets. *Canadian Journal of Agricultural Economics* 54(1): 55-79

Wieck, C., B. Rudloff and T. Wahl. 2005. The bioterrorism act of the USA and international food trade: evaluating WTO conformity and effects on bilateral imports. Selected paper for 2005 annual meetings of the Western Agricultural Economics Association, San Francisco, CA, July 6-8, 2005.

Wilson W.W., X. Henry and B.L. Dahl. 2005. *Costs and Risks of Conforming to EU Traceability Requirements: The case of Hard Red Spring Wheat*. Agribusiness & Applied Economics Report No. 564. Department of Agribusiness and Applied Economics, Agricultural Experiment Station, North Dakota State University.

Appendix A

This section provides details on elasticity estimates used to construction the partial equilibrium trade model. A review of the literature revealed no suitable elasticity estimates for seed potato supply or demand. Therefore, this research required that estimation of supply and demand elasticities for seed potato supply, demand and import demand. Elasticity estimates for the PEI seed potato sector were previously calculated by the authors using ordinary least squares. These estimates were used as proxies for other regions were applicable. Given that technologies used in seed potato production across Canada do not differ substantially, supply and factor demand elasticity estimates are likely similar. The elasticity for world import demand is also likely to be close to the U.S. import demand.

Data collection for the estimation process revealed limitations in the quantity and quality of seed potato data in Canada. These limitations forced the use of unit values for quantity variables and for the price for seed potato exports. Limited observations for seed potato data would have resulted in a degrees of freedom problem if all variables were included in the econometric models. Thus, several specifications were explored, and the variables deemed most significant were included in the final models. Despite these issues, all parameter estimates on seed potato price were statistically significant.

All models were estimated in log-linear form. Variable definitions are presented in table A.1, regression results for seed potato supply are presented in table A.2, result for seed potato demand are presented in table A.3, and import demand results are presented in table A.4. Given the estimation in logarithmic form the parameter estimates for demand and import demand are elasticities. The supply elasticity is calculated using

Nerlove's partial adjustment principle (Greene, 2000). This yields a long-run supply elasticity of 0.5232/(1-0.6003) = 1.309.

Table A.1 Definition of variables used in econometric estimations

Variable	Definition
P^s_t	Seed potato price index
P^l_t	farm labour price index
P^b_t	farm building and fencing price index
P^m_t	farm machinery and motor vehicle price index
P^f_t	Fertilizer price index
P^p_t	Pesticide price index
D^{pw}	Potato Wart dummy variable (crop years 1999-2000 and 2001-2003)
D^{pvyn}	PvYn dummy variable (crop year 1992-1993)
P^x_t	average price of seed potato exports ($/cwt)
Q_t	quantity of seed potato (cwt)

Table A.2 Regression results for seed potato demand in PEI

Variable	Parameter Estimate	*t*-value
Constant	14.73 *	283.6
P^s_t	-0.40	-2.37
P^l_t	-3.91 *	-3.25
P^b_t	2.21 *	2.72
P^m_t	1.64	1.84
Time trend	-0.02	-1.76
D^{pw}	-0.13	-2.11
Model Statistics:		
SSE	0.05	
R2	0.82	
d.f.	8	
F-stat	6.04	

* Significant at 5% level

Note: dependent variable is quantity of seed potatoes; model was estimated for the years 1992-2006; all prices were normalized by the potato output price index

Table A.3 Regression results for seed potato supply in PEI

Variable	Parameter Estimate	*t*-value
Constant	0.62 *	4.30
Q_{t-1}	0.60 *	4.32
P^{s}_{t-1}	0.52 *	5.42
P^{f}_{t-1}	1.44 *	4.15
P^{p}_{t-1}	1.94 *	2.95
P^{m}_{t-1}	-1.52 *	-1.98
Time trend	-0.01	-0.97
Model Statistics:		
SSE	0.02	
R2	0.90	
d.f.	7	
F-stat	10.78	

* Significant at 5% level

Note: dependent variable is quantity of seed potatoes; model was estimated for the years 1992-2006; all prices were normalized by the total input price index

Appendix A.4 Regression results for U.S. seed potato import demand for PEI

Variable	Parameter estimate	*t*-value
Constant	18.46 *	8.96
P^{x}_{t}	-2.14 *	-2.87
D^{pvyn}	-5.01 *	-7.28
Time trend	-0.11 *	-3.43
Model Statistics:		
SSE	5.72	
R2	0.84	
d.f.	14	
F-stat	24.61	

* Significant at 5% level

Note: dependent variable is quantity of seed potato exports to the U.S.; model was estimated for the years 1989-2006; all prices were normalized by the potato output price index

Appendix B

Appendix B.1 Baseline Partial equilibrium model results for North American seed potato market

	Model Result
Atlantic Canada	
Quantity Supplied	5339567
Quantity Demanded	3408024
U.S. Exports	898131.9
ROW Exports	357652.6
Central Canada Exports	674212.7
Western Canada Exports	1545.989
Market Price ($/cwt)	10.0836
Central Canada	
Quantity Supplied	1328733
Quantity Demanded	1981410
U.S. Exports	18335.98
ROW Exports	3199.65
Atlantic Canada Exports	0
Western Canada Exports	0
Market Price ($/cwt)	12.4736
Western Canada	
Quantity Supplied	4741258
Quantity Demanded	2878243
U.S. Exports	1821562
ROW Exports	42999.27
Atlantic Canada Exports	0
Central Canada Exports	0
Market Price ($/cwt)	11.2836

Note: All quantities hundred weight (cwt)