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Re-opening the U.S./Canadian Border to Live Cattle and Beef Trade: Estimated Impacts on U.S. Beef Producers

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Introduction

In May 2003, Canadian authorities announced that a Canadian cow had tested positive for bovine spongiform encephalopathy (BSE or mad cow disease). Almost at once, the United States and many other countries banned all imports of Canadian cattle and Canadian beef. The consequences for Canadian cattle prices were severe. Export markets accounted for almost 40 percent of Canadian beef production and 30 percent of live cattle sales between 1995 and 2002. As a result, Canadian fed steer prices declined 55 percent from about $US 83/cwt in March of 2003 to about $US 37/cwt in September of 2003.[1]

On December 23, 2003, a new BSE case was identified by the U.S. Department of Agriculture (USDA). The case involved a dairy cow located in the state of Washington. Eventually, the USDA determined that the animal had been imported from Canada.[2] Nonetheless, Japan, South Korea, and about 30 other countries rapidly closed their markets to U.S. beef products. As with Canada, U.S. beef exports subsequently declined to a negligible amount. Between 1995 and 2002, U.S. beef exports represented about 8 percent of U.S. beef supplies. By the third week of January 2004, U.S. fed cattle prices had declined to $76/cwt from $97/cwt in early December 2003. However, over the next few months (between February and September of 2004) U.S. fed cattle prices recovered to about $90/cwt, suggesting that once initial domestic concerns about beef food safety declined, the BSE-related loss of major export markets reduced U.S. cattle prices by about $7/cwt.

In early December 2004, the USDA announced a proposed ruling to reopen the border between the U.S. and Canada to live cattle trade. The USDA rule was described as a Minimum Risk-Regional Rule (MRR). Under the MRR, the U.S. cattle and beef industry could import specific ruminants (live), ruminant products (meat), and by-products (tongue, liver, etc.) from certain Canadian regions where the risk of introducing BSE into the United States was evaluated to be minimal. The MRR specifications require Canada to meet numerous criteria. These included import restrictions from countries where BSE had been discovered, BSE surveillance that met or exceeded international guidelines, a ruminant-to-ruminant feed ban, a prohibition of risk materials (brains and spinal cord tissue) from entering food supplies, and other appropriate monitoring and risk assessment procedures.

The final USDA rule was scheduled to be implemented on March 7, 2005. Imports of the following products from Canada were to be allowed: (1) cattle for feeding or immediate slaughter as long as slaughter occurs at less than 30 months of age; (2) bone-in and bone-less beef from cattle less than 30 months of age; and (3) certain by-products such as livers, tongues, gelatin, and tallow. In February 2005, R-Calf USA filed a request for a preliminary injunction against the USDA-MRR final rule on the grounds the final rule was not restrictive enough and, therefore, posed unresolved animal and human health problems. However, in the same month the American Meat Institute filed a preliminary injunction against the USDA (February 2005) in an attempt to end the cattle import ban because meat processors claimed the ban was causing substantial financial losses. These losses were attributed directly to increased excess capacity in cattle slaughtering and meat processing because of the curtailment of live cattle and carcass imports. These issues are currently being addressed by the federal court system.

This policy paper examines the economic impacts on U.S. fed steer and feeder steer prices of reinstating U.S. imports of Canadian live cattle and beef as stipulated by the MRR rule as it would have been implemented March 7, 2005. Two issues are considered: (1) effects on U.S. beef prices from reduced U.S. imports and exports between 2002, the last year of normal trade, and 2004, when U.S. beef exports were adversely affected by the announcement of the U.S. BSE case on December 23, 2003; and (2) the potential

[1] Between September, 2003 and September, 2004, Canadian cattle prices recovered and fed cattle prices increased to about $57/cwt. The recovery was partly attributable to improved domestic demand and partly to the reopening of the U.S. and Mexican markets to Canadian beef products produced from cattle less than 30 months old (although imports of Canadian live cattle into the United States continued to be prohibited).

