

Managing a Border Threat: BSE and COOL Effects on the Canadian Beef Industry

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The Canadian cattle and beef industry incurred severe losses when exports to the United States were halted after the May 2003 discovery of bovine spongiform encephalopathy in a Canadian cow. Although trade in cattle and beef products slowly returned to normal, the potential for upheaval returned when country of origin labeling became mandatory in March 2009. Industry observers fear segregation costs could result in refusal of Canadian cattle by American beef packers. As a result, some industry stakeholders are promoting an expansion of slaughter capacity. This teaching case study focuses on the decision of whether to support such an initiative.

Carol Kuffucy reclined her chair and gazed thoughtfully out the window of her office in Ottawa, Canada's capital city. Carol is Canada's federal Minister of Agriculture, approximately the equivalent of the Agriculture Secretary in the United States, and has just finished a teleconference call with representatives from the Cattle Association of Canada (CAC). The topic of the call was the potential for the Canadian government to play a role in expanding Canada's cattle slaughter capacity. The closure of the U.S. border to live Canadian cattle in the wake of the bovine spongiform encephalopathy (BSE) discovery had taught the industry a tough lesson about relying too heavily on a foreign processing sector. New regulations regarding country of origin labeling (COOL) in the United States were threatening similar impacts.

The CAC is an umbrella organization representing Canada's cow-calf producers, backgrounders and feeders. CAC members from each link of the

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Canadian cattle supply chain were hit hard by the BSE discovery and subsequent border closure. It had become all too clear during that time that Canada's cattle industry was heavily dependent upon American slaughter capacity—over 1 million head were exported to the United States for slaughter in 2002 (Canfax 2003). Many in the CAC accused domestic beef packers of underpaying for cattle when the border was closed and cattle supplies were plentiful. The CAC is pressuring the government to provide support for new processing facilities, for the dual purposes of increasing competition among Canadian packers and lowering the risk of price drops should the U.S. market once again become inaccessible to Canadian cattle and beef.

Although the U.S. border had reopened to beef derived from Canadian cattle under the age of thirty months in the fall of 2003 and to trade in live cattle less than thirty months of age in July of 2005, cull cows and bulls had been prevented from entering the United States until November 2007. This resulted in severely depressed prices for these older animals. Producers received as little as 10% of the pre-BSE price for culls with the border closed. Industry stakeholders are concerned by the lack of any guarantee that live exports will continue to be allowed in the future. There had been no warning prior to the May 2003 BSE announcement that had precipitated the border closure, and there was no assurance that future food safety scares would not result in similar trade restrictions. Now Carol also has to be concerned about the effects of COOL, which had taken effect March 16, 2009. The Prime Minister has asked Carol to make a recommendation to cabinet on the course of action the federal government should take, and she knows that as agriculture minister, her advice will be taken seriously. She is still not sure whether the industry should be moving to expand processing capacity. The question requires careful consideration.

Background

Canada's cattle industry closely resembles that of the United States, with both dairy and beef herds, the latter broken down into cow-calf, backgrounding, and feeding/finishing sectors. Canada's largest cattle-producing region is in the Prairies, with Alberta (5.38 million head) and Saskatchewan (2.65 million head) together accounting for more than half of Canada's 13.18 million head inventory at 1 January 2009 (Canfax 2009). The preponderance of Canada's cattle slaughter takes place in Alberta, where both Cargill (at High River) and Tyson (at Brooks) have large-scale plants with capacities of approximately 5,000 head per day. Of the nearly 3.5 million head processed in Canada in 2008, approximately 66% were processed at Alberta plants, with an additional 20% processed in Ontario. About 8% of processing came from a combination of Saskatchewan, Manitoba, and British Columbia, and the remainder from Quebec and the Atlantic provinces (Canfax 2009). As might be expected, the location of feedlots in Canada closely mirrors the location of processors: 66% of fed cattle come from Alberta feedlots, 19% from Ontario, 10% from the combined provinces of Saskatchewan, Manitoba, and British Columbia, and 4% from Quebec and the Atlantic provinces (Canfax 2009). Quebec processors kill significantly more cattle than the provinces producer feed because Quebec has Canada's highest

concentration of dairy cattle (365,000 head), but a relatively small feedlot sector.

