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U. S. Import Demand for Goat Meat, Sheep and Lamb, and Other Lesser Meat

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Americans consume many species of animals, with poultry, beef, and pork being the most important. While lamb has been a lesser consumed meat since colonial times and goat meat is consumed widely in many countries of the world, consumption of goat meat has been limited in the United States (Locascio and Degner 1988). However, food-consumption patterns have changed considerably over the last few decades, both worldwide and in the United States. These changes in the American diet have resulted in part from increased ethnic diversity in the population, greater disposable income, increased trade, improved transportation, more women in the labor force, and increased awareness and consumer preference for improved quality and healthy products (Regmi 2001).

Two of the most popular and competing diets during the last 15 years have been the low-fat, low-cholesterol diet and the low-carbohydrate diet. As large numbers of Americans adopted these diets, the consumption of different foods changed (Miljkovic and Mostad 2005), particularly consumption patterns for meat and meat products. Declining beef, fast-growing poultry, and leveling-off pork consumption characterized the well-known shift from "red" to "white" meat (Nelson and Liu 2005). American consumers participate in a food system that is characterized by the fulfillment, if not satiation, of basic needs—what is termed a mature market (Ballenger and Blaylock 2003). Rising incomes allow Americans to continue to upgrade their food choices to include, for example, more-expensive cuts of meats, exotic vegetables, luxury food items, ready-to-eat meals, and higher-priced restaurants.

Growing ethnic diversity has contributed to shifts in food preferences as well as a notable expansion of the American food repertoire. Food preferences vary among different nationalities, cultures, and religious and ethnic groups, and current demographic

patterns in the U.S. favor increased consumption of goat meat (Thompson, Backes, and Knipe 2004). Goat meat, commonly referred to as "chevon" or "cabrito," is, however, the most popular meat product in the world and is often served in specialty dishes centered on festival or holiday events (Sande, Sande, and Epperson 2005). Goat meat has also won favorable recognition for its quality (Babiker, El Khider, and Shafie 1990), matching consumer preferences for low-fat and being relatively low in calories but high in protein and other important nutrients. Increased ethnic diversity is hypothesized to increase the demand for many ethnically identified foods, including goat meat, lamb and mutton, and other lesser meats.

The most recent estimate of goat meat demand was done by Gipson (1999), who concluded that about 800,000 goats were slaughtered for U.S. consumption in 1998. The U.S. goat industry is predominantly an infant industry and is noted to be the fastest-growing animal industry in the U.S., at an estimated rate of 10 to 15 percent annually. Still, insufficient goats are produced domestically (Johnson 2002), so the industry depends on imports, mainly from Australia and New Zealand. Currently, the U.S. imports more goat meat than does any other country (Mauldin and Mauldin 2003).

Lamb and mutton consumption remains very low—purchased by fewer than five percent of American households on a weekly basis—compared with other red meats, and its consumers are culturally and ethnically distinct. Consumption has remained constant within these groups, who persist in maintaining their ethnic practices (Jones 2004). Lamb is generally a higher-priced product than beef, pork, and poultry, since lamb consumers prefer higher value cuts of legs and loins. U.S. sheep farmers are less inclined to produce lamb when returns from the whole carcass are based on a few desirable cuts, causing domestic demand to exceed domestic supply (Jones, 2004). From less than 20 percent of consumption in 1995, imports of lamb increased to more than 45 percent in 2004.

Our objective is to analyze quantitatively the import-demand structure for goat meat, lamb and mutton and other lesser meats. Because ethnic communities are believed to be primary consumers of lamb and mutton, and of other lesser meats, we estimate their effect on import demand. To test hypotheses about the import demand for goat meat, sheep and lamb, and other lesser meats, we use the Linear Approximate Almost Ideal Demand System (LA/AIDS). The following section presents the theoretical background underlying this choice, the data set, and the model specification. Empirical findings and a discussion of their implications follow, with a final summary and conclusions derived from the study.

The Lesser-Meats Demand Model

Our analysis of the lesser-meats demand is based on consumer-utility theory: consumers purchase commodities and services to increase their utility/satisfaction. Import demand for minor meats—here defined as goat meat, sheep and lamb, and other lesser meat—will be estimated within a system of demand equations. The demand for each good in the system is specified as a function of its own price, the prices of the other goods in the system, and total expenditures on the group of goods. The model assumes that these meat products are weakly separable from other food and non-food consumption items. We employ the LA/AIDS model of Deaton and Muellbauer (1980a, b) to estimate this system, as it is a flexible functional form and can be estimated in a linear form that allows incorporation of demographic factors in the intercept terms.

