THE SHORT-RUN IMPACT OF BEEF IMPORTS ON U.S. MEAT PRICES

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This paper contains short-run estimates of the impact of beef imports from Australia and elsewhere on U.S. retail meat prices. The U.S. beef demand is separated into two categories, table cuts and processed items. Estimates of direct and cross price elasticities of demand for these products are used together with elasticity estimates for other meats and other foods to assess the effect of imports on prices and upon various portions of the Consumer Price Index.

In June 1972, the President of United States suspended the meat import quotas then in force for the balance of that year. This suspension was extended into 1973.[1] Then in March 1973 the President ordered an indefinite ceiling placed on retail beef, pork, and lamb prices. These moves were designed to contain the rapid inflation in meat prices which had occurred during the previous months and years. (Pork and lamb price ceilings were removed in July 1973 with beef following in September.) The key role which meat plays in the U.S. diet and recent meat price increases, approximating 10 to 15 per cent per year, require no elaboration here.

The main purpose of this paper is to investigate, with partial equilibrium analysis, the extent to which increased meat imports stimulated by the suspension of quotas could dampen price rises in the budgets of U.S. consumers.[2] As a part of this analysis, the effect of beef imports on the Consumer Price Index, a major indicator of inflation, is discussed. A complete investigation of the meat sector is not attempted. In particular, supply response by U.S. and foreign meat producers is not examined; the analysis is thus limited to short-run phenomena.

The results presented here hinge upon some recent estimates of direct and cross price elasticities and income elasticities of the retail demand for beef separated into (1) table cuts such as steaks and roasts, and (2) processed items such as hamburger, frankfurters and sausages. This particular separation follows the major line of demarcation in the use of imported beef in the United States. Beef imports are used almost entirely in processed products.

Approximately 30-35 per cent of the beef consumed in the United States in recent years has come from cull dairy and beef cows, bulls,

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[1] The June 1972 decision suspended *voluntary* quotas arranged with foreign suppliers for 1972. The continued suspension into 1973 applied to both voluntary quotas and legislative quotas under the Meat Import Law (Public Law 88-482). The legislative quota mechanism for 1972 had already been suspended to permit operation of voluntary restraints.

[2] The impact of open import markets in the U.S. upon the inflation in Australian meat prices is an interesting and important question but beyond this paper's scope.

stags, and boxed imports.[3] The bulk of this meat is consumed as hamburger and other processed items. The remainder, largely table cuts, comes from domestic lot-fed cattle.

About one-third of the processed beef supply is imported from Australia, New Zealand, Ireland, Canada, and Central America. Australia now holds about 50 per cent of this import market which accounts for 60 per cent of all Australian beef exports. Consequently, the opening up of the U.S. beef import market through relaxed quota measures has important implications for the Australian meat industry.

Because of data problems and the changing character of the beef sector, the separation of consumption data into table beef and processed beef for analytical purposes has been difficult.[4] However, the imperfect substitution between these two classes of beef makes such a separation critical in evaluating the effects of beef imports on the meat sector. It seems plausible to argue that changes in beef imports from Australia, and elsewhere, should have their greatest impact on the processed beef market. Spillover effects then will occur in the table beef market and further impacts will be distributed into markets for other meats and other foods. Identifying and measuring these effects is the goal of this paper.

Separating the Demand for Beef

A reasonably successful separation of U.S. beef demand into the demand for table cuts and the demand for processed items was completed recently by R. D. Hunt.[5] Using annual data for the 1946-68 period and making his data separation between lot-fed beef and non-fed beef (the latter including imports), Hunt was able to isolate statistically-significant direct and cross price elasticities of demand and income elasticities for these two main classes of beef at the retail level. Under his assumptions, all beef emerging from U.S. feed lots is classed as table beef. All other beef, including imports, is classed as processing beef. This division is somewhat arbitrary since it is known, for example, that some lot-fed beef is processed and that some non-fed and imported beef is consumed as table cuts. But given the data that are available currently, such simplifying assumptions are necessary in order to conduct any analyses. The reasonableness of the results, on both theoretical

[3] Unless otherwise indicated, the figures used in this paper are based on official data of the U.S. Department of Agriculture [12] [13] and the Australian Meat Board [1].