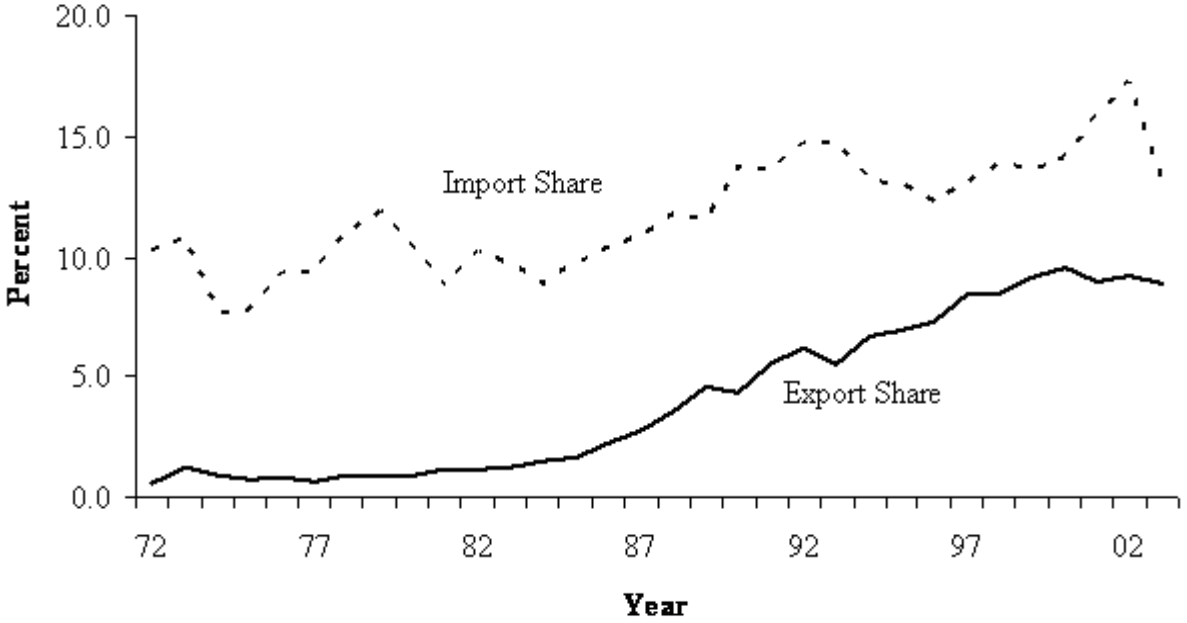
[2] In June 2005, a cow in Texas also tested positive for BSE. This incident appeared to have little effect on cattle prices.

effects on U.S. beef prices of the USDA Minimum Risk-Region Rule had it been implemented on March 7, 2005.

The Empirical Model and Price Impact Estimation Procedures

The economic impacts of the BSE cases are estimated by applying changes in U.S. beef import and export market shares to the parameters of a systems econometric model of demands and supplies in the slaughter steer and feeder steer markets. The model's details are described in the Appendix. Each demand function is estimated in inverse form so that price is the dependent variable. Import market shares are calculated by dividing the quantity of U.S. beef imports (the sum of live cattle and beef) by the quantity of total U.S. beef supplies consisting of wholesale beef production and beef imports. Export market shares are calculated by dividing the volume of total U.S. beef exports of live cattle and beef by the volume of total U.S. beef supplies. Figure 1 shows U.S. beef import and export shares from 1970 to 2003. A priori, increases in beef import market shares are expected to decrease U.S. fed and feeder steer prices. In contrast, increases in beef export shares are expected to increase these prices. An increase in beef imports increases domestic beef supplies while an increase in beef exports reduce domestic beef supplies. The effects of changes in beef import and export shares on fed slaughter prices are estimated using a slaughter steer price flexibility coefficient, which measures the percentage change in slaughter steer prices caused by a 1 percent change in U.S. beef supplies. As shown in Appendix A, the estimated value of this coefficient is -1.518. The effects of market share changes on feeder steer prices are estimated using a slaughter-to-feeder steer price transmission coefficient, which measures the percentage change in feeder steer prices caused by a 1 percent change in slaughter steer prices. This coefficient is estimated to be 1.197.

