Demand for U.S. Lamb and Mutton by Country of Origin: A Two-Stage Differential Approach

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Abstract

Estimates of price and scale demand elasticities for lamb and mutton consumed in the United States are derived. The U.S. lamb and mutton consumption comprises primarily of domestic production, and imports from two countries—Australia and New Zealand. The Netherlands Central Bureau of Statistics (CBS) demand system derived by Keller and Van Driel (1985) is employed. The CBS model is preferred as it combines non-linear Engel curves with the simplicity of the Slutsky matrix and allows for the ease of implementing concavity and other restrictions. The Hausman specification test reveals that both prices and quantities are endogenous in lamb import demand. Empirical results for own-price elasticities of demand indicate inelastic demand for all three countries with New Zealand being highly inelastic. The scale elasticity results indicate that if the U.S. increases total demand for lamb, Australia and New Zealand's share of total demand will more than proportionately increase while the U.S. share of total demand will less than proportionately increase.

Key words: CBS, imports, lamb and mutton, conditional demand, scale elasticity.

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Introduction

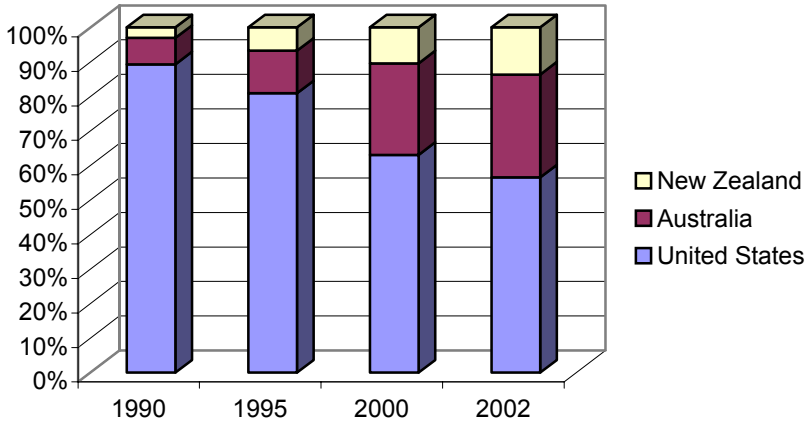
Lamb consumption is an area of concern for U.S. producers. While consumers in countries such as New Zealand and Australia traditionally eat lamb and mutton and have consistently consumed above 12 pounds per capita per annum, the U.S. per capita lamb and mutton consumption has been fairly stable at just about 1 pound per annum. Consumption is confined to ethnic niches and small segments of consumers who remain focused on purchasing high-valued products and demanding higher-quality, higher-priced prime cuts. Since 1975, total use of lamb and mutton consumption has increased only enough to keep pace with population increases and enable per capita consumption to remain fairly stable.

Commercial production of lamb and mutton has mirrored the long-term decline in the U.S. sheep inventory. Historically, the lamb and mutton industry was developed as a by-product of the wool industry. Over time, the depressed wool industry has heavily influenced the direction of the U.S. sheep industry. The result is a declining inventory and a declining number of animals available for market each year. Although productivity gains (output per animal) have been registered it has been far outweighed by declining inventories. As a result, imports have grown to offset the domestic production declines and to maintain stable per-capita consumption. Lamb and mutton imports have surged since the mid-1980's, with very sharp increases since 1994. In 2001, lamb and mutton imports were 12.3 percent higher than in 2000 and 440 percent higher than in 1975. Imports, which currently account for more than one-third of U.S. lamb and mutton consumption, are nearly all from Australia (61 percent) and New Zealand (37 percent). Lamb imports from both countries have increased dramatically, with Australia showing a much faster rate of import growth since 1995.

In July 1999, following the rapid rise in lamb imports in the mid-1990's, (figure 1) the U.S. established a 3-year tariff-rate quota (TRQ). The TRQ essentially rations the available supplies among willing domestic consumers by adjusting the price upward by the value of the *ad valorem* duties levied on lamb.

The *ad valorem* duty is commonly stated as a percentage of a readily observed international price and is designed to increase the price to domestic consumers and thereby reduce the supply of imported lamb. *Ad valorem* duties were levied for both in-quota and over-quota amounts of imported lamb. Removal of the TRQ, as required by a World Trade Organization (WTO) ruling, could lower domestic prices, and thereby increase domestic consumption of imported lamb. This will likely result in a further increase in imports from strong U.S. competitors such as Australia and New Zealand.

