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## **An Economic Assessment of the BSE Crisis in Canada: Impact of Border Closure and BSE Recovery Programs\***

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This article assesses the economic consequences of three alternative government responses to the BSE crisis in Canada: 1) expansion in slaughter capacity; 2) partial destruction of the cattle herd; and 3) deficiency payments. Each of these policies is evaluated under four different border situations: 1) autarky; 2) free trade in young beef only; 3) free trade in young beef and cattle; and 4) complete free trade. The results of the policy analysis are quite sensitive to the border assumptions, making it impossible to select a “best” policy without perfect foresight with respect to the timing and the extent of the border opening.

Keywords: BSE, cattle and beef, partial equilibrium model, simulation, trade ban

## **Introduction**

Canadian cattle and beef producers became increasingly dependent on export markets as a result of major policy changes in the 1980s and 1990s. The elimination of the Crow Rate transportation subsidy in 1995 enabled cattle producers to more easily exploit naturally occurring comparative advantages in sourcing feed grains, especially in Southern Alberta. Prior to the termination of the transportation subsidy, the expansion of cattle feeding activities had been promoted by federal and provincial governments through 1) a national, tripartite, margin-support program for beef cattle; 2) subsidies on feed grains; 3) subsidies for slaughter plant construction; and 4) programs for beef export promotion. The pursuit of these export-oriented policy objectives coincided with the negotiation of the Canada–United States Free Trade Agreement (and later NAFTA), which granted preferential market access to goods produced within the member countries while maintaining tariffs on cattle and tariff-rate quotas on beef imports from outside. The combination of export-oriented domestic policies plus preferential and more secure access to the United States and Mexican markets resulted in rapid expansion in cattle and beef production in Canada and the seamless flow of increasing quantities of cattle and beef among the three NAFTA members.

Unfortunately, the discovery of bovine spongiform encephalopathy (BSE) in Alberta revealed the shortcomings of the export-oriented strategy. On May 20, 2003, the governments of 34 countries, including the United States and Mexico, banned imports of ruminants and ruminant products originating in Canada. As a result, nearly all export markets for live animals and red meat produced in Canada were lost. The resulting dislocation in the Canadian cattle industry was unprecedented and had catastrophic implications for the domestic supply chain.

