A NOTE ON BIAS IN THE
ESTIMATED EFFECTS OF BEEF IMPORTS
ON U.S. MEAT PRICES

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⊿ The impact of beef imports on United States meat prices is a highly emotional and controversial issue. Congressmen representing urban districts, and to a lesser extent the Administration, look towards beef imports as a way of containing rapid increases in meat prices. Congressmen and Senators from beef-producing States regard beef imports as a direct attack on the U.S. beef-producing industry.

These differing views are being reconciled through Congress considering amendments to the Meat Import Law (Public Law 88-482). The impacts and the amendments are of vital interest to Australia because about 25 per cent of Australia's beef production is sold on the lucrative U.S. market.

In this note it is argued that, in general, the reported impacts on U.S. meat prices are overestimates because the analysts misspecify the structure of the U.S. beef industry.

Common Model Structures

The majority of analysts classify the U.S. beef supply into a high-quality (price) category and a low-quality (price) category. The analysts define the high-quality beef as either —
  (a) fed beef, or
  (b) steer and heifer beef.
The low-quality domestic beef sources are defined as —
  (a) all non-fed cattle (which includes non-fed steers and heifers), or
  (b) cows, stags and bulls.
Beef imports, which account for 7 per cent of U.S. beef consumption, are invariably included in the low-quality beef category.

Freebairn and Rausser (1975), and Hunt (1972) are two examples of analysts who used the fed, non-fed beef categorisation. Hunt's analysis is of particular interest because it is the analytical base of Houck's (1974) article on the impact of beef imports on U.S. meat prices published in this *Journal*. Langmeier and Thompson (1967) used the steer, heifer and cow, stag and bull categorisation in spite of the fact that in their article they refer to the high-quality beef as fed beef and the low-quality beef as non-fed beef.

The choice grade steer price series is normally used as the price for the high-quality meat. The hamburger price series is invariably used as the representative price for all low-quality beef end uses. The two prices are treated by analysts as distinct prices although, by construction, the retail

choice steer price series contains the hamburger price as a weighted component.

In the late 'fifties and early 'sixties, the grain feeding of young animals supplanted grass feeding as the common method of finishing the animals for slaughter. From the 'sixties until 1974, fed cattle, and steers and heifers, were virtually synonymous terms. In 1974, 1975 and 1976, conditions in the U.S. beef industry induced a partial reversion to the grass fattening of young animals. The meat from these animals appeared as table cuts in retail stores.

The serious shortcoming, however, of either beef classification scheme is that meat of differing qualities comes off the same carcass. Woods (1975, p. 6) stated that the principal source of hamburger meat is from steers and heifers. A reasonable estimate of the proportion of a steer carcass going into low-quality (price) end uses is 23.2 per cent.[1] The average monthly wholesale sales (1970-77) of cow beef plus imports were 488 million lb.[2] Steer and heifer sales averaged 1534 million lb. The 23.2 per cent implies that on average 356 million lb of beef each month are added to the 488 million lb of cow beef to give the total low-quality beef supplies.

Analysts who employ the classification schemes outlined above do not capture the direct effect of this additonal meat on hamburger prices in their model specifications. They attribute the full variation in hamburger prices to only a part of the actual supply. It is argued in this note that this misspecification leads to biased estimates of the model coefficients.

Bias and Its Direction

Consider the simple case in which price is a function of quantity.[3] Let the true demand model be as shown in equation (1).

$$(1) \qquad P = A_0 - B_1 (Q_1 + Q_2) + v$$

where P is a $n \times 1$ vector of hamburger prices; Q_1 is a $n \times 1$ vector of cow beef plus import quantities; Q_2 is a $n \times 1$ vector of low-quality, steer and heifer beef cuts; and v is a $n \times 1$ vector of error terms assumed to satisfy the standard conditions. The specification of equation (1) explicitly states that the hamburger (low-quality) meat from the two supply sources is, in fact, the same commodity and that meat from either source should have an identical effect on hamburger price, namely $-B_1$.

