

**Potential Effects on U.S. Cattle and Beef Prices from
Reopening the Borders**

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Abstract

U.S. trade of beef and live cattle has declined substantially since the discoveries of bovine spongiform encephalopathy (BSE) in Canada and the United States in 2003. Imports of live cattle from Canada resumed in July 2005, but U.S. beef exports remained substantially below pre-BSE levels as important export markets in Japan and Korea were not regained. The removal of the ban on Canadian imports and the eventual lifting of bans to export markets could affect U.S. cattle and beef prices. In this study, an econometric model is developed and estimated to determine the effects of lifting trade restrictions on cattle and beef prices. Results show that if net cattle imports from Canada increase to 1.5 million animals per year, with beef imports held constant, the slaughter steer, feeder steer, and retail beef prices would decrease \$4.65/cwt, \$5.31/cwt, and 6.55 cents/lb, respectively. However, the drop in prices from increased imports would be more than negated if beef exports returned to near previous levels. If beef exports increased to 100 percent of the 2003 level, slaughter steer, feeder steer, and retail beef prices could increase by \$7.83/cwt, \$8.95/cwt, and 16.0 cents/lb, respectively.

Keywords: bovine spongiform encephalopathy, beef exports, cattle imports, prices

Highlights

Discoveries of bovine spongiform encephalopathy (BSE), commonly referred to as mad-cow disease, in Canada and the United States in 2003 led to the decision by a number of foreign markets to ban beef and cattle imports from these two countries. U.S. imports of live cattle and beef from Canada stopped after BSE was discovered there in May 2003. Within a few months, the United States lifted the ban on beef imports from cattle younger than 30 months, but the ban on live cattle imports remained in effect until July 2005. After the first case of BSE was found in the United States in December 2003, a number of countries imposed bans on U.S. beef. As a result, U.S. beef exports declined by 83 percent in 2004. Some countries have since lifted their bans, but borders remain closed for exports to important markets in Japan and Korea.

An econometric model is developed to estimate the effect that removing these bans would have on U.S. cattle and beef prices. The slaughter steer price is affected by the quantity slaughtered, average dressed weight, beef imports and exports, beef demand factors, by-product values, and the farm-to-retail price spread. The slaughter steer price affects demand for feeder cattle and, therefore, the feeder steer price. The retail beef price is affected by beef supply and demand.

The estimation results demonstrate that beef and live cattle trade have significant effects on U.S. cattle and beef prices. According to the results of our model, if net cattle imports from Canada increased from zero to 1.5 million animals per year, the slaughter steer, feeder steer, and retail beef prices would decrease \$4.65/cwt, \$5.31/cwt, and 6.55 cents/lb, respectively. These price decreases would be declines of approximately 5.5 percent for the slaughter steer price, 4.2 percent for the feeder steer price, and 1.8 percent for the retail beef price. Given the increases in Canada's slaughter capacity and the fact that beef imports from Canada have been permitted since the fall of 2003, the impact of opening the border to live cattle imports may not be quite this great. This is because the meat from some of these cattle may have eventually entered the United States in the form of boxed beef, regardless of the ban on live cattle.

With an open border and increasing slaughter capacity in Canada, imports of either live cattle, boxed beef, or both are expected to increase. However, the negative impact on prices from import increases would be more than negated if beef exports return to near previous levels. The current level of U.S. beef exports is about 24 percent of the 2003 export level. If beef exports increased to 100 percent of the 2003 export level, slaughter steer, feeder steer, and retail beef prices could increase by \$7.83/cwt, \$8.95/cwt, and 16.0 cents/lb, respectively. These price increases would be approximately 9.2 percent for the slaughter steer price, 7.2 percent for the feeder steer price, and 4.4 percent for the retail beef price.

These results suggest that increasing beef exports is important for U.S. cattle producers. For there to be a substantial increase in exports, however, exports to Japan and Korea will need to resume. These two markets accounted for close to 60 percent of U.S. beef exports prior to the BSE bans. It may be unlikely, however, that beef exports would return immediately to previous levels once the bans are lifted. Consumer preferences in Japan and Korea may have changed, and their demand for beef, especially U.S. beef, may have declined.

Potential Effects on U.S. Cattle and Beef Prices from Reopening the Borders

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INTRODUCTION

Discoveries of bovine spongiform encephalopathy (BSE), commonly referred to as mad-cow disease, in Canada and the United States in 2003 led to the decision by a number of foreign markets to ban beef and cattle imports from these two countries. U.S. imports of live cattle and beef from Canada stopped after BSE was discovered there in May 2003. Within a few months, the United States lifted the ban on beef imports from cattle younger than 30 months, but the ban on live cattle imports remained in effect until July 2005. After the first case of BSE was found in the United States in December 2003, a number of countries imposed bans on U.S. beef. As a result, U.S. beef exports declined by 83 percent in 2004. Some countries have since lifted their bans, but borders remain closed for exports to important markets in Japan and Korea.

The objective of this study is to estimate the effect that removing these bans would have on U.S. cattle and beef prices. The resumption of live cattle imports from Canada could cause U.S. prices to decline as supplies increase. With recent increases in Canada's slaughter capacity, Canada has the ability to ship greater quantities of boxed beef to the United States, which could also negatively affect U.S. prices. The increase in slaughter capacity, though, may mean that Canada will not export as many live cattle to the United States as in previous years. As Canadian shipments of live cattle and beef to the United States increase, prices in Canada could improve, and U.S. beef exports to Canada could return to previous levels. Meanwhile, regaining other export markets for U.S. beef, especially Japan and Korea, should have a positive impact on U.S. beef and cattle prices.

This paper is organized as follows. Changes in trade flows since the bans were imposed are discussed in the second section. In the third section, an empirical model is developed and estimated to determine the effect of trade on U.S. cattle and beef prices. Based on these results, the impact on prices from resuming trade is estimated and presented in the fourth section of the paper. The final section includes concluding remarks.

CHANGES IN TRADE FLOWS SINCE BSE BANS WERE IMPOSED

Table 1 shows the quantity of annual U.S. beef and cattle trade from 1989 to 2005, and the value of annual trade is shown in Table 2. Beef exports and imports were steadily increasing until the 2003 BSE discoveries.