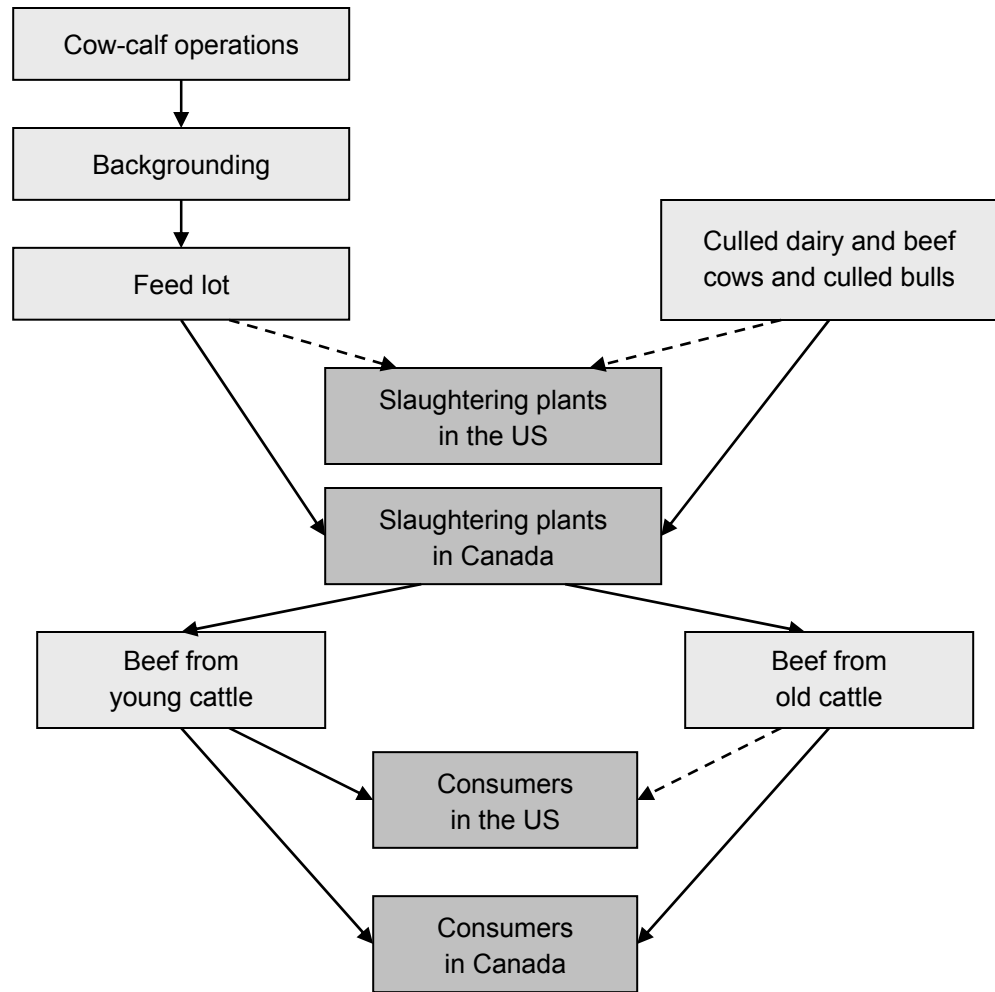
Before May 20, 2003, cattle raised in Canada were slaughtered in processing plants in the United States and in Canada. With few barriers to trade, net exports of cattle from Canada to the United States, which had been small or negative before 1987, grew to 1.5 million head per year by 2002 (Canfax, Agriculture and Agri-Food Canada (annual)). Annual net exports of beef, again of minor magnitude until 1995, grew to 350,000 tonnes by 2002, the equivalent of nearly one-half of the total amount of beef produced in Canada (Canfax, Agriculture and Agri-Food Canada (annual)). When BSE was confirmed in Canada, lucrative lines of production aimed at satisfying foreign consumers became unprofitable. Cattle prices at one Alberta auction dropped from \$1.20/lb to \$0.32/lb before most cattle were taken off the market. Slaughter plants in Canada lost foreign sales, and beef shipments in transit were halted by the

Canadian government. Some live animals already in the United States were returned to Canada.

The extraordinary financial collapse of the beef sector could have been much worse had the United States Department of Agriculture not re-admitted imports of beef muscle cuts from ruminants under 30 months of age on September 10, 2003. With the border partially opened, the quantity and value of beef exports soon approached pre-BSE volumes. Access to the U.S. market improved further on July 18, 2005, when imports of live ruminants under 30 months of age were re-permitted, and exports of young animals to the United States also returned to levels comparable to those prior to the BSE discovery. While exports of cattle under 30 months of age have risen to levels similar to 2002 levels (averaging 8,803 head/week in 2006 vs. 8,802 head/week in 2002), as of October 2007 the border remains closed for older ruminants.<sup>1</sup>

One consequence of restrictions in the United States on imported Canadian cattle and beef is that the cattle market in Canada is now segregated by age: young cattle, less than 30 months old (calves, steers, and heifers), and old cattle, more than 30 months old (bulls and cows). Currently, older cattle cannot be processed in slaughter plants that also process young cattle for export markets. Figure 1 illustrates the resulting distinct, age-specific marketing channels for cattle and beef. In Figure 1 the arrows indicate the marketing channels prior to the discovery of BSE. Following the discovery of BSE the marketing channels indicated by a dashed arrow were closed and this is what we treat as the baseline scenario.