Instead of estimating equation (1), the analyst is assumed to estimate equation (2), in which Q_2, the low-quality cuts from steer and heifer carcasses, is omitted and u is the vector of error terms.

$$(2) \qquad P = a_0 - b_1 Q_1 + u.$$

The specification error may be regarded as an observational error (Q_1 only is measured instead of $Q_1 + Q_2$) or as an omitted variable error (Q_2 is omitted from the equation). The observational error and the omitted

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[1] The 23.2 per cent is taken from Woods (1975) and is substantiated by Duewer (1970, p. 15).

[2] Cow beef is used to describe all domestic supplies of cow, stag and bull beef. All quantities are expressed in carcass weight equivalents.

[3] Heien (1977) advances arguments for the price dependent specification, but here it is used for expositional purposes.

variables error approaches are equivalent in the sense that either approach yields an expected value of the estimated coefficient b_1 which is biased from the true value B_1. The bias is shown in equation (3) where B_1 is the true value.

$$(3) \qquad E[b_1] = -(1 + c)B_1.$$

The extent of the bias depends on c. In the observational error approach, $(1 + c)$ is the regression coefficient of $(Q_1 + Q_2)$, the true value, on Q_1, the observed value (see Theil 1972, p. 607). In the omitted variables approach, c is the regression coefficient of Q_2, the omitted variable, on Q_1 (see Johnston 1972, p. 169). In the following, the omitted variable procedure is adopted.[4]

In this case, the bias depends on the regression coefficient of low-quality steer and heifer beef on cow beef. If steer and heifer (fed) slaughterings are positively correlated with cow (non-fed) slaughterings, then the estimated regression coefficient, b_1, is biased in the upward direction (absolutely too large). This bias implies that the price-reducing effects on an increased supply of cow (non-fed) beef are overestimated.

Hunt's annual data (p. 172), which extend from 1946 to 1968 can be used to try to gain some insight into the likely direction and size of the bias. Assuming that 23.2 per cent of a fed carcass actually goes into low-quality beef end uses, the regression of this quantity on non-fed beef quantities yields a positive 0.26 for coefficient c. The sign and magnitude of the coefficient implies that Hunt has overestimated the price-reducing effects of an increase in beef imports by 26 per cent.[5] The overestimate stems directly from the estimating equation in which the full hamburger price variation is attributed to only a part of the total low-quality beef supplies. Part of the price variation is caused by low-quality cuts from steer and heifer carcasses which, historically, are positively correlated with the cow beef supply. An analyst using equation (2) does not recognise this in his misspecification. Therefore, when he simulates a *ceteris paribus* increase in beef imports, he overestimates the price decline. The same result holds for a simulated *ceteris paribus* increase in cow beef supplies.

A Comparison of Selected Impacts of a Given Beef Import Increase

In June 1978, President Carter announced that the U.S. meat import quotas for the remainder of 1978 would be increased by 200 million lb. This represents a 20 per cent increase (annual basis) over the 1977 import level. Earlier in June, while the increase proposal was under discussion, the Secretary of Agriculture, Bob Bergland, announced (Anon. 1978) that an increase of 250 million lb would reduce the expected rise in 1978 beef prices by 5c/lb. It was not clarified in the article to which beef price the Secretary was referring. Presumably it was the price of hamburger

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[4] If equation (2) were a multivariate equation, c is the regression coefficient on Q_1 when Q_2 is regressed on all variables included in equation (2).

[5] The magnitude of c is debatable because, in a real-world specification of equation (2), other variables such as income are included. For the direction of the bias to be reversed, the influence of other omitted variables from equation (2) would have to override the positive correlation between the two sources of low-quality beef as well as the likely positive relationships between Q_2 and variables such as income. A reversal of the direction of bias appears unlikely to the author.

meat. The Administration's 5 cent estimate, which is equivalent to 4 cents on 200 million lb, may be compared with estimates from other sources.