Live Cattle Imports

From 1992 to 2002, Canadian live cattle exports to the United States averaged 1.25 million animals per year, and reached a high of 1.7 million animals in 2002. Canadian cattle accounted

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for approximately 3 to 4 percent of the supply of cattle slaughter in the United States, which has averaged about 36 million animals in recent years. U.S. live cattle imports from Canada stopped after the discovery of BSE there in May 2003 under a U.S. ban on cattle and beef imports. In July 2005, the United States lifted the ban on imports of live cattle younger than 30 months, and Canadian live cattle exports to the United States have slowly resumed.

Table 1. Quantity of Live Cattle and Beef Trade

| | U.S. Live Cattle Imports | | | U.S. Beef Exports | | U.S. Beef Imports | |
|-------|----------------------------|--------|--------|--------------------------------|--------|-------------------|--------|
| | Total | Canada | Mexico | Total | Canada | Total | Canada |
| | -----thousand animals----- | | | -----thousand metric tons----- | | | |
| 1989 | 1,459 | 585 | 874 | 388 | 34 | 709 | 88 |
| 1990 | 2,135 | 874 | 1,261 | 348 | 69 | 768 | 81 |
| 1991 | 1,939 | 905 | 1,034 | 406 | 91 | 783 | 81 |
| 1992 | 2,255 | 1,273 | 982 | 449 | 85 | 804 | 127 |
| 1993 | 2,499 | 1,202 | 1,297 | 425 | 84 | 794 | 155 |
| 1994 | 2,083 | 1,010 | 1,072 | 531 | 96 | 789 | 178 |
| 1995 | 2,786 | 1,133 | 1,653 | 595 | 103 | 707 | 177 |
| 1996 | 1,965 | 1,509 | 456 | 612 | 97 | 708 | 234 |
| 1997 | 2,046 | 1,377 | 669 | 691 | 93 | 797 | 273 |
| 1998 | 2,034 | 1,313 | 720 | 716 | 87 | 892 | 306 |
| 1999 | 1,945 | 985 | 960 | 804 | 85 | 963 | 345 |
| 2000 | 2,187 | 965 | 1,223 | 835 | 88 | 1,019 | 335 |
| 2001 | 2,437 | 1,306 | 1,130 | 780 | 80 | 1,061 | 356 |
| 2002 | 2,503 | 1,687 | 816 | 829 | 84 | 1,072 | 389 |
| 2003 | 1,752 | 512 | 1,240 | 858 | 81 | 984 | 256 |
| 2004 | 1,371 | 0 | 1,370 | 144 | 20 | 1,197 | 355 |
| 2005* | 685 | 0 | 685 | 102 | 15 | 617 | 203 |

* Six months of data for 2005.

Source: Foreign Agricultural Trade of the United States, ERS/USDA

Table 2. Value of Live Cattle and Beef Trade

| | U.S. Live Cattle Imports | | | U.S. Beef Exports | | U.S. Beef Imports | |
|-------|------------------------------|--------|--------|-------------------|--------|-------------------|--------|
| | Total | Canada | Mexico | Total | Canada | Total | Canada |
| | -----million dollars----- | | | | | | |
| 1989 | 662 | 377 | 284 | 1,419 | 126 | 1,664 | 189 |
| 1990 | 978 | 559 | 419 | 1,580 | 306 | 1,872 | 191 |
| 1991 | 952 | 590 | 361 | 1,759 | 386 | 1,964 | 192 |
| 1992 | 1,245 | 903 | 341 | 2,044 | 355 | 1,891 | 290 |
| 1993 | 1,341 | 911 | 430 | 1,994 | 350 | 1,937 | 367 |
| 1994 | 1,152 | 799 | 352 | 2,305 | 365 | 1,798 | 377 |
| 1995 | 1,413 | 863 | 546 | 2,646 | 364 | 1,447 | 359 |
| 1996 | 1,121 | 999 | 122 | 2,433 | 322 | 1,341 | 462 |
| 1997 | 1,124 | 943 | 177 | 2,494 | 308 | 1,609 | 612 |
| 1998 | 1,144 | 938 | 206 | 2,335 | 285 | 1,842 | 736 |
| 1999 | 1,001 | 708 | 293 | 2,724 | 273 | 2,136 | 937 |
| 2000 | 1,152 | 746 | 406 | 2,986 | 299 | 2,399 | 981 |
| 2001 | 1,461 | 1,052 | 408 | 2,632 | 274 | 2,712 | 1,096 |
| 2002 | 1,446 | 1,146 | 301 | 2,585 | 286 | 2,741 | 1,113 |
| 2003 | 867 | 396 | 471 | 3,145 | 321 | 2,623 | 850 |
| 2004 | 543 | 0 | 543 | 550 | 95 | 3,626 | 1,183 |
| 2005* | 277 | 0 | 277 | 432 | 75 | 1,899 | 712 |

* Six months of data for 2005.

Source: Foreign Agricultural Trade of the United States, ERS/USDA

The United States also imports live cattle from Mexico. These imports, which vary from year to year and month to month, have increased since the ban on imports from Canada, but not substantially. Total U.S. live cattle imports decreased from 2.5 million animals in 2002 to 1.4 million animals in 2004.

Prior to the Canadian BSE discovery, Canada relied on exporting a significant share of its live cattle to the United States because the country did not have sufficient capacity to slaughter its own supply of cattle. After the United States closed the border to Canadian cattle, prices in Canada plummeted, and the country's beef industry responded by increasing slaughter capacity. Prior to the BSE cases, Canadian packers had the capacity to slaughter 3.5 million animals per year. Capacity is now at 4.5 million animals and could continue to rise (Franz-Warkentin 2005). It is possible, though, that Canadian slaughter capacity would have increased to some degree

even without the U.S. ban. As a result of increased slaughter capacity, Canada is no longer as reliant on exporting live cattle to the United States, so imports from Canada may not be as high as in 2002. However, as long as prices are higher in the United States than in Canada, Canadian producers will look to take advantage of the price differential and export live cattle to the United States.

The United States also exports live cattle to Canada and Mexico. Live cattle exports to Canada became somewhat significant in the years before the BSE cases, averaging 250 thousand animals from 1999 to 2002, but the number is still small compared to the level of imports. Live cattle exports declined sharply following the BSE discoveries.