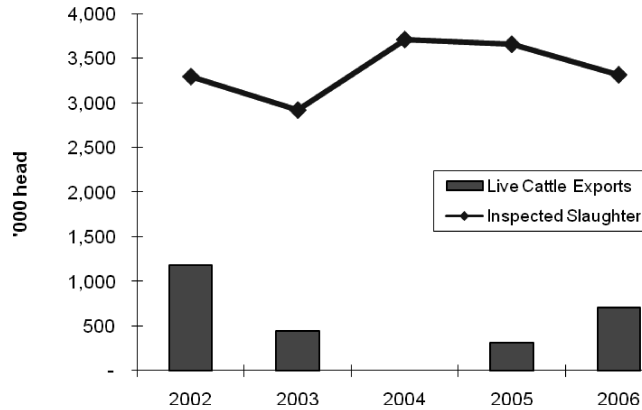
Although a majority of slaughter cattle are located close to processing plants, the large-scale plants are not easily accessible to some of the more remote producers. Canada has vast tracts of marginal land, which are best used as pasture. Although a good deal of this land is found in Alberta's foothills, there are significant amounts in Manitoba, Saskatchewan and B.C. For some producers, distance to processing facilities from commercial-scale feedlots is considerable. For example, the largest feedlot in Manitoba, located at Hamiota, is located 565 miles from the Tyson plant in Brooks, Alberta, 682 miles from Cargill's plant in High River, and 1,545 miles from the country's third-largest packing plant (also owned by Cargill) in Guelph, Ontario. Prior to the border closure, many fed and cull cattle from Manitoba were thus processed in U.S. packing plants.

Canada's slaughter capacity did not always demonstrate such high levels of concentration, in terms of either geography or number of competitors. For instance, at its peak in 1976, Manitoba's beef slaughter hit 675,000 head, a number that dwindled to around 21,000 head by 2006 (Manitoba Agriculture, Food and Rural Initiatives). New slaughter technologies led to rationalization of the packing industry, with a corresponding shift in location close to Alberta's plentiful fed cattle supplies, and access to large U.S. markets in the Pacific Northwest. As a result, cattle producers and feeders located at considerable distance from Alberta began to truck animals to U.S. plants, where a strong exchange rate and cheaper fuel more than offset the inconvenience of longer hauling distances. A considerable part of the Canadian industry became reliant on access to U.S. packing facilities, which in turn became reliant on Canadian supplies of feeder cattle. Figure 1 shows the total Canadian federal slaughter of cattle over the five-year period ending in 2006 as well as exports of cattle from Canada to the United States. In 2006, over 4 million head were either slaughtered or shipped to the United States for slaughter. This is some 300,000 head more than Canada has ever slaughtered, and a 700,000 head increase over what was slaughtered in 2005.

BSE and the Border Closure

Carol frowned as she recalled receiving word of the initial BSE discovery in a cow from the Peace River region of Alberta. BSE—commonly known as “mad cow disease” due to abnormal motor nerve control coupled with aggressiveness (Swanson)—is a member of the group of transmissible spongiform encephalopathies (TSEs), which includes chronic wasting disease (CWD) in deer and elk, scrapie in sheep and goats, transmissible mink encephalopathy, feline spongiform encephalopathy in cats, and variant Creutzfeldt-Jakob disease (vCJD) in humans (Canadian Food Inspection Agency). This class of diseases, caused by abnormal proteins (prions), kills infected individuals' brain cells, creating gaps in the tissue and giving a sponge-like appearance. Although BSE is a naturally occurring phenomenon in cattle, it is also transmissible from cow to calf and by feeding rendered ruminant protein to ruminants. A particularly dangerous characteristic of the disease is that the prions are resistant to heat,

Figure 1. Inspected beef slaughter in Canada and live exports to the United States



and thus can survive high-temperature rendering processes. If high-risk materials—such as those around the brain and spinal cord of infected ruminants—are consumed by humans, vCJD can result after an extended incubation period. All TSEs are fatal in virtually all cases.