Figure 1: U.S. Beef Import and Export Market Shares (Live Cattle and Beef



The structural model presented in Appendix A also allows for dynamic supply response. Thus, initial changes in trade shares that affect market prices lead to subsequent supply responses by feeder cattle producers and feedlots. Over time, these supply responses affect the demand for fed cattle, tempering the effects of the initial changes in import and export market shares on slaughter and feeder cattle price changes. The net effect of these dynamic supply responses is a smaller long run slaughter steer price flexibility coefficient of -1.305. This is the slaughter steer price flexibility coefficient used in the quantitative analysis presented below.

Canadian trade could not be separated into import and export shares for fed beef (steers and heifers) and nonfed beef (cows) because of data limitations. Thus, in our model, quantities related to beef import and export shares and U.S. beef supplies are not segregated according to quality attributes. In the analysis, we assume that a change in beef quantities has similar impacts across all beef cuts. Some beef demand studies have examined the potential for different market impacts for fed beef and nonfed beef on beef prices (Brester and Wohlgenant), but this issue is not examined here.

Comparative Statics

Estimating potential changes in beef prices that would result from re-establishing U.S.-Canadian live cattle and beef trade involves calculating comparative static effects using the estimated coefficients of the structural model. A trade-quantity shock of any given magnitude is expected to change equilibrium fed and nonfed beef prices in accordance with equilibrium demand and supply behavior. A simple example involving imports illustrates this process. Suppose that opening the border to Canadian live cattle would increase the U.S. beef import market share by 3 percentage points. If the initial average market price for fed steers were $86.00/cwt, then the expected impact on fed steer prices, ΔPfed, would be:

(1) ΔPfed = [(3.0 percent import share ÷ 100.0) x (-1.305 price flexibility)] x ($86.00/cwt base price) = -$3.92/cwt

Using equation (1), the estimated change in fed steer prices (ΔPfed) caused by the 3 percentage point increase in the U.S.import market share is -4.55 percent (the expression in the square brackets in equation (1)) multiplied by the $86.00/cwt base price, or -$3.92/cwt. Multiplying this estimated percentage change in fed steer prices by the price transmission coefficient of 1.197 results in an estimated 5.4 percent decline in feeder steer prices. Using an initial average feeder steer market price of $115.00/cwt, the predicted change in the feeder steer price (ΔPfdr) would be:

(2) ΔPfdr = (-5.45 ÷ 100.0) x ($115.00/cwt base price) = -$6.27/cwt

This comparative static approach is also used to estimate the price effects of changes in U.S. beef export shares.

Restrictions Imposed on Beef Trade Changes

Estimating beef price impacts caused by the introduction of the USDA-MRR rule involves expected changes in U.S. imports and exports of live cattle and beef (carcass weight of fed and nonfed beef) as they apply to Canada and two major importers of U.S. beef, Japan and South Korea. These estimates are made using the following assumptions:

1. The United States is assumed to import 400 thousand head of feeder cattle and 1.1 million head of fed steers and heifers between March 2005 and December 2005 (LMIC). This translates into 1.155 billion pounds of carcass weight beef (total of 1.5 million head multiplied by 770 pounds, the average dressed weight of U.S. steers and heifers in 2004). Note that the same average dressed weight is also applied to imported feeder cattle because since they are assumed to be slaughtered in the U.S. at less than 30 months age.

2. U.S. imports of Canadian beef are assumed to equal 2004 import levels of 1.059 billion pounds.

3. U.S. beef exports to Canada are assumed to return to 2002 levels of 0.241 billion pounds.

4. U.S. feeder cattle exports to Canada under the current Restricted Feeder Cattle program are assumed to return to 2002 levels of 134,200 head. The U.S. exported 31,082 head to Canada in 2004 implying an expected net export increase of 103,138 head in 2005. Assuming an average feeder weight of 650 pounds and a dressing percentage of 60 percent, a return to the 2002 export levels results in a 0.040 billion pound increase in carcass weight beef exports.

5. U.S. beef imports and exports to other countries such as Mexico, Russia, Latin America, and Caribbean nations are assumed to be equal to 2002 levels.

6. Import and export flows of live cattle and beef for 2005 are assumed to be uniformly distributed throughout the year. (However, uneven marketings and sales could occur, which could cause larger or smaller price changes in the short term).

7. Changes in beef by-products trade (hides and offal) are not considered in the analysis, but are assumed to remain at 2002 levels.