Beef Imports from Canada

U.S. beef imports from Canada had been increasing rather substantially since the United States and Canada entered into a free trade agreement in 1989. Beef imports from Canada steadily increased from 81 thousand metric tons (\$192 million) in 1991 to 389 thousand metric tons (\$1.1 billion) in 2002. Canadian beef exports to the United States stopped during the summer of 2003 but then resumed in September 2003 as the United States started to accept beef from animals younger than 30 months when slaughtered. Beef imports from Canada quickly returned to previous levels, totaling 355 thousand metric tons (\$1.2 billion) in 2004, and could reach a new high in 2005 with imports at 203 thousand metric tons through the first six months (Figure 1). Total U.S. beef imports reached a high of 1.2 million metric tons, valued at \$3.6 billion, in 2004. While increases in Canada's slaughter capacity could mean less live cattle imports from Canada, it could also mean more beef imports from that country.

Beef Exports

Prior to the BSE discovery, U.S. beef exports had been steadily increasing over time. U.S. beef exports averaged 73 thousand metric tons (retail weight) per month from January to November 2003. However, after the discovery of BSE in the United States in December 2003, U.S. exports nearly stopped as the major export markets closed their doors to U.S. beef (Figure 2). Exports declined to 56 thousand metric tons in December and then dropped to just 2 thousand metric tons in January 2004. U.S. beef exports totaled 145 thousand metric tons in 2004, which is an 83 percent decline from the 858 thousand metric tons exported in 2003. In terms of value, U.S. beef exports sank from \$3.15 billion in 2003 to \$550 million in 2004, which is an 82.5 percent decrease. Since then, beef exports have gradually increased, averaging 17 thousand metric tons per month during the first half of 2005.

The major export markets for U.S. beef are Japan, Korea, Mexico, and Canada. In the past, these four markets have accounted for over 90 percent of U.S. beef exports. In 2003, the United States exported 298 million metric tons (\$1.17 billion) to Japan, 213 million metric tons (\$749 million) to Korea, 192 million metric tons (\$604 million) to Mexico, and 81 million metric tons (\$321 million) to Canada. The next biggest markets have been Taiwan, Hong Kong, Egypt, Russia, the Bahamas, and China. However, the United States did not export any beef to Japan, Korea, Hong Kong, Taiwan, Egypt, and China (among others) in 2004. Table 3 shows the changes in U.S. beef exports to the major markets.