BSE is most notoriously associated with the outbreak in Great Britain that peaked in 1992 with nearly 37,000 head being diagnosed (World Health Organization). It is believed that the British outbreak was caused by the feeding of rendered ruminant protein materials to cattle in the late 1970s through the early 1980s. Since the presence of BSE was confirmed in Great Britain in 1986, there have been over 180,000 confirmed cases of the disease in that country. A massive cull of the British cattle herd was undertaken in order to control the spread of the disease. British scientists also found evidence of a link between human vCJD and exposure to meat ingested from BSE-infected animals. As of February 2009, approximately 220 people have died worldwide because of vCJD (National Creutzfeldt-Jakob Disease Surveillance Unit), and because of the long incubation period for the disease, it is possible that more deaths will follow, although at a greatly reduced rate.

Canada's first case of BSE was discovered in 1993 in a cow imported from Great Britain in 1987. Such importation had been allowed until 1989, at which point authorities began to realize the serious risk of BSE spreading to the Canadian cattle herd. The infected British cow and the herd it came from were destroyed, but it was realized that other high-risk animals had been reexported or introduced into the animal feed chain. Nevertheless, there were no serious trade consequences to the 1993 case, and a decade of vigilant monitoring passed without incident.

On January 31, 2003, a six-year-old "downer" cow—the term refers to an animal that cannot stand—was loaded onto a truck near Wanham, in the Peace River region of Alberta, and transported to a provincially inspected abattoir by an owner who intended to use the meat for personal consumption. Upon inspection, the cow was condemned due to pneumonia, and its head was sent to provincial authorities for testing as part of the BSE surveillance program that

had come into effect in 1997. Due to the ill condition of the cow, it was deemed unfit for human consumption and rendered, entering the animal feed chain. Though Canada had introduced a ban in 1997 on feeding ruminant protein materials to ruminants, it could still be used in poultry, pet, and other types of feed. On May 16, a tentative diagnosis of BSE was made provincially, triggering an immediate federal review. Within two days, a specialized laboratory in Great Britain confirmed the finding, leading to the announcement on the 20th of that month.

Carol noted with some irritation that it had taken several years after the original BSE discovery and border closure for the U.S. border to fully “open” to Canadian cattle and beef exports. For trade purposes, cattle and the beef derived from them are often categorized into “young” (under the age of thirty months) or “old” (over thirty months). It is certain types of beef from the “old” category that are associated with a risk of contracting vCJD. On September 10, 2003, boxed beef exports of boneless beef from young Canadian cattle were once again allowed into the U.S. market, easing a good deal of the downward pressure on Canadian cattle prices. In July 2005, the border opened to live cattle shipments, with new rules covering age verification, pregnancy checking, and other items in place. However, older live animals and beef derived from them were denied entry to the United States until November 2007. This meant that animals culled from beef and dairy herds had to be processed (and the beef derived from them consumed) in Canada. In 2002, the last full year of open trade in live animals between the two countries, 44% of Canadian cull cattle were slaughtered in the United States. Access to American packing plants dedicated to the slaughter of older animals had thus been critically important to the Canadian industry. Canadian processors had captured economies of scale in processing younger animals, but no processor in western Canada had found it profitable to focus on older animals.

The economic consequences of the border closure for the Canadian cattle and beef industries had been considerable. It was estimated that the \$2.5 billion decline in cattle and calf exports from 2002 to 2003 alone had an overall cost of \$5.7 billion and 75,000 jobs to the Canadian economy (Mitura and Di Pietro). Carol knew the updated estimates she would soon receive on the economic losses due to the border closure would paint an even bleaker picture.

