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Demand for red meat, poultry, and fish in Morocco: an almost ideal demand system

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ABSTRACT

There is a paucity of data and basic research needed for policy analysis in Morocco. Subjective estimates for elasticities are currently used in making policy recommendations. An Almost Ideal Demand System model is used to estimate demand elasticities for beef, mutton, poultry, and fish in Morocco. Mutton is shown to be a luxury good reflecting Moroccans' preference for mutton. Demand is shown to be more elastic than has been assumed in some past policy analyses.

INTRODUCTION

In 1983, with World Bank support, the Moroccan government began removing trade restrictions and freeing domestic markets from government regulation. Policymakers now need estimates of social welfare and market adjustments under alternative policies in order to select the most beneficial alternatives. One method used has been a computable general equilibrium (CGE) model. But, CGE models require estimates of the elasticities of demand and supply. A tradition of agricultural economics research has been slow to develop in Morocco. Consequently, the knowledge base on the agricultural economy is not strong. Little basic research needed for

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applied agricultural economic analysis is available. Although estimates of supply and demand elasticities and other basic parameters for the agricultural sector exist, their accuracy is not known.

Elasticity estimates are critical parameters in determining the impacts of any policy change. Subjective estimates of elasticities based on estimates made for other countries are currently being used for policy analysis in Morocco (World Bank, 1989) and the use of these may lead to inaccurate conclusions. AIRD reported elasticity estimates from an unpublished study by Ministère du Plan which used cross-section data. Cross-section elasticities can be quite different from elasticities estimated with time series data. Baijou (1990) attempted to estimate elasticities, but deemed his estimates of the elasticity of demand for livestock products such as beef, mutton, goat and poultry as too inaccurate to be used in policy analysis. Baijou instead used regional elasticities from a World Bank study by Laraki (1989). In fact, most current policy analysis in Morocco is based on elasticities for the aggregate of all meat. The demand for red meat, poultry, and fish in Morocco may be quite different from demand in other countries because of religious and cultural differences. Most Moroccans are followers of Islam and therefore do not eat pork, a popular meat in many other countries. Mutton and goat, however, are eaten in large quantities, and most Moroccans prefer mutton to beef.

The objective of this paper is to determine elasticities of demand for red meats (beef, mutton, and goat), poultry, and fish. An Almost Ideal Demand System (AIDS) was estimated using Moroccan data for 1969–1985. Unlike previous elasticity estimates, our elasticity estimates are restricted to be consistent with the restrictions suggested by demand theory. Three different audiences might benefit from this paper. The first audience is model builders who need these parameters to use in their models. The second audience is the Ministry of Agriculture which must devise policies to mitigate the impact of an adjustment program or must target a policy toward a specific group in the population. The last audience is international donors, such as the World Bank.

THEORETICAL MODEL: THE AIDS MODEL

The Almost Ideal Demand System was developed by Deaton and Muellbauer (1980a,b). The AIDS model is indirectly non-additive and consistent with the requirements of demand theory, and therefore is an appropriate choice for estimating demand for red meat, poultry, and fish. The AIDS model has many desirable attributes: (a) it is an arbitrary first order approximation to any demand system, (b) it satisfies the axioms of choice, (c) it aggregates over consumers, (d) it has a functional form consistent with

previous household budget data, and (e) it is easy to estimate. The estimated coefficients in a linear approximate almost ideal demand system (LA/AIDS) model are easy to interpret (Fulponi, 1989). Also, the AIDS model allows testing for homogeneity and symmetry. The AIDS model has been extensively used in empirical work (Eales and Unnevehr, 1988; Hayes et al., 1990; Green and Alston, 1988; Foster et al., 1990; Chalfant, 1987; Fulponi, 1989; Ray, 1984). Following past literature, we assume that the utility of red meat, poultry, and fish is weakly separable from the quantities consumed of all other goods.

