

# **Economics of Export Demand for U.S. Beef**

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## ECONOMICS OF EXPORT DEMAND FOR U.S. BEEF

Edward Van Eenoo and Wayne D. Purcell\*

### Introduction

Volume of beef moving into export markets has increased during the 1980s and 1990s with strong growth in the last decade. Figure 1 shows quantity of beef both exported from and imported into the domestic beef market. There is a long history of importing beef into the U.S. and that history has often been controversial. Recognizing that imported beef adds to the domestic supply, producers and producer groups have often blamed imports for low and unprofitable cattle prices in the domestic markets. Typically beef of a processing quality, the periodic surges in imports when herds in other countries were being liquidated heightened the controversy, and counter cyclical legislation was passed into law in 1979 (Public Law 96-177, The Meat Import Act of 1979). The general objective of the law was to allow more beef to be imported when the cattle cycle in the U.S. was in a herd-building phase, a period when there is less cow beef and other beef of processing quality available. During liquidation phases of the cycle, when processing beef is more plentiful and cow prices in the U.S. are low, less beef can be imported.

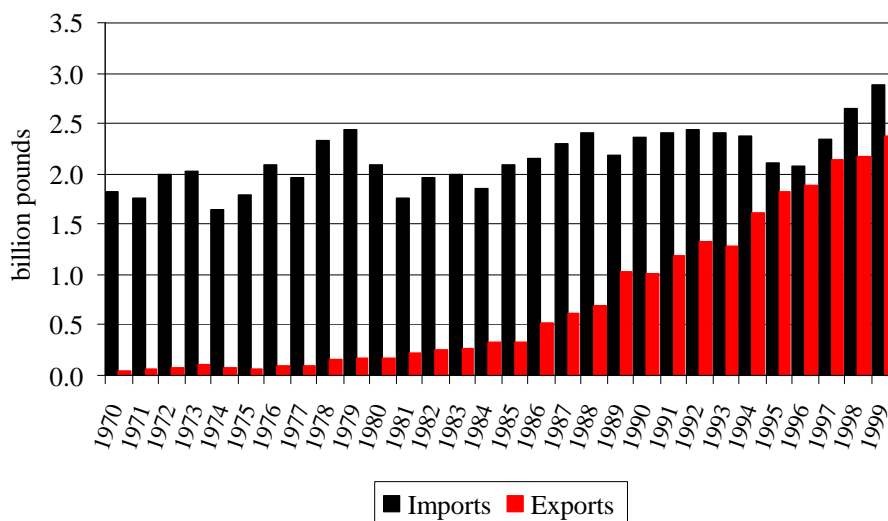


Figure 1. U.S. Beef and Veal Imports and Exports, 1970-1999

Imports of beef and of cattle became very controversial again in the late 1990s when cattle from Canada moved into the U.S. during a period when calf prices in the domestic market were not always profitable. An international court ruled against a “dumping charge” against Canada, but that ruling has been or may be appealed. There is little question that trade in cattle and beef, at least where imports are concerned, is a controversial and often emotional issue in the U.S.

Unlike import activities, producers in the domestic market are generally favorable toward exports. There is an intuitive and logical belief that export demand is a supplement to domestic demand for beef and is, therefore, good for the industry in terms of better prices. But there is also present some uncertainty about the nature and magnitude of the impact of the growing beef export market, and

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objective information is needed on this subject for at least two important reasons. First, there is the issue of whether the export market is or could be responsive to promotion and market building activities on the part of U.S. agencies such as the U.S. Meat Export Federation working on behalf of an expanded export market. Knowing what economic forces are driving the export growth of the past decade would be important to these programs as they seek checkoff funds to support their activities.

The second reason for solid science based information on exports is to extend and expand understanding of what would be forfeited if U.S. based resistance to imports and importing prompts reciprocal actions by trading partners to block access to their beef markets. Answering this implicit question will require analysis of the impact of beef exports on beef and cattle prices, production levels, and the size of the domestic industry. Such an effort is being completed. With financial assistance from the Cattlemen's Beef Board, a study of the global market that involves production, consumption, exporting, and importing activities is being completed. The objective of the study is to analyze and measure the impact of beef exports on the domestic beef industry. As part of that effort, it became important to determine what economic factors are driving export demand and the growing export activity that has pushed beef exports up to nearly 10 percent of domestic production in 1999.

