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# THE IMPACT OF ELIMINATING THE QUOTA ON U.S. IMPORTS OF BEEF

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"THE IMPACT OF ELIMINATING THE QUOTA ON U.S. IMPORTS OF BEEF"

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RESEARCH STUDY

The purpose of this study is to evaluate the impact that elimination of the quota on imports of beef in 1975 would have on the price and availability of beef to consumers and returns to producers in the United States.

The results of the above analysis indicate that removal of the quota in 1975 would result in only a modest decline in retail meat prices with the price decline being much greater for low grade than high grade beef. Also farm prices would fall which in turn would cause reductions in the domestic supply of beef. In addition the lower farm prices would cause a shift in returns to those factors employed in the beef industry with the factors that are most inelastic in supply (and demand) being influenced to the greatest degree from the lower farm prices, e.g., real estate.

The general conclusion reached from this study is that the quota affords only very modest protection or benefits to the U.S. beef producer. When considered in the light of the side effects the quota has on domestic consumption, in terms of higher retail meat prices, and on those countries as a means of improving the incomes of beef producers has very little in its favor.

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# THE IMPACT OF ELIMINATING THE QUOTA ON U.S. IMPORTS OF BEEF *

## I Introduction

Many cattlemen believed that the low prices they received for beef in the early to mid-sixties were due to the imports of beef. A 24 percent drop in the price of fed beef from the end of 1962 to the second quarter of 1964 led to efforts by those representing the beef producers to press for some device to limit imports in addition to the tariff of three cents per pound which was in existence at the time. Despite the serious opposition to this move, import quotas were introduced in Legislation enacted in August, 1964.1/ The purpose of this study is to evaluate the impact that elimination of the quota on imports of beef in 1975 would have on the price and availability of beef to consumers and returns to producers in the United States.

## II The Change in Imports from Eliminating the Quota in 1975

Since 1959 imports have provided from 3.4 percent to 11.4 percent of total civilian consumption of beef in the U.S. (on a quarterly basis). These imports consist of fresh, frozen or chilled beef (hereafter referred to as frozen beef) plus cooked or canned beef. There are certain health regulations which determine the supply regions for frozen beef, which are for the most part directed against those countries with communicable animal diseases which can be transferred in frozen beef, namely foot and mouth disease. The major suppliers of frozen beef in recent years have been Australian (50 percent ), New Zealand (20 percent ), Central America 2/ (12 percent ), Ireland (7 percent),

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1/ Public Law 88-482. This legislation provides that if imports of certain meats (fresh, chilled or frozen cattle meat and the meat of goats and sheep other than lamb) are estimated to equal or exceed 110 percent of an adjusted base quota, then the President is required to invoke a quota on meat imports. The base quota, is equal to the average annual imports during the period 1959/63, plus an adjustment based on U.S. production.

2/ Central America includes Honduras, Panama, Guatemala, Costa Rica and Nicaragua.

*/ The research on which this study is based comes from the author's M.S. Thesis submitted to Cornell University. The author acknowledges the valuable support and comments of K. L. Robinson and B. F. Stanton.

Mexico (6 percent) and Canada (3 percent). Canned beef is not subject to the same regulation as is frozen beef, since cooking evidently kills the disease-producing organism. Most of the cooked beef imports originate in Argentina, Brazil, Paraguay and Uruguay. From 1967 to 1969, imports of cooked beef were less than 15 percent of the total beef imports.

The U. S. market is of considerable importance in relation to world trade in beef. It absorbs about 27 percent of total world imports of frozen beef and about 25 percent of the total world imports of prepared meats (of which beef is a large component). If the region of supply is restricted to those countries specified by the health regulations, then the U. S. absorbs about 67 percent of their total exports of frozen beef. 3/

This implies that the health regulations have restricted the alternative sources of supply for U. S. beef consumption.

Import Projections for 1975

Projections for the supply of exports from the major suppliers to the U. S. market for 1975 were derived from empirical studies for Australia (7), Mexico (13) and Central America (1) while for the remaining countries projections were made by extrapolating linear trends for past exports. It was assumed that 90 percent of the projected exports of the selected countries would go to the U. S. in 1975 if the quota were eliminated. 4/ Also, it was assumed that if the quota remained, imports would enter at the voluntary restraint (quota) level. 5/ Predicting the level of voluntary restraint in 1975 is a difficult task as it is subject to revisions e.g. in 1970 the restraint level was revised upward. The method adopted was to assume that the restraint level would increase at the same rate as in the past.

On combining all of these various predictions, the result was obtained that removal of the quota in 1975 would lead to increased imports of the magnitude of 670 million pounds. This increase in imports represents about 29 percent of total projected exports for 1975. It now remains to analyze the producer and consumer price effects of these increased imports as well as the effect on returns to resources.

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3/ These percentages are based on averages from 1961 to 1968 and were derived from statistics in the F. A. O. Trade and Production Yearbooks (5, 6).

4/ The maximum proportion of beef exported from the selected countries in pre-quota years was about 90 percent (1962). It is assumed that this maximum would be achieved again as it is generally recognized that prices which the U. S. pays for meat are greater than those of other world markets - especially for lower quality beef.

5/ It is interesting to note that the restraint level was not effective until late in 1968, i.e., imports did not reach the quota level.

## III Price Effects of Eliminating the Quota

### Methodology

The change in the level of imports from removing the quota will have repercussions on both retail and farm prices. To determine these repercussions a price forecasting model is used to estimate the change in retail prices and then by using marketing margins it is possible to estimate the change in farm prices.

Since imports are generally considered to be of low quality beef, there may be some advantage in considering beef as a heterogeneous rather than homogeneous commodity. For this reason two grades of beef will be considered - high grade and low grade. This approach of treating beef as heterogeneous commodity has been utilized empirically by Coleman (3) and Langemieir and Thompson (11) with some degree of success. Langemieir and Thompson used the method of considering low grade beef as non-fed beef and high grade beef as fed beef with imports being included in the former category. On the other hand Coleman uses a mere complicated procedure which assumes that most cattle slaughtered have a certain percentage of both high and low grade beef on any given carcass. The method adopted in this study is to use the Langemeier and Thompson definition because of its consistency with other parts of the analysis.