[4] The U.S. demand for beef has been studied in much detail over the years; see [7] for a sizeable bibliography of this work. Only a few previous studies have attempted to separate beef demand into component parts, and with mixed results. A fairly successful attempt by Langemeier and Thompson [7] in 1967 produced empirical results broadly similar to those discussed here. However, their use of the estimates was along different lines. A 1963 study by the U.S. Department of Agriculture [12] also yielded results consistent with this paper. Freebairn's recent work [3] is less comparable. Two recent studies [10] [11] employed a complex model derived from quarterly data. Although the fed *versus* non-fed beef separation was made, no elasticity coefficients were published.

[5] This particular research is reported fully in [6]. The approach and line of argument followed in the balance of the present paper is related to some analysis in Chapter V of that dissertation but departs significantly from it in method, scope, and purpose.

and empirical grounds, suggests that Hunt's particular assumptions are generally appropriate for the purpose at hand.

Table 1 contains the direct retail price, cross price and income elasticities calculated at the data means by Hunt [6]. These results emerge from a seven-equation simultaneous model of the U.S. beef market estimated by the three-stage least squares method. Several important points are illustrated by these results:

1. The direct demand for table beef (denoted TB) is more price elastic than for processed beef (denoted PB).
2. The cross price elasticities approximately fulfill the symmetry relation suggested by the well-known Slutsky equations [17] of demand theory. (Expenditure ratios of 0·7 and 0·3 for TB and PB respectively are indicated by data for recent years and are applied throughout this paper. Other expenditure weights were obtained from [4, p. 36].)
3. The cross elasticities quite plausibly indicate that price changes of table beef have a much larger impact on demand for processed beef than price changes of processed beef have on table beef demand. Moreover, price changes in both table and processed beef have an almost equal (but opposite) proportional effect on the demand for processed beef.
4. The overall direct price elasticity of *all* beef, obtained by a weighted averaging of the direct and cross elasticities of TB and PB is $-0{\cdot}97$. This is quite consistent with much of the other published work in this area [2] [8] [9] [15].
5. The overall income elasticity for *all* beef, obtained by a weighted averaging of the TB and PB income elasticities, is $+0{\cdot}70$. This is roughly consistent with, or slightly higher than, other published work.

These empirical estimates together with some recent price and quantity data suggest the partial equilibrium view of the U.S. beef market which is illustrated in Figure 1. Imagine that DD and SS are retail demand and supply curves for table and processed beef in about 1965 or 1966.[6] The apparent price equality is only for the purpose of easy comparison; think of price indexes. Then D′D′ and S′S′ represent the demand and supply situation in about 1971 or 1972. The more price elastic demand for TB shifted greatly to the right as consumer income increased and as the price of PB (a substitute) also advanced. Less dramatic changes characterize the PB demand, but a shift to the right

TABLE 1

Original estimates of retail price and income elasticities for table beef (TB) and processed beef (PB) in the United States

Quantities of:	Prices of: TB	PB	Income elasticity
TB	−2.03	+ .63	+0.92
PB	+1.37	−1.35	+0.20

TB = Table cuts of beef
PB = Processed beef (including hamburger)
Source: R. D. Hunt [6]

[6] No precise reflection of position or shape is intended in the curves of Figure 1. They are only illustrative.

did occur as both income and the price of TB (a substitute) increased.

Supplies of TB increased about 25 per cent during this 7-year period, but this was not enough to stave off an approximate 30 per cent increase in price.[7] In the PB market, total supplies increased less than 10 per cent; U.S. supplies fell while imports increased. This small increase in PB quantity supplied together with the modest rightward shift in demand induced a PB price increase of about 40 per cent in the 1965-71 period. As is well-known, these general trends, especially the price trends, have continued.

By themselves, these price and income elasticity estimates are sufficient for some analyses of the link between imports and beef prices. However, they are not sufficient for measuring effects on markets for other meats or other foods. The data in Table 2 are estimates of how beef import changes would affect the TB and PB markets, in isolation from wider implications. To obtain these particular estimates, the 2×2 price elasticity matrix of Table 1 was inverted to get the appropriate price flexibility matrix.[8] Then the second column of that flexibility matrix was used because it contains the coefficients which estimate the short-run price effects given a change in the quantity of PB. No U.S. production or other supply adjustments are allowed for in these estimates. Hence, the price flexibilities are estimates of the maximum change since, on one hand, price increases would ultimately call forth additional U.S. supplies which would tend to lower prices. On the other hand, price decreases would discourage U.S. production, and some