Table 1 sets out several different estimates for the impacts of the 200 million lb quota increase. Hunt, and Freebairn and Rausser employed a fed, non-fed plus imported beef categorisation. On the arguments advanced in this note, it is believed the impacts on hamburger prices shown in the table are overestimates.[6] The basis for the Administration's estimate is not known but, since the Hunt, Houck, and Freebairn and Rausser analyses are the main references cited in this area (see Schmitz and Nelson 1977), it is reasonable to suppose it is based on them. The Ryan (1978) estimate was derived from a monthly demand study of the U.S. beef industry. Ryan allocated a fixed proportion (23.2 per cent) of steer and heifer carcasses to hamburger and other low-quality (price) end uses. Ryan also separated the retail choice steer price series and recomputed the price series as part of his model solution.

The different data periods, the unit observation periods (annual or monthly), and my model specifications and methods used in computing the Hunt estimates all make any comparisons tenuous. It is clear, however, that an increase in the quota has a differential impact. Greater price declines occur for hamburger and for cow beef than for choice steers.[7] The Hunt estimates in Table 1 are probably the least reliable because of the assumption of unchanged price flexibilities used in calculating the estimates. Further, during Hunt's estimation period (1946-1968), considerable structural changes in cattle feeding (mentioned earlier) were occurring.

TABLE 1

Estimated Impacts of a 200 Million lb Increase in the U.S. Meat Import Quota on U.S. Prices[a]

	Administration[b]	Hunt[c]	Freebairn[d] and Rausser	Ryan[e]
Hamburger (c/lb)	−4	−6.9	−2.20	−1.47
Farm cow price ($/100 lb)	na	na	−1.88	−0.74
Choice steers				
Retail (c/lb)	na	−3.0	−1.98	−0.34
Farm ($/100 lb)	na	na	−1.18	−0.02

[a] The increase is 20 per cent over 1977 import level.
[b] Calculated from Anon. (1978, p. 10).
[c] Calculated from Table 2 in Houck (1978) and using 1977 average prices (hamburger = 85.5, choice steer = 138.3 c/lb).
[d] Calculated from the current multipliers in Table 9, Freebairn and Rausser (1975).
[e] Impacts after 10 months of a sustained monthly increase of 33 million lb.
na Not available.

[6] The author did not have access to the Freebairn and Rausser data (1956-71). However, employing Hunt's (p. 172) data from 1956 until the end of his data series, 1968, the regression coefficient of interest is 0.25. Neglecting all other errors, this implies a 25 per cent overestimate.

[7] In the monthly model, hamburger beef was not found to be a substitute for the higher priced beef cuts. In the Freebairn and Rausser annual model and the Hunt annual model, non-fed beef entered as a substitute for fed beef. This is the main reason for the much lower impact on choice grade steer prices in the monthly model vis-à-vis the other model estimates. Our interest here is in hamburger prices.

The Administration's estimate of a 4 cent price decline is larger than the Freebairn and Rausser estimate of 2.20 cents and the estimate of 1.47 cents from the Ryan monthly model. The relative difference between the Freebairn and Rausser and the Ryan hamburger price declines have the direction expected from the arguments advanced in this note. If the hamburger price declines are overestimated, then the choice steer price declines will also be overestimated via the substitution effect in the Hunt, and Freebairn and Rausser models.

Concluding Comments

⁀ The available empirical evidence indicates that the impact of an increase in U.S. beef imports will have a small, but differential effect on U.S. beef prices. It is contended that most previous studies overestimated the impacts due to the way the analysts structured their models. If this is the case, then the reported impacts should be regarded at the most as upper-limit effects.

These considerations of a probable overestimate of the impact of beef imports on U.S. prices weaken the U.S. producer arguments against an increase in import quotas. On the other hand, the considerations weaken the appeal to U.S. consumers to support an increase in beef quotas.

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