Figure 1. U.S. Monthly Beef Trade with Canada

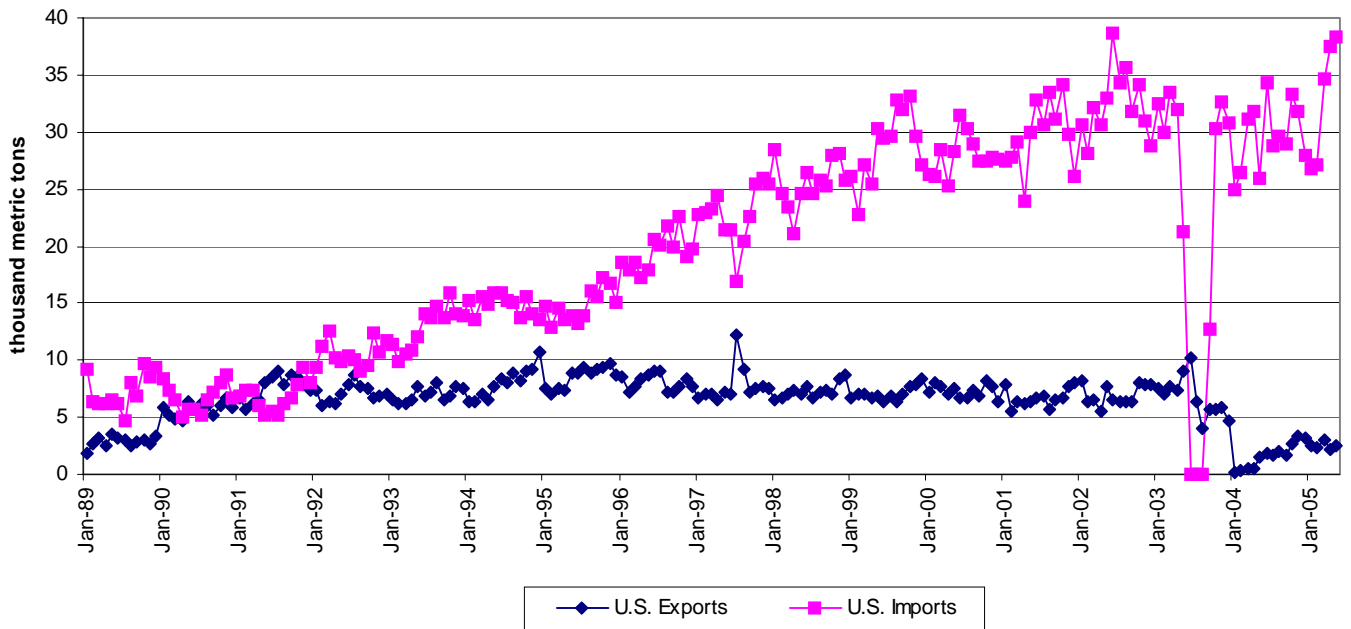


Figure 2. U.S. Monthly Beef Exports

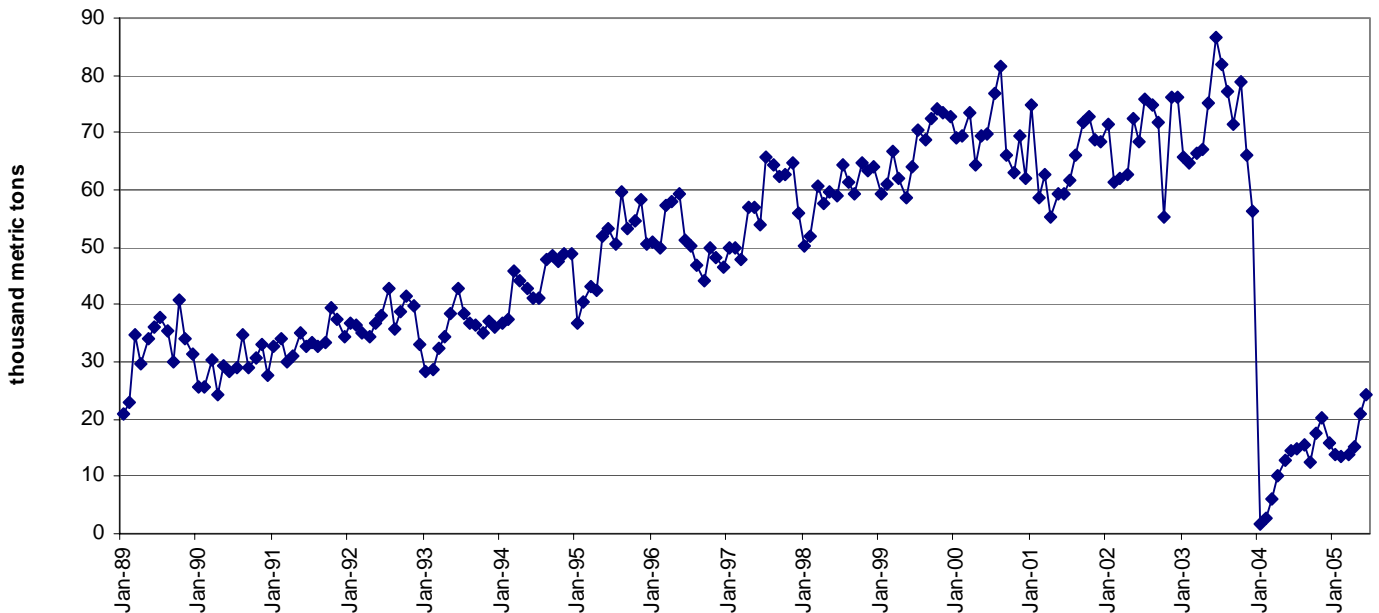


Table 3. U.S. Beef Exports to Major Markets

| | 2000-02 Average | 2003 | 2004 | First half 2005 |
|--------------------------------|--------------------|-------|-------|--------------------|
| -----thousand metric tons----- | | | | |
| Japan | 317.2 | 298.0 | 0.0 | 0.0 |
| Korea | 160.4 | 213.1 | 0.0 | 0.0 |
| Mexico | 185.8 | 192.3 | 106.6 | 67.4 |
| Canada | 83.9 | 81.0 | 19.5 | 15.3 |
| Taiwan | 12.4 | 16.3 | 0.0 | 7.0 |
| Hong Kong | 14.6 | 15.3 | 0.0 | 0.0 |
| Egypt | 4.7 | 7.6 | 0.0 | 0.2 |
| Kuwait | 0.3 | 4.7 | 0.6 | 0.4 |
| Russia | 5.6 | 3.5 | 0.4 | 0.0 |
| Bahamas | 3.0 | 3.2 | 3.8 | 1.5 |
| Indonesia | 0.9 | 3.1 | 1.5 | 2.2 |
| China | 4.3 | 3.1 | 0.0 | 0.1 |

Source: Foreign Agricultural Trade of the United States, ERS/USDA

Exports to Mexico and Canada declined substantially during the first months after the BSE discovery but have since increased, especially exports to Mexico. In January 2004, Canada began allowing imports of U.S. boneless beef from animals less than 30 months of age, and Mexico followed suit in early March. Exports to Mexico from January through June 2005 were at approximately 70 percent of the level of exports to the country during the same months in 2003. Exports to Canada during the first half of 2005 were at 31 percent of the level from 2003. The low level of demand for U.S. beef in Canada could be due to a large supply and lower prices of Canadian-produced beef (ERS 2004). From January 2004 to June 2005, 71 percent of U.S. beef exports (in terms of quantity) was exported to Mexico, and 14 percent was exported to Canada. The next biggest export markets have been Taiwan, which resumed imports in April 2005, and the Bahamas, where the BSE case did not have any noticeable effect.

When beef exports to Japan, Korea, and other countries resume, they are not likely to return immediately to levels found prior to the BSE discovery because of consumer concerns and changing consumer preferences in these countries. Consumers in Japan and Korea could be less likely to purchase U.S. beef than they were previously.

The importance of exports for U.S. beef producers has been increasing over time. Prior to the mid-1980s, less than 2 percent of U.S. beef production was exported, whereas in 2003, that

figure grew to almost 10 percent of U.S. beef production. The percentage of beef production exported dropped to less than 2 percent in 2004.

THE IMPACT OF TRADE ON CATTLE AND BEEF PRICES

Factors Affecting Cattle and Beef Prices

The U.S. General Accounting Office (GAO) (2002) surveyed 30 experts on the cattle industry to identify factors affecting U.S. cattle prices. The study concluded that cattle price is affected by domestic demand for cattle, domestic supply of cattle, structural change, and international trade, and it identified the factors influencing these four determinants of price.

Consumer demand for beef influences demand for cattle. Factors affecting consumer demand for beef include consumer preference, relative prices of substitutes, health concerns, income, and seasonality. Consumer demand for beef directly affects beef price. Since demand for cattle is derived from the demand for beef, cattle price is also affected by changes in consumer beef demand. Other factors that influence demand for cattle, by affecting retailer demand for beef or meatpacker demand for cattle, include packer capacity utilization, packer costs, costs of retailing beef products, and by-product values.

Factors affecting cattle supply include the cattle cycle, expected prices, input costs, and technological changes in production and marketing (GAO 2002). Cattle supply and average dressed weights affect cattle prices and beef prices since these factors determine the domestic supply of beef production.

Structural changes identified in the GAO study include economies of scale, technological change, efficiency of the supply chain, vertical coordination, a thin spot market, economies of scope, vertical integration, industry concentration, and economics of agglomeration.

Beef and live cattle trade also affect U.S. prices. Beef imports and exports influence the domestic beef price, which affects demand for cattle and, therefore, cattle price. Live cattle trade directly affects cattle prices by changing the supply of cattle.

Changes in the fed cattle price affect the feeder cattle price. Since the fed cattle price is the output price for feedlot operators, changes in this price will affect demand for feeder cattle, which will affect the feeder cattle price. An increase in the fed cattle price should have a positive impact on the feeder cattle price. Costs of inputs, especially feed, also affect demand for feeder cattle. Increases in the price of corn, for example, should negatively affect feeder cattle price. Feeder cattle prices are also affected by the supply of feeder cattle, which is determined by previous calf crops.