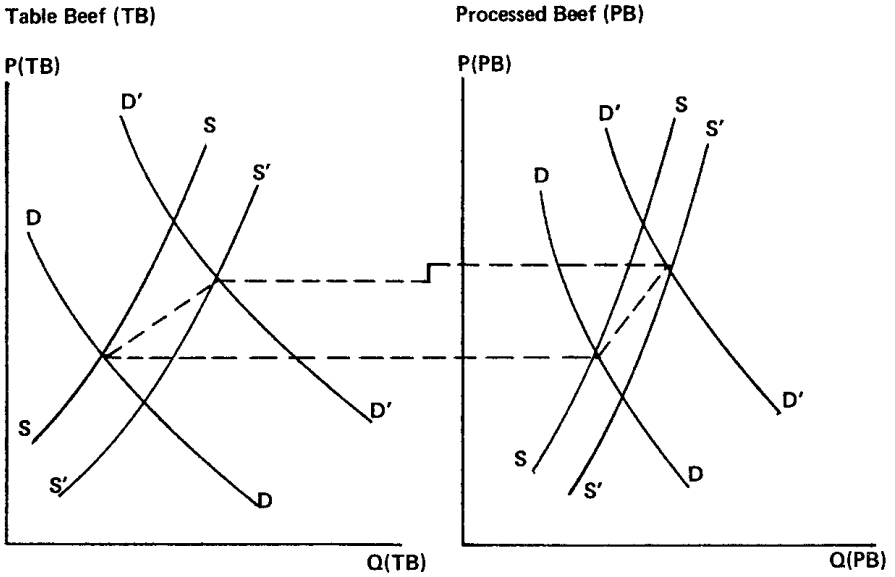

Figure 1. Partial Equilibrium View of U.S. Beef Markets

[7] The average retail price of choice grade beef was taken as the TB price indicator. The PB retail price is that for hamburger. Veal is regarded as a separate commodity throughout this paper.

[8] Price flexibility is defined as the percentage change in the price of a commodity associated with an isolated 1 per cent increase in the quantity demanded of that commodity or a related good, other quantities held constant [5].

TABLE 2

Short-run price effects of changes in processed beef (PB) imports, using original elasticity-flexibility estimates

On retail prices of:	Result of an isolated 10 per cent increase in Total supply of PB	Imports of PB[a]	Imports of PB from Australia[b]
	(per cent change)		
Processed beef (PB)	−10.81	−3.46	−1.73
Table beef (TB)	−3.36	−1.07	−0.54
All beef[c]	−5.59	−1.79	−0.90

[a] Imports at 32 per cent of total PB
[b] Australian shipments at 50 per cent of imports
[c] Weighted average price

upward price pressure then would emerge.

According to these estimates, a given percentage change in the total supply of PB results in an approximately equal but opposite percentage change in the PB price. Through the operation of cross effects, a change in the TB price also can be expected. It will be in the same direction as the change in PB price but only about one-third as large since TB and PB are not perfect substitutes. Table 2 also contains proportionate price effects when only imports, total and Australian, are considered.

Adjusting and Refining the Elasticities and Flexibilities

Beginning with the original elasticity estimates of Table 1, a series of adjustments and refinements were made. The idea was to broaden the scope of the analysis beyond the beef sector. First, the original estimates were adjusted slightly to achieve just a bit more theoretical consistency. Secondly, elasticity coefficients for other meats and other foods were added to the matrix in order to provide estimates of the broader implications of beef import changes. Elasticity estimates provided by other published research were used in this second stage.

Table 3 contains slightly adjusted price elasticities for TB and PB. These somewhat arbitrary adjustments were applied to Hunt's original estimates from Table 1. First, the cross elasticity measuring the change in quantity of PB with respect to price of TB was reduced slightly and the direct elasticity of PB was increased slightly (in absolute terms). The purpose of this adjustment was to make the cross effect smaller than the direct effect (a plausible condition) and to preserve a net substitute relation between all other non-beef goods and PB under the homogeneity condition of demand theory [17]. (Imposing this latter

TABLE 3

Adjusted retail price elasticities for table and processed beef in the United States

Quantities of:	Prices of: TB	PB	Income elasticities
TB	−2.030	+0.530	+0.92
PB	+1.223	−1.493	+0.20

condition requires that all direct and cross elasticity coefficients plus the income elasticity sum to zero.) Consequently, the cross elasticity was lowered slightly more than the direct elasticity was increased (absolutely) with the income elasticity being held constant. Application of the symmetry condition between the cross elasticities necessitated a slight reduction in the cross elasticity of TB quantity with respect to PB price. The adjusted elasticities in Table 3 still reflect all the major relationships discussed earlier among the two categories of beef. The direct price elasticity of *all* beef implied by the adjusted figures in Table 3 is — 1·13, slightly higher than originally.

