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Impacts of the GATT/Uruguay Round Trade Negotiations on U.S. Beef and Cattle Prices

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The GATT/Uruguay Round trade negotiations have resulted in a multilateral relaxation of beef trade restrictions. A linear elasticity model of the U.S. beef industry is developed using log differential equations. Beef consumption, production, and trade are disaggregated into appropriate ground and table cut components. The model predicts the GATT/Uruguay Round will cause asymmetric effects on ground and table cut beef consumers. In general, fed cattle and cow/calf producers will benefit from trade liberalization because of increases in fed and feeder cattle prices. However, nonfed cattle price will decrease.

Key words: beef prices, cattle prices, GATT/Uruguay Round

Introduction and Brief History of Beef Trade Restrictions

The General Agreement on Tariffs and Trade (GATT)/Uruguay Round trade negotiations reduce or eliminate many agricultural trade barriers. Trade barriers for beef products have historically been significant. The effects of trade barrier reductions on U.S. beef and cattle prices are considered here. Specific attention is focused on relative impacts on fed cattle and cow/calf producers.

Prior to the recent GATT/Uruguay Round negotiations, the U.S. Meat Import Act of 1979 (which amended the 1964 act) restricted U.S. beef imports. Hahn et al. describe this regulatory policy in detail. In general, the act established an overall import quota based on a formula designed to make import quantities countercyclical with domestic production (Simpson). Imports could not exceed a calculated base quantity by more than 10%. The base quantity was determined by contemporaneous production levels, an overall growth factor, and average annual imports from 1968–77. The quota was divided among beef exporting countries. In addition, voluntary restraint agreements were negotiated with those countries. Exporting countries agreed to limit beef exports to the United States if U.S. beef imports approached annual trigger quotas. This arrangement avoided the need for imposing further import restrictions and allowed exporting countries to accrue economic quota rents (Goddard).

In several years since 1979, imports reached trigger quota restrictions imposed by the U.S. Meat Import Act of 1979. Hahn et al. noted "the U.S. Meat Import Law occasionally shuts off the additional supplies of beef from exporting nations" (p. 24). In other years, voluntary restraint agreements may have kept imports from reaching the trigger quota

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levels. Thus, it is likely that relaxing U.S. import restrictions will increase U.S. beef imports.

The U.S. annual quantity share of the world fresh beef import market averaged 16.5% between 1980 and 1994 (United Nations). The U.S. is the largest single-country beef importer (Hahn et al.). U.S. beef imports primarily consist of lower-quality, manufacturing-grade beef. The Livestock Marketing and Information Center (LMIC) estimates that ground beef comprises 80% of all U.S. beef imports.

U.S. beef exports have been subject to both tariff and nontariff barriers in many countries. For example, prior to the GATT/Uruguay Round, Japan levied a 50% tariff on imported beef, South Korea imposed beef import quotas, and the European Union (EU) subsidized beef exports.

U.S. quantity share of the annual world beef export market averaged 5.9% between 1980 and 1994, but has increased to approximately 10% in recent years. In terms of beef and veal, the U.S. primarily exports higher-value beef cuts. However, the U.S. also exports significant quantities of lower-value edible offals. Many of these products were subject to less stringent trade restrictions relative to those imposed on higher-value cuts. Recently, U.S. beef exports have increased dramatically. Specifically, quantities of beef exports increased 26% between 1993 and 1994, and 13% from 1994 to 1995.

The GATT/Uruguay Round stipulates that Japan reduce its beef tariffs from 50% to 38.5% by the year 2000. South Korea will increase its beef import quota from its current 106,000 metric tons to 225,000 metric tons by the year 2000. In 2001, South Korean import quotas will be replaced by a 44% tariff which will be reduced to 40% by the year 2004. The EU has agreed to reduce quantities of subsidized exports to 817,000 metric tons by the year 2000 (which is 507,000 tons less than 1992 levels). On 1 January 1995, the U.S. replaced import quotas established by the U.S. Meat Import Act of 1979 with a tariff of 31.1% (which is to be reduced to 26.4% by the year 2000) and a tariff-rate quota of 656,621 metric tons. The tariff will be applied to all imports in excess of the tariff-rate quota [U.S. Department of Agriculture (USDA) 1994b]. Thus, the GATT/Uruguay Round will affect both U.S. beef exports and imports.