In the context of a trade-allocation model, the two-stage budgeting procedure can be explained as follows. In the first stage, an importer's total imports of all goods and services can be expressed as

$$(1) M = M(X, P, P_0, Z_1),$$

where M is total imports of all goods and services, X is the importer's national income, P is an index of the import price of all goods, P_0 is a vector of the prices of all other goods, and Z_1 is a vector of other explanatory variables. In the second stage, total imports of all goods and services are divided up into distinct commodity groups:

$$(2) M_i = M_i(M, P_1, \dots, P_n, Z_2), \quad i = 1, \dots, n,$$

where M_i represents the imports of good i ($i = 1, \dots, n$), P_j represents the import price of good j , and Z_2 is a vector of other exogenous variables. Following Deaton and Muellbauer (1980b), a linear approximation of the AIDS model is used, which substitutes the Stone index for $\log P$. The resulting model is estimated using Zellner's Iterative Seemingly Unrelated Regression (ITSUR) procedure (Zellner 1962). Since budget shares sum to one in the AIDS model, the contemporaneous covariance matrix of disturbance terms is singular, requiring exclusion of one equation in the estimation of the model, chosen to be "other meat." We estimate the model with homogeneity and symmetry restrictions imposed. Given the above specifications, Marshallian (uncompensated) and Hicksian (compensated) demand elasticities are computed from the estimated parameters of the LA/AIDS model, according to Asche and Wessels (1997).

As a general rule, own-price elasticities are expected to be negative and expenditure elasticity to be positive. No a priori assumptions are made for the cross-price elasticities. The increase in the number of Hispanics in the U.S. in recent years is thought to influence the consumption of these minor meats, used mostly in specialty dishes. The demographic elasticity is therefore expected to be positive.

Before estimating import demand using the LA/AIDS model, we test for separability between imports and local production for minor meats. We used the Generalized Composite Commodity Theorem (GCCT) to test for separability. Weak separability of preferences and two-stage budgeting were assumed for the group of minor-meat imports. According to Winters (1984) and Alston, Carter, and Pick (1990), the separability assumptions—that all goods from all sources are separable from each other as well as from all other goods—are not in general necessary between imports from different countries because flexible functional forms such as LA/AIDS allow import-demand equations where the imported goods are not separable. The GCCT, proposed by Lewbel (1996), relaxes the Hicks-Leontief theorem (which requires that prices of all items in the group move absolutely synchronously, conditions which are never satisfied in real-world data) by allowing ρ to vary over time, and instead assumes only that the distribution of ρ is independent of \mathbf{R} and of

income (Lewbel 1996). Following Lewbel, define \mathbf{p} as a vector of p_i , \mathbf{r} as a vector of r_i , and \mathbf{R} as a vector of R_i :

$$(3) \begin{aligned} r_i &= \ln(p_i), \\ R_i &= \ln(P_i), \\ \rho_i &= \ln(p_i/P_i) = r_i - R_i, \end{aligned}$$

where p_i is the price for commodity i , $i = 1, \dots, 3$; P_i is the price index of group I ; and z is the log of total import expenditures.

To test for weak separability, one first tests the time series properties of each p_i and R_i to determine whether they are stationary. This is done using the augmented Dickey-Fuller test (ADF) where the outcome of independence will mean the GCCT holds and thus that imports are separable from local production.

Data and Estimation Procedure

Data on goat meat, sheep and lamb, and "other meat" monthly imports to the U.S. were obtained from the USDA Foreign Agricultural Service, Foreign Trade Statistics (www.fas.usda.gov/ustrdscripts/USReport.exe). The FAS reported both the monthly imported value in U.S. dollars and the total imported volume in metric tons for the period 1989:1 through 2004:12. Real values in 1982–84 dollars were obtained using the monthly consumer price index from the Bureau of Labor Statistics (www.bls.gov/cpi/home.htm). The seasonally unadjusted U.S. average consumer price indexes for all urban consumers with 1982–84 base were utilized. The import prices were thus calculated by dividing the value of imports by the imported quantities. Data on monthly Hispanic population were obtained from the U.S. Census Bureau (www.census.gov).