There is a traditional and long-established price-quantity relationship that is important to both imports and exports. U.S. producers are correct in their belief that increasing the supply of beef in the domestic market via imports, other things equal, will decrease prices. But "other things" are seldom equal or constant and benign in their impact. Demand for beef in the U.S. market has been decreasing for 20 years, with no signs of stabilizing until 1999.<sup>1 2</sup> The beef demand index developed for the industry indicates a cumulative decrease in demand from 1979 to 1998 of nearly 50 percent. The long standing decrease in demand, coupled with a surge in average slaughter weights to record levels in recent years were, arguably, much more important as a cause of the low calf prices that had producers alarmed than was a relatively small surge in imports of slaughter cattle from Canada. Building on this reasoning, it is important to recognize that when the export side of the equation is being examined, the traditional price-quantity relationship will again be important.

Increased export activity reflects export demand that adds to and supplements the domestic demand for beef. Any increase in demand, in the presence of a given domestic supply, will increase beef and cattle prices. But the basic price-quantity relationship emerges again at this point. The domestic supply will not stay "given." Higher prices brought on by export demand in time period  $t$  will usually prompt a supply response in the domestic market in a later period  $t+1$ , increasing the total supply compared to the level we would see if no exports were involved. The initial impact of that export-prompted surge in supply will be to drive domestic prices down or, at the very least, mitigate any increases in price that might be occurring. The net impact on domestic prices will be investigated more thoroughly in the broader study, but it is important to keep in mind that price increases, whatever their source, *will* tend to prompt an increase in supply. In a commodity business like beef production with few significant barriers to entry at the producer level, no constraints on production, and a generally inelastic demand at the live cattle level, the supply increase may drive the price below levels that prevailed before the series of responses to export growth started. Even if that were to occur, the industry is larger and presumably more viable over time because of the growing export activity.

This important price-quantity relationship comes up again as more specific examination of export demand and export activity is started. Plotting quarterly export quantities against domestic Choice boxed

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<sup>1</sup> *A Primer on Beef Demand (or To Fix It You Have to Understand It)* by Wayne Purcell, Research Institute on Livestock Pricing Bulletin 2-98, Virginia Tech, 1998.

<sup>2</sup> *Measures of Changes in Demand for Beef, Pork, and Chicken, 1975-1998* by Wayne Purcell, Research Institute on Livestock Pricing Bulletin 3-98, Virginia Tech, 1998.

beef prices from 1990 through 1998 shows a surprisingly strong inverse relationship (Figure 2). The plot looks much like any demand schedule that has combinations of large quantities at low prices and lesser or even small quantities at higher prices. Clearly, quantity exported increases at lower boxed beef prices and decreases at higher prices. A simple, single-equation model with quarterly export quantity as a function of quarterly boxed beef prices (Choice grade) yields a statistical fit that has R-squared values of nearly 0.80. This indicates that changes in quarterly beef prices explain over 79 percent of the variation in quarterly beef prices during the 1990-1998 period, a very strong inverse price-quantity relationship.