U.S. COOL Legislation

Some cattle industry observers were optimistic that the worst was over with respect to disruptions in trade of cattle and beef products. The border had first been reopened to trade in young live animals, restrictions on processing older animals in the same plants as younger animals had then been loosened, and finally the USDA had passed a new rule allowing older cattle and beef derived from them to again enter the United States from Canada. Carol’s satisfaction at these developments was tempered by the knowledge that there were no assurances of continued access to the U.S. market. Lack of preparedness to deal with a closed U.S. border had cost the Canadian beef industry dearly, and she was resolved to take all possible steps to prevent a recurrence of the economic losses that had occurred.

Chief among Carol's concerns was COOL. It was first introduced in the 2002 farm bill (the U.S. Farm Security and Rural Investment Act), and covered various meat products such as beef, pork, and lamb, as well as seafood, produce, and peanuts sold at retail. Originally COOL was voluntary, but after numerous delays and voluntary implementation the legislation had finally become mandatory on March 16, 2009. Under the new law, ostensibly designed to provide consumers with additional information about these products but regarded by some as a method to reduce competitiveness in certain markets, meat products must be labeled as to where animals were born, raised, and slaughtered. To be labeled "Product of the U.S.," expected to be an advantage with respect to demand, all three phases must have been completed in the United States.

Carol had been briefed on the considerable projected costs associated with COOL compliance. Under the legislation, retailers of covered products were required to be able to verify origin of labeled products using an auditable records system. For the beef industry—which markets approximately 8 billion pounds of fresh beef annually through retail outlets in the United States—such a requirement could be extremely expensive. New costs would be introduced at every stage of the beef supply chain, from primary production (cow-calf/ranch and background/stocker), through the feeding, processing, and even retailing sectors of the supply chain. Each of those sectors would encounter new costs specifically associated with its own activities, but would also be responsible for a share of costs of the tracking system Carol feared COOL would necessitate.

U.S. feedlots, both at the backgrounding/stocking and finishing stages, often draw cattle from several different sources, and even different countries. For example, there could be commingling of cattle born and backgrounded in Canada but finished in an American feedlot with U.S. born, backgrounded, and finished cattle. Once in a finishing lot, the individual identities of such commingled cattle would have to be maintained. Costs generated by COOL at both the primary and feeding stages of the supply chain were thought to be modest, in the range of \$5 per head or less for each.¹

Some of the highest costs associated with COOL would be incurred at the processing (packing) stage. Many industry observers felt that tagging and tracking animals through the finishing stage would be relatively inexpensive but recognized that once the animal was slaughtered, all of the information contained in the ear tag (or other animal-specific identification vehicle) would have to be transferred to individual boxes of beef containing primal or subprimal cuts derived from the animal. Given that boxes usually contain products derived from more than one animal, either each vacuum-packed cut would need to be labeled as to country of origin or "lots" of cattle of similar origin would need to be segregated together as they were processed to ensure common origin. Carol had been given some industry estimates that placed capital costs associated with COOL compliance as high as \$50 million per modern scale packing plant. Overall costs to segregate both animals and carcasses, maintain records, and hire and train personnel were expected to approach \$20 for every animal for processors, a cost increase of approximately 2% per head. In an industry characterized by high volumes and very low margins. Carol knew this was not an insignificant amount.

As those responsible for labeling products as to their country of origin, retailers would also see significant cost increases due to the new requirements. Just as beef packers were obliged to transfer information from live animals to individual boxes or perhaps even cuts, retailers would need to take the information pertaining to origin from boxes or individual cuts and transfer it to products available for final sale. It was thought that costs at the retail level for segmenting and labeling products, maintaining records, training and compensating personnel and various other costs would total around \$20 or \$25 on a live animal basis. The total expense per animal, once costs to individual supply chain members were aggregated, could thus approach \$50 per head if spread out evenly across all animals being processed in the United States.