Houck (1974) considered the impact of beef import restrictions on U.S. retail prices of beef, other meats, and other foods. Houck's short-run, partial equilibrium analysis was based on data from 1948–71 but did not consider the supply response of U.S. and foreign meat producers. He noted that ground beef (e.g., hamburger) and table cut beef (e.g., steaks and roasts) were imperfect substitutes. Data limitations, however, have frequently forced researchers to use nonfed beef as a proxy for ground beef production and fed beef as a proxy for table cut beef production (Brester and Wohlgenant). Nonetheless, an accurate evaluation of beef import restrictions must appropriately disaggregate these two products (Brester).

Similarly, Freebairn and Rausser disaggregated beef production and consumption into fed and nonfed components and used data from 1956–71 to examine the effects of beef import quotas. They concluded that changes in U.S. beef import restrictions would have asymmetric effects on feedlot operators (i.e., producers of fed cattle) and cattle ranchers (i.e., producers of nonfed and feeder cattle).

Simpson evaluated the U.S. Meat Import Act of 1979 which was supposed to correct a flaw in the 1964 act. Specifically, the early version failed to prevent concurrent increases in imports and U.S. beef production. However, Simpson noted that the 1979 act

would also fail to make imports countercyclical with U.S. production if an unexpected slow growth in cattle inventories occurred.

We estimate the effects of the GATT/Uruguay Round on the U.S. beef industry. In addition, we use recent data and incorporate supply responses of cattle producers into the analysis. Thus, like the work of Freebairn and Rausser, this research represents a multimarket equilibrium analysis. Furthermore, given the aforementioned concerns of Houck, we disaggregate the retail market into ground beef and table cut beef components and explicitly recognize that neither of these products are produced exclusively by a single animal type. Because both imports and exports directly affect the prices of ground and table cut beef, the impacts of changes in beef imports and exports indirectly affect cattle prices through shifts in the derived demands for fed, nonfed, and feeder cattle.

A Disaggregated Model of the U.S. Beef Industry

The following equations represent a disaggregated model of the U.S. beef industry:

(1) Ground beef demand: $Q_G = f_1(P_G, P_T)$,

(2) Table cut beef demand: $Q_T = f_2(P_G, P_T)$,

(3) Ground beef supply: $Q_G = f_3(Q_F, Q_N, Q_M)$,

(4) Table cut beef supply: $Q_T = f_4(Q_F, Q_N, Q_M, Q_X)$,

(5) Joint product price of fed cattle: $P_F = f_5(P_G, P_T)$,

(6) Joint product price of nonfed cattle: $P_N = f_6(P_G, P_T)$,

(7) Supply of fed cattle: $Q_F = f_7(P_F)$,

(8) Supply of nonfed cattle: $Q_N = f_8(P_N)$,

(9) Supply of feeder cattle: $Q_C = f_9(P_C)$,

(10) Derived demand for feeder cattle: $P_C = f_{10}(P_F, Q_C)$,

(11) Ground beef market clearing identity: $Q_G = f_{11}(Q_{GD}, Q_M)$, and

(12) Table cut beef market clearing identity: $Q_T = f_{12}(Q_{TD}, Q_M, Q_X)$.

Variable definitions are presented in table 1. For each equation, those demand and supply shifters which are likely unaffected by exogenous trade liberalization policies are excluded from the specifications. Equations (1) and (2) represent consumers' demand for ground beef and table cut beef ignoring other demand shifters (i.e., income, prices of other goods). The supply of ground beef at the retail level (3) is a function of ground beef obtained from fed cattle, nonfed cattle, and imports. Exports are not included in the specification because very little ground beef is exported. In addition, edible offal and variety meat exports are excluded from this analysis because the demand for these products is quite different from the demand for ground beef. The supply of table cut beef at the retail level (4) is a function of table cut beef obtained from fed beef, nonfed beef, and imports less table cut beef exports. Equations (5) and (6) represent the prices of fed cattle and nonfed cattle as functions of changes in the prices of the joint products (i.e., ground beef and table cut beef) produced by these two inputs (Houck 1964). Processing costs are excluded from these equations because they are probably unaffected by trade negotiations. Changes in the supply of fed cattle, nonfed cattle, and feeder cattle [(7),