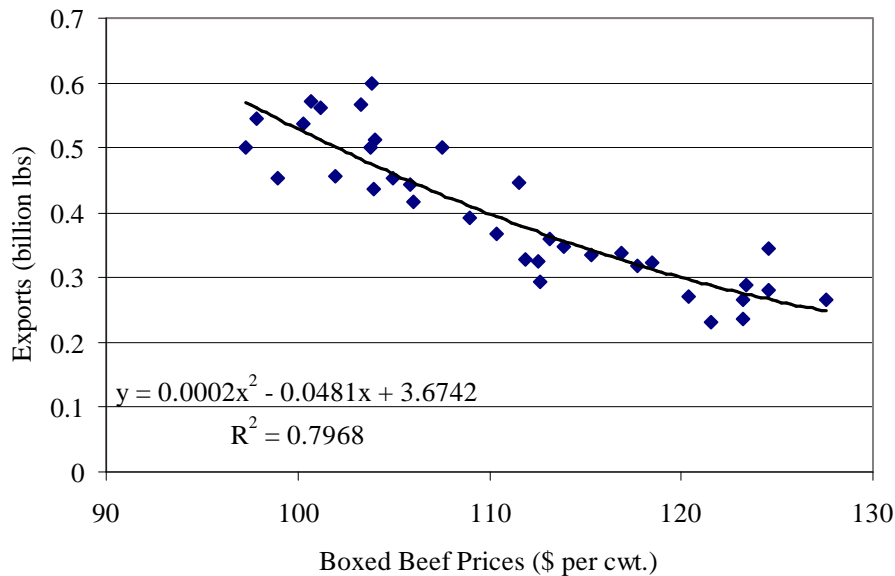
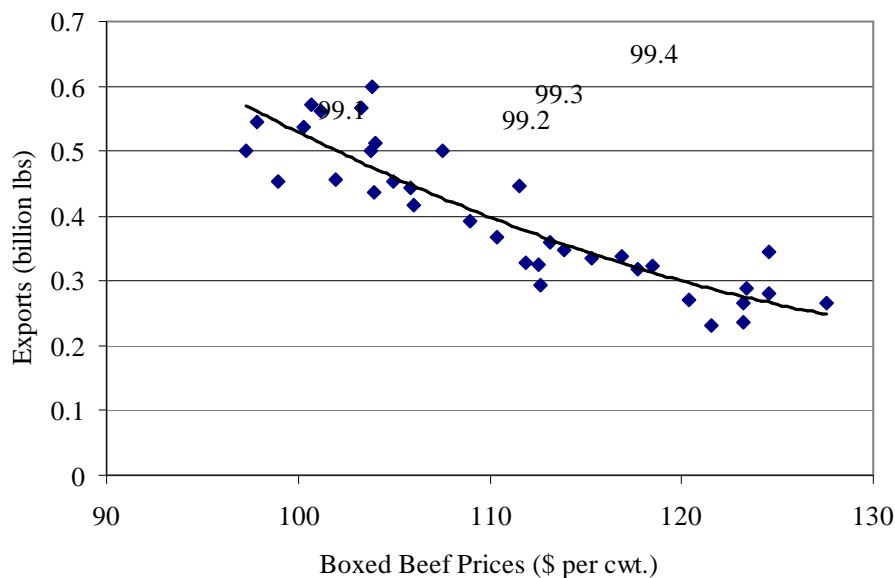


Figure 2. The Relationship Between Beef and Veal Exports and Nominal Boxed Beef Prices, by Quarters, 1990-1998

This preliminary finding is interesting and useful, but it does not contribute directly to understanding of what can be done to help boost export demand. Price is not something that can be controlled in a policy or programmatic way, but there is nonetheless useful insight to be found in this relationship. When domestic prices of beef in general and boxed beef in particular are low, there will be an increase in quantity demanded and taken in the export markets. That is, of course, exactly what the industry needs when the pipelines are jammed with product and increased consumption can be generated only if prices decline. It may well be the case, continuing this line of thought, that the periodic low prices of the 1990s in the domestic U.S. beef market were checked and halted at least partly by an export market that clearly responds to lower prices. Efforts to stimulate export quantity movement by publicizing the low prices should be fruitful during these periods, given that export quantity is very responsive to price for a given level of demand. To guide those efforts, it would be useful to know the demand elasticity for beef exports in major buying countries.

If money is to be spent on efforts to stimulate increases in aggregate beef exports in the long run, it needs to be used to increase the export demand for U.S. beef. The long recognized and traditional demand shifters are changes in income, changes in prices of other (especially substitute) products, and changes in tastes and preferences. Recognizing that changing incomes, changing substitute product prices, or changing tastes and preferences is also beyond the scope of the export agencies, knowing which of these demand shifters is at work will nonetheless provide very important information.