BSE Effects: Comparing 2004 with 2002

The last year in which cattle and beef trade between the United States and Canada was unaffected by BSE concerns was 2002. However, the full effects of the 2003 BSE events on U.S. and Canadian cattle and beef markets were probably not manifest until 2004. Thus, changes in imports and export shares between 2002 and 2004 are used to estimate the consequences of the 2003 BSE incidents for U.S. fed steer and feeder cattle prices (Table 1).

The U.S. beef export share was 8.71 percent in 2002, but declined to 1.73 percent in 2004 as access to foreign markets were restricted. Based on an average December 2004 U.S. fed cattle price of $86.85/cwt, the decrease in the export share (a reduction of 6.99 percentage points) reduced fed steer prices by $7.93/cwt. For a 1,200 pound fed steer, this represents a decrease in revenues of $95 per head. Based on an average December 2004 feeder steer prices of $113.40, lower export shares reduced feeder steer prices by $12.40/cwt. For a 650-pound feeder steer, this represents an $81/head decrease in revenues.

Table 1: Import and Export Market Shares and Beef Price Effects of BSE, 2002 and 2004

Year/ Cattle Price	Import Share	Export Share	Import Price Effects	Export Price Effects
2002	15.89%	8.71%		
2004	14.39%	1.72%		
Fed Steer			+$1.70/cwt (1.32/cwt to $2.05/cwt)	-$7.93/cwt (-6.14/cwt to -9.56/cwt)
Feeder Steer			+$2.66/cwt (2.06/cwt to 3.21/cwt)	-$12.40/cwt (-9.60/cwt to -14.96/cwt)

Note: Market shares and price effects are based on changes from 2002 (pre-BSE trade year) to 2004 (post-BSE trade year). The top numbers in the *Fed Steer* and *Feeder Steer* rows are average or mean price estimates and the ranges given in parentheses are upper and lower bound price estimates based on 95 percent confidence intervals. The mean slaughter steer price flexibility coefficient (E_f) of the systems model is -1.305 (allowing for supply adjustment) and the upper and lower bound E_f's of the confidence interval are -1.575 and -1.010.

In 2004, however, the import share of U.S. beef supplies also declined from 15.89 percent in 2002 to 14.39 percent in response to the ban on live cattle imports from Canada. This 1.5 percentage point decrease in the import share resulted in an estimated $1.70/cwt increase in fed steer prices (or $20 per head) and an estimated $2.66/cwt increase in feeder steer prices (or $17/head). Overall, the BSE outbreaks in Canada and the United States resulted in a net decrease of $6.23/cwt in U.S. fed steer prices (about $75 per head) and $9.74/cwt in U.S. feeder steer prices (about $63 per head). Most of the price declines were caused by reduced access for U.S. beef in Asian markets rather than reduced live cattle imports from Canada.

Re-opening the Canadian Border in 2005: Assuming No Access to Japan and South Korea

In this section, we present estimates of the impacts on U.S. fed and feeder steer prices of re-establishing beef trade relationships with Canada under the proposed MRR rules. Under the assumption that trade patterns with Canada will return to their 2002 levels, re-opening the Canadian border will increase the U.S. beef export share of domestic supplies by 1.03 percentage points from 1.72 percent in 2004 (Table 1) to 2.75 percent in 2005 (Table 2). Assuming other market factors remain unchanged, this translates into increases in fed steer prices of $1.17/cwt ($14 per head) and feeder steer prices of $1.83/cwt ($12 per head). At the same time, U.S. imports are estimated to increase by 3.38 percent from 14.39 percent in 2004 (Table 1) to 17.77 percent in 2005 (Table 2). The resulting estimated reduction in fed steer prices is $3.82/cwt. The estimated reduction in feeder steer prices is $5.98/cwt. Therefore, the estimated *net* effects on beef prices from reopening the border with Canada are decreases of $2.65/cwt in fed steer prices and $4.15/cwt in feeder steer prices (equal to the price increases resulting from the increase in export share minus the price decreases resulting from the increase in import share). Note that these estimates assume that Japanese and South Korean export markets remain closed to U.S. beef exports.