Table 1. Variable Definitions, Elasticity Estimates, and Mean Values (1990–94)

Symbol	Definition, Units, and Source	Estimate or Mean Value
Q_G	Total ground beef consumed (carcass weight, mil. lbs.) at the retail level (LMIC; Brester and Wohlgenant)	10,225.5
Q_T	Total table cut beef consumed (carcass weight, mil. lbs.) at the retail level (LMIC; Brester and Wohlgenant)	14,042.4
Q_F	Production of fed cattle (carcass weight, mil. lbs.; LMIC; Brester and Wohlgenant)	19,008.0
Q_N	Production of nonfed cattle (carcass weight, mil. lbs.; LMIC; Brester and Wohlgenant)	4,206.6
Q_M	Quantity of beef imports (carcass weight, mil. lbs.; USDA 1990–95)	2,394.4
Q_X	Quantity of beef and veal exports (carcass weight, mil. lbs.; USDA 1990–95)	1,281.0
Q_C	Production of feeder cattle (calf crop, thousand head; USDA 1995)	39,127.2
Q_{GD}	Quantity of U.S.–produced ground beef consumed domestically (carcass weight, mil. lbs.; LMIC; Brester and Wohlgenant)	8,348.8
Q_{TD}	Quantity of U.S.–produced table cut beef consumed domestically (carcass weight, mil. lbs.; LMIC; Brester and Wohlgenant)	14,865.8
P_G	Price of ground beef (dollars/lb.) at the retail level (U.S. Dept. of Labor)	1.70
P_T	Price of table cut beef (dollars/lb.) at the retail level (Brester and Wohlgenant)	4.09
P_F	Price of fed cattle (900–1,100 lb. choice steers, Nebraska, dollars/cwt; USDA 1990–95)	74.22
P_N	Price of nonfed cattle (breaking utility cows, Sioux Falls, dollars/cwt; USDA 1990–95)	49.24
P_C	Price of feeder cattle (500–700 lb. feeder steers, Oklahoma City, dollars/cwt; USDA 1990–95)	89.09
E	Relative change operator (e.g., $EQ_G = dQ_G/Q_G = d\ln Q_G$)	n.a.
η_{GG}	Own-price elasticity of demand for ground beef at the retail level (Brester)	−0.96
η_{GT}	Cross-price elasticity of demand for ground beef with respect to the price of table cut beef at the retail level (Brester)	0.29
η_{TG}	Cross-price elasticity of demand for table cut beef with respect to the price of ground beef at the retail level (Brester)	0.10
η_{TT}	Own-price elasticity of demand for table cut beef at the retail level (Brester)	−0.80
a_{GF}	Proportion of meat obtained from fed beef carcasses that is marketed as ground beef (LMIC)	0.25
a_{GN}	Proportion of meat obtained from nonfed beef carcasses that is marketed as ground beef (LMIC)	0.86
a_{GM}	Proportion of meat obtained from beef imports that is marketed as ground beef (LMIC)	0.80
a_{TF}	Proportion of meat obtained from fed beef carcasses that is marketed as table cut beef (LMIC)	0.75
a_{TN}	Proportion of meat obtained from nonfed beef carcasses that is marketed as table cut beef (LMIC)	0.14
a_{TM}	Proportion of meat obtained from beef imports that is marketed as table cut beef (LMIC)	0.20
a_{TX}	Proportion of beef exports marketed as table cut beef	1.00
ϵ_F	Own-price elasticity of supply of fed cattle (Marsh)	0.60
ϵ_N	Own-price elasticity of supply of nonfed cattle (Brester et al.)	1.41
ϵ_C	Own-price elasticity of supply of feeder cattle (Brester and Marsh)	0.41
τ	Elasticity of price transmission from fed cattle to feeder cattle	1.11
η_C	Derived demand own-price flexibility for feeder cattle	−0.85
Q_{GM}	Quantity of imported ground beef consumed domestically (carcass weight, mil. lbs.; $Q_M^*0.80$)	1,915.5
Q_{TM}	Quantity of imported table cut beef consumed domestically (carcass weight, mil. lbs.; $Q_M^*0.20$)	478.9
Q_{TX}	Quantity of exported table cut beef (Q_X)	1,281.0