The price forecasting model is comprised of four equations which are used to determine the impact of eliminating the quota on the retail prices of all beef, high grade beef, low grade beef and other meats. These equations are -

(1) $P_b = P_b\ (Q_b, Q_{om}, Y)$

(2) $P_{hg} = P_{hg}\ (Q_{hg}, Q_{lg}, Q_{om}, Y)$

(3) $P_{lg} = P_{lg}\ (Q_{hg}, Q_{lg}, Q_{om}, Y)$

(4) $P_{om} = P_{om}\ (Q_{hg}, Q_{lg}, Q_{om}, Y)$

where 6/

$P_b$ = retail price of beef (cents per lb.)

$P_{hg}$ = retail price of high grade beef (cents per lb.)

$P_{lg}$ = retail price of low grade beef (cents per lb.)

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6/ See Appendix A for more detailed description of variables and the actual data.

$P_{om}$ = retail price of other meats - chicken and pork (cents per lb.)

$Q_b$ = quantity of all beef consumed per capita (lbs.)

$Q_{hg}$ = quantity of high grade beef consumed per capita (lbs.)

$Q_{lg}$ = quantity of low grade beef consumed per capita (lbs.)

$Q_{om}$ = quantity of other meats consumed per capita (lbs.)

Y = personal disposable income per capita

For the first equation it is considered that beef imports contribute to the total quantity of beef, whereas in the remaining equations, beef imports contribute only to the quantity of low grade beef. Using this approach it is possible to determine the retail price effects for meats from eliminating the quota.

If it is assumed that all factors (inputs) supplied to the slaughtering, processing and distribution activities for meat have an infinite supply elasticity, then the retail price change will be passed on in total to the farmers. To estimate the price change at the farm level, the price charge at retail is divided by the proportion that the farmer receives of retail price, i.e.

$$P_{farm} = P_{retail} \div \left( \frac{\bar{P}_{farm}}{\bar{P}_{retail}} \right)$$

where the bar denotes the average for the period and

$$\bar{P}_{retail} - \bar{P}_{farm} = \text{Marketing margin.}$$

Results

(a) Effect on Retail Prices

The estimates made are derived from quarterly data from 1959 to 1969 which came from various sources (17, 18, 21). Since quarterly data are being used, a seasonal dummy is included in all of the regressions in the following way

$S_i$ = 1 in the ith quarter, i = 1,2,3

= 0 otherwise.

All of the variables (except the seasonal dummies and constant term) are in logarithms and are not deflated. (See Appendix A). The results from estimating the equations using ordinary least squares are presented in Table 1. Although the fit ($R^2$) of the equations was satisfactory,

Table 1. Estimates of Retail Price Forecasting Equations, Linear in Logs, 1959-1969

| Equation No. | Dependent Variable | Independent Variables: Constant | $S_1$ | $S_2$ | $S_3$ | $Q_b$ | $Q_{hg}$ | $Q_{lg}$ | $Q_{om}$ | Y | $R^2$ | D.W. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1') | $P_b$ | 1.344 | -0.0068 (0.0129)a/ | -0.0027 (0.0105) | 0.0161*/ (0.0097) | -1.0369**/ (0.1337) | | | -0.0175 (0.1498) | 0.8546**/ (0.0897) | .81 | .98##/ |
| (2') | $P_{hg}$ | 0.8301 | -0.0063 (0.0129) | 0.0045 (0.0129) | 0.0132*/ (0.0099) | | -0.6627**/ (0.1113) | -0.1056*/ (0.0735) | 0.0171 (0.1679) | 0.8682**/ (0.1308) | .87 | 1.11#/ |
| (3') | $P_{lg}$ | 0.4542 | 0.0097 (0.0165) | 0.0178 (0.0165) | 0.0339**/ (0.0127) | | -0.9136**/ (0.1423) | -0.2296**/ (0.0939) | 0.2748 (0.2164) | 0.9378**/ (0.1671) | .76 | .81##/ |
| (4') | $P_{om}$ | 1.5798 | -0.0455**/ (0.0160) | -0.0435**/ (0.0160) | -0.0209**/ (0.0124) | | -0.6125**/ (0.1384) | -0.0972 (0.0913) | -0.8173**/ (0.2088) | 0.9200**/ (0.1626) | .80 | .94##/ |

*/ t statistic significant at $\alpha$ = .10 level

**/ t statistic significant at $\alpha$ = .05 level

#/ Inconclusive test for autocorrelation

##/ Test indicates first order autocorrelation

a/ Values in parenthesis are the standard errors of the estimates

first order autocorrelation exists in at least three of the four equations. Although the estimates obtained are not best, they are still unbiased (10). No attempt is made in this paper to reduce this autocorrelation problem. 7/

To use the above equations for price forcasting it is necessary to have some knowledge of the per capita consumption of beef in 1975 so as to be able to determine the percentage increase in per capita supplies from eliminating the quota. The figures for per capita consumption in 1975 were obtained by extrapolating linear trends based on quarterly observations from 1959 to 1969. This yielded the result that when imports were considered part of the supply of all beef, quota elimination would increase per capita supplies by 2.5 percent and when imports are taken as only contributing to the supply of low grade beef, the per capital supply of low grade beef is increased by 11.0 percent. Substituting these quantity changes into the appropriate equations yields the price changes shown in Table 2. 8/

The results indicate that price reductions for consumers are relatively small. By distinguishing between low and high grade beef, some further conclusions can be drawn. The results indicate that the relative price reduction for low grade is twice that of high grade beef.