The AIDS model is:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log(X/P) \tag{1}$$

where w_i is the ith budget share, p_j are prices, γ_{ij} are the price coefficients, β_i is the expenditure coefficient, X is total expenditure on all commodities in the system, and:

$$\log P = \alpha_0 + \sum_k \alpha_k \log p_k + \tfrac{1}{2} \sum_j \sum_k \gamma_{kj} \log p_k \log p_j \tag{2}$$

is a price index. For consistency with demand theory, the following restrictions must hold:

$$\sum_i \alpha_i = 1 \qquad \sum_i \gamma_{ij} = 0 \qquad \sum_i \beta_i = 0 \qquad \text{(adding up restriction)} \tag{3}$$

$$\sum_j \gamma_{ij} = 0 \qquad \text{(homogeneity)} \tag{4}$$

$$\gamma_{ij} = \gamma_{ji} \qquad \text{(symmetry)} \tag{5}$$

Constraints (3), (4) and (5) ensure that the system satisfies the adding up, homogeneity, and symmetry restrictions.

PROCEDURE AND MODEL SPECIFICATION

The AIDS model described in the previous section is estimated for 1969–1985 using annual Moroccan data. The model is estimated for four products, i.e., beef, mutton, poultry, and fish. Mutton and goat were aggregated and considered a single commodity. The specified model is:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log(X/P^*) \tag{6}$$

where P^* is the 'Stone index' calculated as:

$$\log P^* = \sum_k w_k \log p_k \tag{7}$$

This linear approximation of the AIDS model (LA/AIDS) is estimated by using Zellner's seemingly unrelated regression method (Zellner, 1962). The LA/AIDS model was estimated with symmetry and homogeneity restrictions imposed. Because of the adding up condition, the contemporaneous covariance matrix is singular and, therefore, one equation was deleted from the system. The parameter estimates are the same regardless of which equation is omitted. Initial empirical estimates showed all the Durbin–Watson statistics to be in the indeterminant range, but were low enough to be of concern. Therefore, the estimates were adjusted for autocorrelation using one Colchrane–Orcutt iteration and imposing that each equation have the same autocorrelation parameter.

Marshallian and Hicksian elasticities are computed from the estimated parameters of the LA/AIDS model as (Hayes et al., 1990):

$$\epsilon_{ii} = -1 + \gamma_{ii}/w_i - \beta_i \tag{8}$$

$$\epsilon_{ij} = \gamma_{ij}/w_i - \beta_i(w_j/w_i) \tag{9}$$

$$\delta_{ii} = -1 + \gamma_{ii}/w_i + w_i \tag{10}$$

$$\delta_{ij} = \gamma_{ij}/w_i + w_j \tag{11}$$

where the ϵ's denote Marshallian elasticities and the δ's Hicksian elasticities. The expenditure elasticities were calcutated as:

$$\eta_i = 1 + \beta_i/w_i \tag{12}$$

The standard errors of the elasticities were calculated at the mean assuming the mean budget shares to be fixed. The standard errors were then calculated using the usual formulas for the distribution of a linear transformation of a normally distributed random vector. Equations (8)–(12) can be rewritten in matrix form as:

$$e = Ab \tag{13}$$

where e is the vector of estimated elasticities (ϵ's, δ's, η's), b is the vector of estimated AIDS model parameters (α's, γ's, β's), and A is a matrix. The variance covariance matrix of e, VAR(e) is

$$\text{VAR}(e) = A\ \text{VAR}(b)\ A' \tag{14}$$

where VAR(b) is the variance covariance matrix of b.

