The Impact Of Price Changes And Trends On Demand For Meat In Nigeria

Gbolahan Solomon Osho (Email: oshos@uhd.edu), University of Houston-Downtown, USA
Matthew Uwakonye (Email: uwakonyem@uhd.edu), University of Houston-Downtown, USA

Abstract

This study determines the responsiveness of demand for meat to variations in prices and incomes on the basis of food demand data for the time period between 1980 to 2001 using an Almost Ideal Demand System (AIDS) model. These findings are reasonable given the position that beef holds as the dominant and traditional meat in Nigeria. These elasticities also imply that beef and chicken are luxury goods, while other fish and demersal fish are normal goods for Nigeria households consistent with the findings of previous studies. With the exception of some cross-price elasticities, the majority of the price elasticities exhibit the expected signs and magnitudes. This indicates that demand for beef and other meat Nigeria is very price elastic. In general, the results suggest that own-prices as well as incomes are the predominant factors determining consumer choice and meat consumption patterns in Nigeria rather than relative prices.

1. Introduction

Before the 1970's oil boom, agricultural exports were the backbone of the Nigerian economy with livestock products accounting for a significant share of exports. During this period, the country had a well-developed domestic agricultural market. However, despite this sound potential for growth in the domestic market, Nigeria is currently witnessing a drastic decline in agricultural production, especially in livestock and meat sectors of the industry. This decline in agricultural production coincides with the nation's oil boom.

Furthermore, Nigeria has enjoyed yearly economic growth (GDP) of 10.8 percent in real terms between 1980 and 1987 as a result of export earnings from petroleum. Real per capita income rose at 60 percent per year during this period. However, the decline in the world oil prices experienced in 1987, combined with the reduction in world market prices of agricultural products in 1995 brought an end to country's economics growth and real per capita income. Between 1989 and 1997 real per capita income dropped at a rate of 7.8 percent per year.

During this period, the federal government of Nigeria maintained a trade policy dominated by quantitative restrictions and price controls on food items. In January 1990, a tax was imposed on meat imports, ostensibly to raise government revenues and stimulate domestic meat production. The abrupt drop in meat imports, coupled with inadequate domestic supply pushed up price of meat and thus depressed domestic demand. For example, per capita meat consumption that had risen from 12.05 kg in 1981 to 13.8 kg in 1986 dropped to 11.6 kg in 1992. Also meat prices rose by 70 percent from 1987 to 1999, resulting in a decline in Nigerian per capita meat consumption from 10.5 kilograms of meat per year in 1987 to 9.4 kilograms per year in 1999 (*FGS*, 1999)[1]. Although the federal government of Nigeria has designed various programs to help stabilize meat prices and consumption, the country is still experiencing meat shortage and price fluctuations.

The purpose of this study is to understand the source of the change and fluctuation in meat consumption in Nigeria. In order to determine the cost or likely success of the various government programs, this research paper will examine the responsiveness of demand for meat to variations in prices and incomes on the basis of food demand data for the time period between 1980 to 1999. Additionally, it will also assist in formulating recommendations for

[1] Nigeria, Federal Office of Statistics. *Economic and Social Statistics Bulletins* (Special Series) (January 1999).

policies with the potential to create more stable meat consumption and prices for the nation. In order to understand the source of the decline and instability in consumption and to determine whether the shock is from changing incomes or from changing prices, this paper will determine whether demand for meat is price-elastic on the basis of food demand data during the time period studied from 1980-2001.

World demand for meat has risen sharply during the last few decades. The key reasons for these increases in meat demand are increasing population, improving technology and increasing incomes. However, despite this overall improvement in technologies and incomes, per capita consumption of meat has lagged especially in the less-developed countries of the world because protein is the most costly food item.

The early empirical studies of demand were characterized by the extensive use of single equation methods centered on the measurement of elasticities since they are easily understood and conveniently dimensionless. Hence, demand could be directly measured as the parameters of a regression equation linear in the logarithms of purchase, outlay and prices.

Agricultural economists have long been interested in the proper measurement and interpretation of elasticities and flexibilities among endogenous variables in systems of simultaneous equations. