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Live Cattle Trade Between the United States and Canada: Effects of Canadian Slaughter Capacity and Health Regulations

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Objective Analysis
for Informed
Decision Making

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The purpose of research discussion papers is to make research findings available to researchers and the public before they are available in professional journals. Consequently, they are not peer reviewed.

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Introduction

Imports of live cattle from Canada have increased more than threefold since the implementation of the Canada-U.S. Free Trade Agreement (CFTA) in 1989. A high percentage of these imports originate from Alberta, averaging 32 to 50 percent over the 1986–1996 period. Expansion of the meat packing industry in Alberta and potential changes in sanitary regulations are anticipated to affect live cattle trade between the U.S. northern tier states and Alberta. In this paper we present the impacts of increased Alberta slaughter capacity on live cattle trade flows and on price in the U.S. feeder calf market. We also discuss the price impact of a proposed change in Canadian and U.S. sanitary regulations. This change is based on concepts embedded in the Sanitary and Phytosanitary Agreement of both the North American Free Trade Agreement (NAFTA) and the Uruguay Round of the General Agreement on Tariffs and Trade (GATT).

Integration of the U.S. and Canadian Beef Markets

Policy changes in both the United States and Canada due to commitments made under the CFTA and the Uruguay Round of the GATT have increased the integration of the North American beef markets. Prior to the CFTA, U.S. import tariffs on Canadian feeder and slaughter cattle were 1.7 cents per kilogram, or approximately $4.82 per head for feeder cattle and $8.50 per head for slaughter cattle. The tariff for carcasses was 3.9 cents per kilogram, and for high-quality cuts the ad valorem tariff rate was 4 percent. The CFTA eliminated tariffs on live cattle and beef products, including both carcasses and boxed beef. [1] With the CFTA each country exempted the other from quantitative restrictions on imports. This was one factor that encouraged investment by Cargill and Iowa Beef Processors in packing facilities in Alberta.

Although tariffs have been eliminated, integration of the markets is incomplete. For example, beef grading standards have been nearly identical since 1996, but the United States and Canada do not have an agreement recognizing the reciprocity of their meat grading standards. This means that Canadian boxed beef must be sold into the United States at the discounted no-roll price. Consequently, this encourages the Canadian industry to export carcasses that can be cut and graded in the United States. For the United States it means that boxed beef must be sold into Quebec as "USDA" beef and into Ontario as "ungraded" beef at discounts that discourage sales into these markets (Hayes, Hayenga, and Melton 1996).

Sanitary barriers are now of greater relative importance since the decline of other barriers to trade (Josling 1994). The Uruguay Round Agreement and NAFTA contain similar provisions specifying the basis for sanitary regulations that affect trade. In short, science is to dictate bona fide regulations. The incentive to lower the costs of moving cattle across the border has motivated industry associations on both sides to use the new criteria for sanitary regulations. This will make it possible for packing plants to procure animals within a least-cost distance of their plants without reference to national borders.

Alberta's Cattle Feeding Industry

Several factors have motivated the expansion of Alberta's beef packing industry, which is the center of the Canadian beef industry. The beef industry anticipates increased import demand for fed beef by countries in the Pacific Rim and feels that Alberta has a locational advantage to service that market. The August 1995 removal of transportation subsidies for Canadian grain destined for offshore export is expected, over the long run, to reduce exports and decrease the price of barley used for domestic feed (Produce Payment Panel 1994). Previously, grain shippers had to pay only a portion, roughly half, of the rail rate to move grain to offshore positions and the government paid the rest. Such feed cost conditions would give Alberta a competitive advantage in supplying grain-finished cattle.

Growth in Alberta's packing industry has been hampered by the long distance to deficit markets on the Canadian east coast. As impediments to the U.S. market were removed, north-south trade has increased, with live cattle flowing from western provinces into the western United States, and boxed beef being exported from the midwestern United States into the eastern population centers in Canada.

After the CFTA, two large American multinationals, Cargill and Iowa Beef Processors (IBP) purchased packing facilities in High River and Brooks, Alberta, Canada, respectively. Subsequent investments by these companies have increased both the fabrication and the kill capacity in Alberta to an estimated 2.3 million head per year (U.S. International Trade Commission 1997). Investments over the past few years by Cargill have doubled their daily kill capacity from 1,750 head in 1995 to 3,500 head in 1997. IBP increased their capacity to a daily kill of 2,300 head in 1997 and may increase it further. With the expansion of the Alberta beef packing industry, these companies have begun to increase sales to eastern Canadian markets. Correspondingly, there has been a decrease in U.S. exports of boxed beef to eastern Canada (ERS 1997).

Alberta's beef cattle herd increased over the years 1980–1996 due to the normal incentives in a cattle cycle and to recent expectations of increases in Alberta's beef packing capacity (see Figure 1). Canada's cyclical increases in herd size and beef cow productivity demonstrate the ability of their cow-calf sector to respond to increases in beef demand.

U.S.-Canada Cattle and Beef Trade

U.S.-Canadian beef trade consists primarily of trade in live cattle (feeders and slaughters), carcasses, and boxed beef (and minor trade in by-products, not addressed here). U.S. imports of Canadian feeder and slaughter cattle have increased substantially since 1987, from 244,710 head in 1987 to 1,509,136 head in 1996. Recent data also show that a comparison of 1996 with 1995 indicates that U.S. imports increased slightly over 33 percent of the previous year (USDA 1997). This is partially accounted for by an expansion of Alberta's herd in expectation of increased 1995 slaughter capacity at Cargill. However, as slaughter capacity did not increase on the expected time line, some of these cattle were exported to the United States. Historically, U.S. exports of live cattle to Canada have been much smaller than imports (see Figure 2), with only 41,000 head (0.11 percent of U.S. slaughter cattle) being exported to Canada in 1996 (USDA 1997).

Several reasons exist for mutual border trade in live cattle. In Canada, the accepted weight for carcasses is within a range of 600–750 pounds, and carcasses above that weight are discounted (Dunford pers. comm. 1996). The United States has a higher (acceptable) upper range for carcasses of 700–850 pounds. This means that there is an incentive for Canadian stock growers to export heavy cattle to the U.S. market if additional transportation costs are less than the discount due to the heavy carcass weight. Seasonality plays an important role in determining the reverse, that is, Canadian import demand for U.S. cattle. Production patterns for spring-born calves in Alberta result in a shortage of slaughter cattle in late fall and early winter, and as capacity during this window increases, the industry looks to a wider area for its cattle supply.

Figure 3 shows U.S. boxed beef imports from and exports to Canada from 1985 to 1996. Wholesale trade in both directions has increased, with the U.S. net trade balance declining by about 35 percent. Overall, 1996 net imports of live cattle and beef from Canada, stated as a carcass weight equivalent, were 5.2 percent of U.S. beef production. However, these have varied from over 12 percent in the years 1990 and 1993 to 8 percent in 1994 (Peck, Greer, and Marsh 1996). This variation in net imports from Canada is an important factor in evaluating the impact of a change in net trade on U.S. feeder cattle prices.

Given the expansion of Alberta's packing capacity, the Alberta industry expects to import feeder cattle from the United States (Thorlakson pers. comm. 1996; Hayes, Hayenga, and Melton 1996). The level of imports depends on future increases in plant capacity, supply response from Alberta's stock growers, the cost and availability of feeder cattle from Saskatchewan, and the ability of Alberta to compete for feeders in the northern United States. Anticipation of increased flows of cattle from U.S. northern tier states to Alberta has been an important motivation for reducing the cost associated with sanitary border regulations, as proposed in the Montana Pilot Project.

Criteria for Sanitary Regulations

The premise of the Montana Pilot Project is that sanitary regulations at national borders should acknowledge regional differences in disease incidence. When disease is limited to an area, regions (rather than countries) should form the basis for sanitary regulations. The concept of regionalization was included in the sanitary and phytosanitary agreement of both NAFTA and the Uruguay Round Agreement. The concept has been summarized:

> A member country shall recognize the concepts of regions of low pest or disease prevalence, and shall ensure that its sanitary and phytosanitary measures are adapted to take into account the characteristics of regions from which products originate and to which products are destined. In doing so, the Member should take into account relevant geography, ecology, methods of surveillance and effectiveness of control systems. (APHIS 1996)

Both trade agreements embody similar criteria for sanitary and phytosanitary regulations, including that they must be based on science and that the procedures used for risk assessment must meet internationally accepted standards. Countries are encouraged to work toward international harmonization by adopting the standards developed by the Office International des Épizooties (OIE). This organization was designated by the World Trade Organization (WTO) to set standards for animal health. A country can choose to impose a more stringent standard to reflect a preferred level of risk if the standard is based on science; however, more stringent standards may be challenged by other members of the WTO.

The Montana Pilot Project

The Montana Pilot Project has been proposed to reduce the cost of moving animals across the border by removing unnecessary sanitary requirements, defined as those that cannot be justified on the basis of science, and by streamlining procedures. The pilot project enacts these changes:

- Cattle entering the United States from Canada are subject to both federal requirements and additional requirements that vary by state. Under the pilot project, Animal and Plant

Health Inspection Services (APHIS) would waive the federal test requirements for brucellosis and tuberculosis for Canadian cattle entering Montana, and the State of Montana would eliminate the vaccination requirement for brucellosis (Rath pers. comm. 1996).

- Canada would utilize special feedlots for imported feeder cattle (for the period October 1 to March 31) from Montana without tests that are currently required for anaplasmosis, brucellosis, or tuberculosis. There would be strict requirements for identification of cattle and records indicating that all sales are to packers only. Currently, these tests cost U.S. producers $25 per head (Rath pers. comm. 1996).
- In Montana there are certification fees at the border of $49.50 per head for the first animal and $1.50 for each animal after that included in the shipment. For a 50,000-pound truckload these costs average about $2 per head. In addition, complying with border regulations takes management time and skills. Both countries are investigating ways to streamline operational procedures used to implement the regulations to reduce the cost and shorten the process of moving the livestock from one country to another.

Montana is an appropriate choice for implementation of the pilot project due to its ample supply of feeder cattle, low incidence of disease, and proximity to Alberta. Although Montana has a substantial cow-calf industry, it does not have major feedlot and packing facilities. Cargill's packing plant is located in High River, Alberta, which is 278 miles from Great Falls, substantially closer than some other out-of-state destinations for Montana cattle. Savings in transportation costs and increasing the number of plants as active bidders for Montana cattle are important economic incentives for the industry to pursue the project. In addition, APHIS has stated that the pilot project serves as a test case for implementing the regionalization concept (Arnoldi 1996).

Although the project also reduces the cost of moving Canadian cattle into Montana, imports into Montana are not expected to be great, as tests for brucellosis and tuberculosis will be required for Canadian cattle moving from Montana into other states. In the Canadian view, the incentive to insist on a reciprocal decrease in border regulations is recognition of Canada's brucellosis-free status by the United States (Greenwood pers. comm. 1996), a first step to the elimination of the brucellosis test on all Canadian feeder cattle exported to the United States.

Due to differences in the two countries' regulatory systems, Canadian cattle will be gaining additional access only to the state of Montana, whereas access for Montana cattle will not necessarily be restricted to Alberta. The Canadian Food Inspection Agency will designate special feedlots that can receive the cattle, and those designations will limit access.

The concept of regionalization for sanitary restrictions has both associated costs and benefits. It provides for greater economic efficiency; however, performing the risk assessment required to assess proposed changes, the process of regulatory change, and monitoring of the pilot project all have associated costs.

Economic Impact on the U.S. Feeder Cattle Market

Overall, Canadian packing plant expansions have several market implications for both U.S. and Canadian cattle producers. One obvious Canadian consequence is the impact via regional income and employment due to packing plant (carcass and fabrication) investment and

Alberta feedlot expansion. Other factors include Canadian marketing of boxed beef products to the United States and to international markets in the Pacific Rim, changes in the derived demands and prices for Canadian and U.S. feeder and slaughter cattle, and potential changes in transfer costs as U.S. live cattle flows respond to market demands in southern Alberta.