Table 2. Changes in the Retail Price from Elimination of Quota in 1975.

| Commodity | Change in Price (percent) |
|---|---|
| All beef | -2.6 |
| High grade beef | -1.2 |
| Low grade beef | -2.5 |
| Other meats | -1.1[a] |

a. Based on a regression coefficient not significantly different from zero at the 10 percent level of significance.

7/ In the original manuscript (9), an alternative model specification was used which was partially successful in overcoming first order autocorrelation.

8/ Using Coleman's definition of high and low grade beef and total beef consumption gave similar results. These are presented in Table 2a below.

Table 2a. Price Changes at Retail from Eliminating the Quota in 1975 (Coleman's Definition)

| Retail Price of | Change in Price (percent) |
|---|---|
| All beef | -2.2 |
| High grade beef | -0.8 |
| Low grade beef | -2.2 |
| Other meats | -1.7 |

If one is willing to assume that low grade beef is consumed more by low income families then elimination of the quota has a favorable income distribution feature, i.e., low income families would become better off relative to the high income families.

Apart from the distribution consequences the general impact for consumers of removing the quota would be to cause a small reduction in the prices of high and low grade beef as well as other meats. With total expenditure on meat remaining about the same, consumers will be on a higher indifference curve with more meat consumption and the same quantities of other goods and services.

(b) Effect on Farm Prices

By determining the effect upon farm prices from elimination of the quota, an estimate of the "at-farm" tariff level implicitly implied by the quota can be made. Using figures for the last six years (17, 1970) it appears that the farmer receives about 64 percent of the retail price for choice beef. No comparable figures were available for low grade beef and therefore the same 64 percent is applied. 9/ The estimates of farm price changes due to quota elimination are presented in Table 3 for all beef and high and low grade beef.

Table 3. Price Change at Farm Price from Elimination of the Quota in 1975

| Commodity | Change in Price (Percent) |
|---|---|
| All beef | -4.1 |
| High grade beef | -1.9 |
| Low grade beef | -3.9 |

These results indicate that the price reduction will be much greater for low grade (cull cows) than for high grade beef (fed beef) from elimination of the quota. The lower prices for high grade beef will cause a small reduction in the demand by feed lot operators for feeder cattle. This decline in demand will cause a small price reduction for feeder cattle. This would imply that some of the 1.9 percent fall in price for fed beef may be passed onto the suppliers of feeder cattle, i.e., the ranchers. In terms of the distributional impact for producers from eliminating the quota, the ranchers will be worse off relative to the producers of fed beef via the larger price fall for cull cows and the possibility of reduced prices for feeder cattle, both of which comprise most of the output of cattle ranches.

9/ Since much of low grade beef is used for processing, e.g., sausages, luncheon meats, etc., the 64 percent figure may be an overestimate.

The lower farm prices will have repercussions on the production of beef. In the short run the supply of high grade beef will be reduced via lighter slaughter weights of cattle sold from feedlots while the effect on low grade beef is indeterminate. 10/ In the long run it is expected that there will be a modest reduction in the supplies of both high and low grade beef. With the general reduction in the incentives to produce and the associated domestic supply reduction, higher prices than in the initial situation are likely to prevail.

## IV The Effect of Eliminating the Quota on the Returns to Resources Employed in Beef Production

In making a policy proposal it is desirable to have some knowledge of the impact that such a proposal would have upon the returns to resources employed in the industry. A model is presented in which an expression is derived which shows that the change in returns to resources is a function of own, cross and product price elasticities of demand for the input, the input supply elasticity and the change on the tariff rate on the output (or the tariff equivalent of the quota). Using the results of this model it is possible to determine the effects of eliminating the quota on returns to resources employed in the beef industry.

### The Model

The change in factor demand due to a tariff on output for a particular industry, k, can be expressed as follows. There are n factors of production (or inputs), $X_j$ $(j = 1, \ldots, n)$, which are demanded for the production of Zk. The demand for any factor, $X_j$, can be expressed as a function of the marginal productivity of a factor - as indicated by the slope of the production function - $A_j$, the price of the product produced by the industry, p, and the prices of the n inputs $P_j (j = 1, \ldots, n)$.

In algebraic notation this can be expressed as:

$$X_j = X_j \; (A_j; \; P; \; P_1, \ldots, P_n) \tag{5}$$

10/ In a study made by Tweeten and Quance (14) it was indicated that, for livestock in total, the output per animal is much more responsive to changes in price in the short run than is the number of animals.

By making a linear approximation for the change in demand for $X_j$ following a change in output and/or input prices and ignoring changes in marginal productivity (i.e., technology is constant), the following obtains: 11/

$$(6) \qquad dX_j = \frac{\partial X_j}{\partial P} \cdot dP + \frac{\partial X_j}{\partial P_1} \cdot dP_1 + \ldots\ldots + \frac{\partial X_j}{\partial P_n} \cdot dP_n$$

By multiplying both sides of equation (6) by the reciprocal of $X_j$, the relative change in the use of factor $X_j$ is:

$$(7) \qquad \frac{dX_j}{X_j} = \frac{\partial X_j}{\partial P} \cdot \frac{dP}{X_j} + \frac{\partial X_j}{\partial P_1} \cdot \frac{dP_1}{X_j} + \ldots\ldots + \frac{\partial X_j}{\partial P_n} \cdot \frac{dP_n}{X_j}$$

The first term on the right hand side of equation (7) is multiplied by P/P and the remaining terms by $P_i/P_i$ $(i = 1, \ldots, n)$ to yield

$$(8) \qquad \frac{dX_j}{X_j} = \frac{\partial X_j}{\partial P} \cdot \frac{P}{X_j} \cdot \frac{dP}{P} + \frac{\partial X_j}{\partial P_1} \cdot \frac{P_1}{X_j} \cdot \frac{dP_1}{P_1} + \ldots\ldots + \frac{\partial X_j}{\partial P_n} \cdot \frac{P_n}{X_j} \cdot \frac{dP_n}{P_n}$$

By letting $t = dP/P$, where t indicates the tariff rate on output, the relative change in the demand for $X_j$ by industry k can be expressed in terms of elasticities, the tariff rate on output and the change in factor prices induced by the output tariff.

$$(9) \qquad \left(\frac{dX_j}{X_j}\right)_d = \eta_j \cdot t + \sum_{i=1}^{n} E_{ji} \cdot \frac{dP_i}{P_i}$$

where $\eta_j$ = the elasticity of demand for factor $X_j$ with respect to change in product price (usually positive)

$E_{ji}$ = for $i = j$, the own price elasticity of demand for $X_j$ (usually negative)

= for $i \neq j$, the cross price elasticity for $X_j$ (positive for substitutes and negative for compliments) 12/

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11/ This linear approximation is equivalent to taking the first terms (linear) of a Taylor series expansion.