(8), and (9)] are specified as functions of own prices. Because feed prices (as well as other inputs) are likely unaffected by beef trade liberalization, they are excluded from these supply function specifications. Equation (10) represents the derived demand for feeder cattle as a function of the price of fed cattle and the production of feeder cattle. Equations (11) and (12) represent market clearing identities for ground beef and table cut beef.

Totally differentiating (1)–(12) and using log differentials to convert to elasticities results in the following linear elasticity model which is used to approximate changes from initial equilibrium in the relevant product and factor markets of the U.S. beef industry:

$$(13)\quad EQ_G = \eta_{GG}EP_G + \eta_{GT}EP_T,$$

$$(14)\quad EQ_T = \eta_{TG}EP_G + \eta_{TT}EP_T,$$

$$(15)\quad EQ_G = a_{GF}(Q_F/Q_G)EQ_F + a_{GN}(Q_N/Q_G)EQ_N + a_{GM}(Q_M/Q_G)EQ_M,$$

$$(16)\quad EQ_T = a_{TF}(Q_F/Q_T)EQ_F + a_{TN}(Q_N/Q_T)EQ_N + a_{TM}(Q_M/Q_T)EQ_M - a_{TX}(Q_X/Q_T)EQ_X,$$

$$(17)\quad EP_F = a_{GF}(P_G/P_F)EP_G + a_{TF}(P_T/P_F)EP_T,$$

$$(18)\quad EP_N = a_{GN}(P_G/P_N)EP_G + a_{TN}(P_T/P_N)EP_T,$$

$$(19)\quad EQ_F = \epsilon_F EP_F,$$

$$(20)\quad EQ_N = \epsilon_N EP_N,$$

$$(21)\quad EQ_C = \epsilon_C EP_C,$$

$$(22)\quad EP_C = \tau EP_F + \eta_C EQ_C,$$

$$(23)\quad EQ_G = (Q_{GD}/Q_G)EQ_{GD} + (Q_{GM}/Q_G)EQ_M, \qquad \text{and}$$

$$(24)\quad EQ_T = (Q_{TD}/Q_T)EQ_{TD} + (Q_{TM}/Q_T)EQ_M - (Q_{TX}/Q_T)EQ_X.$$

The linear elasticity model presented in equations (13)–(24) is a linear approximation to the underlying (unknown) demand and supply functions. The model's accuracy depends upon the degree of nonlinearity of the true functional forms, and the magnitude of deviations from equilibrium being simulated. That is, the model is less accurate the more nonlinear the true underlying demand and supply functions and less accurate as larger deviations from equilibrium are considered because of the assumption of constant elasticities between equilibria. In addition, this particular specification of the linear elasticity model implicitly assumes constant-returns-to-scale production technologies. The length of run considered by such a model depends upon the selected elasticities. Furthermore, because of data limitations, we assume that proportions of ground and table cut beef obtained from fed and nonfed cattle are time invariant. To the extent that these proportions do vary in response to market conditions, supply responses for each product will be understated and associated price effects will be overstated. However, our model does allow for substitution between each product by consumers.

Values of Market Parameters

Equations (13)–(24) are rewritten below using parameter estimates reported in table 1:

$$(25)\quad EQ_G = -0.96EP_G + 0.29EP_T,$$

$$(26)\quad EQ_T = 0.10EP_G - 0.80EP_T,$$

$$(27)\quad EQ_G = 0.46EQ_F + 0.35EQ_N + 0.19EQ_M,$$

(28) $EQ_T = 1.02EQ_F + 0.04EQ_N + 0.03EQ_M - 0.09EQ_X$,

(29) $EP_F = 0.57EP_G + 4.13EP_T$,

(30) $EP_N = 2.97EP_G + 1.16EP_T$,

(31) $EQ_F = 0.60EP_F$,

(32) $EQ_N = 1.41EP_N$,

(33) $EQ_C = 0.41EP_C$,

(34) $EP_C = 1.11EP_F - 0.85EQ_C$,

(35) $EQ_G = 0.81EQ_{GD} + 0.19EQ_M$, and

(36) $EQ_T = 1.06EQ_{TD} + 0.03EQ_M - 0.09EQ_X$.

Demand elasticity estimates for (25) and (26) are obtained from Brester. Quantity and value share data for (27)–(30), (35), and (36) are obtained using LMIC procedures outlined by Brester and Wohlgenant. An estimate of the own-price elasticity of supply for fed cattle [0.60 in (31)] is obtained from Marsh. The own-price elasticity of supply for nonfed cattle [1.41 in (32)] is obtained from Brester et al. The own-price elasticity of supply for feeder cattle [0.41 in (33)] is obtained from Brester and Marsh. These supply elasticities represent medium-run producer behavior. Thus, they are appropriate for considering the effects of exogenous changes in imports and exports over a three–eight year horizon.

Elasticity estimates for the feeder cattle derived demand equation (34) are obtained from the following ordinary least squares regression using annual data from 1962–94:

$$\begin{aligned}(37)\quad \ln P_C = {} & 8.67 + 1.11^* \ln P_F - 0.85^* \ln Q_C + 0.37^* \rho_{t-1}, \\ & (2.24)\ (17.30)\qquad (-2.41)\qquad (2.32)\end{aligned}$$

$$\bar{R}^2 = 0.97, \quad S_y = 0.091, \quad \bar{Y} = 3.88, \quad \text{DF} = 30, \quad \text{DW} = 1.83,$$

where ρ_{t-1} is the lagged error term, numbers in parentheses are t-values, $\bar{R}^2$ is the adjusted R-squared, S_y is the standard error of the estimate, $\bar{Y}$ is the mean of the dependent variable, DF is the degrees of freedom, and DW is the Durbin-Watson statistic. Because the data are in natural logarithms, 1.11 represents an estimate of the elasticity of price transmission from fed cattle to feeder cattle (τ), and -0.85 represents the own-price flexibility for the derived demand for feeder cattle (η_C) in (34).

The system of equations (25)–(36) can be solved numerically for relative changes in quantities, input prices, and output prices as functions of relative exogenous changes (i.e., those caused by trade liberalization policies) in imports and exports. In matrix notation, equations (25)–(36) can be written as:

$$(38)\qquad A \cdot Y = B \cdot E,$$

where A is a 12×12 matrix of parameters, Y is a 12×1 vector of changes in the endogenous variables, and B is a 12×2 matrix of parameters associated with a 1% change in the exogenous variables which are represented by the 2×1 vector E. Explicitly, (38) has the form:

$$
(39)\quad
\begin{bmatrix}
1 & 0 & 0.96 & -0.29 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 1 & -0.10 & 0.80 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
1 & 0 & 0 & 0 & 0 & 0 & -0.46 & -0.35 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 & 0 & -1.02 & -0.04 & 0 & 0 & 0 & 0 \\
0 & 0 & -0.57 & -4.13 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & -2.97 & -1.16 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & -0.60 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & -1.41 & 0 & 1 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & -0.41 & 0 & 0 \\
0 & 0 & 0 & 0 & -1.11 & 0 & 0 & 0 & 0.85 & 1 & 0 & 0 \\
1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -0.81 & 0 \\
0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1.06
\end{bmatrix}
\begin{bmatrix}
EQ_G \\ EQ_T \\ EP_G \\ EP_T \\ EP_F \\ EP_N \\ EQ_F \\ EQ_N \\ EQ_C \\ EP_C \\ EQ_{GD} \\ EQ_{TD}
\end{bmatrix}
=
\begin{bmatrix}
0 & 0 \\ 0 & 0 \\ 0.19 & 0 \\ 0.03 & -0.09 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0.19 & 0 \\ 0.03 & -0.09
\end{bmatrix}
\begin{bmatrix}
EQ_M \\ EQ_X
\end{bmatrix}.
$$