Empirical Model

An econometric model for cattle and beef prices is developed from the GAO (2002) findings to estimate the effect of trade on prices. The slaughter steer price is affected by the quantity slaughtered, average dressed weight, beef imports and exports, beef demand factors, by-product

values, and the farm-to-retail price spread. This price spread, which can also be represented by the farmers' share of the beef value, is affected by factors such as marketing costs, meatpacker costs, and structural changes. As marketing or processing costs increase, retailer demand for beef and meatpacker demand for cattle will decline, and the price received by farmers will decrease. The opposite is also true, as Marsh and Brester (2003) found that cost savings from meatpacking technologies increase real livestock prices. Live cattle imports will affect price by affecting the quantity of cattle slaughtered in the United States. Beef imports from Canada may affect prices differently than imports from the rest of the world, since they are of a higher quality beef that is more competitive with U.S. product compared to beef imports from Australia and other countries. Therefore, the model separates imports of Canadian beef from imports from the rest of the world. The slaughter steer price equation is specified as follows:

$$P_{st} = \alpha_0 + \alpha_1 Q_{st} + \alpha_2 ADW_t + \alpha_3 M_{bt}^C + \alpha_4 M_{bt}^{ROW} + \alpha_5 X_{bt} + \alpha_6 Y_t + \alpha_7 BD_t + \alpha_8 BPV_t + \alpha_9 FS_t + \varepsilon_t \quad (1)$$

where P_{st} = real slaughter steer cattle price in time t
 Q_{st} = quantity of cattle slaughtered in time t
 ADW_t = average dressed weight in time t
 M_{bt}^C = beef imports from Canada in time t
 M_{bt}^{ROW} = beef imports from rest of world in time t
 X_{bt} = beef exports in time t
 Y_t = real per capita disposable income in time t
 BD_t = beef demand index in time t
 BPV_t = real value of by-products in time t
 FS_t = farmers' share of retail beef price in time t.

Cattle slaughter, average dressed weights, and beef imports are expected to have negative effects on cattle price; and beef exports, per capita income, beef demand, and the farmers' share of the retail beef price should positively affect cattle price. The beef demand index measures changes in consumer demand for beef due to changes in consumer tastes and preferences, prices of substitute meats, and other factors. Per capita disposable income is also included in the model as a beef demand shifter.

The slaughter steer price affects demand for feeder cattle and, therefore, the feeder steer price. Corn is a major input cost for cattle, so the price of corn also affects demand and price of feeder cattle. The previous year's calf crop affects the supply of feeder cattle, also affecting price. Seasonality may also affect feeder steer price. The feeder steer price equation is specified as follows:

$$P_{ft} = \beta_0 + \beta_1 P_{st} + \beta_2 P_{ct} + \beta_3 Q_{ft} + \beta_4 Q1_t + \beta_5 Q2_t + \beta_6 Q3_t + e_t \quad (2)$$

where P_{ft} = real feeder steer price in time t
 P_{ct} = real corn price in time t
 Q_{ft} = quantity of feeder cattle in time t measured as previous year's calf crop

$Q1_t, Q2_t, Q3_t$ = quarterly dummy variables.

The slaughter steer price should have a positive effect on the feeder steer price, while the price of corn and the supply of feeder cattle is expected to negatively affect feeder steer price.

The retail beef price is affected by beef supply and demand. Domestic beef supply can be divided into domestic production, beginning cold storage stocks, beef imports, and beef exports. The retail beef price equation is specified as follows:

$$P_{bt} = \gamma_0 + \gamma_1 BS_t + \gamma_2 BPROD_t + \gamma_3 M_{bt}^C + \gamma_4 M_{bt}^{ROW} + \gamma_5 X_{bt} + \gamma_6 Y_t + \gamma_7 BD_t + \gamma_8 P_{bt-1} + v_t \quad (3)$$

where P_{bt} = real retail beef price in time t

BS_t = beginning cold storage stocks in time t

$BPROD_t$ = domestic beef production in time t.

Beginning stocks, domestic beef production, and beef imports should negatively affect beef price; beef exports, per capita income, and beef demand should positively affect price. A lagged depended variable is added to capture dynamic effects.

While it is expected that beef imports affect beef price, beef price may also affect beef imports. That is, a decrease in beef imports may cause the U.S. beef price to increase, but an increase in the U.S. beef price may also cause exporters in Canada, Australia, and elsewhere to ship more beef to the United States to take advantage of the higher prices. Therefore, beef imports are treated as endogenous variables and are estimated as a function of U.S. beef price, exchange rates, a dummy variable for BSE, and a lagged depended variable as follows:

$$M_{bt}^C = \rho_0 + \rho_1 P_{bt} + \rho_2 ER_t^C + \rho_3 BSE_t + \rho_4 M_{bt-1}^C + v_{1t} \quad (4)$$

$$M_{bt}^{ROW} = \lambda_0 + \lambda_1 P_{bt} + \lambda_2 ER_t^A + \lambda_3 M_{bt-1}^{ROW} + v_{2t} \quad (5)$$

where ER_t^C = U.S.-Canada real exchange rate in time t

ER_t^A = U.S.-Australia real exchange rate in time t

BSE_t = dummy variable for ban on U.S. beef imports from Canada

U.S. beef price is expected to positively affect beef imports. The exchange rates are measured in foreign currency per U.S. dollar, so an increase indicates an appreciation of the U.S. dollar. The exchange rate, therefore, is expected to also have a positive effect on imports. The U.S.-Australia exchange rate is used as a determinant of beef imports from the rest of the world because a majority of non-Canadian beef imports are from Australia. The BSE dummy variable is included in Equation 3 to account for the period in which the United States banned or restricted beef imports from Canada.

Data and Estimation Procedure

Equations 1-5 are estimated simultaneously using the three stage least squares (3SLS) approach. Cattle price, beef price, and beef imports from Canada and the rest of the world are treated as endogenous variables, and the remaining variables are assumed to be exogenous. Quarterly data from 1989-2004 are used in the estimation. Data for prices, beef imports and exports, cattle slaughter, average dressed weights, beef production, beginning cold storage stocks, by-product values, the farmer's share of the beef value, and the calf crop were all obtained from the Economic Research Service's (ERS) *Red Meat Yearbook* and recent issues of the *Livestock, Dairy, and Poultry Outlook*. Real exchange rate data were also obtained from ERS. Per capita disposable income data were obtained from the Bureau of Economic Analysis's National Income and Product Accounts data. Prices and income were converted to real dollars, with 2004 as the base, using the Consumer Price Index from the Bureau of Labor Statistics. In the model, cattle prices and by-product values are measured in dollars per hundredweight, beef price in cents per pound, and corn price in dollars per bushel; cattle slaughter is measured in thousands of animals; averaged dressed weight is measured in pounds; beef imports, exports, and production are measured in millions of pounds; per capita income is measured in dollars; the farmer's share of the beef value is a percentage; the exchange rate is measured in foreign currency per U.S. dollar; and beef demand is an index. The beef demand index is calculated according to a technique described by Purcell (1998).