Figure 1. U.S. Lamb and Mutton Production, and Imports as a percent of Total U.S. Lamb Disappearance



However, estimation of the U.S. demand for lamb and mutton based on the source country of production has not been explored. This study attempts to examine the U.S. total lamb and mutton demand and U.S. elasticities for demand for lamb differentiated by source country of production. Specifically, the paper aims to: (1) empirically estimate the total demand for lamb by the U.S. and the conditional import demand for lamb consumed in the U.S. with an econometric model; (2) to calculate short-run and long-run elasticities of total demand and conditional import demand from estimated demand parameters; (3) determine the impact of seasonality on U.S. lamb consumption; (4) and determine the impact of the 29-month TRQ on U.S. import demand.

Past Studies

Past research on U.S. lamb demand has been limited. Purcell (1989) estimated quarterly lamb demand over the 1978-1988 period and found that lamb price was only marginally significant in determining demand and that other economic indicators normally relevant in determining demand were not important. He estimated the short-run elasticity to be –0.51 but found no substitution effect and found that lamb consumption declined as consumer income increased.

Byrne, et al. (1993) also estimated a quarterly lamb model over about the same time period, 1978-1990, but, unlike Purcell, found that per capita lamb consumption was significantly related to lamb price with a short-run elasticity of –0.63 and a long-run elasticity of –0.79. Again, contrary to Purcell, Byrne et al observed weak substitution effect between lamb and pork.

Schroeder, et al. (2001) estimated a quantity-dependent lamb demand model using quarterly data from 1978 to 1999. Due to the unavailability of a consistent lamb retail price series during the study period, a derived lamb retail price index from a Bureau of Labor Statistic (BLS) U.S. city retail lamb average price between 1991 and 1993 was constructed. Similar to Byrne, et al. (1993) they found that lamb price was a significant determinant of lamb demand, but, contrary to the previous studies they observed a more sensitive consumer price response. They estimated an own-price elasticity for lamb of -1.09. Schroeder, et al. attributed the elastic lamb demand to the changing behavior of lamb consumers. Again, contrary to Purcell (1989), who found no substitutability between lamb and other meats, Byrne et al. (1993) found substitution between lamb and pork, and Schroeder et al. (2001) found substitution between only lamb and beef.

While the cited previous studies of lamb demand offer many insights, there are obvious data limitations observed in all of them. In all cases, the analysts attempted to estimate retail lamb demand but, due to the unavailability of a consistent retail price series, had to use proxy variables to represent retail lamb price.

Also, none of the previous studies looked at lamb as a product differentiated by source country. This study extends previous analyses by estimating an aggregate U.S. demand for lamb and mutton and also U.S. demand by source country of origin. The advantage of estimating country of origin elasticities is that the impact of country specific production shocks or policy changes can be evaluated through its impacts on demand.

Model Specification

In this paper, the Netherlands Central Bureau of Statistics (CBS) demand system derived by Keller and Van Driel (1985) is used to estimate demand parameters. The CBS model combines the non-linear expenditure effects of the Almost Ideal Demand System (AIDS) (Deaton and Muellbauer, 1980b)) and the price effect of the Rotterdam model (Theil, (1966) and Barton, (1969)). The Rotterdam model meets the negativity condition on the Slutsky matrix required for a downward sloping demand curve if its price coefficients are negative, semi-definite. It is a set of partial differential equations. Differential demand systems are estimated based on the assumption that the differential systems are well approximated by difference systems. Usually, these models are specified using first differences. Consider the general CBS model: (You could say, "The general CBS model has the following following form:)

$$(1)\quad w_i \cdot \left[\partial Lnq_i - \sum_j w_j \partial Lnq_j \right] = a_i + \sum c_{ij} \partial Lnp_j + b_j \left(\partial Lnx - \sum_j w_j \partial Lnp_j \right)$$

where:

$$(2)\quad w_i = \frac{p_i q_i}{x}$$

In (1) and (2) above, q_i is the quantity of good "*i*," p_j is the price of good "*j*," and x the total expenditure on all goods. The terms $\partial \ln q_i$,.$\partial \ln p_j$, and $\partial \ln x_i$ are the partial derivatives of the logarithms of the quantity, price, and expenditures, and the c_{ij} and b_{ij} are coefficients. The w_i is the budget share for the ith good.