Adding the four quarters for 1999 to the presentation in Figure 2 illustrates the point about demand (Figure 3). There were apparently significant developments in the export price-quantity relationships during 1999. The beef demand index and more sophisticated analyses documented an increase in demand in the beef market during 1999. Increased production moved into domestic consumption at higher inflation adjusted prices. Obviously, beef moving into export markets must compete in the same higher priced domestic market for boxed beef, and the observation that nominal prices of U.S. boxes going into exports were higher during 1999 is not surprising.<sup>3</sup> But it is clear that there was increased quantity moving into export channels at higher prices or, at a minimum, higher prices being paid for export quantities similar to earlier years. There is preliminary evidence that export demand was also increasing in 1999, and the need to understand why and to identify the “drivers” of any increases in demand is reinforced.



**Figure 3. The Relationship Between Beef and Veal Exports and Nominal Boxed Beef Prices, 1990-1998, with Quarterly Data for 1999**

If growing incomes, for example, are identified as an important demand driver, then efforts can be aimed at the buying countries where the economies are strong and incomes are growing. If it is higher prices of competing world supplies of beef that appear to be the catalyst for demand for U.S. beef, then efforts to promote beef in markets shown to be responsive to changes in relative prices from the various possible suppliers would be appropriate. It is this type of direction to export agencies that this effort is designed to provide.

### *The Analytical Framework*

The question is one of identifying drivers of growth in export demand. This single focus avoids the issues of simultaneity where there are questions of whether it is quantity that causes price or, conversely, whether it is price change that causes quantity to change. The interest is in what set of

<sup>3</sup> Boxed beef prices in the domestic market are not, of course, the direct prices for exported product. But export buyers have to compete for product, and the prices to major buyers in 1999 would have moved in concert with prices in the U.S.

potential “drivers” have been at work in determining export quantities in the 1990s. This suggests a single equation model of the form

$$B_q = f(X_1, X_2, \dots, X_n)$$

where

$B_q$  is the quantity of beef exported, and  
 $X_1, X_2, \dots, X_n$  are potential explanatory variables for beef exports.

The potential explanatory variables are economic forces that would influence the quantity of beef moving into export channels.

The quantifiable demand shifters are incomes and prices of other products. Having determined that Japan, Canada, Mexico and South Korea are the four major buyers of U.S. beef and veal, accounting for 90 percent of the total value exported in 1998, models were estimated for each of the four countries. A single demand equation model was used for this analysis. This implicitly assumes that foreign exports do not have an impact on domestic production decisions. Armah and Epperson<sup>4</sup> argue that this assumption may be appropriate when exports are a small percentage of total domestic production. They utilize a single equation model to estimate U.S. exports of frozen orange juice concentrate and support this approach based on the fact that nearly 90 percent of total U.S. frozen orange juice concentrate is consumed domestically indicating that importing countries are likely “price takers.” The same argument can be made here since domestic consumption represents over 90 percent of total U.S. beef production.

The per capita export demand for U.S. beef was expressed as a linear function of inflation-adjusted or real U.S. boxed beef prices (Choice grade) in the importing country, real per capita income in the importing country, and the real price of beef substitutes in the importing country. In addition, the dependent variable (export quantity) was lagged one period and included as an explanatory variable. For convenience, the data from each country were combined or “stacked” and a single export demand equation for U.S. beef estimated. Dummy variables were included to account for differences between countries. Mathematically, the estimated export demand equation was specified as

$$\frac{EX_t^i}{POP_t^i} = a_0 + a_1 \frac{PB_t^i}{CPI_t^i} + a_2 \left( \frac{I_t^i / POP_t^i}{CPI_t^i} \right) + a_3 \frac{PP_t^i}{CPI_t^i} + a_4 \frac{PC_t^i}{CPI_t^i} + a_5 \frac{EX_{t-1}^i}{POP_{t-1}^i} \quad 1.1$$

$$+ a_6 ER_t^i + a_7 JDUM + a_8 MDUM + a_9 CDUM$$

where

- $EX_t^i$  = total quantity exported (measured in kilograms) to country  $i$  in period  $t$ ;
- $POP_t^i$  = population of country  $i$  in 1998;
- $PB_t^i, PP_t^i, \text{ and } PC_t^i$  = prices (measured in U.S. dollars per kilogram) of U.S. beef, pork, and poultry respectively in country  $i$  in period  $t$ ;