12/ The $E_{ji}$'s are analogous to total elasticities, taking account of all direct as well as indirect or secondary effects of changes in $P_i$ on all other inputs.

In some past theoretical and empirical studies on the subject of effective protection and resource allocation a convenient simplifying assumption of fixed factor proportions has been made to account for changes in the demand for factors. This implies a direct relation between changes in factor demand (use) and output, i.e.,

$$(9') \qquad \frac{dX_j}{X_j} = \frac{dZ}{Z}$$

where

Z = output of the industry (See Massel (12)). This assumption is unrealistic in a world where some factors are fixed in supply.

In determining the change in factor supply due to a tariff on output, the supply of a factor is expressed only as a function of the factor price, i.e.,

$$(10) \qquad X_j = X_j\,(P_j)$$

By a similiar procedure to that presented above, the change in the quantity supplied of a factor due to a change in price is:

$$(11) \qquad \frac{dX_j}{X_j}\Big|_s = \frac{dP_j}{P_j} \cdot S_j$$

where $S_j = \frac{\partial X_i}{\partial P_j} \cdot \frac{P_j}{X_j}$ = elasticity of supply of factor $X_j$ with respect to factor price (usually positive) 13/

In equilibrium the change in the quantity of $X_j$ demanded by industry k will equal the change in the quantity supplied of $X_j$ to the industry, and since the quantity demanded equals the quantity supplied before the imposition of the tariff, then

$$(12) \qquad \left(\frac{dX_j}{X_j}\right)_s = e \left(\frac{dX_j}{X_j}\right)_d$$

To achieve this equilibrium there will have to be a change in factor returns to induce the appropriate shift of resources. 14/ By substituting (11) and (9) into (12) an expression for the change in factor returns can be derived as follows:

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13/ In a limiting case where factors of production are infinitely elastic in supply, the change in factor returns will equal the tariff rate on the factors.

14/ Equation (12) does not infer that the rates of change of supply and demand for a factor are the same.

$$\frac{dP_j}{P_j} S_j = \eta_j \cdot t + \sum_{i=1}^{n} E_{ji} \cdot \frac{dP_i}{P_i}$$

on rearranging this becomes,

$$\frac{dP_j}{P_j} (S_j - E_{jj}) = \eta_j \cdot t + \sum_{\substack{i=1 \\ i \neq j}}^{n} E_{ji} \cdot \frac{dP_i}{P_i}$$

Therefore,

$$(13) \qquad \frac{dP_j}{P_j} = \frac{\eta_j \cdot t + \sum_{\substack{i=1 \\ i \neq j}}^{n} E_{ji} \cdot \frac{dP_i}{P_i}}{(S_j - E_{jj})}$$

Since $j = 1, \ldots, n$, there will be $n$ such equations for industry $k$ containing $n$ unknowns, $dP_j / P_j$, so that a unique solution for the change in factor returns from imposing a tariff on output does exist.

Empirical Application of the Model

The production process for U.S. beef can be divided into two parts: one relates to high grade beef and the other to low grade beef. To produce high grade beef, feeder cattle or calves are produced on ranches then sold to feed lots where they are fed until they reach a marketable weight and are then sold to yield high grade beef; on the other hand the production of low grade beef consists of culled cattle, both dairy and beef. 15/ In this study only that part of low grade beef which consists of beef culls is considered. The two major subsectors of the beef industry are the ranch and the feed lot.

In the model presented above the cross elasticity terms ($E_{ji}$'s, $j \neq i$) are omitted from equation (13) to determine the change in factor rewards. This implies that the $E_{ji}$'s $= 0$, $i \neq j$. Equation (13) then becomes

$$(14) \qquad \frac{dP_j}{P_j} = \frac{\eta_j \cdot t}{s_j - E_{jj}}$$

15/ About 40 percent of cow slaughterings in 1969 were comprised of dairy culls while the remainder were culled beef breeding cows.

a) Data

Even after eliminating the cross elasticity terms the data requirements are quite formidable. Estimates of the elasticity of demand for the factor with respect to product prices, the supply elasticity of the factor and its own price elasticity of demand with respect to factor prices are required. Fortunately empirical estimates of $E_{jj}$ and $\eta_j$ are available based on studies made by Tweeten and Quance (14).

These estimates are reproduced in Table 4. The short run here refers to a period of two years while the long run is many years.

Table 4. Estimates of Elasticities of Input Demand for U.S. Agriculture [a]

| | Own Price ($E_{jj}$) | | Product Price ($\eta_j$) | |
|---|---|---|---|---|
| Input | S.R. | L.R. | S.R. | L.R. |
| Fertilizer and lime | -0.6 | -1.8 | 0.5 | 2.4 |
| Machinery and operating expenses | -1.0 | -1.5 | 0.5 | 2.5 |
| Feed, seed and livestock | -0.8 | -1.5 | 0.7 | 2.0 |
| Miscellaneous current operating expenses | -0.3 | -0.5 | 0.3 | 2.5 |
| Crop and livestock inventory | -0.2 | -1.0 | 0.2 | 2.5 |
| Machinery inventory | -0.2 | -1.0 | 0.2 | 2.6 |
| Labor | -0.1 | -0.5 | 0.1 | 1.0 |
| Real estate | 0 | 0 | 0.1 | 0.3 |

a/ Source: Tweeten and Quance (14, p. 350)

In Table 4 the estimates for "feed, seed and livestock" will be taken as applying to both feed grains and feeder cattle for the feedlot, while the "crop and livestock inventory" will apply to the breeding stock of ranches. The "labor input is taken to refer to the labor of farm families which includes the services of both management and labor."