The financial fallout from the discovery of BSE in Canada has motivated a debate about the response governments ought to have taken to restore and ensure the long-run viability of Canada's cattle and beef sector. The purpose of this article is to provide an assessment of three proposed alternative policy responses on the basis of their respective economic consequences. This assessment involves four alternative assumptions about border policy: 1) free trade in young beef only, the baseline situation; 2) autarky; 3) free trade in young beef and cattle; and 4) free trade. To this end, a static, multimarket, partial equilibrium model of the Canadian cattle and beef markets is used to quantify the economic impacts of the discovery of BSE and the impacts of three possible BSE recovery programs. The proposed policy responses include 1) government subsidization of improvements in slaughtering capacity; 2) a coordinated mass cull of part of the Canadian beef cow herd; and 3) the provision of deficiency payments to ranchers based on the slaughter of old cattle.



**Figure 1** Marketing channels for cattle and beef in Canada.

### Framework for Analysis

The conceptual analysis consists of a partial equilibrium model of two vertically related markets (cattle and beef) and two horizontally related markets (young and old). These four interrelated markets are illustrated in figure 2. The cattle supply curves, in the top two panels of figure 2, show how the supply of old ( $S_{oc}$ ) and young ( $S_{yc}$ ) cattle change as the breeding herd expands or contracts with changes in profitability. The slaughter demand curves for both old ( $D_{oc}$ ) and young ( $D_{yc}$ ) cattle are kinked and become perfectly price inelastic at the point of maximum slaughter capacity (top two panels of figure 2). The quantities supplied of old ( $S_{ob}$ ) and young ( $S_{yb}$ ) beef are determined by the quantities demanded (slaughtered) of old ( $D_{oc}$ ) and

young ( $D_{yc}$ ) cattle by processors, given the assumption of a fixed-proportions technology. The bottom two panels in figure 2 show the quantities of old ( $S_{ob}$ ) and young ( $S_{yb}$ ) beef supplied domestically as well as the domestic demands for both kinds of beef ( $D_{ob}$  and  $D_{yb}$ ).

Border restrictions influence the prices and the quantities demanded and supplied of cattle and beef. Under free trade, all markets face world market prices. In figure 2 the world market prices for old cattle, young cattle, old beef, and young beef are given by  $P_{oc}^w$ ,  $P_{yc}^w$ ,  $P_{ob}^w$ , and  $P_{yb}^w$ , respectively. As drawn, under free trade Canada exports all four products. Conversely, under autarky, prices are determined by the intersection of domestic demand and supply in each market. In figure 2 the autarky prices of old cattle, young cattle, old beef, and young beef are given by  $P_{oc}^d$ ,  $P_{yc}^d$ ,  $P_{ob}^d$ , and  $P_{yb}^d$ , respectively. Note that the processing capacity constraint is only binding in the market for old cattle (top left panel of figure 2). The baseline equilibrium in 2004 is characterized by internally determined prices for all cattle and for old beef. World prices determine only the quantities demanded and supplied of young beef. Under partial trade liberalization (trade in young beef and cattle), prices in the old cattle and beef markets are determined domestically while young cattle and beef face world prices.

The three alternative policy responses are modeled in the following way:

- i. Expand slaughter capacity: increase the intercept of the old cattle demand function and the capacity limit by 10 percent.
- ii. Destroy a part of the cattle herd: shift the breeding inventory supply schedule to the left by 10 percent, which shifts the supply curve for old and young cattle to the left.
- iii. Subsidize the slaughter of old cattle: create a positive price wedge between the price producers receive and the price packers pay for old cattle.

Details of the empirical model, data used, and results under alternative policy responses are provided in the technical annex. The following sections discuss the key results.