The purpose of this section is to provide a statistical analysis of the impacts of expected growth in southern Alberta beef packing capacity on the demand price of U.S. feeder cattle. A model is developed to estimate price and quantify effects of the expansion as well as estimate the effects of reducing sanitary costs in U.S.-Canadian cattle trade.

Model

A five-equation model is used to quantify the effects of Canadian slaughter capacity on U.S. feeder cattle price. In concept, changes in packing capacity in Alberta, Canada, are transmitted to the U.S. cattle market via derived demand and live cattle trade. Thus, equations are specified that include the derived demand for slaughter cattle in Alberta, Canada, excess demand/excess supply for net live cattle trade between Alberta and the United States, and derived demand for feeder cattle in the United States. The model is based on quarterly observations so as to capture short-term dynamics of livestock demand and live cattle trade. Primary supply relationships are not specified since capacity requirements can draw upon existing cattle supplies via Canada-U.S. trade adjustments and Canadian interprovincial flows. Over the longer term, however, supply responses would be expected to emanate from herd adjustments in the cattle cycle. The structural model with market clearing conditions are given as follows:

(1) $Q_{Dsl}^{CA} = f_1 (P_{sl}^{CA}, P_{bx}^{CA}, B_p^{CA}, D, \mu_1)$ (Alberta slaughter cattle demand)

(2) $NT^{CA\text{-}US} = f_2 (P_{sl}^{US} - P_{sl}^{CA}, P_{fd}^{CA} - P_{fd}^{US}, I_{A\text{-}1}, D, \mu_2)$ (Alberta net cattle exports)

(3) $Q_{Dfr}^{US} = f_3 (P_{fr}^{US}, P_{sl}^{US}, P_{fd}^{US}, D, \mu_3)$ (U.S. feeder cattle demand)

(4) $Q_{Dsl}^{CA} = Q_{Ssl}^{CA} + NT^{CA\text{-}US}$ (Alberta market clearing)

(5) $Q_{Dfr}^{US} = Q_{Sfr}^{US} + NT^{US}$ (U.S. market clearing)

The variables Q_{Dsl}^{CA}, Q_{Ssl}^{CA} are Alberta, Canada slaughter cattle demand and supply, respectively; Q_{Dfr}^{US}, Q_{Sfr}^{US} are U.S. feeder cattle demand and supply, respectively; $NT^{CA\text{-}US}$, NT^{US} are Alberta net exports of live cattle to the United States (Alberta exports minus imports from the United States) and total U.S. net imports of live cattle from Canada and Mexico, respectively; $I_{A\text{-}1}$ is Alberta cattle inventory lagged one period; P_{sl}^{CA}, P_{sl}^{US} are respective prices of Canadian and U.S. slaughter steers; P_{bx}^{CA}, B_p^{CA} are prices of Canadian wholesale boxed beef and beef by-products, respectively; P_{fd}^{US}, P_{fd}^{CA} are prices of U.S. corn and Canadian barley, respectively; P_{fr}^{US} is price of U.S. feeder steers; D is the set of intercept shifters (dummy variables) for seasonality; and μ_1, μ_2, μ_3 are random error terms with assumptions of zero mean, constant variance, and zero autocorrelation.[2]

Canadian demand for slaughter cattle (equation 1) is a derived demand that depends upon the input price of slaughter cattle, the output price of wholesale beef, the output price of joint products, and seasonality. The U.S. demand for feeder cattle (equation 3) is a derived demand that depends upon the input price of feeder cattle, output price of slaughter cattle, the input cost of feed (corn) and seasonality. The linkage between the Canadian slaughter and U.S. feeder cattle demands occurs via net live cattle trade (equation 2). This relation is based upon theoretical U.S.

excess demand and Alberta excess supply of feeder and slaughter cattle.[3] Given transportation costs, the economic incentives for U.S.-Canadian trade are provided through inter-country price differences of slaughter cattle and feedgrains.[4] For example, ceteris paribus, increased Canadian slaughter cattle demand and hence price (P_{sl}^{CA}) narrows the U.S.-Canadian slaughter price differential (P_{sl}^{US} - P_{sl}^{CA}) which reduces the profit incentives for Alberta producers to export slaughters and feeders. Less import supplies are received into the United States and consequently U.S. feeder cattle prices increase. Or, if the price of Canadian barley increased relative to U.S. corn price (P_{fd}^{CA} - P_{fd}^{US}), Alberta cow-calf /yearling producers would export more feeder cattle to the United States for feedlot finishing. The resulting expansion of import supplies would then reduce U.S. feeder cattle price.

Using equations (3) and (5), measuring the impact of trade flows on U.S. feeder price is facilitated by specifying an inverse demand, given by:

(6) $P_{fr}^{US} = f_4 (Q_{Sfr}^{US}, P_{sl}^{US}, P_{fd}^{US}, NT^{US}, D, \mu_4)$.

Feeder cattle supply (Q_{Sfr}^{US}) and net trade (NT^{US}) enter inverse demand via the market clearing of equation (5). In the net trade variable (NT^{US}) Mexico is also included since a specification bias would occur if U.S. trade in North America only included Canada. In 1995, U.S. imports of live cattle were 2.79 million head, of which 1.65 million head originated from Mexico. Also, all of Canada is included in the net trade variable since the United States trades cattle with provinces besides Alberta. For 1995 and 1996, U.S. cattle imports from Alberta averaged about 51 percent of total imports from Canada. Quarterly data for U.S. cattle imports in the sample period were disaggregated by Canada and Mexico, but quarterly data for U.S. cattle exports were not consistently available by country of destination. Consequently, in the analysis, the aggregate trade variable NT^{US} was proportioned to account for the effects of Alberta trade.