In order to be consistent with utility maximization, the coefficients have to meet the following restrictions:

(3) $\sum_i c_{ij} = \sum_j c_{ij} = \sum_i b_{ij} = \sum_i a_i = 0,$ implying homogeneity of degree zero and the adding-up condition holds for the budget constraint.

(4) $c_{ij} = c_{ji}, \forall ij$, implying symmetry

Further, the matrix formed by the c_{ij} has to be negative, semi-definite, a restriction that implies, among other things, that the compensated demand slopes downward. It is not usually imposed when estimating the CBS or related demand systems models.

The U.S. lamb demand model is built on the assumption of a two-stage budgeting process, where in the first stage the quantity of lamb and mutton consumed by the U.S. is expressed as a function of a mixed weighted lamb price, the price index for all meats, prices of substitutes and expenditures. The two-stage budgeting approach implies a relationship between the first stage (aggregate demand), and the second stage, (source country of origin demand) according to Kesavan, et al., (1993). Based on the methodology of Pollak and Wales (1969), we assume that an individual consumer's preferences are represented by a well-behaved utility function, $U(x_i,...,x_n)$ where x_i signifies the rate of consumption of the i^{th} good, say lamb and mutton, and his or her utility is maximized subject to a budget constraint. If we further assume a theoretically plausible complete system of "market" demand functions, we can derive the aggregate utility function and the corresponding aggregate demand function (mixed quantity divisia index). As such, in the first stage the aggregate demand for U.S. lamb is expressed as a function of a mixed weighted lamb price based on all the source countries, the price index for all meats, prices of substitutes, and expenditure on all food. This procedure yields a differential total U.S. demand for lamb represented by the mixed quantity divisia index.

In the second stage, the demand for lamb and mutton, both domestic and imported is specified as a function of prices and the mixed quantity divisia index from the first stage. Separability is assumed in the demand for lamb from other products, i.e. beef, pork, etc. for each country. See Deaton and Muellbauer (1980b) and Moschini et al. for a good exposition of the validity of the separability assumption in demand systems. Unlike, Kesavan, et al., (1993) who assumed a theoretical relationship between stage I and stage II, but derived both processes under static conditions, here the mixed quantity index which was endogenous in the first stage is exogenous in the second stage, thus capturing the expenditure effects with regards to the country import demands.

Consumers are unlikely to adjust to equilibrium in every time period (Anderson and Blundell (1983) and Kesvan et al (1993)). Habit persistence, adjustment costs, incorrect expectations and misinterpreted real price changes have been cited as possible reasons for this short-run disequilibrium. This is consistent with the findings of Kesvan et al., (1993), who observed a rejection of these restrictions in the short-run and instead had to assume that the restrictions were met.

A dynamic approach is applied to the general CBS model to capture both the short-run and long-run relations in the two stages of lamb and mutton demand. In the first stage a differential total demand equation is specified:

$$
\begin{aligned}
dBQ_t = {} & \alpha_i + \beta_1 dBQ_{t-1} + \beta_2 dBP_t + \beta_3 dBP_{t-1} + \beta_4 dCPI_t + \beta_5 dCPI_{t-1} + \beta_6 dEX_t \\
& + \beta_7 dEX_{t-1} + \delta_{ij}\left(\sum_j dSP_{jt}\right) + \gamma_{im}\left(\sum_m dSP_{mt-1}\right) + \sum_k^3 [\tau_{ik} D_k] + \lambda_1 T + \nu_{it}
\end{aligned} \tag{5}
$$

where

dBQ = the mixed quantity divisia index (lamb and mutton consumption)

dBP = the mixed price divisia index (lamb and mutton price)

$dCPI$ = the consumer price index for all meats

dEX = consumption expenditure

dSP = the price of substitutes (beef and pork)

D = represent a vector of seasonal dummies for the k[th] quarter

T = dummy for the period of the TRQ imposition

$\alpha_1, \beta_i (i = 1,....,7), \delta_{ij}, \gamma_{im}, \tau_{ik}$ and λ_1 are parameters to be estimated and ν_{it} is the disturbance term.