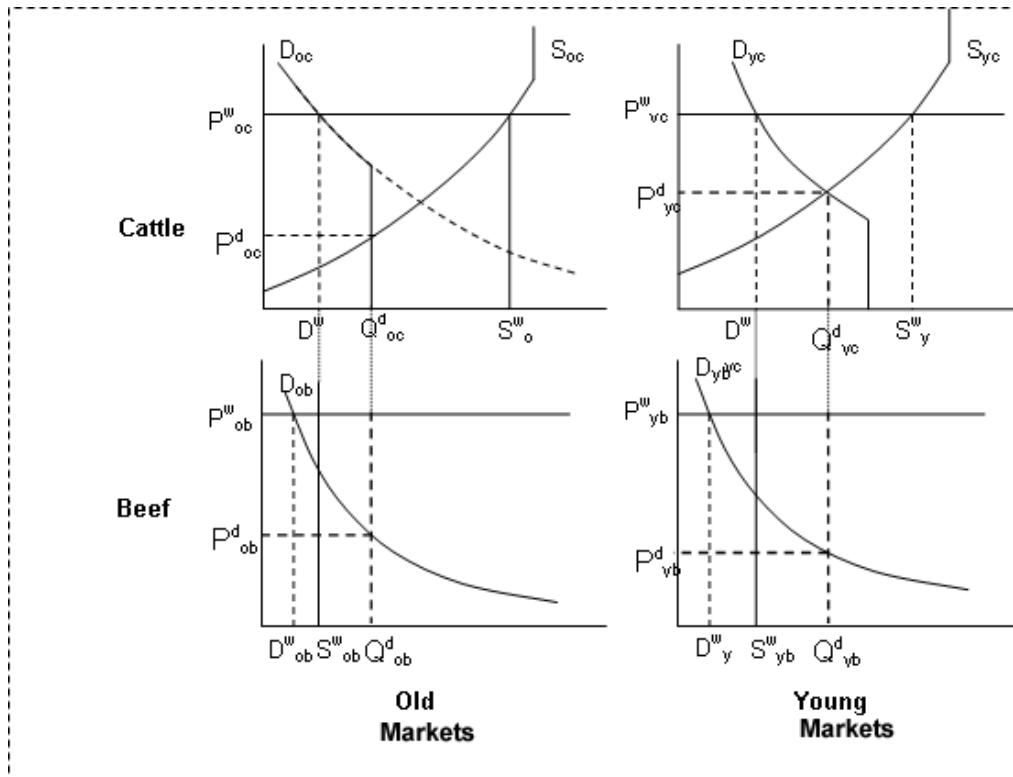


Figure 2 Equilibrium in cattle and beef markets under various scenarios.

### Baseline Equilibrium

The baseline scenario replicates market conditions in 2004, when beef produced from young cattle could be exported from Canada but live cattle and beef from old cattle could not. As imports of live cattle from Canada were not permitted in the United States, all the beef produced in Canada was derived from Canadian animals processed in Canadian slaughtering plants. In other words, the quantity demanded domestically for cattle equaled the domestic quantity supplied.

In 2004, 518 thousand head of old cattle and 3,738 thousand head of young cattle were slaughtered in Canada. The average per head price paid for old cattle was \$321 while young cattle fetched an average of \$1,098.<sup>2</sup> The production of beef from old cattle totaled 162.8 thousand tonnes, all of which was consumed in Canada. The production of beef from young cattle was 1,280.31 thousand tonnes, of which 466.37 thousand tonnes were exported. The remaining 813.94 thousand tonnes were consumed in Canada. Suppliers of young beef in Canada received an average of \$4,960 per tonne, an amount equal to the beef price in the United States less transportation and other transaction costs. The domestically determined price of old beef was \$2,507 per tonne. The Canadian cattle industry earned \$4,271 million in total

revenues. Cattle producers' surplus equaled \$3,613 million, which was distributed between producers of old cattle (\$165.6 million) and producers of young cattle (\$3,448 million).<sup>3</sup>

## **Outcomes with Alternative Trade Regimes**

**B**y changing the restrictions on beef and cattle trade, the empirical model can be used to quantify the effects of three alternative trade regimes: autarky (no trade in cattle or beef), partial free trade (trade in young beef and cattle only), and free trade (trade in all cattle and beef).