Slaughter Capacity Linkage

The above equations provide a logical framework for evaluating the effects of increases in Canadian beef packing capacity. Using partial derivatives specific to equations (1), (2), and (6), slaughter capacity changes are shown to affect the U.S. feeder cattle market via price incentives and quantity adjustments (following). As stated, demand and trade behavior are assumed to be dynamic. Given exogenous shocks, short-term (quarterly) rigidities such as biological growth, institutional factors, and expectations of market participants would prevent instantaneous adjustments of the dependent variables. The dynamics are assumed to be represented by Koyck distributed lags, whereby, conceptually, current values of the dependent variables are generated by information on past prices, characterized by infinitely declining geometric weights (Nerlove 1972).[5]

An infinite Koyck lag necessitates a transfer to an estimable, first-order difference equation. Consequently, the lagged dependent variable of equation (1) provides a lagged slaughter demand that can reflect capacity constraints. A priori, an arbitrary increase in lagged slaughter demand, commensurate with an assumed capacity increase, would shift Canadian slaughter cattle price. As a consequence, the U.S.-Canadian slaughter price difference, net trade flows, and ultimately inverse demand for U.S. feeder cattle would be affected. Represented by a chain-derivative process these relationships are shown as (using the defined variables):

$$(7) \quad \frac{\delta\, P_{sl}^{CA}}{\delta\, Q_{D-1}^{CA}} \quad \frac{\delta\, NT^{CA-US}}{\delta\, (P_{sl}^{US} - P_{sl}^{CA})} \quad \frac{\delta\, P_{fr}^{US}}{\delta\, NT^{US} \cdot \theta} = \pi,$$

where π is the anticipated impact on U.S. feeder cattle price given a capacity change in Alberta beef packing (Q_{D-1}^{CA}). The first partial derivative term in equation (7) is based on direct estimation of equation (1) and then appropriately solving for the P_{sl}^{CA} variable. The marginal impact is expected to be positive, as capacity increases by a packing firm would translate into increased derived slaughter demand, hence price.

The second partial derivative term indicates the price differential between the United States and Canada would change, affecting net trade flows and U.S. feeder price as demonstrated through the last partial derivative term in equation (7). However, NT^{CA-US} as a proportion of NT^{US} must be included (given by θ) in order to relate provincial Alberta trade to the U.S. feeder market. For the years 1988–1996 the Alberta proportion averaged 24 percent.

Empirical Results

Table 1 gives the statistical results of the structural model. Quarterly data from 1985 through 1996 were utilized, however a shorter period for the net trade function (1988–1996) was used due to data limitations on Alberta live cattle exports. The Canadian slaughter demand and Alberta-U.S. net trade equations were estimated by OLS, while the U.S. feeder inverse demand equation was estimated by nonlinear least squares to account for the nonstochastic components of the difference equation.[6] In the Canadian slaughter demand, the Hausman specification test was applied to the P_{sl}^{CA} and P_{bx}^{CA} variables, but simultaneity bias was rejected at the $\alpha = .05$ level of significance. Both these price variables were highly confounded, demonstrated by respective insignificant t values of .13 and .55 in the initial run. Consequently, the boxed beef price was omitted, with significance occurring on slaughter price, a focal point for transmitting capacity effects to feeder price shown in equation (7).

The net trade function possessed serial correlation up to the Wallis fourth-order coefficient. The U.S.-Canadian slaughter price differential possessed the correct (positive) coefficient sign and was statistically significant at the $\alpha = .01$ level. The coefficient indicates every one dollar increase in the price difference increased Alberta cattle exports by about 7,703 head. The price difference variable for feedgrains, although possessing the correct sign, was statistically insignificant. Its direct effect may have dissipated as feed costs were bid into the cattle price differences. The lagged dependent variable was not statistically significant and therefore omitted, its effect dominated by the importance of the lagged inventory variable (I_{A-1}).

The U.S. feeder price equation was augmented to a second-order difference equation (second-order lag on the dependent variable). The equation expansion resulted from a high significance ($\alpha = .01$) on the first-order lag of the dependent variable in the initial run. All economic variables in the equation are statistically significant at the $\alpha = .01$ level and possess theoretically correct coefficient signs. Due to the endogeneity of slaughter price and live cattle imports, the equation was estimated by instrumental variables.[7] As a second-order polynomial, the difference equation possessed conjugate complex roots, indicating U.S. feeder price oscillates as it asymptotically approaches an equilibrium. Such would be consistent with feeder prices behaving in accordance with the U.S. cattle cycle (Rosen, Murphy, and Scheinkman 1994).

Table 2 gives price elasticity and flexibility estimates of the model, both for the short term (one quarter) and long term (beyond one year). Note the relative response of Alberta net cattle exports to changes in the inter-country slaughter price difference, i.e., a quarterly elasticity coefficient of .387. Though inelastic, the short-term response underscores the revenue importance to Alberta beef producers of utilizing U.S. livestock markets when economically feasible. For the sample period, Alberta net cattle exports averaged about 32 percent of the province's domestic slaughter. Note, on the other hand, the small flexibility coefficients that relate the impact of net cattle trade on U.S. feeder price (-.023 short-run and -.058 long-run). Their small size suggests domestic factors and not live cattle trade dominate causality of U.S. feeder prices. From 1985-1996 the data indicate that U.S. total net cattle trade as a proportion of total domestic cattle slaughter averaged 4.4 percent.

Simulation Results

Capacity Effects. Alberta's two major beef packers (IBP and Cargill) constitute the majority of current and anticipated increases in Canadian slaughter capacity. Based upon reports from economists familiar with the Canadian meat packing industry (CANFAX; Hayes, Hayenga, and Melton 1996) the impacts of three capacity increases are estimated: an increase of 0.5, 0.8, and 1.2 million head. This range encompasses realistic parameters of expansion; it captures relatively small-to-large capacity increases in order to predict possible price impacts. In time, expected capacity benefits may accrue more to the U.S. northern-tier states in terms of fewer imports of live cattle, transportation advantages to southern Alberta markets, and more competitive bidding for feeder cattle that ordinarily are demanded in other stocking/finishing regions of the United States. The disadvantages are that slaughter capacity increases in Alberta will result in additional wholesale Canadian beef sold into the United States and the Pacific Rim market where the United States has been the prime supplier of fed beef. Thus, there would be an expected reduction in the growth rate of U.S. beef exports to this region.