Some specification problems need to be mentioned. First, the fact that we are using import data has implications for the interpretation of the results. The LA/AIDS model is a consumer-demand model, so using import data implies that we are actually estimating a derived demand system. This might cause problems, as consumers' preferences are not necessarily reflected by the importers' demand. However, since the AIDS model is also used in estimating international trade models, it is possible to interpret the results in our case as import demand, according to Asche et al. (2005). To test

for the GCCT, the time-series properties of the individual prices p_i , relative prices ρ_i , group-price index R_i , shares w_i and the real-expenditure variable x , were investigated using the ADF test (Dickey and Fuller 1979). Based on the outcome of these tests, we chose an appropriate test for independence between the relative prices ρ_i and the group price index R_i (Davis, Lin, and Shumway 2000).

Results and Discussion

Import demand for goat meat, sheep and lamb, and other lesser meat was estimated using monthly data from 1989:1 to 2004:12. Lesser meat constitutes almost 50 percent of minor-meat imports, while sheep and lamb have almost the same share as goat meat. Unit prices show the U.S. pays more for goat meat than for sheep and lamb, consistent with Solaiman (2005): \$0.64, \$0.49, and \$2.61 per pound for goat meat, sheep and lamb, and other lesser meats, respectively.

The null hypothesis of nonstationarity (unit root) was not rejected in the ADF test (Dickey and Fuller 1979) for all six variables at a five percent level. After differencing each of the variables, the null hypothesis of nonstationarity was rejected at the five percent level, indicating the series is $I(1)$. The group-price index for the minor-meat group was created using the Tornquist index, and this was found to be stationary. Relative prices for each of the three commodities were also found to be stationary. Spearman's rank-correlation test was used to test for cointegration (independence) between each of the relative prices and the group index, according to Davis, Lin, and Shumway (2000). Results indicate that each of the relative prices is independent of the group-price index, and so the GCCT holds, meaning imports are separable from local production.

Import Demand Estimation

Table 1 presents the estimated parameters for the LA/AIDS using Zellner's ITSUR for goat meat, sheep and lamb, and other lesser meats, respectively. The equation for other lesser meats was dropped from the system to avoid the singularity condition in the variance-covariance matrix, and parameter estimates were recaptured from the estimated models using the homogeneity and symmetry conditions. The parameter estimate for the Hispanic popula-

Table 1. ITSUR Parameter Estimates of LA/AIDS Model for Goat, Sheep and Lamb, and Other Lesser Meats, Homogeneity and Symmetry Restrictions Imposed, 1989–2004.

Independent variable	Goat meat	Sheep and lamb	Other lesser meats
Lpgoat	0.157***	0.03***	0.014
Lpsheep	-0.17***	0.03***	0.03
Lpothor	0.014	0.02	-0.046*
lxp	0.03	0.019***	-0.25***
hispop	-0.000009*	0.0000048**	-0.0000006
DPI	0.0001***	0.000022***	0.00003
Intercept	-0.33**	0.12***	1.96**
R^2	0.45	0.57	0.63

* 0.10 level of significance.

** 0.05 level of significance.

*** 0.01 level of significance.

tion in the U.S. is significant in the sheep and lamb equation and in the goat meat equation, but it is not significant to other lesser meat import demand. However, the estimate has a negative sign and is close to zero in all equations. This could be because official Hispanic population statistics are below the true figures. Asians and African-Americans are also major consumers of exotic meats like goat meat and lamb and mutton, and thus the demographic effect on these meats was likely underestimated by including only the official Hispanic population.

Disposable personal income is significant in the goat meat and sheep and lamb equations, but not to other lesser meats demand. The estimate has a negative sign in the sheep and lamb demand; that is, as incomes go up, less sheep and lamb is imported. This can be linked to the fact that a majority of the American population does not consume sheep and lamb, and with higher disposable income, they will tend to substitute other meats. There is also the likelihood that Hispanic and other ethnic populations do not report their correct incomes, thus underestimating the effect of their DPI on demand.

Price and Income Effects

Except for goat meat, the estimated own-price effects are negative and consistent with a priori expectations (Tables 2 and 3). All own-price elasticities

of import demand for the minor-meat categories were negative, consistent with economic theory: -0.138, -0.21 and -0.63 for goat meat, sheep and lamb, and other lesser meats, respectively. These magnitudes suggest all three minor meat types to be highly inelastic, and thus quantities consumed will not vary much with changes in prices, consistent with Lillywhite (1999).