Relative changes in the endogenous variables caused by relative changes in imports and exports are calculated by solving (38) as:

$$
(40)\quad Y = A^{-1} \cdot B \cdot E.
$$

Reducing U.S. Beef Import Restrictions

Various methods for restricting U.S. beef imports have been in effect since 1964 (Hahn et al.). Thus, it is difficult to directly estimate increases in beef imports resulting from reductions in those restrictions. The USDA (1994a) projects imports to increase by 6–10% over 1994 levels by the year 2005. The GATT/Uruguay Round does not completely remove U.S. beef import restrictions given that a tariff-rate quota and a 31.1% tariff (which will gradually be reduced to 26.4%) on imports in excess of the quota have been negotiated. Because of this sizeable tariff, significant quantities of beef in excess of the tariff-rate quota will only be imported if rest-of-the-world (predominantly Australian) beef prices are substantially lower than U.S. prices.

Trigger levels for import quotas under the U.S. Meat Import Act of 1979 averaged 587,193 metric tons annually from 1990 to 1994 (Downing). The GATT/Uruguay Round establishes a U.S. tariff-rate quota of 656,621 metric tons which is divided among Australia (378,214), New Zealand (213,406), Japan (200), and several other countries (64,805). Imports from Canada and Mexico are not counted towards the tariff-rate quota. The tariff-rate quota represents an 11.8% increase over previous trigger quota levels. Furthermore, the agreement allows the tariff-rate quota to increase by 20,000 metric tons for both Uruguay and Argentina if they are able to meet sanitary requirements for uncooked beef. In this case, the tariff-rate quota would increase to 696,621 metric tons—which is an 18.6% increase over the average previous trigger levels. Thus, our analysis evaluates the effects of the GATT/Uruguay Round using increases in imports ranging from 6% (the USDA's lowest estimate) to 19%.

Reducing Export Restrictions on U.S. Beef

Estimating the impact of reductions in rest-of-the-world beef trade restrictions is complicated by the heterogeneity of exported beef products, the number of countries involved, and a myriad of country-specific regulations. Hayes projects the value of beef exports to increase by 8–10% per year between 1994 and 2004 if several conditions

Table 2. Impacts of Small, Medium, and Large Increases in U.S. Beef Imports and Exports on U.S. Meat Consumption, Meat Prices, Cattle Prices, and Production

Endogenous Variables	% Change in the Endogenous Variables		
	Small Increases in Imports and Exports[a]	Medium Increases in Imports and Exports[b]	Large Increases in Imports and Exports[c]
Ground beef consumption	0.66	1.78	3.09
Table cut beef consumption	−0.29	−1.06	−1.97
Price of ground beef	−0.60	−1.51	−2.57
Price of table cut beef	0.29	1.14	2.14
Price of fed cattle	0.84	3.85	7.36
Price of nonfed cattle	−1.45	−3.16	−5.17
Fed cattle slaughtered	0.50	2.31	4.42
Nonfed cattle slaughtered	−2.04	−4.46	−7.29
Feeder cattle production	0.28	1.30	2.48
Price of feeder cattle	0.69	3.17	6.06
U.S. consumption of domestically produced ground beef	−0.60	−0.62	−0.64
U.S. consumption of domestically produced table cut beef	0.41	2.05	3.97

[a] A "small" change refers to a 6% increase in U.S. beef imports and a 10% increase in U.S. beef exports over 1990–94 average levels.
[b] A "medium" change refers to a 12% increase in U.S. beef imports and a 40% increase in U.S. beef exports over 1990–94 average levels.
[c] A "large" change refers to a 19% increase in U.S. beef imports and a 75% increase in U.S. beef exports over 1990–94 average levels.

favorable to U.S. trade occur (e.g., U.S. promotional expenditures increase to offset Australian competitive pressures in Japan and favorable exchange rates exist). However, export quantities will probably not increase as much as export values. Therefore, we use 75% as the upper-bound increase in export quantities occurring between 1994 and 2004. The USDA's (1994a) estimate of a 19–25% total increase in value (and a 10–14% increase in export quantities) from 1994 to 2005 is more conservative. Therefore, our analysis uses 10% as the lower bound and 75% as the upper bound for percentage increases in U.S. beef export quantities resulting from the GATT/Uruguay Round.