Subscripts j=1 and 2 for beef and pork prices; subscript m=1 and 2 for lagged beef and pork prices; and subscript k=1, 2, 3 for first, second and third quarters.

The CBS model used in the second stage allows for the estimation of source country lamb and mutton demand without imposing restrictive *a priori* assumptions with regard to expenditure effects (Deaton and Muellbauer 1980a).

$$w_{it} \cdot \left[\partial Lnq_i - \sum_j w_j \partial Lnq_j \right] = a_i + \sum c_{ij} \partial Lnp_{jt} + \sum d_{ij} \partial Lnp_{jt-1} + b_{i1} dBQ_t + b_{l2} dBQ_{t-1} + \sum_k^3 [g_{ik} D_k] + f_i T + e_{it} \quad (6)$$

where w_{it} is the expenditure share of lamb consumed from the i^{th} source country, p is the differential price based on the unit value of imports and the domestic wholesale price, and a, c_{ij} d_{ij}, b_1, b_2, g_{ik}, and f are parameters to be estimated and e is the disturbance term. The source countries included in the model are Australia, New Zealand and the United States. The United States was omitted to avoid singularity in estimation of the empirical model.

Own-price, cross-price, and expenditure elasticities, η are calculated for import from each country.

$$\eta_{ij} = \frac{(c_{ij} - d_{ij} + w_i w_j)}{w_i} \quad \text{Own-price and cross-price elasticities} \quad (7)$$

$$\eta_{iy} = 1 + \frac{\beta_i}{w_i} \quad \text{Expenditure elasticity} \quad (8)$$

Data

The data are monthly import quantities and expenditures for lamb and lamb cuts obtained from the U.S. Department of Commerce, U.S. Census Bureau; Foreign Trade Statistics. Import prices are based on unit values of total imports, which are assumed to be the wholesale values. U.S. wholesale lamb prices and domestic sheep and lamb production are obtained from the USDA, National Agricultural Statistics Service. Since U.S. lamb exports are negligible, domestic production was assumed to be all consumed domestically. Imports from countries other than New Zealand and Australia are also negligible. Thus, U.S. production along with imports from Australian and New Zealand provides a fairly accurate account of U.S total lamb and mutton consumption. Import data are converted to carcass weight equivalent to correspond with U.S. production data. The demand analysis is done at the wholesale level. A summary of the descriptive statistics is presented in table 1.

Empirical Results and Discussion

A separate system of demands is estimated for total lamb and mutton consumed and lamb and mutton identified country of origin. A set of hypotheses is tested to examine the seasonal effects on lamb and mutton import demand and also to look at the effect of the tariff rate quota imposed on lamb imported from Australia and New Zealand between July of 1999 and November of 2001. The 3sls procedure in SAS was used to estimate both the first stage and the second stage equations as a system. The U.S. equation was deleted in the second stage due to adding up restrictions. Symmetry and homogeneity restrictions were imposed on the lagged variables, following Anderson and Blundell (1983) and Kesvan et al., (1993).

The CBS model used here assumes endogenous quantities and predetermined prices. The Hausman statictic was used to test weather all prices can be taken as predetermined. Rejecting the CBS model suggests that prices and quantities are endogenous and shows that employing a 3sls is an appropriate method of estimation. Table 2 shows the test of predeterminedness of prices as a group and one at a time.

Specification test results suggests that both prices and quantities are endogenous in the lamb demand system using monthly data indicating that monthly prices and quantities from U.S. and importing countries adjust to changing factors within the entire lamb demand system.

Table 3 shows the parameter estimates for the first stage total lamb and mutton demand and Table 4 shows the parameter estimates for second stage lamb and mutton demand by country of origin. The mixed quantity index that was endogenous in the first stage became exogenous in the second stage, thus capturing the expenditure effects with respect to the country import demands. Homogeneity and symmetry were rejected in the long-run. The U.S. share equation was calculated based on the adding-up restrictions. In terms of seasonality, a significant difference is seen in the 2nd and 3rd quarters total demand, though there were no quarterly differences in import demand from either Australia or New Zealand. This is expected since U.S. lamb demand is highest during the religious holidays, Easter and Passover, which often occur in the early April.