The input supply elasticities ($S_j$'s) are derived from various sources and are presented in Table 5. It is assumed that fertilizer and lime, machinery operating expenses and machinery inventory have infinite supply elasticity, at least as far as the beef industry is concerned.

Table 5. Estimates of Supply Elasticities for Inputs Employed in the Beef Industry

| Input | Ranch S.R. | Ranch L.R. | Feedlot S.R. | Feedlot L.R. |
|---|---|---|---|---|
| Fertilizer and lime | | | | |
| Machinery operating expenses | | | | |
| Miscellaneous current operating expenses | $\infty$ | $\infty$ | $\infty$ | $\infty$ |
| Machinery inventory | | | | |
| Feeder cattle a/ | -- | -- | 0.12 | 1.80 |
| Feed grains b/ | -- | -- | 0.17 | 1.56 |
| Breeding stock a/ | 0.12 | 1.80 | -- | -- |
| Labor c/ | 0.10 | 0.36 | 0.10 | 0.36 |
| Real estate d/ | 0.036 | 0.112 | 0.036 | 0.112 |

a/ Supply elasticity for animal units. Tweeten and Quance (14, p. 349).

b/ Supply elasticity for all crops. Tweeten and Quance (14, p. 349).

c/ Supply elasticity of family labor on farms using net farm incomes as relative price or decision variable. Heady and Tweeten (8, p. 252).

d/ Estimated using a Nerlove adaptive expectations model where the estimated equation is

$$Q_t = 0.572 + \underset{(0.024)}{0.036}\, P_t + \underset{(0.199)}{0.679}\, Q_{t-1} \qquad R^2 = 0.95$$

where $Q_t$ = index of quantity of farm real estate inputs (1950=100)

$P_t$ = index of price of farm real estate (1950=100) 16/

The change in the tariff rate on output (or the tariff equivalent of the quota) for low grade beef is -3.9 percent and for high grade beef is -1.9 percent.

b) Results

The results for changes in the short- and long-run returns to factors employed in the ranch and feedlot are presented in Tables 6 and 7.

16/ For data and definitions of variables see /20/.

Table 6. Change in Factor Returns for the Feedlot

| | S.R. Change (Percent) | L.R. Change (Percent) |
|---|---|---|
| Fertilizer and lime<br>Machinery and operating expenses<br>Miscellaneous current operating expenses<br>Machinery inventory | 0 | 0 |
| Feeder cattle | -1.4 | -1.2 |
| Labor | -1.0 | -2.2 |
| Real estate | -5.3 | -5.1 |
| Feed grains | -0.7 | -1.2 |

Table 7. Change in Factor Returns for the Ranch

| | S.R. Change (Percent) | L.R. Change (Percent) |
|---|---|---|
| Fertilizer and lime<br>Machinery operating expenses<br>Miscellaneous current operating expenses<br>Machinery inventory | 0 | 0 |
| Breeding stock | -1.3 | -1.8 |
| Labor | -1.0 | -2.3 |
| Real estate | -5.6 | -5.4 |

As was indicated above ranches produce both low grade beef and feeder cattle and calves so that the tariff rate applicable to ranches is not necessarily the same as that for low grade beef. In a publication on farm costs and returns (15, p. 70) it was reported that three-fourths of ranch revenue is derived from the sale of feeder cattle and the remainder from culled cows and bulls. The tariff rate applicable to the ranch will be a weighted average of the change in the farm price of feeder cattle (from Table 6) and the change in the price of non fed or low grade beef, where the weights are 0.75 and 0.25 respectively. The weighted tariff on ranch output then is

$$t = 0.75\ (1.4) + 0.25\ (3.9) \simeq 2.0$$

The results of Tables 6 and 7 indicate that returns to all factors fall in both the short run and long run (except those that are subject to an infinite elasticity of supply). The short-run decline in returns to factors appears to be greatest for those factors with the lowest elasticity of supply. These are the factors relatively fixed in supply in the short run, namely real estate (which includes land and buildings).

For some factors the change in returns is greater in the long run than in the short run, these being labor, feed grains for the feedlot and breeding stock for the ranch. This phenomenon is attributed to the sum of own price and supply elasticities increasing relatively less in the long run than the elasticity of demand for the factor with respect to product price.

Some interesting policy implications can be derived from Table 6 and 7. First, the effect of the quota on labor returns appears to be very small. The quota if removed in 1975 would lower returns to labor (the farm family) by about one percent in the short run and about two percent in the long run (with the long-run effect being a little greater for ranches compared to feedlots. Secondly, a more interesting effect of the quota removal is the potential effect on returns to real estate. A moderately large decline in returns to this factor would occur from removal of the quota. The corollary of this is that current real estate values are somewhat higher than they would be in the absence of the quota. This result supports the oft referred to hypothesis that the quota has been capitalized into the value of fixed assets, i.e., real estate. It appears that the group most affected from the quota removal are the owners of real estate used to produce beef.

## V Conclusions

The results of the above analysis indicate that removal of the quota in 1975 would result in only a modest decline in retail meat prices with the price decline being much greater for low grade than high grade beef. Also farm prices would fall which in turn would cause reductions in the domestic supply of beef. In addition the lower farm prices would cause a shift in returns to those factors employed in the beef industry with the factors that are most inelastic in supply (and demand) being influenced to the greatest degree from the lower farm prices, e.g., real estate.

The general conclusion reached from this study is that the quota affords only very modest protection or benefits to the U.S. beef producer. When considered in the light of the side effects the quota has on domestic consumption, in terms of higher retail meat prices, and on those countries as a means of improving the incomes of beef producers has very little in its favor.