TABLE 1

Prices and quantities of red meat, poultry and fish consumed in Morocco

Year	Quantities (kg per person per year)				Prices (dirham [a] per kg)				Price Index
	Beef	Mutton	Poultry	Fish	Beef	Mutton	Poultry	Fish	
1969	5.95	6.72	1.68	2.78	6.19	7.54	8.97	1.48	1.00
1970	6.80	5.68	1.97	3.20	6.70	7.53	8.88	1.56	1.01
1971	6.31	5.34	2.01	3.88	7.14	8.25	9.09	1.66	1.05
1972	4.98	6.03	2.56	3.61	7.53	8.93	9.01	1.98	1.09
1973	7.19	7.56	2.97	3.86	7.97	9.39	9.16	2.15	1.14
1974	5.67	3.68	2.83	4.12	9.72	11.77	10.38	2.32	1.34
1975	7.64	4.37	2.92	3.61	10.35	12.74	11.68	2.75	1.44
1976	5.79	2.85	3.15	4.11	12.99	15.02	13.99	3.37	1.56
1977	7.34	4.84	4.54	4.59	14.75	18.19	14.63	4.29	1.76
1978	4.22	3.23	4.92	4.01	16.15	18.42	15.83	5.14	1.93
1979	5.10	3.66	5.27	4.07	16.83	20.34	16.25	5.65	2.09
1980	5.44	3.83	5.14	4.64	17.20	20.26	17.04	6.35	2.29
1981	6.42	4.22	3.76	4.21	17.05	19.66	18.60	6.36	2.57
1982	4.48	2.15	5.39	5.20	23.41	24.94	13.63	7.54	2.85
1983	4.54	2.46	5.98	4.39	25.03	28.45	13.82	7.84	3.02
1984	4.81	2.70	5.36	4.94	29.54	30.78	15.79	8.99	3.40
1985	3.82	2.54	5.57	6.51	32.11	33.92	16.95	9.49	3.66

Source: Ministry of Agriculture and Agrarian Reform, Morocco.

[a] The exchange rate varied from 3.90 dirhams per U.S. dollar in 1979 to 10.06 dirhams per dollar in 1985.

DATA

The quantities and prices were taken from a study conducted by the Ministry of Agriculture, Direction de la Planification et des Affaires Economiques, in collaboration with FAO. The quantity data were estimated using the 'Food Balance Sheet' approach, which requires the existence of statistical data on production, imports and exports, and changes in stocks in order to determine the quantity available for human consumption. Using this approach, the availability for per capita consumption of beef, mutton, goat, poultry, and fish were estimated for 1969–1985. To enable other researchers to replicate our study, the data are presented in Table 1. Although the price index is not used in estimation, it is included in the table so that real prices could be calculated. Table 1 shows that consumption of poultry and fish has increased, but consumption of beef and mutton has decreased.

Through licensing, the government of Morocco controls (except for the army) the quantity of meat imported. Local municipalities set prices and marketing margins for red meat. The prices fetched in Rabat and

Casablanca are used to control prices set locally in the rest of Morocco. At the butchers' shop, prices must be set within a margin of 2 to 3 dirhams per kg of the price paid to the wholesaler. Because of the lack of price variation across the country, a cross section study would be unlikely to yield accurate estimates of demand elasticities.

RESULTS

The estimated parameters are presented in Table 2. Most coefficients are statistically significant at the 5% level and have the expected sign. The elasticity estimates are presented in Table 3. Mutton is a luxury good which conforms with Moroccans' preference for mutton. The own price elasticity of mutton is less than for poultry and beef. Mutton may be less price elastic because it is customary to eat mutton on special social and religious occasions. For example, between 1.5 and 2 million male sheep are slaughtered each year during 'Aid Al Adha', a religious feast commemorating Abraham's sacrifice. The demand for beef and poultry is elastic since the Marshallian price elasticities are less than minus one. The demand for fish is, however, quite inelastic. Beef, poultry, and mutton are net substitutes, as shown by the positive Hicksian cross price elasticities. Fish is a complement in two instances. Other researchers (e.g. Hayes et al., 1990) have obtained unexpected results for fish. This may be because fish is an aggregation of very different products.