<sup>4</sup> Armah, Jr., B.K. and J.E. Epperson. "Export Demand for U.S. Orange Juice: Impacts of U.S. Export Promotion Programs." *Agribusiness*. Vol. 13, No. 1(1997): 1-10.

$I_t^i$	= gross domestic product (measured in U.S. dollars) of country $i$ in period $t$ ,
$CPI_t^i$	= consumer price index of country $i$ in period $t$ (base year 1990)
$ER_t^i$	= exchange rate for country $i$ in period $t$ , and
$JDUM, MDUM, \text{ and } CDUM$	= dummy variables for Japan, Mexico, and Canada respectively.

Equation 1.1 was estimated using quarterly observation from 1992 I – 1997 IV, the time period for which all needed data series were available. Exchange rate data are reported by the Federal Reserve Board and can be accessed via the World Wide Web. The International Monetary Fund publishes gross domestic product and consumer price index data in the “International Financial Statistics Yearbook.” Data on retail beef, pork, and poultry prices are published in the "Livestock, Dairy, and Poultry Situation and Outlook" by the United States Department of Agriculture (USDA). Export data for U.S. beef were obtained upon special request from the Foreign Agriculture Service, USDA. Population data are United Nations estimates.

The parameter estimates of the export demand equation for U.S. beef are shown in Table 1. The R-square measure for the regression was 0.90 indicating that the model explains approximately 90 percent of the variation in export quantities of U.S. beef. The signs of the statistically significant parameter estimates were generally consistent with prior expectations. Price was significant at the .01 level for Japan (the P-value is only 0.002) indicating an extremely small probability that the measured inverse price-quantity relationship is due to chance. This is the typically powerful price-quantity relationship discussed earlier.

The price parameter showed the expected negative sign for Canada, with this relationship significant at the .10 level. Price was not statistically significant in Mexico or South Korea. The finding for South Korea is probably explained by the fact that the country was bound by agreement to import a required level but did not reach agreed upon levels in 1996, 1997, and 1998. A specified quantity level was in effect during the decade of the 1990s, and this likely interfered with any quantity response to price. The coefficient on real price in Mexico was not statistically significant.

Both Mexico and South Korea show statistically significant and positive relationships between changes in U.S. beef exports and changes in real incomes. Income changes were not significant for Canada or Japan.<sup>5</sup> The exchange rate was important in Mexico where a major currency devaluation occurred during the 1990s.

The price of pork was statistically significant only for Mexico. The relationship is the expected positive one: increased prices of pork to Mexico would prompt that country to take more U.S. beef for given beef prices. This is the "crossover" impact that is often seen when modeling demand for two meats that are potential substitutes for each other. The price of chicken in Mexico, while statistically significant, does not show the expected positive sign.

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<sup>5</sup> This result was surprising for Japan. Examining the GDP data for Japan, the series was trending strongly higher in the early 1990s and then turned lower. From 1997 to 1998, to illustrate, real GDP in Japan declined 2.99 percent. This unusual behavior is likely the reason the statistical measure is not significant, but it would be a mistake to assume changes in GDP in Japan will not be important in the future.