Cross-price elasticities indicate goat meat and sheep and lamb are complements, consistent with Nelson and Liu (2005), but contrary to an earlier-held belief that they are substitutes among ethnic communities (Lillywhite 1999). Other lesser meat is, however, shown to be a substitute both for goat meat and for sheep and lamb. This substitution effect is slightly larger for sheep and lamb than for goat meat, a further indication of the inelasticity of goat meat demand compared to lamb and mutton.

Total expenditure on minor meats is significant and positively related to sheep and lamb expenditures and significant and negatively related to other lesser-meats expenditures, but not significant to goat meat expenditure. All expenditure elasticities have positive signs, as expected (Table 2), with goat meat and sheep and lamb being expenditure elastic, suggesting luxury expenditures. Estimated expenditure elasticities are 1.12 for goat meat, 1.81 for sheep and lamb, and 0.47 for other lesser meats. Sheep and lamb are mostly purchased by consumers with

Table 2. Estimated Lesser-Meat Expenditure and Uncompensated Price Elasticities, 1989–2004.

	Expenditure elasticity	Uncompensated price elasticity		
		Goat meat	Sheep and lamb	Other meat
Goat meat	1.12	0.43	-0.68	-0.001
Sheep and lamb	1.81	-0.85	-0.70	-0.26
Other meat	0.47	0.17	0.21	-0.85

Table 3. Compensated Lesser-Meat Price Elasticities, 1989–2004.

	Compensated elasticity		
	Goat meat	Sheep and lamb	Other meat
Goat meat	-0.138	-0.38	0.52
Sheep and lamb	-0.37	-0.21	0.58
Other meat	0.29	0.337	-0.63

higher incomes (Jones 2004), and results are consistent with the belief that consumers readily substitute lamb and mutton with other protein sources such as beef, pork, and chicken, when expenditure declines (Steller 2003).

Conclusions

Meat-consumption patterns in the U.S. have changed toward white meat and away from red meat. These changes have been attributed to changes in the diversity of the American population as well as to health and nutritional concerns. Ethnic populations that require goat meat for religious and cultural reasons are increasing due to increasing immigration. The U.S. does not presently produce enough goats and sheep to supply its needs, and this has resulted in an increase in imports for these meats. Our results indicate goat meat import demand to be highly inelastic, and yet import prices have been noted to have risen. Recent initiatives, such as the Tobacco Buy-Out Program, have caused a shift in agricultural production to those types of products that are more sustainable and consumer friendly, such as goat meat. However, production costs in the U.S. often result in goat meat that is substantially higher-priced than imports. While the quality

of such domestically produced goat meat is vastly superior, it remains to be seen if ethnic minorities will recognize the price differential for quality.

The decline in the U.S. sheep industry is well-documented, with sheep numbers falling from 56 million in 1942 to under 8 million in 1998. However, recent strong domestic demand from increasing ethnic populations has surpassed the low supplies and thus led to increased imports. From less than 20 percent of consumption in 1995, imports increased to more than 45 percent in 2004 and will likely continue increasing.

Our main objective in this study was to determine the import demand for goat meat, sheep and lamb, and other lesser meat imports by the U.S. as a proxy to estimate local demand, particularly for goat meat. We found that import demand for the three minor meats is inelastic, and the implication of inelastic demand in the face of increasing ethnic populations is an increasing market for these meats. The U.S. sheep and lamb industry has been declining, with an increase in imports. Given that import demand, the new, larger consumer base—notably ethnic populations—bodes well to possible revitalization. While not entirely conclusive, we show that the minor meat market in America can sustain increasing local production.