TABLE 2

Linear approximate ideal demand system parameter estimates for beef, mutton, poultry and fish for Moroccan data, 1968–1985

Type of expenditure	INTERCEPT	Price				Expenditures	Mean budget share
		Beef	Mutton	Poultry	Fish		
BEEF	0.48*	−0.20	0.01	0.002	0.19*	−0.06	0.374
	(2.39)	(−0.82)	(0.05)	(0.05)	(2.54)	(−0.54)	
MUTTON	−0.40*	0.01	0.09	0.10*	−0.20*	0.25*	0.303
	(−2.32)	(0.05)	(0.35)	(2.03)	(−2.75)	(2.80)	
POULTRY	0.37*	0.002	0.10*	−0.06*	−0.04*	−0.15*	0.234
	(4.75)	(0.05)	(2.03)	(−2.80)	(−2.07)	(−3.49)	
FISH	0.19*	0.19*	−0.20*	−0.04*	0.05	−0.04	0.089
	(2.37)	(2.54)	(−2.75)	(−2.07)	(1.14)	(−1.26)	

Figures shown are for the logarithms of prices.
t-Statistics are in parenthesis, an asterisk indicates significance at 5% level.

TABLE 3

Mean price and expenditure elasticities for meat in Morocco, 1968–1985 [a]

Type of expenditure	Marshallian elasticities		Hicksian elasticities	
Beef demand				
Beef	−1.811	(1.422)	−1.633	(1.470)
Mutton	0.093	(1.305)	0.233	(1.276)
Poultry	0.047	(0.358)	0.163	(0.360)
Fish	0.821	(0.506)	0.866	(0.496)
Expenditure	0.761	(0.464)		
Mutton demand				
Beef	−0.252	(1.569)	0.295	(1.621)
Mutton	−0.775	(1.439)	−0.343	(1.407)
Poultry	0.325	(0.395)	0.683	(0.396)
Fish	−1.143	(0.558)	−1.006	(0.547)
Expenditure	2.348	(0.511)		
Poultry demand				
Beef	0.242	(0.963)	0.249	(0.995)
Mutton	0.818	(0.883)	0.824	(0.864)
Poultry	−1.263	(0.242)	−1.258	(0.243)
Fish	−0.190	(0.342)	−0.187	(0.336)
Expenditure	0.032	(0.314)		
Fish demand				
Beef	3.402	(1.970)	3.457	(2.036)
Mutton	−3.215	(1.808)	−3.172	(1.768)
Poultry	−0.525	(0.496)	−0.489	(0.498)
Fish	−0.182	(0.700)	−0.168	(0.688)
Expenditure	0.235	(0.642)		

[a] The numbers in parentheses are standard errors.

The elasticities with respect to beef and mutton prices have larger standard errors than the other elasticities. The two prices are collinear and thus it is difficult to separate the effects of the two prices.

TABLE 4

Elasticity estimates used in previous studies involving Morocco

Commodity	Demand			Income	
	AIRD	Gardiner et al.	Baijou	AIRD	Baijou
Beef	−2.33	−0.28	−0.72	0.88	0.27
Mutton	−1.00	−0.50	−0.21	0.96	0.43
Poultry	−1.23	−0.40	−0.24	0.84	0.69

Some of the elasticity estimates are for a region including Morocco and are not specific to Morocco. None of the three studies referenced estimated the elasticities, but instead reported elasticities from other sources. The elasticities were originally obtained subjectively or based on unpublished research.

Table 4 shows the demand and income elasticities used in previous studies. Our elasticities of demand are close, but slightly lower, than the demand elasticities reported in the AIRD study. The demand elasticities used by Baijou (1990) and Gardiner et al. (1989) are substantially lower. Baijou concluded that with a free trade policy, Morocco's net balance of trade would be highly volatile. With the more elastic demands found here, the volatility would be substantially reduced. The expenditure elasticities calculated here cannot be directly compared to the income elasticities in past studies. But the relative magnitudes of the elasticities should be the same. Neither past study found the substantially higher preference for mutton which we found.

CONCLUSION

Elasticities are critical parameters in developing models for policy analysis. Elasticities used in past applied models in Morocco have frequently been based on subjective judgment and are not supported by quantitative and empirical evidence. The objective of this paper was to estimate Moroccan demand elasticities for beef, mutton, poultry, and fish. These elasticities can be used for policy analyses in Morocco instead of using elasticities based on subjective estimates or unpublished research. The results revealed that demand for poultry and beef is elastic. Mutton is a luxury, while poultry, beef, and fish are normal goods. Thus, the estimates demonstrate Moroccans' preference for mutton.

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