Impacts of the GATT/Uruguay Round on Prices, Consumption, and Production

Table 2 presents results obtained by solving the linear elasticity model (38) for small, medium, and large percentage changes in U.S. beef imports and exports resulting from the GATT/Uruguay Round trade negotiations. In general, increased imports decrease the prices of ground beef and nonfed cattle. Nonfed cattle slaughter declines as does the U.S. consumption of domestically produced ground beef. Nonetheless, total per capita ground beef consumption increases. Increased exports cause the prices of table cut beef, fed cattle, and feeder cattle to increase. Per capita consumption of table cut beef declines slightly, and fed cattle slaughter and feeder cattle production both increase.

Specifically, the first column of table 2 presents the impacts of "small" increases

(defined as the lower-bound estimates) in U.S. beef imports (6%) and exports (10%) from average 1990–94 levels. Ground beef consumption increases 0.66% in response to a 0.60% decrease in the price of ground beef. Table cut beef price increases by 0.29% and U.S. consumption declines by 0.29%. The price of fed cattle increases by 0.84% and the price of nonfed cattle declines by 1.45%. Feeder cattle production increases by 0.28% in response to a 0.69% increase in feeder cattle price.

The second column of table 2 presents results for "medium" increases in U.S. beef imports (12%) and exports (40%). In this case, ground beef price declines by 1.51% and table cut price increases by 1.14%. The price of fed cattle increases by 3.85%, the price of nonfed cattle declines by 3.16%, and the price of feeder cattle increases by 3.17%.

The last column of table 2 presents results using upper-bound estimates for increases in U.S. beef imports (19%) and exports (75%). In this case, ground beef price decreases by 2.57% in response to increased imports which causes ground beef consumption to increase by 3.09%. U.S. table cut beef consumption declines by 1.97% because of a 2.14% increase in table cut beef price. However, increased exports cause fed cattle price to increase by 7.36% and, through an increase in the derived demand for feeder cattle, feeder cattle price to increase by 6.06%. Increased beef imports cause nonfed cattle price to decline by 5.17%.

Model Validation and Sensitivity to Elasticity Estimates

Validating the linear elasticity model posed in equation (38) is problematic. The model is designed to measure the impact of U.S. beef imports and exports on U.S. beef and cattle prices. However, a market-determined metric of these effects does not exist. Thus, one is unable to use either in-sample or out-of-sample prediction criteria to validate the model.

One approach to validating such a model is to compare its performance with that of an established simulation model. For example, although the Food and Agricultural Policy Research Institute's (FAPRI) model does not disaggregate ground and table cut beef production and consumption, it does consider fed cattle price and production variables. A recent FAPRI study evaluates the effects of an immediate, and sustained, 500-million-pound increase in exports on fed cattle price (and many other variables). This represents a 39% increase over 1990–94 average export levels. For a relevant comparison, the linear elasticity model (38) is resolved for a 39% increase in exports and no change in imports. Our model predicts that such an increase would result in a 4.23% increase in fed cattle price. After five periods, the FAPRI model predicts an increase in fed cattle price of 5.92%. The somewhat higher impact suggested by the FAPRI model should be expected because that simulation considers an immediate and sustained 39% increase in exports—whereas our model considers a 39% increase in exports that occurs gradually over several years.

An important consideration is the sensitivity of the simulation results to the nine demand and supply elasticity estimates used in (38). Using the "medium" effects scenario (i.e., a 12% increase in imports and a 40% increase in exports), the model was resolved using 25% more inelastic and 25% more elastic estimates for each elasticity. For example, the own-price elasticity of demand for ground beef is the first elasticity in (38). The model was resolved using a 25% more inelastic estimate (relative to the baseline value) for that own-price elasticity holding the remaining eight elasticities at their baseline values. Then, the procedure was repeated using a 25% more elastic estimate

Table 3. Sensitivity of Results of Medium Increases in U.S. Beef Imports (12%) and Exports (40%) to Alternative Supply and Demand Elasticity Estimates