Re-opening the Canadian Border in 2005: Access to Japanese and South Korean Markets

In this section, we estimate the impacts of trade resumption with Canada under the assumption that, at the same time, the U.S. re-gains access to the Japan and South Korea beef markets (primarily high quality table cuts) and exports return to their 2002 levels. In 2002, the U.S. exported 0.771 billion pounds of beef to Japan and 0.597 billion pounds of beef to South Korea. In 2004, these exports declined to 0.012 billion pounds and 0.001 billion pounds, respectively.

Table 2: Import and Export Market Shares and Beef Price Effects of Opening the Canadian Border in 2005: No Access to the Japanese and South Korean Markets

Year/ Cattle Price	Import Share	Export Share	Import Price Effects	Export Price Effects	Net Price Effects
2005	17.77%	2.75%			
Fed Steer			-$3.82/cwt (-2.96/cwt to -4.62/cwt)	$1.17/cwt (0.91/cwt to 1.41/cwt)	-$2.65/cwt (-2.05/cwt to -3.20/cwt)
Feeder Steer			-$5.98/cwt (-4.63/cwt to -7.21/cwt)	$1.83/cwt (1.41/cwt to 2.20/cwt)	-$4.15/cwt (-3.21/cwt to -5.01/cwt)

Note: Market shares and price effects are based on projected changes from 2004 to 2005. The top numbers in the *Fed Steer* and *Feeder Steer* rows are average or mean price estimates and the ranges given in parentheses are upper and lower bound price estimates based on 95 percent confidence intervals. The mean slaughter steer price flexibility coefficient (E_f) of the systems model is -1.305 (allowing for supply adjustment) and the upper and lower bound E_f's of the confidence interval are -1.575 and -1.010, respectively.

The resumption of trade with Japan, South Korea and Canada in 2005 is, therefore, estimated to increase the beef export share of total U.S. beef supplies to 7.37 percent. This increase would raise fed steer prices by $6.42/cwt ($77 per head) and feeder steer prices by $10.03/cwt (or $65 per head), as shown in Table 3.

In summary, the estimated average net impacts of increased U.S. import and export shares associated with the resumption of beef trade with Canada, Japan, and South Korea are as follows:

- an increase in U.S. fed steer prices of $2.59/cwt
- an increase in U.S. feeder steer prices of $4.05/cwt (as shown in Table 3).

The estimated average net impacts of increased U.S. import and export shares associated with the resumption of beef trade with Canada, Japan, and South Korea are as follows:

- an increase in U.S. fed steer prices of $2.59/cwt
- an increase in U.S. feeder steer prices of $4.05/cwt (as shown in Table 3).

Table 3 also shows 95 percent confidence intervals for these estimates, which indicate with a 95 percent probability that the net price increases will lie in the range of $2.00-$3.13/cwt for fed steer prices and $3.13-$4.89/cwt for feeder steer prices.

The above estimates are generally consistent with those reported in another study of the impacts of BSE discoveries on the U.S. beef industry (Coffey, et al.). Note that positive estimated beef price effects of re-establishing trade in 2005 are not symmetric with the negative beef price effects from trade restrictions that occurred between 2002 and 2004 for two reasons. First, import and export market shares provide the basis for the analysis and these shares were different in the two periods. Second, the LMIC estimates that U.S. live cattle imports from Canada for 2005 (1.5 million head) will be smaller than the impacts which occurred in 2002 (1.7 million head).

Conclusions

The USDA-MRR rule to allow U.S. imports of Canadian feeder and fed cattle as of March 7, 2005 was postponed under a preliminary court injunction. On July 14, 2005, the 9th Circuit Court of Appeals overturned the injunction, and Canadian cattle moved into the U.S. four days later. Appeals have been filed and the matter has yet to be completely resolved by the court system. The re-establishment of beef trade has generated considerable controversy among beef producers. Some producers fear that re-entry of Canadian live cattle into the United States will disrupt marketings and prices, and may cause animal and human health problems in the United States. Other producers are more confident in the ability of Canadian and U.S. safeguards to protect meat supplies against BSE contamination.