If the legislators of the United States consider that it is in the best interest of the country to support beef producers a method other than a quota (or tariff) should be chosen from the point of view of economic efficiency. Bhagwhati and Rasaswami (2) indicate that if the problem faced is one of domestic distortion, e.g., the income levels of those employed in the beef industry are lower than in the rest of the economy, then [an optimum] subsidy is necessarily superior to any tariff (or quota) policy. Given that some type of intervention is to be made for the beef industry, then on the grounds of economic efficiency a producer subsidy or income support payment is perferable to an input quota.

The decisions as to whether institutional intervention will be made for an industry appear to be based more on political feasibility than on strict economic efficiency criteria. In the author's opinion this is an acceptable state of affairs so long as the political process is concerned with the general social welfare of the community. But all too often, as in the case of the beef industry, it is the interest of a particular producer group that prevails rather than the interests of consumers.

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# APPENDIX A

## DATA

The data used in the regression analysis is presented in Tables A1 and A2. The methods used in deriving these time series and the data sources are given below. All the quantity series are expressed in pound per capita terms.

The series in columns 1, 2, and 3 of Table A1 are derived using Coleman's (6) definitions of low grade, high grade, and total beef consumed.

1. $Q_{lg}'$ = total boneless cutter and canner cow beef produced
   + total boneless bull and staff beef produced
   + 66.7 percent of total boneless commercial and utility cow beef produced
   + 25.5 percent total dressed weight of steer and heifer beef produced
   + total imported beef

2. $Q_{hg}'$ = 59.5 percent of the dressed weight of steer and heifer carcasses produced, minus 36 pounds of bone per carcass
   + 33.3 percent of boneless commercial and utility cow beef produced

3. $Q_b'$ = $Q_{lg}$ adjusted for stocks, multiplied by 100/70 (to convert from boneless to carcass weight)
   + 33.3 percent of boneless commercial and utility cow beef produced, multiplied by 100/70
   + 59.5 percent of the dressed weight of steer and heifer carcasses produced

A description of the components of each of these series is presented below. All of the components were estimated from monthly data and aggregated to form the quarterly estimates. Since data were available only for Federally Inspected Commercial Cattle and Calf Slaughter, which does not include Total Commercial Cattle and Calf Slaughter, an adjustment factor for each month was estimated to allow for this. It is assumed that the totals for classes of slaughter under Federal Inspection are in the same proportion as the totals for classes of the estimated total commercial slaughter.

$$\text{Adjustment Factor} = \frac{\text{Total commercial cattle and cattle slaughter}}{\text{Federally inspected commercial cattle and calf slaughter}}$$

All the data come from Livestock and Meat Statistics put out by the U.S.D.A. .This includes the supplementary issues from 1960 to 1970.

| | | |
|---|---|---|
| a. | Total boneless canner and cutter cow beef | = Number of canner and cutter cattle under Federal Inspection |
| | | x Adjustment factor |
| | | x Average dressed weight of cows under Federal Inspection |
| | | x A calculated boning percentage of 61.1 |
| b. | Total boneless commercial and utility cow beef | = Number of cows slaughtered under Federal Inspection |
| | | x Adjustment factor |
| | | x Average dressed weight of cows slaughtered under Federal Inspection |
| | | x 70 percent boning out percentage |
| | | - Total boned out weight of canner and cutter cow-beef (estimated above) |
| c. | Total boneless bull and staff beef | = Number of bulls and stags slaughtered under Federal Inspection |
| | | x Adjustment factor |
| | | x An estimated boned out weight of 588 pounds per carcass |
| d. | Total dressed weight of steer (heifer) beef | = Number of steers (heifers) slaughtered under Federal Inspection |
| | | x Adjustment factor |
| | | x Average dressed weight of steers (heifers) slaughtered under Federal Inspection |
| e. | Total imported beef: | This was available and needed no manipulation |

4. $Q_{lg}$ = quantity of beef produced domestically

- $Q_{hg}$

+ imports of beef

5. $Q_{hg}$ = total dressed weight of steer beef
+ total dressed weight of heifer beef

This division of high and low grade beef treats the components of fed and non-fed beef along the lines of Langemeier and Thompson (24). In estimating these series a similar procedure was used as that outlined above.

6. $Q_b$ = total civilian consumption of beef in the U.S.

(Quarterly estimates were taken from the Livestock and Meat Situation, U.S.D.A.: 1960-1970).

7. $Q_{om}$ = total quantity of chicken and pork consumed in the U.S.

Veal and lamb were omitted from other meats as they only represent a very small fraction of total U.S. meat consumption.

The quarterly figures for pork were taken from the Livestock and Meat Situation, U.S.D.A. (1960-1970). The figures for chicken are from the Survey of Current Business, and Consumption is assumed to equal production of chicken plus an allowance for stocks.

8. $P_{lg}$ = the price of low grade beef (cents/pound)

For this the retail price of hamburger was used with the quarterly data being derived from averaging monthly data from the Meat and Livestock Situation.

9. $P_{hg}$ = the price of high grade beef (cents/pound)

The quarterly estimates were obtained by averaging monthly data on the retail prices of round steak and rib roast from the Meat and Livestock Situation.

10. $P_b$ = the price of beef (cents/pound)

Quarterly estimates of the average retail price for all beef cuts comes from the Meat and Livestock Situation.

11. $P_{om}$ = the price of other meats (cents/pound)

Included here are the retail prices of chicken and pork and the prices are weighted according to the consumption of pork (or chicken) relative to $Q_{om}$ for the quarter under consideration.

The retail pork price comes from the Meat and Livestock Situation and chicken (or broiler) retail prices come from the Poultry and Egg Situation. The latter was converted to quarterly data by averaging monthly observations.