Endogenous Variables	% Change in the Endogenous Variables Using		
	25% More Inelastic Elasticity Estimates Relative to Baseline[a]	Baseline Elasticity Estimates	25% More Elastic Elasticity Estimates Relative to Baseline
Ground beef consumption	1.95	1.78	1.65
Table cut beef consumption	−1.23	−1.06	−0.95
Price of ground beef	−1.69	−1.51	−1.37
Price of table cut beef	1.35	1.14	0.99
Price of fed cattle	4.73	3.85	3.24
Price of nonfed cattle	−3.69	−3.16	−2.77
Fed cattle slaughtered	2.49	2.31	2.15
Nonfed cattle slaughtered	−5.13	−4.46	−3.92
Feeder cattle production	0.97	1.30	1.63
Price of feeder cattle	3.89	3.17	2.67
U.S. consumption of domestically produced ground beef	−0.40	−0.62	−0.77
U.S. consumption of domestically produced table cut beef	2.22	2.05	1.91

[a] Baseline elasticity estimates are reported in table 1.

(relative to the baseline value) for the own-price elasticity of demand for ground beef. Percentage changes in the endogenous variables were recorded, and the procedure was repeated for each of the remaining elasticity estimates. Table 3 presents the widest range of changes in the endogenous variables obtained from these simulations. From the nine simulations which use 25% more inelastic estimates, the first column presents the largest percentage change in the endogenous variables from baseline values. The second column presents results obtained using baseline elasticity estimates (the same results as presented in the second column of table 2). From the nine simulations which use 25% more elastic estimates, the third column presents the largest percentage change in the endogenous variables from baseline values. The resulting ranges are relatively small with, perhaps, the exception of percentage changes in fed and nonfed cattle prices. That is, medium increases in imports and exports result in a 4.73% increase in fed cattle price and a 3.69% decrease in nonfed cattle price when 25% more inelastic estimates are used. The baseline predictions for percentage changes in these two prices is 3.85% and 3.16%, respectively. Using 25% more elastic estimates results in an increase in fed cattle price of 3.24% and a decrease in nonfed cattle price of 2.77%. Given that these two price variables are somewhat sensitive to selected elasticity estimates, accurate estimates of the own-price elasticities of fed and nonfed cattle supplies are important for evaluating the effects of trade liberalization on U.S. cattle prices.

Conclusions and Implications

Multilateral trade liberalization will have significant impacts on U.S. beef and cattle prices. For example, quantities of U.S. beef imports and exports have been projected to

increase by 6–19% and 10–75%, respectively, because of the GATT/Uruguay Round. Because U.S. beef imports are primarily ground beef and exports are primarily table cut beef, beef trade liberalization will have different impacts on fed cattle and nonfed cattle producers. For example, ground beef price could decline by 0.60–2.57% from average 1990–94 levels because of increased imports. Thus, the price of nonfed cattle (which generally produce ground beef) could decline by 1.45–5.17%. Given that the price of nonfed cattle averaged $49.24/cwt between 1990 and 1994, increased imports could reduce nonfed cattle price by $0.71–$2.55/cwt. Conversely, because the U.S. primarily exports table cut beef, table cut beef price in the U.S. could increase by 0.29–2.14%. Increased foreign demand for table cut beef would cause fed cattle price to increase by 0.84–7.36%. Thus, fed cattle price could increase by $0.62–$5.46/cwt over the average price of $74.22 received during the 1990–94 period. In addition, increased demand for fed cattle increases the derived demand for feeder cattle. Thus, feeder cattle price could increase by 0.69–6.06% which represents $0.61–$5.40/cwt over the average price of $89.09/cwt received during the 1990–94 period.

Obviously, the GATT/Uruguay Round will have positive impacts on fed cattle producers. In addition, even though nonfed cattle price may decline, cow/calf producers will also benefit from these trade negotiations because feeder cattle price will increase. Given that approximately 80% of cow/calf producers' revenue is derived from feeder cattle sales, revenue gains from feeder cattle price increases should more than offset losses resulting from reductions in nonfed cattle price.

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