Table 3: Import and Export Market Shares and Beef Price Effects of Opening the Canadian Border in 2005: Access to the Japanese and South Korean Markets

Year/ Cattle Price	Import Share	Export Share	Import Price Effects	Export Price Effects	Net Price Effects
2005	17.77%	7.37%			
Fed Steer			-$3.82/cwt (-2.96/cwt to -4.62/cwt)	$6.42/cwt (4.97/cwt to 7.74/cwt)	$2.59/cwt (2.00/cwt to 3.13/cwt)
Feeder Steer			-$5.98/cwt (-4.63/cwt to -7.21/cwt)	$10.03/cwt (7.76/cwt to 12.10/cwt)	$4.05/cwt (3.13/cwt to 4.89/cwt)

Note: Market shares and price effects are based on projected changes from 2004 to 2005. The top numbers in the *Fed Steer* and *Feeder Steer* rows are average or mean price estimates and the ranges given in parentheses are upper and lower bound price estimates based on 95 percent confidence intervals. The mean slaughter steer price flexibility coefficient (E_f) of the systems model is -1.305 (allowing for supply adjustment) and the upper and lower bound E_f's of the confidence interval are -1.575 and -1.010, respectively.

Some argue that restoring U.S. beef trade with Canada is a critical prerequisite for restoring trade with Japan and South Korea .

In this study, we have used a systems econometric model to estimate price flexibilities, price transmissions, and supply elasticities in the fed slaughter and feeder cattle sectors. These parameters, along with import and export market shares, were used in a comparative statics framework to analyze the effects on U.S. cattle prices of resuming live cattle and beef trade with Canada in 2005. It appears that a recent order lifting a preliminary injunction on the MRR may cause trade between Canada and the U.S. to return to pre-BSE levels. However, many important export markets continue to ban U.S. beef. The results of our analysis indicate that, had the USDA-MRR rule been implemented on March 7, 2005 and Japanese and South Korean markets also remained closed to U.S. exports, U.S. fed cattle and feeder cattle prices would have declined by $2.65/cwt and $4.15/cwt, respectively, in 2005. Given the size of the 2004 U.S. calf crop and fed steer and heifer slaughter in that year, these decreases in cattle prices would have reduced fed cattle revenues by $890 million and feeder calf revenues by $976 million (or, respectively, about 3.1 percent and 3.8 percent of 2004 total revenues for these sectors).

Resumption of live cattle and beef trade with Canada border may be a necessary precursor for resuming beef trade with Japan and South Korea. If these markets resume U.S. beef imports, fed steer prices would increase by $2.60/cwt and feeder steer prices by $4.05/cwt in 2005. Such price changes would increase total U.S. fed cattle revenues by $873 million and total U.S. feeder calf revenues by $952 million (or, respectively, 3.1 percent and 3.7 percent of 2004 total revenues in each sector).

Our estimates of BSE-related effects on U.S. fed and feeder cattle prices are based on ceteris paribus assumptions. Other potentially important factors such as the effects of by-product trade (hide and variety meats) are not included in the analysis. Over 40 percent of U.S. beef by-products are exported. Thus, changes in beef by-product values from trade sanctions would also be bid into live cattle prices. In addition, this study has only considered changes in beef trade with Canada, Japan, and South Korea. Projecting the economic effects of trade changes with other countries (e.g., Mexico, Russia, and Caribbean nations) and the economic effects of 2005 domestic market changes (i.e., cattle inventories, feed prices, red meat and poultry production, and consumer beef demand) would result in different estimates of beef price and revenue impacts.

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Appendix A: The Econometric Model

A systems econometric model of the U.S. fed and feeder cattle sectors was specified and estimated. The following four equations (and market clearing conditions) constitute the mdoel: (1) inverse slaughter cattle demand, (2) ordinary slaughter cattle supplies, (3) inverse feeder cattle demand, and (4) ordinary feeder cattle (calf crop) supplies. The model consisted of jointly dependent variables with contemporaneously correlated errors and was therefore estimated by Iterative Three Stage Least Squares. The supply equations included lagged exogenous variables and a Koyck term (lagged dependent variable); thus, the supply equations were estimated as an autoregressive–distributed lag (ARDL) structure.