Results

The estimation results demonstrate that beef and live cattle trade have significant effects on U.S. cattle and beef prices. The estimation results for Equation 1 show that the explanatory variables have the expected effects on the slaughter steer price (Table 4). Most variables are significant at the 5 percent or 1 percent level. Beef imports from the rest of the world have an unexpected positive effect, but it is statistically insignificant. Slaughter quantity, average dressed weights, and beef imports from Canada have negative and statistically significant effects on the cattle price. Beef exports, per capita income, beef demand, and the farmers' share all have significant positive effects on the cattle price. By-product value is also found to have a positive effect on price, but it is not statistically significant at the 10 percent level. Beef imports from the rest of the world may have an insignificant effect on cattle price because they are largely lower-quality, lean, grass-fed beef used to produce ground beef. They are not as competitive with U.S. beef and may, in fact, have a complementary relationship with fatter U.S. grain-fed beef in some cases.

Table 4 also shows calculated price flexibility coefficients for the explanatory variables. These show the percentage change in price resulting from a 1 percent change in the explanatory variable. According to these results, the cattle slaughter price flexibility coefficient is -1.2, which means a 1 percent increase in cattle slaughter results in a 1.2 percent decrease in the slaughter steer price. Results from previous studies have shown price flexibility coefficients for cattle slaughter ranging from -0.6 to -1.5. Buhr and Kim (1997) calculated a cattle slaughter price flexibility coefficient of -0.61, and Marsh (2003) estimated it at -0.69. However, results from Marsh (2004) indicate an estimated price flexibility coefficient of -1.4 (see also Marsh et al. 2005), and according to McKissick (1998), a 1 percent increase in beef supply (which would result from a 1 percent increase in cattle slaughter) causes a 1.5 percent decline in cattle prices. The price flexibility coefficients in our slaughter steer equation are highest for cattle slaughter

Table 4. Model Estimation Results

| Explanatory variables | parameter estimate | t value | estimated price flexibility coefficient |
|--|--------------------|----------|---|
| <u>Real Slaughter Steer Price</u> | | | |
| Intercept | 170.312 | 6.21** | |
| Cattle slaughter | -0.012 | -10.53** | -1.22 |
| Average dressed weight | -0.214 | -6.98** | -1.74 |
| Beef imports Canada | -0.022 | -2.30** | -0.04 |
| Beef imports ROW | 0.001 | 0.11 | 0.01 |
| Beef exports | 0.016 | 4.57** | 0.08 |
| Real per cap disp income | 0.002 | 4.44** | 0.66 |
| Beef demand index | 0.987 | 6.49** | 0.75 |
| Real byproduct value | 0.312 | 1.48 | 0.08 |
| Farmers' share | 0.839 | 7.05** | 0.48 |
| <u>Real Feeder Steer Price</u> | | | |
| Intercept | 270.217 | 3.13** | |
| Real slaughter steer price | 1.142 | 13.24** | 0.88 |
| Real corn price | -6.406 | -3.22** | -0.17 |
| Lagged calf crop | -0.006 | -2.8** | -2.13 |
| Q1 | 4.032 | 1.43 | |
| Q2 | 7.623 | 2.69** | |
| Q3 | 6.601 | 2.38** | |
| <u>Real Retail Beef Price</u> | | | |
| Intercept | 62.053 | 2.99** | |
| Beg cold storage stocks | 0.006 | 0.68 | 0.01 |
| Beef production | -0.023 | -10.87** | -0.42 |
| Beef imports Canada | -0.034 | -2.51** | -0.02 |
| Beef imports ROW | 0.009 | 0.77 | 0.01 |
| Beef exports | 0.034 | 6.35** | 0.04 |
| Per capita disp income | 0.003 | 5.03** | 0.27 |
| Beef demand index | 1.214 | 5.43** | 0.24 |
| Lagged dependent variable | 0.682 | 12.74** | |
| <u>Beef Imports from Canada</u> | | | |
| Intercept | -314.710 | -2.26** | |
| Real retail beef price | 0.399 | 1.73* | 0.84 |
| Real exchange rate | 179.610 | 2.95** | 1.49 |
| BSE dummy variable | -135.240 | -6.26** | |
| Lagged dependent variable | 0.688 | 7.41** | |
| <u>Beef Imports from Rest of World</u> | | | |
| Intercept | -531.743 | -3.02** | |
| Real retail beef price | 2.066 | 4.81** | 1.39 |
| Real exchange rate | 223.047 | 3.93** | 0.65 |
| Lagged dependent variable | 0.021 | 0.16 | |

System Weighted $R^2 = .97$

Note: *denotes significance at the 10 percent level, **denotes significance at the 5 percent level.

and average dressed weights, followed by beef demand. Price flexibility coefficients are low for beef imports and exports because the quantity of beef trade is small compared to domestic production, so a 1 percent change in imports or exports would have a small effect on price.

The slaughter steer price is found to have a significant positive effect on the feeder steer price, as expected, with a price flexibility coefficient of 0.88, while corn price and lagged calf crop have the expected negative effect.

Results from Equation 3 show that domestic beef production, beef imports from Canada, beef exports, per capita income, and beef demand have statistically significant effects on the retail beef price at the 5 percent level. Beginning cold storage stocks and beef imports from the rest of the world are not found to significantly affect the retail beef price. Domestic beef production is found to have the highest price flexibility coefficient at -0.42.

The results from the estimation of Equations 4 and 5 show that U.S. beef price and exchange rates have significant positive effects on U.S. beef imports, and that the BSE case in Canada led to a reduction in U.S. beef imports from Canada. An appreciating dollar and increases in U.S. beef prices are found to result in increased U.S. beef imports from Canada and the rest of the world.