The TRQ had no statistical significance on either total lamb demand or individual country import demand. This was probably due to the fact the despite implementation of the TRQ, imports from Australia and New Zealand did not slow as effects of the TRQ were largely offset by the strong U.S. dollar and unusually weak Australian and New Zealand currencies. However, the fact that the TRQ dummy is not significant lends validity to the demand system. If our demand system is valid, it has all the explanatory variables in it that it needs to explain lamb demand. The TRQ raises imported lamb prices, and that should be its only effect on demand.

Estimated conditional price and share demand elasticities (the share demand elasticity could be referred to as a scale elasticity) are reported in table 5. The conditional own-price elasticities represent both the substitution and the income effect of price changes. The conditional elasticities are averaged over the values for the years 1989 to 2002, the entire sample period. The own-price elasticities for both the short-

run and the long-run were negative. Own-price elasticities were less than one for all three countries implying that it is possible for them to increase revenue by increasing price. New Zealand was highly inelastic, suggesting that they stand to gain most from increases in prices.

The results suggest significantly different effects from price changes on U.S. lamb and mutton demand. If the price of U.S. and Australia lamb and mutton increases by 1-percent, the quantity demanded for lamb and mutton from these countries will decrease by 0.88 percent and 0.82 percent, respectively, in the short-run, and 0.88 percent and 1.93 percent in the dynamic long-run framework. Own-price changes have a greater effect on New Zealand lamb and mutton import demand. A 1-percent increase in New Zealand lamb price would decrease the import quantity demanded by the U.S. by about 0.29 percent in the short-run and 0.35 percent in the dynamic long-run framework.

The conditional scale elasticity measures the degree by which the U.S. country of origin demand changes when U.S. total lamb and mutton demand changes. Embodied in the scale elasticity is the expenditure effect, which captures the amount by which the lamb quantities demanded change when U.S. lamb expenditure changes. The conditional scale elasticities in table 5 are calculated based on the average total demand share for lamb from 1989 to June, 2002. In both the short-run and the dynamic long-run modeling frameworks, scale elasticities for all three countries were positive and greater than one but the U.S. scale elasticities, while positive was less than 1. These results indicate that, in the short-run, if the U.S. demand for lamb increases by 1 percent the quantity demanded of lamb and mutton from Australia and New Zealand increases by 1.12 percent and 1.15 percent, respectively, while the quantity demanded of U.S. lamb increase by 0.96 percent. A similar pattern was seen in the long-run and dynamic frameworks where Australia and New Zealand have positive scale elasticities of 1.23 percent and 1.63 percent, respectively, and the U.S. have a positive scale elasticity of 0.89 percent. Since the scale elasticities capture the income effect, it is expected that increases in income would cause lamb consumers

to consume more of the high-valued products, supplied by Australia and New Zealand, which may explain size of the scale elasticities of these two countries.

Table 6 presents the estimated conditional price and scale demand elasticities for the CBS model based on the average shares between 1989-1995 and table 7 presents similar conditional price and scale demand elasticities based on average shares between 1996 and June, 2002. The two time-periods were evaluated in order to look at elasticity changes especially since 1995 when increases in lamb imports to the U.S. were most dramatic. The results show a similar pattern to those reported in table 5 with average shares for the 1989-2002 period. However, relative own price elasticities for Australia and the United States was less between 1996 and 2002 than the period prior to 1996. This suggests that the U.S. dependence on lamb imports since 1995 has caused it to be less price responsive. For Australia, the short-run own price elasticity of import demand through 1995 was elastic at -1.29, while since 1995, it became inelastic at --0.69. For the U.S. the conditional short-run own-price elasticities became even more inelastic over time, changing from -0.96 prior to 1996 to -0.73 since 1995. The conditional own-price elasticity for New Zealand also showed a relative increase since 1995, increasing from -0.44 to -0.27.

Based on the conditional scale demand elasticity estimates presented in tables 6 and 7 the relative scale elasticities for all three countries also declined. Between 1989 and 1995, import demand responses for Australia and New Zealand were large in the short-run, 1.26 percent and 1.30 percent, respectively, while the U.S. showed a scale elasticity of -0.97 percent. Since 1995, the share import demand responses from Australia and New Zealand have decreased though they remain greater than 1. Since 1995, the U.S. scale elasticity of total demand decreased even further. A 1-percent increase in U.S. total lamb demand will result in 0.88 percent increase in U.S. share of total lamb demanded.