References

- Alston, J., R. G. Carter, and D. Pick. 1990. "Whither Armington Trade Models?" *American Journal of Agricultural Economics* 72:455–67.
- Asche, F., A. G. Guttormsen, D. Kristofersson, and C. Roheim. 2005. "Import Demand Estimation and the Generalized Composite Commodity Theorem." Paper Presented at the American Agricultural Economics Association Annual Meeting, Providence, RI, July 24–27.
- Asche, F., and C. R. Wessels. 1997. "On Price Indices in the Almost Ideal Demand System." *American Journal of Agricultural Economics* 79:1182–1185.
- Babiker, S. A., I. A. El Khider, and S. A. Shafie. 1990. "Chemical Composition and Quality Attributes of Goat Meat and Lamb." *Meat Science* 28:273–277.
- Ballenger, N., and J. Blaylock. 2003. "Consumer-Driven Agriculture: Changing U.S. Demographics Influence Eating Habits." *Amber Waves* 1(2): 28–33.
- Davis, G. C., N. Lin, and C. R. Shumway. 2000. "Aggregation without Separability: Tests of the United States and Mexican Agricultural Production Data." *American Journal of Agricultural Economics* 82(1):214–230.
- Deaton, A. and J. Muellbauer. 1980a. "An Almost Ideal Demand System." *The American Economic Review*. 70(3):312–326.
- Deaton, A. and J. Muellbauer. 1980b. *Economics and Consumer Behavior*. Cambridge: Cambridge University Press.
- Dickey, D. A. and W. A. Fuller. 1979. "Distribution of Estimators for Autoregressive Time Series with a Unit Root." *Journal of the American Statistical Association* 74:427–431.
- Gipson, A. T. 1999. "Demand for Goat Meat: Implications for the Future of the Industry." In: *Proceedings of the Fourteenth Annual Goat Field Day*, Langston University, Langston, OK. www.attra.org/attra-pub/meatgoat.html.
- Johnson, A. S. 2002. "Goat Briefing." Ames: Iowa State University Extension Service.
- Jones, K. G. 2004. "Trends in the U.S. Sheep Industry." USDA-ERS Agricultural Information Bulletin no. 787.
- Lewbel, A. 1996. "Aggregation Without Separability: A Generalized Composite Commodity Theorem." *The American Economic Review* 86(3):524–543.
- Lillywhite, J. 1999. "The Feasibility of Meat Goats in Minnesota. Phase I Project Report." Marshall, MN: Agricultural Utilization Research Institute (AURI) Publication.
- Locascio, J. D., and R. L. Degner. 1988. "Opinions and Attitudes of Chain Supermarket Representatives toward Goat Meat." Staff report - Florida Agricultural Market Research Center, Food and Resource Economics Department, Institute of Food and Agricultural Sciences, no. 14.
- Mauldin, J. and A. Mauldin. 2003. "U.S. Goat Production Remains Far Behind Demand for Meat." *Meat Goat Monthly Magazine*. http://www.jackmauldin.com/us_can't_meet_demand.htm.
- Miljkovic, D. and D. Mostad. 2005. "Impact of Changes in Dietary Preferences on U.S. Retail Demand for Beef: Health Concerns and the Role of Media." Paper presented at the American Agricultural Economics Association Annual Meeting, Providence, RI, July 24–27.
- Nelson, M. C. and X. Liu. 2005. "Demand Potential for Goat Meat in Southern States: Empirical Evidence from a Multi-State Goat Meat Consumer Survey." Providence, RI.
- Regmi, A., ed. 2001. *Changing Structure of Global Food Consumption and Trade: An Introduction. Changing Structure of Global Food Consumption and Trade*. USDA - ERS Publication WRS01-1.
- Sande, D. N., J. E. Houston, and J. E. Epperson. 2005. "The Relationship of Consuming Populations to Meat-Goat Production in the United States." *Journal of Food Distribution Research* 36(1):156–160.
- Solaiman, S. G. 2005. "Outlook for a Small Farm: Meat Goat Industry for California." Davis: University of California Small Farm Center.
- Steller, R. M. 2003. "Industry Trade and Summary: Live Sheep and Meat of Sheep." Washington, D.C.: U.S. International Trade Commission.
- Thompson, E., G. Backes, and D. Knipe. 2004. *MarketMaker Chicago Ethnic Markets*. Urbana: University of Illinois Extension.
- USDA Foreign Agricultural Service. *Foreign Trade Statistics*. www.fas.usda.gov/ustrdscrip/USReport.exe.
- U.S. Bureau of Labor Statistics. www.bls.gov/cpi/

home.htm.

U.S. Census Bureau. No date. www.census.gov.

Winters, L. A. 1984. "Separability and the Specification of Foreign Trade Functions." *Journal of International Economics* 17:239-63.

Zellner, A. 1962. "An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests for Aggregation Bias." *American Statistical Association* 57(298):348-368.