### *Trade Regime 1: Autarky*

Suppose the United States border had been closed to young Canadian beef in 2004. With the United States market unavailable to Canadian suppliers, all young beef would be consumed domestically. The results suggest that in these circumstances young beef prices would have fallen from \$4,960 to \$2,784 per tonne (44 percent). The reduction in the young beef price shifts the demand for young cattle down and lowers the price of young cattle from \$1098 to \$499 per head (54 percent). As a result, the equilibrium young cattle quantity supplied and demanded would have declined from 3,738 to 3,061 thousand head (18 percent) and the old cattle price would have dropped from \$321 to \$157 per head (51 percent). This decrease in price and quantity results from shifts in both the demand and the supply of old cattle. Old cattle demand shifts to the left because of movement along the old beef demand curve as old beef prices drop from \$2,507 to \$1,575 per tonne (37 percent). Due to changes in cattle prices and supply levels, total producer surplus drops 59 percent from \$3,613 to \$1,458 million, and the gross revenue of cattle producers falls 62 percent from \$4,271 to \$1,595 million. These figures reveal that the opening of the United States border for young beef was an important development – things were bad in 2004 but they could have been much worse!

### *Trade Regime 2: Partial Free Trade (trade in young beef and cattle)*

If imports of young Canadian cattle had been permitted in the United States in 2004, cattle producers would have received higher prices for young cattle, and young cattle supply would have increased 9.8 percent from 3,738 to 4,106 thousand head. The increase in the quantity of young cattle supplied results from an increase in the breeding inventory caused by higher prices for young cattle. However, as a result of trade restrictions on old cattle, the larger domestic supply of old cattle has no market in the United States. Consequently, a larger number of old cattle are slaughtered and

consumed in Canada with a concomitant decrease in price from \$321 to \$140 per head (56 percent). The large price decrease is a product of a rightward shift in the old cattle supply along a very inelastic domestic demand, given the constraints on slaughter capacity. Net exports of young cattle and young beef would have been 1,623 thousand head and 41.9 thousand tonnes, compared to zero young cattle exports and 466 thousand tonnes of young beef in the baseline. When the border is closed to young cattle trade, beef rather than cattle moves south. Relative to the baseline scenario with trade only in young beef, the gross revenue of the industry would have increased 42.3 percent from \$4,271 to \$6,080 million. Total producer surplus would have increased 36 percent from \$3,613 to \$4,917 million. The prosperity of Canadian cattle producers requires, at least, an open border for young cattle and beef.

### ***Trade Regime 3: Free Trade***

If there had been no trade impediments in 2004 (the pre-BSE situation), producers in Canada would have received higher prices for all types of cattle and beef. This price increase would have generated larger supplies of cattle and beef and greater net exports of cattle and young beef. The supply of old and young cattle would have increased 12.9 percent, while net exports of old and young cattle would have been 400 and 1,737 thousand head, respectively, instead of zero. Domestic demand for cattle and the production of beef would have been lower. Old beef production would have been 58 thousand tonnes instead of 163 thousand tonnes, a reduction of 64 percent, resulting in net imports of 87 thousand tonnes of old beef. Young beef production would have been 851 thousand tonnes, of which 31 thousand tonnes would have been net exports. Again, open borders result in an increase in the quantity of cattle traded and a decrease in the quantity of beef traded. Total producer surplus would have been 53 percent higher at \$5,523 million, \$605 million more than when the border was open only to young cattle and beef. Gross revenue in the cattle industry would have increased from \$4,271 to \$6,694 million, a 57 percent increase.

### **Impacts of Different Policy Proposals**

Three different BSE mitigation policies are evaluated under each of the four possible trade regimes: baseline (trade in young beef only); autarky; partial free trade (trade in young beef and cattle); and free trade. The specific mitigation policies include 1) increasing slaughter capacity for old cattle; 2) a mass cull; and 3) a subsidy on the slaughter of old cattle.