**Table 1. Estimated Export Demand Equation for U.S. Beef and Veal Exports**

Variable	Estimate	P-value
Intercept	1.50	0.12
<b>Real Price Japan</b>	<b>-0.45</b>	<b>0.002</b>
Real Price Mexico	0.10	0.68
<b>Real Price Canada</b>	<b>-0.32</b>	<b>0.08</b>
Real Price Korea	0.05	0.79
Real GDP Japan	0.000001	0.57
<b>Real GDP Mexico</b>	<b>0.0002</b>	<b>0.05</b>
Real GDP Canada	0.0001	0.45
<b>Real GDP Korea</b>	<b>0.000001</b>	<b>0.02</b>
Exchange Rate Japan	0.0007	0.77
<b>Exchange Rate Mexico</b>	<b>-0.06</b>	<b>0.08</b>
Exchange Rate Canada	-0.75	0.13
Exchange Rate Korea	-0.0003	0.14
Real Price of Pork Japan	-0.21	0.36
<b>Real Price of Pork Mexico</b>	<b>0.57</b>	<b>0.04</b>
Real Price of Pork Canada	-0.24	0.22
Real Price of Pork Korea	0.10	0.64
Real Price of Chicken Japan	0.49	0.56
<b>Real Price of Chicken Mexico</b>	<b>-1.88</b>	<b>0.003</b>
Real Price of Chicken Canada	0.05	0.96
Real Price of Chicken Korea	-1.16	0.32
<b>Lagged Export Quantity (1 period)</b>	<b>0.17</b>	<b>0.03</b>
Intercept Dummy Japan	-0.98	0.51
Intercept Dummy Mexico	-1.12	0.31
Intercept Dummy Canada	0.96	0.53

R-squared: 0.94  
Adjusted R-squared: 0.91  
Durbin-Watson: 2.29  
Degrees of freedom: 70

*Note: Bolded Variables are significantly different than zero at the 10% confidence level.*

The lagged export quantity explanatory variable is very significant in a statistical sense, a totally expected result. Including a lagged version of the dependent variable in single equation models is often required to correct problems of autocorrelation.

For statistical estimation reasons, only three of the four 0-1 or dummy (intercept shift) variables are included. None are statistically significant but are included for conceptual completeness and as evidence of the correctness of the analytical process that combines all four countries into one model.

As noted, the model shows significant responses to changes in real income and to changes in real prices. Tastes and preferences cannot be included directly, but the findings give a base for a useful inference. A desire for more meat in diets, a positive "taste and preference" measure, typically underlies the willingness to spend added incomes on beef. This is an especially useful finding for Mexico and South Korea. Economic growth in those countries will boost incomes and increase the demand for U.S. beef and veal.

To insure the validity of the regression model, a series of misspecification tests were conducted. Tests for violations of independence (or autocorrelation), normality, homoskedasticity, and linearity were conducted.<sup>6</sup> The results, reported in Table 2, indicate no serious departures from the underlying model assumptions. The findings from the model can thus be used with confidence. It is a statistically valid model of long established economic relationships across prices, quantities, incomes, and relative prices. These tests do not, of course, guarantee that some other model specification might not have been equally or even more effective.

**Table 2. Model Misspecification Tests**

<i>Misspecification Test</i>	<i>P-Value</i>
<i>Modified-LM residual autocorrelation F-test of order 1</i>	<i>0.15</i>
<i>Modified-LM residual autocorrelation F-test of order 2</i>	<i>0.26</i>
<i>Bera-Jarque Normality test</i>	<i>0.64</i>
<i>D'Agostino-Pearson Normality test</i>	<i>0.52</i>
<i>RESET test for Heteroskedasticity of order 2</i>	<i>0.11</i>
<i>Linearity RESET test of order 2</i>	<i>0.65</i>

### *Parameters from the Export Demand Model*

In the existing literature on beef trade, not many studies have estimated important parameters such as income elasticity or cross elasticity in various countries. Income elasticities measure the relationship between incomes and quantities of a good or service taken at constant commodity prices. Changes in incomes are important demand shifters, and income elasticities provide measures of how much quantity will change for a 1.0 percent change in incomes. This is, then, a direct measure of how much demand shifts when incomes change, other factors equal. In the world market, increasing incomes in developed and developing countries are expected to be primary drivers of increases in demand over time.