Carol was gravely concerned that one or both of two things would occur after COOL was implemented on a mandatory basis. First, while COOL costs in the supply chain would lower everyone's profit levels, primary producers would bear the brunt of the costs. It made sense to Carol that whatever link of the supply chain was at the greatest relative bargaining disadvantage could be responsible for a disproportionate share of COOL costs. A second—and even more alarming—possibility was that non-U.S. cattle would be shunned by U.S. supply chain members. The significant proportions of COOL costs associated with segregation could be avoided on cattle that were born, raised, and slaughtered in the United States. The introduction of non-U.S. cattle at any point of the feeding, finishing, processing, or retail sectors would immediately mean the imposition of segregation costs. An integrated supply chain with only U.S. cattle would avoid these costs.

The Canadian industry thus faced the prospect of severely reduced prices for its animals if COOL costs from all stages of the beef supply chain were passed back to them, or perhaps even outright refusal by U.S. feeders, finishers, and processors to accept Canadian cattle because of the additional time and expense required to accommodate them (Grier and Martin, 2007). Either scenario had the potential to further weaken an industry still recovering from the financial stress that had resulted from the BSE-related border closure. Carol hoped a solution could be devised that would not only mitigate the potential negative effects of COOL, but also help the industry become more prepared for future trade disruptions. Her thoughts turned to the prospect of increasing processing capacity in Canada.

Support for Potential Slaughter Expansion

Carol recalled that prior to the BSE-related border closure, the Canadian and American cattle and beef markets were highly integrated. Canada exported considerable volumes of both beef and live cattle to the United States. When this important market was no longer available after the discovery of BSE, cattle prices in some parts of Canada declined up to 75% (Weerahewa, Meilke, and LeRoy). Beef derived from low-risk (i.e., younger) animals was reallocated in to the United States within a few months, relieving some of the downward pressure upon prices. But when the embargo upon live animals was still in place, there were too many animals competing for too few hooks in Canada. As

a result, live prices remained depressed; there was just not enough beef packing capacity to process all the cattle (Rude and Carlberg).

Almost immediately after the border closure, ways to increase processing capacity were being planned. Since fed and cull animals had to be segregated for processing—not only was beef from older animals not permitted into the United States; older animals could not even be processed in the same facilities as younger ones—most plans focused on slaughter of one or the other categories (i.e., under thirty months of age or over) of cattle. There were thus three main types of initiatives being proposed: construction of new facilities dedicated to one class of cattle or the other, expansion of existing facilities, or construction of multispecies facilities.

A multitude of opportunities for new processing facilities was discussed in the months following the BSE discovery. Several of these perceived opportunities proceeded to the planning stage; most were to be of modest scale and regional in nature, sometimes led by a producer cooperative or other group ownership structure. Canada's two largest plants, owned by Cargill and Tyson, at the time were each processing around 4,000 head per day. This size of plant is generally regarded as efficient given the significant scale economies that characterize beef packing (Ward). None of the proposed new initiatives matched the size of the Cargill or Tyson plants—for instance, the "Rancher's Beef" facility constructed just outside Calgary at Balzac, Alberta that opened in June 2006 before closing fourteen months later due to insufficient operating funds had a capacity of 800 head per day—and questions arose as to whether these smaller-scale operations would be able to compete in an industry where profitability is determined by production efficiencies.

A number of existing packers announced expansion plans after the border was closed. Cargill and Tyson both announced plans to expand to 5,000 head per day capacity (Rude, Carlberg, and Pellow). Such processors, with modern, large-scale facilities, have obvious advantages over new competitors entering the market, perhaps the most important of which is established relationships with both cattle feeders and beef customers. Smaller processors, such as XL Beef in Moose Jaw, Saskatchewan, and Levinoff in St. Cyrille, Quebec (a cull-only facility), also announced plans to expand.