Conclusions

Previous studies, have attempted to examine lamb demand in the U.S., but have had a narrow focus, using single-equation, quantity-dependent models as the analytical tool to estimate lamb demand. This study estimates U.S. demand for lamb and mutton by looking at source country of origin. The model assumes a two-stage budgeting process, where in the first stage the aggregate U.S. demand of lamb is estimated and in the seconds stage the aggregate demand index which was endogenous to the first stage becomes exogenous to the second stage thus capturing the expenditure effects with regards to the country import demands. This allows us to better evaluate the potential impacts that production and policy shocks that come from source country of origin will have on the U.S. demand for lamb, through their effects on price. For this purpose, a CBS version of the almost ideal demand system was employed. The CBS model combines Engel conditioning with the simplicity of the Slutsky matrix to allow for implementing concavity and other restrictions with relative ease. The resulting model allows for both short-run and long-run specifications in a two-stage framework, while exploring effects of seasonality and the impact of a TRQ established for a 29-month period between July 1999 and November 2001.

The empirical results indicate a significant difference in the second quarter total demand for lamb but no difference in quarterly import demand from either Australia or New Zealand. The TRQ, however, had no impact on either total lamb demand or individual country import demand.

The conditional own-price elasticities for both the short-run and the long-run were negative. No significant differences were observed in elasticities in the short-run and long-run due to the slow rate of adjustment in consumer demand behavior to price changes. There is evidence that, over time, conditional own-price elasticities of demand for New Zealand and Australia have shown relative decreases while the conditional own-price elasticity for the United States has shown relative increases.

A positive but less than proportionate scale elasticity was observed for the United States while positive, and more than proportionate scale elasticities were observed for Australia and New Zealand lamb, suggesting greater preference for lamb from other countries. Over time, however, scale elasticities for Australia and New Zealand have shown relative decreases, though still positive and greater than 1, while the United States scale elasticity has moved even closer to unity.

The study results reported here suggest that Australia is able to increase its revenue while decreasing price due to its elastic own-price elasticity of import demand while the U.S. and New Zealand sheep producers could increase their total revenue by increasing prices because of the inelastic nature of their share demands. Also, the negative scale elasticity of total demand for the U.S. suggests a lack of preference for domestic lamb by U.S. consumers.

Limitations of the Study

In the absence of retail prices and quantities, wholesale level data was used for the analysis. Ideally, retail level prices and quantities would be more appropriate to gauge consumer response. However, retail level time series data is unavailable for lamb and mutton. Also, it is highly likely that the results of the study were influenced by the fact that different countries supply different mixes of lamb and mutton cuts. An interesting feature would be to evaluate the source country demand for lamb and mutton based on types of cuts. However, although imported quantities and unit values can be obtained for some cuts, though limited, the U.S. supply is not differentiated by cuts.

Table 1. Descriptive Statistics on U.S. Consumption of Lamb and Mutton by Source Country, January 1989 to 2002.

	Australia	New Zealand	U.S.
Value (000 USD)			
Mean	$5,513.53	$4,159.96	$35,297.70
Median	4,396.84	3,457.13	35,488.75
Minimum	1,082.60	869.27	20,763.20
Maximum	21,247.48	10,995.32	53,840.00
Coefficient of Variation	70.83	67.68	15.41
Quantity (000 pounds)			
Mean	4,715.00	2,146.85	23,800.60
Median	3,766.70	1,867.42	23,000.00
Minimum	1,329.49	652.93	15,100.00
Maximum	16,689.51	5,298.45	36,000.00
Coefficient of Variation	56.55	52.75	20.43
Unit Value ($ per hundred Pound)			
Mean	109.10	178.95	151.49
Median	112.05	172.33	152.74
Minimum	54.53	98.26	106.50
Maximum	161.50	301.48	216.75
Coefficient of Variation	26.27	25.48	15.70
Expenditure Shares			
Mean	0.12	0.09	0.79
Median	0.10	0.08	0.83
Minimum	0.03	0.02	0.49
Maximum	0.33	0.22	0.94
Coefficient of Variation	64.03	60.58	15.70