Most products and services show a positive relationship between changes in incomes and changes in the quantity taken at constant prices. When incomes go up, more is taken so that both income changes and quantity changes are positive. Understanding the nature of this relationship and the magnitude of the income elasticity parameter is very important to any business or any country interested in selling product or service in a marketplace. In the case of beef exports, the U.S. industry would like to see positive and large income elasticities in buying countries.

Income elasticity parameters must be estimated using inflation-adjusted or real measures of incomes and changes in income. If the influence of overall price inflation is not removed from the income data, then it is impossible to disentangle the impact of price inflation from the impact of changes in income. Procedurally, the parameters on the measures of real GDP in the demand model give the rate of change between incomes and quantity, and the beta coefficient on that variable is then applied at the mean levels of income and quantity. Applying this process to the parameters in the demand model for which the relationship is statistically significant, the following income elasticities are generated:

For Mexico	2.64
For South Korea	0.91

<sup>6</sup> *Statistical Foundation of Econometric Modeling* by A. Spanos, New York: Cambridge University Press, 1986.

In the domestic U.S. beef market, income elasticities are usually in the 0.2 to 0.4 range. The estimate for Mexico looks very large in comparison, but there are logical reasons for a large parameter in countries like Mexico. The baseline levels are important.

The parameter for Mexico indicates that a 2.64 percent increase in quantity of U.S. beef taken at constant beef prices would accompany each 1.0 percent increase in the inflation-adjusted incomes in Mexico. Such a relatively large parameter is typical in markets or in countries where the starting point is relatively small. In the U.S., beef is the single food item that attracts the largest expenditures. Per capita consumption has varied between 65 and 95 lbs across the past 25 years, and a 2.64 percent change in recent per capita levels of some 68 lbs would be almost 1.8 lbs per capita, a relatively large increase that would pull significant food dollar expenditures into the beef sector. In Mexico, the per capita consumption base is much smaller. Any shift in demand for beef brought on by increased incomes would therefore prompt a bigger percentage response because the base is much smaller. It is also the case that when incomes are high, there will be some limit on how much added beef can be consumed even if incomes increase. This is another reason for the much smaller elasticity in the U.S.

That reasoning would also support expectations for large income elasticities in South Korea where the share of world consumption of beef is much smaller than is the case in Mexico. The 0.91 estimate for South Korea is larger than the typical estimates for the domestic U.S. market, but it is substantially smaller than the estimate for Mexico. It would appear that the demand for beef from the U.S. would grow faster in Mexico, as incomes in that country advance, than would be the case in South Korea.

U.S. agencies interested in boosting overseas markets for U.S. beef should support policies that encourage economic stability and income growth in buying countries, especially in Mexico and South Korea. In these countries, efforts to enhance buying power will likely do more good for the last \$1 spent than they would in Japan and Canada. Attention should be paid to the developing and industrializing countries of the world where better incomes will encourage more diverse diets with meat playing an important role. It appears that it is these countries that will see the biggest boost in demand of U.S. beef as the incomes and standards of living advance and spread through the populace.

In Mexico, the model results show two added factors in the demand for U.S. beef. The exchange rate shows a negative and statistically significant coefficient. Turning this into elasticity by applying the coefficient at the mean levels of the quantity of beef exports and exchange rates, the elasticity is -1.99. Interpreted, this means a 1.0 percent increase in the number of Pesos required to equal one U.S. dollar will decrease the quantity of U.S. beef moving to Mexico by 1.99 percent at constant beef prices. This continues the mounting body of evidence that indicates an important determinant of export demand is how well the economies in buying countries are performing. U.S. agencies trying to enhance export movements cannot control exchange rates, of course, but when and if the Peso is decreasing versus the U.S. dollar, efforts might be adjusted or diverted to some other buying country where the exchange rate is not causing problems.