Some industry observers considered multispecies facilities to be the most sensible vehicle for expansion of Canada's slaughter capacity. Carol had carefully considered the role these smaller, more flexible facilities might play in expanding packing capacity. Sometimes described as "New Zealand model" plants, these alternatives to the large industrial models focus on species diversity, reduced throughput, and in some cases, social and environmental considerations (Holz-Clause). Such enterprises could play a limited role in alleviating reliance on foreign meat packers while potentially enjoying steady demand for their services due to their flexibility for different marketing chains. Not only can these plants accommodate multiple species, but also they can provide more customized service, providing, for example, meat cut to very precise specifications. Such plants do face considerable challenges, such as significantly higher per-unit costs that would likely prevent them from competing with larger competitors in the commodity beef market. They also generally are not able to provide a large enough supply of coproducts such as

hides and offal to rely upon these for supplementary revenue, as many larger plants do.

Carol knew even though multispecies facilities could provide important services for the industry, they could not provide all of the additional slaughter capacity needed should another border closure occur. Nearly 1.6 million live beef animals and over a billion dollars worth of beef products were exported from Canada into the United States in 2008 (Canfax 2009), and Carol was acutely aware that the Canadian industry is not yet prepared for another major trade disruption. She understood that if another animal health issue arose, or if COOL causes American packers to heavily discount or even refuse Canadian cattle, the industry would again be thrown into crisis mode. The live animals currently being exported to the United States would once again have to be slaughtered domestically, and experience has shown this has the potential for drastically negative impacts upon Canadian producers and feeders.

Even though she would like the industry to add capacity, Carol wondered whether there was a better alternative than small, multispecies facilities. She recognized that given the locations of cattle feeding activity and existing packers, it might not make sense to construct a single, large-scale facility to provide the entire additional capacity she believes the industry requires. Although the cattle feeding and packing industries were centered in Alberta, Carol thought new plants in smaller but still significant cattle feeding areas may be worth considering. It might be a good idea to locate plants in areas containing the more than 5 million head of feeder cattle and calves not housed in commercial feedlots.

These new plants, whatever form they would take, would not be cheap to build. Construction costs for a facility of even modest scale, slaughtering perhaps a few hundred head per day, would be tens of millions of dollars. And the prospect for success of such plants, competing in an industry characterized by economies of scale, are not encouraging—failure rates for new plants are extremely high in general, and even more so for those operating on a small scale (MacDonald and Ollinger). Carol realized that any medium-sized plants could require governmental support with respect to both construction and operating costs. That government support often takes one of three forms: direct grants to organizations attempting to build new or expand existing facilities; loans to prospective firms that could not meet the standards to procure financing from commercial lenders at reasonable rates; or loan guarantees from the government. In the latter case, the government would underwrite borrowing from commercial banks, and be responsible for repayment in the case of default.

Such governmental support, Carol worried, could turn out to be a hard sell around the cabinet table. Both senior (i.e., federal and provincial) levels of government had made major outlays for support programs during the period of border closure, and direct aid to firms for processing may lead to trade retaliation under international trade agreements. It was not clear that her colleagues would see the need to provide more financial resources to an industry that many believed had moved beyond its period of crisis. With cattle trade having returned to some level of normalcy, Carol knew not everyone would see the need for expansion of slaughter capacity. She knew she would

face a very pointed question from her colleagues: “Why can’t these cattle just keep going south?”

Some parliamentarians had begun to study the problem and were supportive of the idea that slaughter capacity should be expanded. A Canadian Senate report asserted that expansion of packing capacity would enhance the strength and stability of the domestic cattle and beef industries moving forward (Standing Senate Committee on Agriculture and Forestry). However, others were less enthusiastic about adding capacity: Grier and Martin (2005) argued no expansion would be needed to handle expected future marketings, and that such an expansion would distort the market and cause economic harm to producers. There was no shortage of opinions on both sides of the issue.