### ***Scenario 1: Impact of an Increase in Slaughter Capacity***

The first policy simulation quantifies the economic consequences if Canadian domestic slaughter plant capacity had been 10 percent higher for old cattle. Expanded slaughter capacity shifts the demand curve for old cattle to the right (figure 2) and, hence, would have increased the price of old cattle from \$321 to \$481 per head (30 percent).<sup>4</sup> Young cattle prices would have dropped from \$1,098 to \$1,094 per head. The price changes and the extra capacity produce only slightly higher levels of slaughter for old and young cattle because of the inelastic nature of supply response. All of the increased supply of cattle would have been processed in Canadian slaughter plants, and hence the production of old (0.3 percent) and young beef (0.3 percent) would have been slightly higher. However, the increase in the supply of old beef would have depressed the old beef price by 0.4 percent while the young beef price would have been unchanged with the open border. From the base level, the increased slaughter capacity would have increased the gross revenue of Canadian cattle producers by 1.2 percent, from \$4,271 to \$4,322 million.

A 10 percent expansion in old cattle slaughter capacity has varying impacts under the scenarios of autarky, trade in young beef and cattle, and free trade. For example, the autarky results show what the impact of an increase in slaughter capacity might have been if in 2004 the border had been closed to all cattle and beef trade. The results indicate the adverse impacts of the border closure would have been smaller under this scenario if Canada had more slaughter capacity for old cattle. Prices for old cattle under autarky would have been 43.5 percent higher (\$225/head) with more slaughter capacity, and prices for young cattle would have been only 1.2 percent lower. Producer surplus would have increased from \$1,458 million to \$1,474 million, and gross revenues would have risen from \$1,594 million to \$1,607 million. If all borders had been closed to Canadian exports in 2004, the economic situation would have been a disaster for cattle producers and beef processors, but the disaster would have been slightly smaller with more slaughter capacity for old cattle.

In trade regime two (partial trade liberalization, that is, trade in young cattle and beef), if the border had been open for young cattle and young beef, then more slaughter capacity for old cattle would have increased the supply of old cattle from 569 to 571 thousand head, the price of old cattle by 61 percent, from \$140 to \$225 per head, the supply of young cattle from 4,107 to 4,120 thousand head, total producer surplus from \$4,917 to \$4,984 million dollars, and gross revenue from \$6,080 million to \$6,148 million. While most of the changes are small, the extra slaughter capacity for old cattle is important for cow-calf producers when old cattle cannot be exported.

If the border had been open for all types of beef and cattle (regime three – free trade), an increase in slaughter capacity in Canada would not have changed cattle producer surplus through prices or supply levels. An increase in slaughter capacity would not have helped cattle producers, because it is assumed that old cattle in Canada receive the U.S. price adjusted for transfer costs.

### ***Scenario 2: Impact of a Mass Cull***

The second policy simulation evaluates the impact of a 10 percent reduction in the inventory of old and young cattle. Because of the feedback effects in the model, a 10 percent cow cull would have reduced the output of old and young cattle by only 7.4 percent. The leftward shift in cattle supply curves as a result of the forced culling increases the price of old cattle by 42.4 percent and that of young cattle by 7.3 percent. From the baseline, total producer surplus would have increased 0.06 percent, from \$3,613 to \$3,615 million. Gross revenue would have increased 0.6 percent, from \$4,271 to \$4,298 million, which suggests that in the medium term, under the 2004 trade regime, cattle producers would have benefited slightly from a mass cull. It is important to note that costs of the cow cull and disposal are not included in these calculations, and these costs would have been substantial.

Again, culling 10 percent of the cattle herd has different effects under different trade regimes. Under autarky, mass culling of the cattle herd would have increased the surplus and gross revenue of cattle producers through an increase in cattle prices. The price for old cattle would have increased from \$156 to \$302 per head, while that for young cattle would have increased from \$499 to \$675 per head. A cull would have increased the total producer surplus from \$1,458 to \$1,889 million and gross revenue from \$1,594 to \$2,113 million. However, if the border were open for young cattle and/or beef (trade regimes two and three), the mass cull would have led to reductions in gross revenue for the industry, as it reduces the capacity to export. The supply of old cattle would have decreased from 569 to 516 thousand head (9.3 percent) under partial opening (trade in young cattle and beef) and from 585 to 527 thousand head (10 percent) under free trade. The supply of young cattle would have decreased from 4,107 to 3,722 thousand head (9.3 percent) under partial opening and from 4,221 to 3,799 (9.9 percent) under free trade. Reductions in producer surplus and gross revenue would have been observed under both the partial trade and free trade regimes. As a consequence, a mass cow cull would not be a wise policy if trade were to resume for young cattle or for all types of cattle and beef.