Table 3 gives the expected U.S. feeder price effects due to increases in Canadian slaughter capacity and the expected impact of eliminating the cost of meeting current border tests required to export U.S. cattle to Canada. The numbers reported (percentages and dollars per cwt) represent the long term and are relative to the base year 1994, since capacity expansion began subsequent to that year. The price effects are net estimates; that is the gross effects on feeder price as calculated by equation (7) less the effects of a reduced growth rate in U.S. exports of boxed beef and an inventory supply response. Though somewhat arbitrary, the growth rate reduction is assumed to be 5 percent. Over the long term, a feeder cattle supply response would be expected due to a price increase; thus, the price effect was adjusted assuming the feeder supply elasticity to exceed unity, selected here as 1.20 (Marsh 1994).

The projected Alberta capacity changes (percentage-wise) are substantial increases over the 1994 slaughter base of 1.449 million head, but nevertheless result in small impacts on U.S. feeder prices. For example, a 0.5 million head capacity expansion (or 34.5 percent) is expected to increase U.S. feeder cattle price (net-wise) by about $0.24 per cwt. The 0.8 million head capacity change (55.2 percent) would increase price by about $0.38 cwt, and a 1.2 million head slaughter expansion (82.8 percent) would increase feeder price by about $0.57 cwt (all increases based on the 1994 U.S. feeder steer price of $83.25 cwt). These amount to a range of about $1.56 to $3.71 per head for a 650-pound feeder, roughly increasing the aggregate value of the October 1, 1996, feeder cattle supply (36.38 million head) by $135.0 million, using the highest value.

The small values of the capacity-price effects reflect demand and supply conditions of the more fully integrated markets of U.S.-Canadian beef trade. Increases in Alberta slaughter capacity would be sourced by a decrease in Alberta live cattle exports, provincial feeder supply response, and cattle supplies from other provinces such as Saskatchewan. Given capacity growth, the impact on import demand (hence price) for U.S. feeder cattle is conditional upon these factors. In 1995, Alberta imports of live cattle from the United States as a percentage of Alberta cattle slaughter was slightly less than 1 percent; thus, conceptually, demand increases above this percent would be expected to produce only minor shifts in U.S. feeder price. Quantitatively, the change can be calculated via an elasticity coefficient using equation (7), showing the percentage change in U.S. feeder price due to a 1 percent increase in Alberta slaughter capacity. The formula, using π of equation (7) is:

$$\text{(8)} \qquad \frac{\%\ \Delta\ P_{fr}^{US}}{\%\ \Delta\ Q_{D-1}^{CA}} = (\pi)\left(\frac{Q_{D-1}^{CA}}{P_{fr}^{US}}\right)(\phi)$$

where π is the partial derivative, $\partial P_{fr}^{US}/\partial Q_{D-1}^{CA}$, and ϕ is Alberta live cattle exports (to the United States) as a proportion of U.S. net live cattle trade. From 1988–1996 the proportion was 0.24. Using the sample means, the long-run coefficient is quite inelastic at 0.062. This elasticity, however, is not adjusted for reduced U.S. beef export growth or supply response of feeder cattle.

Sanitary Regulations. The economic effects of reducing U.S.-Canadian sanitary costs in live cattle trade are applied to shipping feeder cattle, the major input in meeting Canadian finishing requirements. The economic basis of analyzing the effects is analogous to that of marketing margins; that is, within the framework of competitive markets, a reduction in margin costs increases derived demand and derived supply (Tomek and Robinson 1990). If the Montana Pilot Project is implemented, marketing costs would be reduced by $27 per head, the cost of meeting 1997 sanitary requirements and paperwork certification for a 625-pound feeder calf. The reduction is equivalent to $3.31 cwt for a 1100 lb. Canadian slaughter steer. If we assume the cost saving is passed through and lowers Canadian slaughter price, the additional quantity demanded by Canadian packers translates to an increase in demand for U.S. feeders. Specifically, using (in Table 3) the long-run Canadian price elasticity of slaughter demand (-1.711) and the long-run U.S. price flexibility with respect to feeder inventories (-0.622), the result is a 7.17 percent increase in quantity demanded or a $0.144 cwt increase in U.S. feeder price, unadjusted for supply response.[8] This small but positive price impact does not include other benefits from a reduction in health regulations, such as the value of operators' time in meeting test requirements and paperwork. In addition, increased demand by Alberta packers will result in reduced transportation costs for U.S.-shipped cattle.