Although the total price and income elasticities for all beef suggested by Tables 1 and 3 are similar to those obtained by others using U.S. data from the 1960s and earlier, somewhat different results emerged from a recent effort by George and King [4] to incorporate all food commodities into an internally consistent demand matrix. In this massive effort, the authors updated and expanded on Brandow's pioneering work [2] of 1961. George and King included beef as a single commodity with a direct price elasticity of — 0·644 and an income elasticity of + 0·290. Compared with earlier work, George and King imply that beef is less price and income elastic than previously estimated. Beef prices surely seem to be more sensitive to short-run supply conditions in recent years, but the suggested decrease in income response is not so apparent.

However in order to use other elasticity estimates from George and King's complete retail demand matrix, the entire set of price and income elasticities for beef shown in Table 3 of this paper was reduced by the multiplicative factor of 0·569. This factor is the ratio of —0.644 (the George-King direct price elasticity for beef) divided by —1·131 (the direct elasticity for all beef from Table 3). Thus, the direct price elasticity for all beef computed from the scaled down matrix of TB and PB is —0·644. This adjustment preserves the relations between TB and PB, as estimated by Hunt (and revised slightly), but brings the scale of the elasticities to a size consistent with the complete George-King matrix of all foods.[9] Then, elasticities for other goods from the George-King work were used together with those developed here.

In Table 4, the elasticities within the dotted lines emerged from the scaling down process described above. The balance of the elasticities in Table 4 were synthesized from individual commodity elasticities presented by George and King. They include (1) other meats (OM), (2) other foods (OF), and (3) all else (AE). This synthesizing process was based on the fundamental theoretical relationships among demand relations; *viz* the homogeneity condition among direct, cross, and income elasticities for a given commodity, the Slutsky symmetry condition between cross price elasticities, and the principles of aggregating individual price and income elasticities into larger commodity groups [2] [4] [17]. Table 4 fulfills all these conditions and is the basis for the analyses which follow. Negative direct price elasticities are displayed along the main diagonal of the price-quantity matrix. Cross price

[9] The scaled down income elasticity of TB is + 0·524, and for PB it is + 0·114. This adjustment brings the total beef income elasticity to + 0·401. This is somewhat higher than the George-King figure of + 0·290, but the higher figure was retained here.

TABLE 4

Final price and income elasticity matrix

Quantities of:	Retail Prices of: TB	PB	OM	OF	AE	Income elasticity	Expenditure proportion[a]
TB	−1.156	+0.302	+0.218	+0.019	+0.093	+0.524	0.0184
PB	+0.696	−0.850	+0.027	+0.002	+0.011	+0.114	0.0079
OM	+0.085	+0.004	−0.375	+0.041	+0.063	+0.182	0.0508
OF	+0.009	0.000	+0.016	−0.218	+0.058	+0.135	0.1508
AE	−0.017	−0.009	−0.050	−0.156	−1.011	+1.243	0.7721

TB = Table beef
PB = Processed beef
OM = Other meat[b]
OF = Other food
AE = All else

[a] From [4, p. 36.] The expenditure proportion for all beef was allocated to TB and PB by the factors of 0.7 and 0.3 resepctively.

[b] Veal, pork, lamb-mutton, chicken, turkey and fish.

Source: Table 3 and [4].

TABLE 5

Price flexibility matrix implied by elasticities in Table 4

Prices of:	Quantities of: TB	PB	OM	OF	AE
TB	−1.164	−0.415	−0.690	−0.120	−0.162
PB	−0.962	−1.520	−0.653	−0.112	−0.152
OM	−0.272	−0.107	−2.819	−0.394	−0.224
OF	−0.055	−0.017	−0.186	−4.433	−0.271
AE	+0.050	+0.029	+0.186	+0.707	−0.932

elasticities are arranged in the off-diagonal positions. They are mostly positive and absolutely smaller than their corresponding direct price elasticities. The negative cross elasticities in the last row (AE) resulted from the large income factor in the symmetry relation and are similar to those computed by Brandow [2] and George and King [4].