### ***Scenario 3: Impact of Introducing a Slaughter Subsidy***

The final policy scenario assesses the impacts of introducing a slaughter subsidy for old cattle of \$104 per head. The slaughter subsidy would have lowered the price paid by packers for old cattle and increased the price received by cow-calf producers (market price plus subsidy). An imposition of a slaughter subsidy equivalent to \$104 per head would have led to a drop in the packers' price for old cattle from \$321 to \$316 per head and for young cattle from \$1,098 to \$1,095 per head. Since producers receive a subsidy of \$104 per head on top of the prices paid by the packers, the old and young cattle supply levels would have been about 0.3 percent higher. As there was no trade in live cattle in the baseline, cattle would have had to be slaughtered in Canadian plants, and hence local supply of both old and young beef also would have increased. Exports of young beef would have increased by 4 thousand tones (1 percent). The gross revenue and producer surplus of the industry would have increased by 1.2 percent and 1.5 percent from the baseline, respectively.

The results suggest that the adverse impacts on cattle producers of the border closure would have been slightly smaller if a slaughter subsidy had been present. With slaughter subsidies, gross revenue for cattle producers would have increased from \$1,594 to \$1,613 million under autarky. Total producer surplus would have risen from \$1,458 to \$1,481 million. If the border had been open for young cattle, a slaughter subsidy would have increased the gross revenue from \$6,080 to \$6,109 million, and under the free trade scenario it would have increased the gross revenue from \$6,694 to \$6,780 million. Total producer surplus would have increased from \$4,917 to \$4,945 million under partial trade (free trade in young cattle and young beef) and from \$5,523 to \$5,607 million under free trade. Government expenditures on the subsidy program would have been \$54, \$43, \$59, and \$61 million if it had existed under the regimes of 2004, autarky, partial opening, and free trade, respectively. The results reveal that a subsidy program for the slaughter of old cattle expands output under all trade regimes and that in all of these cases additional output is either not wanted or not necessary.

### **Lessons Learned from Policy Evaluations**

**T**he implications of various policy alternatives depend crucially on the long-run border situation. Encouraging the expansion of slaughter capacity, mass culling of cows, and provision of subsidies for the slaughter of old cattle all involve sizable taxpayer transfers and other significant costs not captured in this analysis, especially with regard to the cow cull program (and the slaughter capacity expansion). Among the policies proposed, the expansion of slaughter capacity for old cattle seems sensible if the border remains closed for old cattle and the costs are not too high. However, if

the border is open for all cattle and beef this program will provide few benefits to producers. The imposition of a slaughter subsidy could also increase the welfare of producers, but it seems unwise to expand the size of the cattle herd if the border is going to remain closed. The destruction of part of the cow herd might be a viable policy under autarky but foolish under other trade regimes given its undoubtedly high cost.

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## Endnotes

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- \* This project received financial support from the North American Agrifood Market Integration Consortium, the Canadian Agricultural Trade Policy Research Network and the Ontario Ministry of Food, Agriculture and Rural Affairs. The views expressed in the paper are those of the authors and should not be attributed to the funding agencies.
1. On September 14, 2007, the USDA announced that it would allow U.S. packers to resume importing Canadian cattle over 30 months of age beginning November 19, 2007, provided sellers can prove the animals were born after March 1, 1999.
  2. All values are in Canadian dollars unless otherwise noted.
  3. The surplus for producers of old cattle applies only to cull cows and bulls; the return on feeder animals by cow/calf operators is captured in the calculation of the surplus for producers of young-cattle.
  4. It is assumed that with increased capacity processors are willing to purchase more old cattle at all prices.

The technical annex to this paper, pages 25-37 is available as a separate document.

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