Table 2. Hausman Test Results of Predeterminedness of Prices, Grouped and One by One

Variables	Grouped	Australia	New Zealand	United States
Price	172.9*	90.3*	124.5*	108.9*

Statistics are Chi-square at 91 and 59 degrees of freedom, respectively. Cut-off for 0.01 at df=>50 is 29.06

Table 3. Estimated parameters for the total lamb and mutton demand model

Parameters	Coefficient	Standard error	t ratio
α_1	0.293	0.055	5.31
β_1	-1.262	0.101	-12.54
β_2	-0.009	0.241	-0.04
β_3	0.906	0.392	2.31
β_4	-3.398	2.589	-1.31
β_5	-1.322	0.384	-3.45
β_6	1.162	0.356	3.26
β_7	-0.122	0.368	-0.33
δ_{i1}	2.944	3.242	0.91
δ_{i2}	-1.416	0.612	-2.31
γ_{i1}	2.630	0.546	4.81
γ_{i2}	-0.543	0.637	-0.85
τ_{i1}	-0.153	0.090	-1.7
τ_{i2}	-0.685	0.088	-7.78
τ_{i3}	-0.300	0.090	-3.34
λ_1	-0.067	0.118	-0.57

Table 4. Three Stage Least Squares parameters of the dynamic CBS of U.S. lamb and mutton demand

Parameters	Coefficient	Standard error	t ratio
α_{11}	0.013	0.006	2.05
β_1	-1.443	0.056	-25.64
C_{11}	-0.088	0.012	-7.61
C_{12}	-0.012	0.011	-1.10
C_{13}	-0.013	0.033	-0.39
D_{11}	-0.121	0.022	-5.64
D_{12}	-0.024	0.020	-1.23
D_{13}	0.071	0.052	1.36
B_{11}	0.015	0.023	0.64
B_{12}	0.013	0.035	0.37
τ_{11}	-0.011	0.012	-0.94
τ_{12}	-0.004	0.012	-0.36
τ_{13}	-0.030	0.011	-2.67
λ_{11}	0.001	0.013	0.10
α_{21}	-0.010	0.007	-1.32
C_{21}	0.006	0.014	0.44
C_{22}	-0.017	0.013	-1.26
C_{23}	0.060	0.040	1.50
D_{21}	0.033	0.024	1.35
D_{22}	-0.002	0.023	-0.07
D_{23}	0.016	0.063	0.26
B_{21}	0.013	0.028	0.48
B_{22}	0.043	0.043	1.00
τ_{21}	0.029	0.014	2.06
τ_{22}	0.008	0.014	0.60
τ_{23}	0.019	0.013	1.44
λ_{21}	-0.018	0.016	-1.12

Table 5. Estimated conditional price and share demand elasticities for the CBS model, 1989-2002.

	Australia	New Zealand	United States	Share of total Demand
Short-run				
Australia	-0.882	-0.206	-1.000	1.124
New Zealand	-0.067	-0.293	-0.239	1.150
United States	-0.010	-0.048	-0.825	0.965
Dynamic long-run				
Australia	-1.927	-0.419	-0.484	1.234
New Zealand	0.246	-0.354	-0.443	1.635
United States	0.110	-0.010	-0.879	0.894

Table 6 Estimated conditional price and share demand elasticities for the CBS model, 1989-1995

	Australia	New Zealand	United States	Share of total Demand
Short-run				
Australia	-1.629	-0.275	-1.354	1.258
New Zealand	0.064	-0.443	0.189	1.303
United States	0.036	-0.010	-0.924	0.969
Dynamic long-run				
Australia	-3.785	-0.708	-0.307	1.487
New Zealand	0.755	-0.522	-0.327	2.284
United States	0.139	0.021	-0.965	0.907

Table 7. Estimated conditional price and share demand elasticities for the CBS model, 1996-2002

	Australia	New Zealand	United States	Share of total Demand
Short-run				
Australia	-0.687	-0.214	-0.815	1.082
New Zealand	-0.151	-0.273	-0.309	1.100
United States	-0.052	-0.085	-0.729	0.959
Dynamic long-run				
Australia	-1.379	-0.358	-0.468	1.154
New Zealand	0.037	-0.328	-0.411	1.422
United States	0.091	-0.037	-0.799	0.878

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