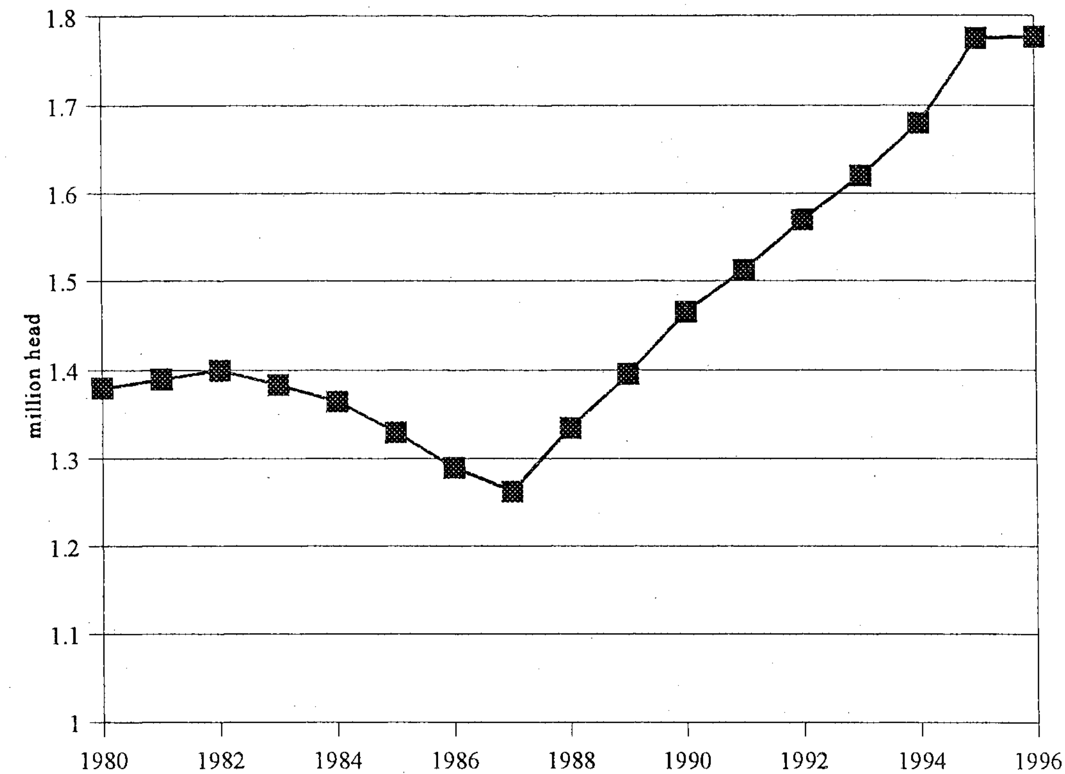
Conclusions

The increase in beef packing capacity in Alberta, Canada will have a small but positive impact on prices in the U.S. feeder cattle market. Feeder cattle prices are estimated to increase (net-wise) by $0.24 to $0.57 per cwt. This should alleviate some of the tension that exists in the United States concerning imports of live cattle to the U.S. market, particularly in U.S. northern tier states. Northern tier states should benefit over time from transportation advantages to the southern Alberta market and increases in competitive bidding for feeder cattle that ordinarily are demanded in other stocking/finishing areas of the United States. However, the expansion will also increase Canadian beef exports to the U.S. and Canada's ability to compete with the United States in the Pacific Rim export markets.

Empirical results in this paper indicate that Alberta's net cattle exports are relatively sensitive to short-term differences in U.S. and Canadian slaughter cattle prices. However, U.S. cattle imports from Canada have an extremely small price impact on domestic feeder cattle price, which is in keeping with their small size vis-à-vis the U.S. market. Domestic factors in the U.S. market, not imports of live cattle at their current levels, determine U.S. cattle prices.

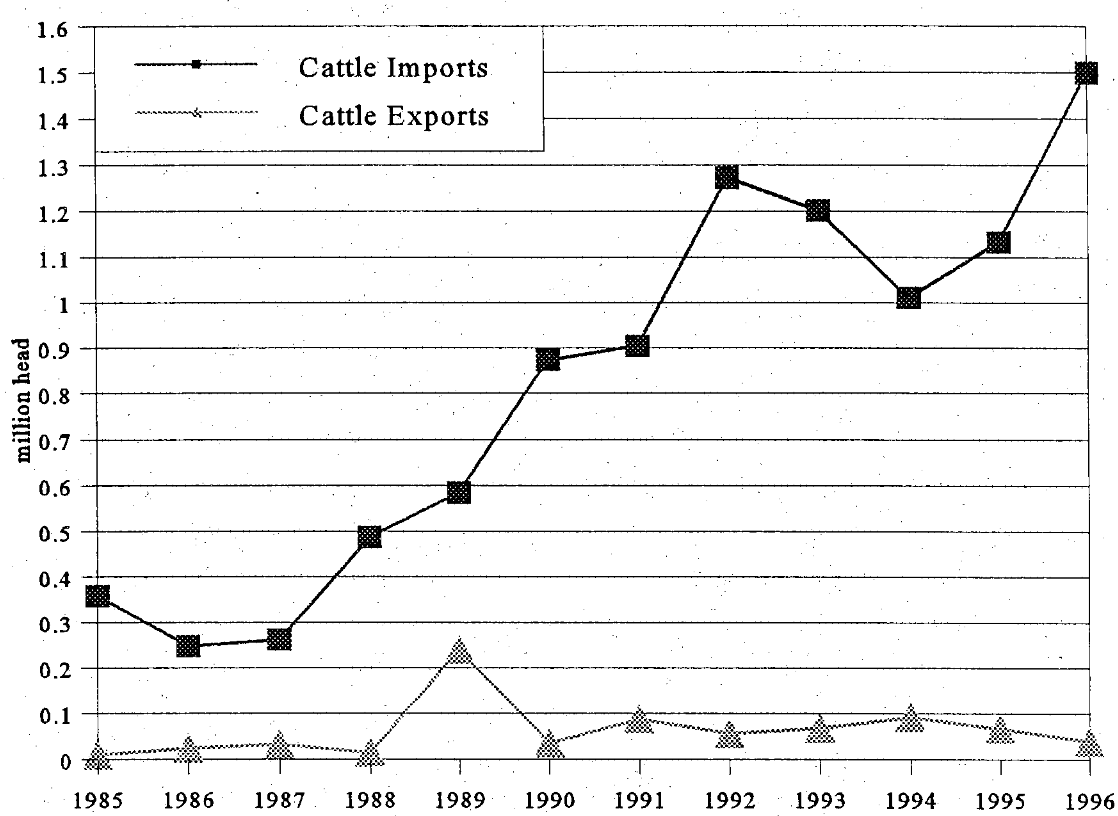
The integration of the U.S. and Canadian livestock industries will be facilitated by a potential reduction in the sanitary regulations at the border. Although the price impact is small, an estimated $0.14 cwt, it does not include the value of reduced time expended to ship cattle over the border. In addition, the industry will gain from reduced transportation costs for cattle. This change in border regulations is an example of the type of benefit industries can realize with the implementation of the Sanitary and Phytosanitary Agreements contained in both GATT and NAFTA. Complete integration of the U.S. and Canadian live cattle markets would also require harmonization of policies affecting grain markets and standardization of the health regulations and grading in the meat packing industries. However, since the implementation of the free trade agreement between Canada and the United States substantial progress in market integration has been made.