THE IMPACT ON PRICES FROM RESUMING TRADE

Using the parameter estimates in Table 4, the effects of various import and export scenarios on prices are estimated. The resumption of live cattle imports increases the quantity of cattle slaughtered in the United States. If imports return to previous levels of about 1.5 million animals per year, with everything else held constant, the slaughter steer, feeder steer, and retail beef prices would decrease \$4.65/cwt, \$5.31/cwt, and 6.55 cents/lb, respectively (Table 5). These price decreases would be declines of approximately 5.5 percent for the slaughter steer price, 4.2 percent for the feeder steer price, and 1.8 percent for the retail beef price. If imports increase to just 1 million animals per year, the price effects would be \$3.10/cwt, \$3.54/cwt, and 4.36 cents/lb for slaughter steer, feeder steer, and retail beef prices, respectively, which would represent price decreases of approximately 3.6 percent, 2.8 percent, and 1.2 percent, respectively. The impact in percentage terms would be the greatest for slaughter steer prices and the smallest for retail beef prices.

Increases in Canada's slaughter capacity may indicate that the country will export less live cattle to the United States than in previous years, but if cattle prices remain higher in the United States than in Canada (as they have been recently), Canadian producers will export live cattle to the United States to take advantage of the price differential. The negative impact from live cattle imports could be negated somewhat if the United States increases live cattle exports to Canada. From 1999 to 2001, annual U.S. live cattle exports to Canada ranged from 223 thousand animals to 350 thousand animals, but exports dropped to just 14 thousand animals in 2004.

Table 5. Impact of Live Cattle Imports from Canada on Prices

| Annual Live Cattle Imports* | Price Changes | | | | | |
|-----------------------------|-----------------------|------|--------------------|------|-------------------|------|
| | Slaughter steer price | | Feeder steer price | | Retail beef price | |
| | (\$/cwt) | (%) | (\$/cwt) | (%) | (cents/lb) | (%) |
| 0.5 million | -1.55 | -1.8 | -1.77 | -1.4 | -2.18 | -0.6 |
| 1 million | -3.10 | -3.6 | -3.54 | -2.8 | -4.36 | -1.2 |
| 1.5 million | -4.65 | -5.5 | -5.31 | -4.2 | -6.55 | -1.8 |

* Annual live cattle imports from Canada ranged from 1 million to 1.7 million in the decade before the BSE ban, and net cattle imports ranged from 0.6 million to 1.6 million.

Given the increases in Canada's slaughter capacity and the fact that beef imports from Canada have been permitted since the fall of 2003, the impact of opening the border to live cattle imports may not be quite as great as indicated in Table 5. This is because the meat from some of these cattle may have eventually entered the United States in the form of boxed beef, regardless of the ban on live cattle. Table 6 shows the impact of increased beef imports from Canada on U.S. prices. The percentage increases are based on the 2004 import level, which averaged about 270 million pounds carcass weight per quarter and was near a record high. Increasing beef imports from Canada by 75 percent or more could have almost as large of an impact on prices as would importing 1.5 million live animals.

Table 6. Impact of Increased Beef Imports from Canada on Prices

| Percentage Increase in Imports* | Price Changes | | | | | |
|---------------------------------|-----------------------|------|--------------------|------|-------------------|------|
| | Slaughter steer price | | Feeder steer price | | Retail beef price | |
| | (\$/cwt) | (%) | (\$/cwt) | (%) | (cents/lb) | (%) |
| 10% | -0.58 | -0.7 | -0.67 | -0.5 | -0.93 | -0.3 |
| 25% | -1.46 | -1.7 | -1.67 | -1.3 | -2.32 | -0.6 |
| 50% | -2.92 | -3.4 | -3.34 | -2.7 | -4.63 | -1.3 |
| 75% | -4.38 | -5.2 | -5.00 | -4.0 | -6.95 | -1.9 |

* Percentage increases based on the 2004 level of imports, which averaged 270 million pounds per quarter.

Beef imports from Canada in 2004 were near pre-BSE levels, but live cattle imports, which previously ranged from 1 million to 1.7 million animals, were zero. With an open border and increasing slaughter capacity in Canada, imports of either live cattle, boxed beef, or both are expected to increase. Table 5 examines the price impact from live cattle imports assuming beef levels are held constant at the 2004 level, and Table 6 shows the price impact from increased beef imports if cattle imports remain at zero. However, it is likely with the opening of the border

that there may be some combination of live cattle import and beef import increases. Table 7 shows the results from a combination of live cattle import and beef import increases. For example, if annual live cattle imports are 1 million animals and beef imports increase 25 percent, the slaughter steer price would decrease \$4.56/cwt. Lower levels of live cattle imports could be accompanied by large increases in boxed beef imports, while high levels of live cattle imports could be accompanied by small increases or no increases in boxed beef imports.

Table 7. Price Impact from Combination of Live Cattle and Beef Imports

| Annual Live Cattle Imports (million) | Increased Beef Imports (% increase) | Price Changes | | | | | |
|---|--|-----------------------|-------|--------------------|------|-------------------|------|
| | | Slaughter steer price | | Feeder steer price | | Retail beef price | |
| | | (\$/cwt) | (%) | (\$/cwt) | (%) | (\$/cwt) | (%) |
| 0.5 | 10% | -2.13 | -2.5 | -2.44 | -1.9 | -3.11 | -0.9 |
| | 25% | -3.01 | -3.5 | -3.44 | -2.7 | -4.50 | -1.2 |
| | 50% | -4.47 | -5.3 | -5.11 | -4.1 | -6.82 | -1.9 |
| | 75% | -5.93 | -7.0 | -6.77 | -5.4 | -9.13 | -2.5 |
| 1 | 10% | -3.68 | -4.3 | -4.21 | -3.4 | -5.29 | -1.5 |
| | 25% | -4.56 | -5.4 | -5.21 | -4.2 | -6.68 | -1.9 |
| | 50% | -6.02 | -7.1 | -6.87 | -5.5 | -9.00 | -2.5 |
| | 75% | -7.48 | -8.8 | -8.54 | -6.8 | -11.31 | -3.1 |
| 1.5 | 10% | -5.23 | -6.2 | -5.98 | -4.8 | -7.47 | -2.1 |
| | 25% | -6.11 | -7.2 | -6.98 | -5.6 | -8.86 | -2.5 |
| | 50% | -7.57 | -8.9 | -8.64 | -6.9 | -11.18 | -3.1 |
| | 75% | -9.03 | -10.6 | -10.31 | -8.2 | -13.50 | -3.7 |

The negative impact on prices from import increases would be more than negated if beef exports return to near previous levels. Table 8 shows that the positive impact from regaining exports would be greater than the negative effect from resuming live cattle imports. The current level of U.S. beef exports is about 24 percent of the 2003 export level. If beef exports increased to 100 percent of the 2003 export level, slaughter steer, feeder steer, and retail beef prices could increase by \$7.83/cwt, \$8.95/cwt, and 16.0 cents/lb, respectively. These price increases would be approximately 9.2 percent for the slaughter steer price, 7.2 percent for the feeder steer price, and 4.4 percent for the retail beef price. The greatest impact, again, is on the slaughter steer price.