The statistical properties of the empirical model conceptually result in consistent and asymptotically efficient coefficient estimates. These distribution properties lend accuracy to estimation of BSE-induced fed and feeder cattle price effects as they relate to beef trade changes in the Canadian and Asian markets. The dynamics of the beef supply relations incorporate supply feedbacks into the expected price responses in the comparative static analyses.

The regression results for the beef model, estimated using 1970-2003 annual data, are given in the following equations (estimated in double logs).

Slaughter Sector:

Inverse Slaughter Demand:

$$(1)\ PS_t = \underset{(6.294)}{10.362} - \underset{(-7.676)}{1.518}QB_t + \underset{(4.499)}{0.225}B_t - \underset{(-2.615)}{0.663}MC_t + \underset{(5.342)}{0.363}RD_t + \underset{(2.252)}{0.086}PH_t$$

$t = 1, 2, \ldots, n \qquad \bar{R}^2 = 0.967 \qquad S.E. = 0.052$

Slaughter Supply:

$$(2)\ QS_t = \underset{(5.382)}{2.470} + \underset{(2.286)}{0.122}PS_{t-1} - \underset{(-11.180)}{0.344}PF_t - \underset{(-2.494)}{0.044}PN_{t-1} - \underset{(-3.408)}{0.004}T + \underset{(7.187)}{0.616}QS_{t-1}$$

$\bar{R}^2 = 0.772 \qquad S.E. = 0.031$

The variables are: PS = price of choice slaughter steers ($/cwt); QB = U.S. beef supplies (carcass weight) consisting of beef production plus beef imports (bil. lbs.); B = beef by-product value (cents/lb.); MC = index of food marketing costs (1987 = 100.0); RD = retail beef demand index (1970 = 100.0); PH = price of barrow and gilts ($/cwt); QS = U.S. cattle slaughter supplies (liveweight, bil. lbs.); PF = price of feeder steers (600-650 lbs., $/cwt); PN = price of #2 yellow corn ($/bu.); and T = trend, representing technology. The subscript *t-1* represents a lag of one period.

Feeder Sector:

Inverse Feeder Demand:

$$(3)\ PF_t = \underset{(3.381)}{3.337} - \underset{(-3.720)}{1.047}CC_t + \underset{(14.3.27)}{1.197}PS_t - \underset{(-2.455)}{0.124}PN_t$$

$\bar{R}^2 = 0.878 \quad S.E. = 0.088$

Calf Crop Supply:

$$(4)\ CC_t = \underset{(0.263)}{0.054} + \underset{(2.946)}{0.1313}P_{t-2} - \underset{(-2.264)}{0.050}PY_{t-2} - \underset{(-1.044)}{0.039}PW_{t-2} + \underset{(15.460)}{0.932}CC_{t-1}$$

$\bar{R}^2 = 0.957 \qquad S.E. = 0.018$

The variables are: CC = U.S. calf crop (mil. hd.); PY = price of hay ($/ton); and PW = price of slaughter cows ($/cwt). Other variables are defined above. The subscript *t-2* represents a lag of two

periods. The adjusted R-squared is $\overline{R}^2$ and the standard error of regression is S.E. All price and value variables are in real terms (1982-84 constant dollars). The asymptotic t-values are in parentheses below the coefficients. The critical *t* value at the $\alpha = 0.05$ and $\alpha = 0.10$ significance levels are 1.658 and 1.980, respectively (110 degrees of freedom for the systems estimation).

Appendix B: Data Development

Annual time series data from 1970-2003 are used to estimate the econometric model. Data relevant to the livestock sectors are obtained from the USDA Red Meats Yearbook and USDA Livestock, Dairy, and Poultry Situation Outlook Reports. Corn and hay price data are obtained from the USDA Feed Yearbook and USDA Agricultural Statistics series. All price and value data are deflated by the Consumer Price Index (CPI, 1982-84=100). The CPI data are obtained from the Economic Report of the President. The food marketing cost index is obtained from the USDA's Agricultural Outlook series.

Feeder cattle prices are assumed to be determined by feeder cattle supplies in the econometric model. The U.S. calf crop is use as a proxy for feeder cattle supplies. In the fed cattle slaughter price equation, beef demand is represented by the retail beef demand index (Marsh 2003, LMIC).