Figure 1: Alberta Beef Cow Inventory, 1980–1996



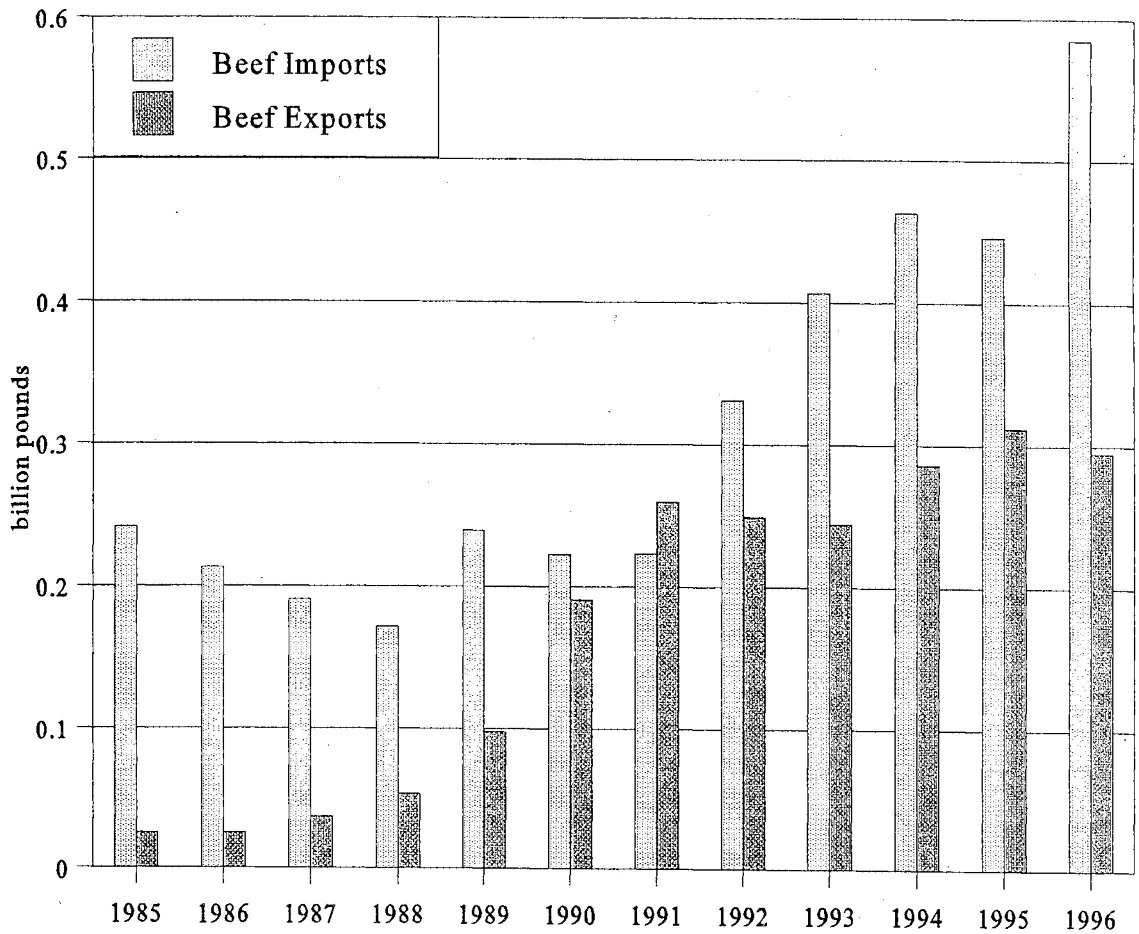
SOURCE: ***Statistics Canada*****, Ottawa, 1996**

Figure 2: U.S. Live Cattle Imports and Exports to Canada, 1985–96



SOURCE: *Livestock Marketing Information Center*, 1997

Figure 3: U.S. Boxed Beef Imports from and Exports to Canada, 1985–96



Source: Marsh and Peck, 1996

Table 1. Regression Results of U.S. - Alberta Cattle Demand and Net Trade Model

Independent Variables	*Dependent Variables*			
	Q_{DSL}^{CA}	$NT^{CA\text{-}US}$	P_{fr}^{US}	
P_{sl}^{CA}	-1248.813 (-2.460)			
$I_{A\text{-}1}$		92.081 (2.322)		
B_p^{CA}	1247.583 (0.951)			
P_{sl}^{US} - P_{sl}^{CA}		7702.612 (3.220)		
P_{fd}^{CA} - P_{fd}^{US}		1337.259 (0.166)		
Q_{Sfr}^{US}			-0.000430 (-5.403)	
P_{sl}^{US}			.482 (7.346)	
P_{fd}^{US}			-2.042 (-5.436)	
NT^{US}			-.00363 (-3.161)	
Dep-j	.827 (9.565)		1.031 (8.006)	-.423 (-4.126)
Constant	124775.5 (2.412)	-593321.0 (-4.894)	19.073 (4.872)	
AR(j)		See Below		
$\overline{R}^2$	.850	.900	.954	
S/Y	.054	.144	.034	
Dw/Dh	2.307	2.099	1.736	

Notes: The values of the asymptotic t ratios are given in parentheses below the coefficients. The critical value at the $\alpha = .10$ significance level is 1.697 and the critical value at the $\alpha = .05$ significance level is 2.042 (30 degrees of freedom). The term Dep-j is the lagged dependent variable; for the P_{fr}^{US} equation they are first and second order lags listed horizontally.

AR(j) is the auto-regressive error, and AR(1) - AR(4) is the fourth-order autoregressive error for the net trade equation. The coefficients are, with t-ratios in parentheses, AR(1) = .388 (1.870), AR(2) = -.511(-2.550), AR(3) = .412 (1.987), and AR(4) = .260 (1.300). The seasonal binaries, not shown, were estimated, for the second (D2), third (03), and fourth quarters (D4). They are: slaughter demand, D2 = 19703.76 (2.657), D3 = -12131.96 (-1.549), D3 = -23059.88 (-3.039); net trade, D2 = 123592.2 (3.621), D3 = 94525.45 (2.072), D4 = -50820.28 (-1.572); and feeder price, D2 = -5.796 (-3.539), D3 = 2.396), D4 = -2.033 (-1.339). The t ratios are given in parentheses. $\bar{R}^2$ is the adjusted R-squared, S/Y is the standard error of regression ÷ mean of dependent variable, and Dw/Dh are the appropriate Durbin-Watson and Durbin h tests. The Dh test was used for Canadian slaughter demand and the Dw test was used for the NSDE equation of U.S. feeder price.