Not surprisingly, there is evidence that Mexico will divert buying to other meats when the price relatives change. The coefficient on pork in the model is positive, suggesting that Mexico sees pork and beef as substitutes. Applying the coefficient at the mean level of beef exports and pork prices (and these are U.S. pork prices) generates a cross elasticity estimate of 8.12. This parameter indicates that a 1.0 percent change in pork prices will prompt a very large 8.12 percent change in quantity of beef taken at constant beef prices. If pork prices are going up in the U.S., this result indicates that Mexico moves aggressively away from pork to beef. Conversely, if pork prices in the U.S. are decreasing, the demand for U.S. beef will decline significantly.

In Canada and in Japan, the model results suggest the two buying countries are very responsive to changes in beef prices. The coefficients from the model are -0.45 and -0.32 for Japan and Canada respectively, and the relationship is very strong in terms of statistical significance in Japan. The P-value is 0.002, indicating there is less than a 1 in 100 probability that the relationship measured in the model could occur just due to chance. These results allow the estimation of own-price demand elasticities for Japan and Canada.

In the U.S. domestic market, demand elasticity is generally found to be around -0.67. A level of -0.67 was used in the construction of the demand index, and elasticities in various studies are usually below 1.0 in absolute value and in the -0.50 to -0.75 range. The coefficients in the model lead to elasticity estimates of -1.79 and -1.00 for Japan and Canada respectively.

Interpreted, this means a 1.0 percent change in U.S. boxed beef prices as a price measure for beef going into the export market will prompt a 1.79 percent change in quantity taken by Japan. The response in Canada is smaller but still generally larger than the response we usually see in the U.S. If there is a need to move more products through the pipelines and into consumption, these findings suggest an important strategy: work on getting the price to Japan and Canada down to move product aggressively. But on the other side of the coin, the same relationship is there. If U.S. prices go up for market-related reasons, there will be a substantial reduction in the quantity of beef exported to Japan and to Canada.

These findings give direction to strategies trying to enhance export volumes. In the developing countries and semi-industrialized countries like Mexico and South Korea, a sound economy and growing inflation-adjusted incomes will be needed for exports to grow. In more established markets like Japan and Canada, export quantity will be responsive to price changes.

### ***Overall Observations***

Quantities of beef and veal exports from the U.S. respond to price changes, especially in Japan and Canada. This is the expected inverse price-quantity relationship. It is important to the U.S. beef industry to know that when supplies surge and beef prices decline in the U.S., export quantities to Japan and Canada *will* respond and help clear the market. This responsiveness constrains the magnitude of price decreases in the U.S. and, other things equal, helps prevent U.S. boxed beef prices from declining to even lower levels.

A quantity response to a price change is typically a movement along a demand surface. Demand can be constant, with the only thing changing being quantity supplied to the market. Prices go up when supply decreases, and they go down when supply increases when demand is constant.

Changes in income, if there is a significant relationship to export quantity, *shift* the demand surface. Growth in export demand for U.S. beef has come from Mexico and South Korea as their incomes, albeit in a volatile setting in recent years, are trending higher. Incomes in Japan were not statistically significant, a somewhat surprising finding. Graphing the real GDP for Japan shows a strong positive trend in the early 1990s, but that changed in the mid 1990s as Japan ran into an economic recession. More sophisticated analysis would be required to partition the impact of incomes in Japan and get more refined measurement, but the positive relationship is likely to be there behind the diverging trends in income in recent years. Improving economies and increasing consumer incomes can be a major source of growth in export demand for beef and veal.

U.S. beef and veal exports do not avoid competition. There is evidence that Mexico in particular will change what meat is bought when relative prices change. That finding will, in all likelihood, extend to prices from other producing and exporting countries. Thus, big supplies of pork or chicken that bring

down the price of these competing meats in the world market can and will decrease the demand for beef in the export market.

Overall, exports in the beef market respond to the familiar economic measures: prices, incomes, and relative prices. As the collection of actual prices for exported beef develops and the quality mix in a shipment is specified in more detail, traditional demand analysis can be applied and should yield results that will be useful to the U.S. beef sector. Analysis of the situation in Europe and other potential buyers would likely show other buying countries also respond to the same economic factors and forces. These findings, in turn, help guide efforts to boost export demand for U.S. beef.