These estimates are conservative compared to the values listed by some other studies. According to Doud (2004), the total value of the U.S. export market equates to approximately \$15/cwt. for a fed steer. Therefore, regaining the three-fourths of the export market that are still lost would add \$11/cwt to the fed steer price, according to his estimates. Mark (2005) estimates

that regaining exports to Japan alone would lead to a \$5.00/cwt increase in the fed cattle price. On the other hand, Marsh et al. (2005) estimate that returning beef exports to 2002 levels would translate into a \$6.75/cwt increase in the fed steer price, which is similar to our estimate, and a \$11.62/cwt increase in the feeder steer price.

Table 8. Impact of Increased Beef Exports on Prices

| Beef Exports as a Percentage of 2003 Level* | Price Changes | | | | | |
|--|-----------------------|-----|--------------------|-----|-------------------|-----|
| | Slaughter steer price | | Feeder steer price | | Retail beef price | |
| | (\$/cwt) | (%) | (\$/cwt) | (%) | (cents/lb) | (%) |
| 50% | 2.65 | 3.1 | 3.03 | 2.4 | 5.42 | 1.5 |
| 75% | 5.24 | 6.2 | 5.99 | 4.8 | 10.71 | 3.0 |
| 100% | 7.83 | 9.2 | 8.95 | 7.2 | 16.00 | 4.4 |

*Price changes are based on increases from the current level of exports, which are at 24 percent of the 2003 level.

It may be unlikely, however, that beef exports would return immediately to previous levels once the bans are lifted. Consumer preferences in Japan and Korea may have changed, and their demand for beef, especially U.S. beef, may have declined. Trading relationships could change, and other exporting countries could become more competitive in these markets. If beef exports returned to 75 percent of the 2003 level, slaughter steer, feeder steer, and retail beef prices could increase by \$5.24/cwt, 5.99/cwt, and 10.71 cents/lb, respectively, which would represent increases of approximately 6.2 percent, 4.8 percent, and 3.0 percent.

These results suggest that increasing beef exports is important for U.S. cattle producers. The effect of beef exports on price is likely greater than the effect of live cattle imports from Canada, because it represents a larger percentage of supply. Before BSE, the United States exported close to 10 percent of its beef production, while cattle imports from Canada represented about 3 to 4 percent of U.S. cattle slaughter. Currently, Mexico is by far the largest market for U.S. beef exports. Mexico accounted for 74 percent of U.S. beef exports in 2004 and 66 percent in the first six months of 2005. Taiwan, which was the fifth largest market for exports in 2003, has resumed imports of U.S. beef. However, although it was the fifth largest market, less than 2 percent of U.S. beef exports were shipped to Taiwan in 2003. The top four markets (Japan, Korea, Mexico, and Canada) accounted for over 90 percent of U.S. beef exports before BSE. Regaining markets such as Taiwan and increasing exports to other markets could have some small, positive effects on prices, but the most significant effects will come from increasing exports to the four main markets.

Canada, which had been the fourth largest market for U.S. beef exports before BSE, does not ban U.S. beef, but their beef imports from the United States have been significantly lower than prior to the BSE discovery. The smaller quantity of exports could be due to low Canadian prices

caused by a large supply of beef in Canada following their BSE discovery. Resuming cattle imports from Canada could improve the condition in that country, raising Canadian prices, and U.S. beef exports to the country may eventually increase.

For there to be a substantial increase in exports, however, exports to Japan and Korea will need to resume. These two markets accounted for close to 60 percent of U.S. beef exports prior to the BSE bans. It is unclear when exports to these two markets will resume or if they will return to near previous levels. Demand for U.S. beef in these countries could change, or some restrictions that hamper trade could remain in place.

CONCLUSIONS

Because of BSE discoveries in the United States and Canada and the resulting trade bans, U.S. trade of beef and live cattle has declined substantially. The eventual lifting of trade restrictions will affect cattle and beef prices. In this study, an econometric model is developed and estimated to determine the effects of beef and cattle trade and other factors on cattle and beef prices.

Live cattle shipments from Canada began entering the United States in July 2005 after being banned for two years. In the decade prior to the BSE ban, Canadian live cattle exports to the United States averaged 1.25 million animals per year, and they had reached a high of 1.7 million animals in 2002. According to the results of our model, if net imports from Canada increased to 1.5 million animals per year, the slaughter steer, feeder steer, and retail beef prices would decrease \$4.65/cwt, \$5.31/cwt, and 6.55 cents/lb, respectively. These price decreases would be declines of approximately 5.5 percent for the slaughter steer price, 4.2 percent for the feeder steer price, and 1.8 percent for the retail beef price.

Because of continued bans on U.S. beef exports to Japan and Korea and reduced exports to Canada, U.S. beef exports in the first half of 2005 are at just 24 percent of the level of exports in 2003. The negative impact on prices from import increases would be more than negated if beef exports returned to near previous levels. Results show that if beef exports increased to 100 percent of the 2003 export level, slaughter steer, feeder steer, and retail beef prices could increase by \$7.83/cwt, \$8.95/cwt, and 16.0 cents/lb, respectively. These price increases would be approximately 9.2 percent for the slaughter steer price, 7.2 percent for the feeder steer price, and 4.4 percent for the retail beef price.

It is unknown, however, if trade will return quickly to previous levels once the bans are removed. Changes in the Canadian beef industry, driven to some extent by its loss of export markets, could have long-term effects on trade. Increases in Canada's slaughter capacity could mean fewer exports of live cattle to the United States, but they could export more beef to the United States and also grow more competitive in foreign markets. It is also uncertain how Japanese and Korean consumers will respond once the bans on U.S. beef are eventually lifted. Results show, however, that even if exports return to just 75 percent of the 2003 level, it would still more than negate the negative effect on prices from live cattle imports from Canada.

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