Table 2. Price Elasticity and Flexibility Estimates of the U.S.-Alberta, Canada, Demand and Trade Model

	Variables that Respond		
Variables that Shift	Q_{DSl}^{CA}	$NT^{CA\text{-}US}$	P_{fr}^{US}
P_{sl}^{CA}	-.239 -1.711		
$P_{sl}^{US} - P_{sl}^{CA}$		.387 .387	
Q_{Sfr}^{US}			-.260 -.629
P_{sl}^{US}			.455 1.102
P_{fd}^{US}			-.058 -.141
NT^{US}			-.017 -.041

Notes: The top rows are the elasticity coefficients for the short run (one quarter); the bottom rows refer to the elasticity coefficients of the long run. The coefficients are evaluated at the sample means of the variables. The long-run elasticities are the short-run elasticities divided by one minus the summation of the coefficient (s) of the lagged dependent variables.

Table 3. Impacts on U.S. Feeder Cattle Price From Slaughter Capacity Increases in Alberta, Canada

	Capacity Increases (Head)		
Net Unit Changes	*500,000*	*800,000*	*1,200,000*
Percent over 1994 Base	34.52	55.23	82.84
Percentage effect	0.284	0.455	0.681
Dollars/cwt effect	$0.236	$0.379	$0.567
Health cost effect	$0.144	$0.144	$0.144

Notes: Under the "Net Unit Changes" column, the first row represents percent capacity increases over the 1994 slaughter cattle base of 1,448,526 head. The second row ("percentage effect") is the net percentage increase in U.S. feeder price over 1994, accounting for additional Canadian beef exports to the U.S. and Pacific Rim markets and a U.S. feeder cattle supply response; the third row ("dollars cost effect") is the percentage of the second row multiplied by the 1994 U.S. feeder price of $83.25 cwt; and the last row ("health cost effect") is the dollar/cwt increase in U.S. feeder price resulting from a $27 per head reduction in sanitary costs at the U.S.-Canadian border, assuming 625-pound feeder cattle.

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Endnotes

1.The following products became "free":

Fresh or chilled beef and veal carcasses effective April 1, 1990

Frozen beef and veal carcasses; fresh, chilled or frozen other cuts bone-in; and fresh boneless beef and veal on July 1, 1991

Frozen boneless beef and veal on July 1, 1993.

2.All cattle numbers are in thousands of head. Cattle prices for Canada are in 1986 constant dollars (per cwt) and cattle prices for the United States are in 1982-84 constant dollars (per cwt). In the slaughter price differential of equation (2), U.S. slaughter price (P_{sl}^{US}) is converted to Canadian dollars. All feed prices (dollar per bushel) and Canadian by-product price (dollars per cwt) are also in the appropriate constant dollars and common units of measurement. The U.S. feed price in the feed price differential of equation (2) is adjusted for the Canadian exchange rate. The Canadian wholesale beef price (carcass converted to box) and slaughter steer price are based on A1 grade steer, Alberta. The U.S. slaughter steer price is based on USDA choice grade steers, Nebraska direct. The U.S. feeder steer price is based on medium #1 grade, 600-650 lbs, Oklahoma City.

3. For a theoretical discussion of excess demand and excess supply relationships involving trade between two regions/countries see Tomek and Robinson, pp 147-153.

4. U.S.-Canadian feeder cattle price differentials are also important but changes in slaughter prices are bid into feeder cattle price differences.

5. Given a Koyck equation of $Y_t = \beta X_t + \lambda Y_{t-1} + U_t$, the declining weights are given in the infinite series

$$\frac{\partial Y_t}{\partial X_{t-j}} = \beta\left(1 + \lambda + \lambda^2 + \ldots\right) \qquad j = 0, 1, 2, \ldots,$$

where λ is the difference equation coefficient. The cumulative, long run effect is given as

$$\frac{\partial\ Y_t}{\partial\ X_{t-j}} = \frac{\beta}{1\ -\ \lambda}, \qquad j \rightarrow \infty\ .$$

6. U.S. feeder price was estimated as a second order difference equation, the function being a nonstochastic difference equation (NSDE). For the NSDE, the lagged dependent variables do not consist of their observed values, but rather lagged expected values. The NSDE produces nonlinearities in the parameters, thus, the equation was estimated by a modified Marquardt nonlinear least squares algorithm. For a complete discussion and justification of the NSDE procedure, see Rucker, Burt, and LaFrance (1984). In addition, model variables were tested for nonstationarity, the results of the augmented Dickey-Fuller test indicating stationarity in the series.

7. On a quarterly basis it has been established that slaughter price is jointly dependent in inverse feeder demand (Marsh 1988). The endogeneity of imports indicates Mexican producers export more feeder cattle to the United States when U.S. feeder price increases. Lagged values of these variables were used as instruments, providing consistent estimators in the absence of serial correlation.

8.The procedure to calculate the health cost effect is as follows: \$27 cwt cost savings ÷11 cwt slaughter steer x 1.35 Canadian exchange rate = \$3.31. The \$3.31 cwt ÷ \$78.99 cwt mean Canadian slaughter price = 4.19 percent, and 4.19 x 1.711 (long-run Canadian price elasticity of slaughter demand) = 7.17 percent increase in Canadian demand for slaughter cattle. The 7.17 percent multiplied by 1,759,032 head of Alberta slaughter in 1996 indicates a 126,123 head increase in Canadian slaughter demand due to the cost savings. If satisfied by imports of U.S. feeder cattle, for the U.S. feeder market this implies 126,123 head ÷ 35,529,000 head of U.S. feeder inventory 1996 x .622 (long-run U.S. feeder price flexibility with respect to feeder cattle inventory) = .221 percent increase in U.S. feeder price. U.S. feeder steer price in 1996 was $65.21 cwt, thus, the final price effect of the $27 health cost savings would be $1.44 cwt.

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