Carol’s Decision

Carol glanced at her watch as she collected a few key papers to take home for the evening to aid her with her decision. It was just after 6:00 pm, which meant she would be making a recommendation to cabinet in a little less than fourteen hours. She realized that moving to expand the industry is a potentially expensive proposition, and that many felt an expansion was not needed given renewed access to U.S. packers. On the other hand, Carol could not help but worry that the Canadian industry could not risk another crippling blow like the one dealt by the 2003 border closure. By ensuring adequate packing capacity—not so much as to result in chronic overcapacity, but enough that appropriate kill levels could be maintained in the event of border disruptions—in Canada, the industry might be able to minimize the deleterious effects of events like BSE and COOL. As she turned out the light and pulled her door closed for the evening, a wry smile spread across the Minister’s face—she had a lot of things to consider, and knew a long evening awaited.

Acknowledgments

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Endnote

¹Cost estimates for COOL compliance are taken from the COOL cost assessment carried out by Sparks Companies.

References

- Canadian Food Inspection Agency. *Narrative Background to Canada’s Assessment of and Response to the BSE Occurrence in Alberta*. Ottawa, ON, 2003.
- Canfax Research Services. 2002 Annual Report. Calgary, AB, 2003.
- . 2009 Annual Report. Calgary, AB, 2009.
- Grier, K., and L. Martin. *The Ruminant Slaughter Equity Assistance Program: A Commentary*. Guelph, ON: George Morris Center, 2005.
- . *Country of Origin Labeling. . .The Biggest Challenge*. Guelph, ON: George Morris Center, 2007.
- Holz-Clause, M. “Co-location of industries with small livestock slaughter facilities in the Midwest.” Competitive Grant Report 03-M4, Leopold Center for Sustainable Agriculture, Iowa State University, 2003.

- MacDonald, J.M., and M. Ollinger. "U.S. Meat Slaughter Consolidating Rapidly." *Food Rev.* 20(1997):22-7.
- Manitoba Agriculture, Food and Rural Initiatives. Table 44, "Cattle Slaughtered in Manitoba by Month." *Manitoba Agricultural Yearbook 2006*, Winnipeg, MB, 2008.
- Mitura, V., and L. Di Pietro. "Canada's beef cattle sector and the impact of BSE on farm family income." Working Paper No. 69, Agriculture and Rural Working Paper Series, Agriculture Division, Statistics Canada, Ottawa, ON, 2004.
- National Creutzfeld-Jakob Disease Surveillance Unit. *Variant Creutzfeld-Jakob Disease: Current Data*. Available at: Internet site <http://www.cjd.ed.ac.uk/vcjdworld.htm> (accessed May 2009).
- Rude, J., J. Carlberg, and S. Pellow. "Integration to Fragmentation: Post-BSE Canadian Cattle Markets, Processing Capacity and Cattle Prices." *Cdn. J. Agr. Econ.* 55(June 2007):197-216.
- Rude, J., and J. Carlberg. "Kill or Shill: Processing Capacity and Cattle Prices with a Closed Border." *Curr. Agric., Food Resource Issues* 7(2006):85-93.
- Sparks Companies Inc. *COOL Cost Assessment*. Memphis, TN, 2004.
- Standing Senate Committee on Agriculture and Forestry. *Cattle Slaughter Capacity in Canada and Interim Report*. Ottawa, ON, May 2005.
- Swanson, J.C. "Bovine Spongiform Encephalopathy." Special Reference Brief SRB 91-05, U.S. Department of Agriculture, National Agricultural Library, Beltsville, MD, 1990.
- Ward, C.E. *Meatpacking Competition and Pricing*. Blacksburg, VA: Research Institute on Livestock Pricing, 1988.
- Weerahewa, J., K.D. Meilke, and D. LeRoy. "An Economic Assessment of the BSE Crisis in Canada: Impacts of Border Closure and BSE Recovery Programs." CATPRN Working Paper 2007-1, Canadian Agricultural Policy Trade Research Network, 2007.
- World Health Organization. *Understanding the BSE Threat*. Geneva, Switzerland, October 2002.