Since the central goal is to examine the effect of changes in supplies of processed beef, the price flexibility counterpart of Table 4 is required. The inverse of the 5 × 5 price elasticity matrix of Table 4 is displayed in Table 5. The second column of Table 5 is of immediate interest. That column estimates the percentage change in the various prices associated with an isolated 1 per cent increase in the quantity of PB. For this paper, the possible effects of PB quantities on prices beyond the food sector are ignored. The fifth row and column of Tables 4 and 5 were added only to provide overall internal consistency to the matrixes and not as a specific group of items on which to estimate price changes. It is too large and diverse for such analysis.[10]

TABLE 6

Short-run effects of changes in processed beef (PB) imports, using final elasticity-flexibility estimates

On retail prices of:	Result of an isolated 10 per cent increase in: Total supply of PB	Imports of PB[a]	Imports of PB from Australia[b]
	(per cent change)		
Processed beef (PB)	—15.20	—4.86	—2.43
Table beef (TB)	—4.15	—1.33	—0.66
All beef[c]	—7.47	—2.39	—1.20
Other meats (OM)	—1.07	—0.34	—0.17
Other foods (OF)	—0.17	—0.05	—0.03

[a] Imports at 32 per cent of total PB

[b] Australian shipments at 50 per cent of imports

[c] Weighted average

Price Effects

Table 6 corresponds in purpose and in form with Table 2. Both

[10] The inverse of the first four rows and columns of table 4 (omitting AE) is a matrix whose second column is almost the same as the first four elements in the second column of table 5.

contain figures which illustrate the estimated impact of changes in processed beef supplies on prices. The Table 6 estimates are based on the flexibilities of Table 5 and include the price changes in other meats and other foods. Notice how the effect of an increase in PB is distributed. The largest impact is, naturally, upon the PB price. Next largest is its effect on the TB price. Smaller, but observable, changes occur for other meats and other (non-meat) foods. The PB and TB price effects shown in Table 6 are somewhat larger than those in Table 2 because the price elasticities on which they are based were scaled down from the original estimates. This makes the price flexibilities absolutely larger. These are the pure short-run effects of changes in PB quantities, net of other factors. Dynamic changes in these markets originating from other sources could easily override and obscure the effects of changes in imports or domestic supplies.

The estimates in Table 6 highlight the price-reducing effects of increased supplies of PB. The following are measures of what would happen if, through trade restrictions, the imports of PB were reduced:

Effect on:	Imports reduced *to zero*	Imports reduced *by half*
	(per cent change)	
Price of PB	+48.6	+24.3
Price of TB	+13.3	+6.6
Price of all beef	+23.9	+12.0
Price of OM	+3.4	+1.7
Price of OF	+0.5	+0.3

The first column of figures shows the extent to which U.S. retail prices of beef and other meats are being held down by imports. (Recall that these are short-run measures and, as such, are maximums since no U.S. supply response is taken into account.) The approximate Australian role in this price-controlling effort is shown in the second column of figures; Australian beef is about half of total PB imported. The appropriate weighted averaging of PB and TB price changes suggests that imports from all sources are holding all beef prices in check to the extent of about 24 per cent.

Beef Imports and the Consumer Price Index

In order to assess the inflation-fighting potential of the suspension of meat import quotas, one might look at the relation between beef imports and the Consumer Price Index. The consumer experiences inflation first-hand in the shops and supermarkets, but political leaders and policy-makers will gauge success or failure in terms of objective indicators which apply to the economy as a whole. The Consumer Price Index (CPI), computed and published monthly by the Bureau of Labour Statistics, U.S. Department of Commerce, is the most relevant indicator for the purpose at hand.

The overall CPI includes a variety of sub-indexes, the important ones for this paper being (1) Total Food, (2) Meats, Fish and Poultry, and (3) Beef and Veal.[11] The relative expenditure weights [14] for

[11] The Total Food sub-index includes food purchased for home use and food consumed away from home. Since the expenditure for veal is only about 7 per cent as large as that for beef, no attempt was made to re-arrange the CPI weights to place veal with other meats.

these sub-indexes are:

Item	*Percentage weight*
All items	100.0
Total Food	22.4
Meat, Fish, Poultry	5.6
Beef and Veal	2.2

These expenditure weights indicate the importance of each particular subgroup in the total CPI. They can be used to reflect the effect of changes in a subgroup upon a more aggregated index grouping. For instance, if all beef imports into the United States were stopped, the short-run changes in the CPI and the relevant sub-indexes would be as follows:

Price Index	*Per cent Change*
All Beef	+23.8
Meat, Fish, Poultry	+11.4
Total Food	+3.2
Total CPI	+0.7

The All Beef sub-index rises (+ 23·89 per cent) as prices of PB and TB change. Then the Meat, Fish, and Poultry sub-index increases (+ 11·4 per cent) as the All Beef index changes and as the prices of other meats (OM) are affected through the cross flexibilities. Similarly, the Total Food index advances (+3·2 per cent) in response to meat price changes and induced changes in prices of other foods (OF). Since price effects beyond the Total Food sector are ignored the CPI moves up (+ 0·7 per cent) in response to these food price increases.