12. $P_{ogs}$ = the price of other goods and services purchased by consumers

This is an index of prices compiled from monthly data with a base 1957-59 = 100. The monthly data for each series were averaged for the quarters and the quarterly data were combined using the following weights (derived in 1963):

| Item | Weight |
|---|---|
| Cereal and bakery products | .0270 |
| Dairy products | .0297 |
| Fruit and vegetables | .0320 |
| Other food and home preparation | .0423 |
| Other food away from home | .0481 |
| Other goods and services | .8219 |
| | 1.0000 |

The basic indices come from the Handbook of Basic Economic Statistics.

13. Y = personal disposable income per capita

These are quarterly observations seasonally adjusted by the annual rate from the Handbook of Basic Economic Statistics.

14. POP = estimated U.S. population

The population for the quarter was taken as the population in the middle month of the quarter (Handbook of Basic Economic Statistics).

TABLE A1.--Quantity (consumption) data.

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| | | $Q_{1g}'$ | $Q_{hg}'$ | $Q_b'$ | $Q_{1g}$ | $Q_{hg}$ | $Q_b$ | $Q_{om}$ |
| 1959 | I | 6.94 | 7.44 | 18.26 | 4.49 | 13.83 | 18.88 | 23.62 |
| | II | 7.77 | 8.35 | 20.27 | 4.70 | 15.46 | 20.07 | 23.95 |
| | III | 8.35 | 8.77 | 21.47 | 4.77 | 16.39 | 21.02 | 24.53 |
| | IV | 7.48 | 8.26 | 20.03 | 4.65 | 15.57 | 20.26 | 28.65 |
| 1960 | I | 7.87 | 8.81 | 21.07 | 4.47 | 16.29 | 20.58 | 24.39 |
| | II | 7.81 | 8.80 | 21.06 | 4.26 | 16.42 | 20.53 | 23.61 |
| | III | 8.49 | 9.25 | 22.49 | 4.87 | 17.35 | 22.01 | 24.16 |
| | IV | 7.66 | 8.43 | 20.68 | 4.26 | 16.27 | 20.59 | 26.84 |
| 1961 | I | 7.61 | 8.84 | 20.83 | 4.07 | 16.53 | 20.61 | 23.20 |
| | II | 8.09 | 9.65 | 22.25 | 3.88 | 18.13 | 21.92 | 24.37 |
| | III | 8.46 | 9.66 | 22.68 | 4.46 | 18.05 | 22.30 | 24.22 |
| | IV | 8.14 | 9.03 | 21.72 | 4.67 | 16.93 | 21.61 | 28.16 |
| 1962 | I | 8.33 | 9.10 | 21.80 | 4.67 | 16.99 | 21.66 | 23.83 |
| | II | 8.28 | 9.40 | 22.07 | 4.31 | 17.49 | 21.72 | 24.51 |
| | III | 9.04 | 9.05 | 22.68 | 5.62 | 17.06 | 22.50 | 23.80 |
| | IV | 8.51 | 8.66 | 21.67 | 5.47 | 16.13 | 21.54 | 28.49 |
| 1963 | I | 8.46 | 9.37 | 22.25 | 4.27 | 17.27 | 22.05 | 24.10 |
| | II | 8.62 | 10.30 | 23.49 | 4.10 | 19.05 | 23.03 | 24.62 |
| | III | 9.54 | 10.11 | 24.35 | 5.41 | 18.84 | 24.08 | 24.85 |
| | IV | 8.94 | 9.76 | 23.47 | 5.28 | 18.25 | 23.60 | 28.89 |
| 1964 | I | 8.79 | 10.28 | 23.82 | 4.76 | 19.04 | 23.71 | 24.73 |
| | II | 9.20 | 11.29 | 25.62 | 3.99 | 21.65 | 25.28 | 24.60 |
| | III | 9.47 | 10.45 | 25.14 | 4.75 | 20.62 | 25.02 | 25.15 |
| | IV | 9.21 | 10.05 | 24.70 | 5.04 | 19.97 | 24.87 | 28.98 |
| 1965 | I | 8.99 | 10.13 | 24.24 | 5.31 | 19.09 | 24.18 | 24.06 |
| | II | 9.00 | 9.72 | 23.76 | 5.43 | 18.56 | 23.59 | 23.99 |
| | III | 9.04 | 9.84 | 24.42 | 5.97 | 18.88 | 25.02 | 24.53 |
| | IV | 10.17 | 9.69 | 25.48 | 7.32 | 18.60 | 25.00 | 26.61 |
| 1966 | I | 9.58 | 10.24 | 25.30 | 5.98 | 19.44 | 24.89 | 22.94 |
| | II | 9.66 | 10.72 | 25.79 | 5.56 | 20.37 | 25.22 | 24.18 |
| | III | 10.08 | 11.16 | 26.84 | 6.53 | 20.54 | 26.46 | 25.53 |
| | IV | 9.59 | 10.94 | 26.10 | 5.32 | 20.91 | 25.77 | 29.11 |
| 1967 | I | 9.71 | 11.21 | 26.40 | 5.82 | 20.69 | 25.81 | 25.69 |
| | II | 9.65 | 11.90 | 26.62 | 5.23 | 21.88 | 26.28 | 26.09 |
| | III | 10.35 | 11.28 | 27.11 | 5.60 | 21.67 | 26.46 | 27.36 |
| | IV | 9.84 | 10.90 | 26.22 | 5.85 | 20.49 | 25.51 | 30.06 |
| 1968 | I | 10.00 | 11.47 | 26.96 | 5.66 | 21.36 | 26.39 | 25.81 |
| | II | 9.97 | 11.62 | 27.04 | 5.40 | 21.74 | 26.35 | 26.32 |
| | III | 10.69 | 11.73 | 28.19 | 6.43 | 22.02 | 27.80 | 27.39 |
| | IV | 10.13 | 11.40 | 27.22 | 6.01 | 21.46 | 26.96 | 30.21 |
| 1969 | I | 9.95 | 11.41 | 26.88 | 6.15 | 21.25 | 26.35 | 26.70 |
| | II | 10.10 | 11.04 | 26.52 | 6.10 | 20.72 | 25.94 | 26.62 |
| | III | 10.88 | 11.64 | 28.25 | 6.79 | 21.86 | 27.89 | 26.80 |
| | IV | 10.39 | 11.87 | 28.01 | 6.27 | 22.16 | 27.42 | 29.98 |