To look at these relationships in at least one other way one might ask how the imports of PB would have to change in order to induce, say, a 1 per cent decrease in the CPI or in one of the relevant sub-indexes. Table 7 summarizes the answers and also shows how the resulting price decreases would be spread over beef, other meats, and other foods. The results illustrate that the price effects of increased imports (or other supplies of processed beef) are concentrated in the beef sector, but do tend to spread out through the economy via the operation of substitution effects.

In order to place the role of beef imports in clearer perspective, the price effects of changes in table beef supplies can be examined briefly. The first column of price flexibilities in Table 5 is relevant in this connection. These flexibilities indicate that a 16·7 per cent decrease in TB supplies would have virtually the same overall effect on the Total Food index and the overall CPI as a complete stoppage of PB imports. Moreover, a *simultaneous* increase of 1 per cent in imports and a 1 per cent increase in table beef supplies would cause all beef prices to fall 1·34 per cent and the Total Food portion of the CPI to fall by 0·22 per cent. About 85 per cent of this price change is due to the effect of table beef supplies. This is largely because the volume of beef imported is only about 16 per cent as large as all table beef consumed in the U.S. Thus, a 1 per cent increase implies a much larger volume change in TB than in PB.

Even on a pound-for-pound basis, the conclusions are similar. A given equal increase in the tonnage supplied of both TB and PB obviously would place downward pressure on the price indexes. The

TABLE 7

Increases in processed beef imports needed to reduce selected U.S. retail price indexes by 1.0 per cent, and the resulting distribution of price changes

Price index	Required increase in PB imports to obtain a 1 per cent fall in price index	Resulting changes in prices of:				
		PB	TB	All beef	OM	OF
	(per cent change)					
All Beef	+4.2	—2.0	—0.6	—1.0	—0.1	—
Meat, Fish, and Poultry	+8.8	—4.3	—1.2	—2.1	—0.3	—
Total Food	+31.0	—15.0	—4.1	—7.4	—1.1	—0.2
Total CPI	+140.8	—68.4	—18.7	—33.7	—4.8	—0.7

PB = Processed beef
TB = Table beef
OM = Other meat (including fish and poultry)
OF = Other foods

pressure exerted by an increased volume of TB is more than double the pressure exerted on prices by the equivalent volume of PB.[12] This is because, while direct effects are similar, the cross effects show that TB quantities put substantially more pressure on PB prices than PB quantities exert on TB prices. Consequently, while imports have a clear and measurable impact on food prices, a modest change in the table beef market can swamp and obscure changes due to imports alone.

Concluding Comments

Imports of processing beef into the United States play a rather important role in keeping retail meat prices lower than they otherwise might be. The major impact, by far, is upon retail prices for hamburger and other processed items. Based on this analysis of estimated price elasticities and flexibilities, beef imports hold processed meat prices some 35 to 50 per cent below the short-run levels which would exist in their absence. Through the operation of cross effects based on substitution, retail prices of table cuts of beef are 11 to 13 per cent lower than they otherwise would be. (The latter class of beef is the basic output of the U.S. cattle feed-lot industry.) The weighted average of all beef prices would be 18 to 24 per cent higher without imports in the short-run. Considering the further cross effects, imports hold down other non-beef meat prices by about 3 to 4 per cent at retail. When all cross effects are accounted for and aggregated, the Meat, Fish, and Poultry portion of the U.S. Consumer Price Index would be 11 to 12 per cent higher in the short-run without beef imports and the entire CPI about 3 per cent higher.

The analyses in this paper take no explicit account of supply response by U.S. or foreign producers to price change. Therefore, these results reflect maximum price effects due to demand phenomena. Longer-run output adjustments would tend to soften the short-run impacts.

Australia's role in the structure of U.S. meat prices is proportional to her share of the import market, now about 50 per cent. One might say that Australian beef exports to the United States keep retail prices paid by U.S. consumers for beef an average of 9 to 12 per cent below what they otherwise would be in the short-run.

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