TABLE A2.--Price, income, and population data.

| | | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|
| | | $P_{1g}$ | $P_{hg}$ | $P_b$ | $P_{om}$ | $P_{gs}$ | Y | POP |
| 1959 | I | 55.5 | 94.7 | 83.0 | 54.4 | 100.8 | 187.2 | 176.1 |
| | II | 55.2 | 95.4 | 83.4 | 52.2 | 101.5 | 191.2 | 176.8 |
| | III | 54.9 | 95.5 | 82.6 | 51.3 | 102.2 | 190.9 | 177.5 |
| | IV | 54.1 | 94.6 | 82.1 | 49.3 | 103.2 | 191.1 | 178.9 |
| 1960 | I | 52.8 | 93.1 | 81.2 | 49.7 | 103.2 | 191.7 | 179.6 |
| | II | 52.9 | 94.5 | 82.1 | 51.7 | 103.3 | 194.4 | 180.2 |
| | III | 52.3 | 93.6 | 80.6 | 52.9 | 103.7 | 194.7 | 180.9 |
| | IV | 57.6 | 92.9 | 79.9 | 52.2 | 104.1 | 194.4 | 181.8 |
| 1961 | I | 52.4 | 94.3 | 81.7 | 54.0 | 104.3 | 194.4 | 182.5 |
| | II | 51.5 | 92.3 | 79.1 | 50.7 | 104.5 | 196.8 | 193.2 |
| | III | 50.0 | 90.2 | 76.9 | 50.2 | 105.1 | 199.5 | 183.9 |
| | IV | 50.9 | 91.5 | 78.9 | 49.7 | 105.3 | 202.9 | 184.7 |
| 1962 | I | 51.4 | 93.9 | 80.6 | 52.6 | 105.5 | 204.4 | 185.4 |
| | II | 51.4 | 94.0 | 80.5 | 51.0 | 106.0 | 206.3 | 186.1 |
| | III | 52.3 | 96.5 | 83.0 | 53.9 | 106.2 | 207.1 | 186.8 |
| | IV | 53.3 | 99.0 | 85.6 | 52.5 | 106.5 | 208.3 | 187.6 |
| 1963 | I | 52.6 | 93.5 | 84.5 | 52.2 | 106.7 | 210.6 | 188.4 |
| | II | 50.8 | 93.2 | 79.1 | 49.8 | 107.2 | 212.1 | 188.9 |
| | III | 50.9 | 94.4 | 80.4 | 51.6 | 107.8 | 214.6 | 189.6 |
| | IV | 51.1 | 94.3 | 80.0 | 50.3 | 108.3 | 217.5 | 190.4 |
| 1964 | I | 49.7 | 92.7 | 77.5 | 49.4 | 108.8 | 221.9 | 190.4 |
| | II | 48.4 | 90.9 | 76.0 | 48.2 | 109.0 | 227.5 | 191.6 |
| | III | 49.6 | 94.1 | 78.5 | 49.9 | 109.3 | 230.4 | 192.3 |
| | IV | 50.4 | 95.3 | 79.3 | 49.6 | 109.6 | 233.0 | 193.0 |
| 1965 | I | 48.9 | 94.9 | 78.6 | 50.2 | 109.9 | 235.4 | 193.7 |
| | II | 49.9 | 98.1 | 80.5 | 51.5 | 110.4 | 239.3 | 194.2 |
| | III | 52.5 | 102.4 | 84.2 | 56.6 | 110.6 | 246.8 | 194.8 |
| | IV | 51.7 | 100.9 | 82.9 | 55.7 | 111.2 | 251.5 | 195.5 |
| 1966 | I | 52.7 | 97.4 | 84.6 | 62.9 | 111.7 | 255.1 | 196.0 |
| | II | 55.4 | 103.1 | 85.5 | 59.8 | 112.9 | 257.5 | 196.3 |
| | III | 54.4 | 101.4 | 84.4 | 59.2 | 114.1 | 261.5 | 197.1 |
| | IV | 54.6 | 101.0 | 83.9 | 55.9 | 115.2 | 265.8 | 197.7 |
| 1967 | I | 54.3 | 100.6 | 82.9 | 55.8 | 115.5 | 269.4 | 198.3 |
| | II | 54.0 | 100.3 | 82.5 | 53.9 | 116.4 | 272.4 | 198.8 |
| | III | 54.9 | 97.6 | 84.9 | 55.4 | 117.5 | 276.0 | 199.3 |
| | IV | 55.3 | 104.9 | 86.0 | 53.4 | 118.7 | 279.9 | 199.9 |
| 1968 | I | 55.1 | 105.6 | 86.4 | 55.7 | 119.9 | 286.6 | 200.4 |
| | II | 55.5 | 105.4 | 86.6 | 55.9 | 121.4 | 292.0 | 200.8 |
| | III | 56.5 | 107.0 | 87.8 | 56.4 | 123.7 | 294.3 | 201.4 |
| | IV | 57.3 | 108.0 | 88.3 | 55.4 | 124.4 | 298.4 | 201.9 |
| 1969 | I | 57.8 | 110.8 | 90.1 | 57.7 | 125.8 | 301.5 | 202.4 |
| | II | 61.8 | 118.6 | 97.9 | 59.3 | 127.7 | 306.6 | 202.9 |
| | III | 65.5 | 123.9 | 101.0 | 62.6 | 129.3 | 314.2 | 203.4 |
| | IV | 64.5 | 118.8 | 96.3 | 62.1 | 131.2 | 317.2 | 204.0 |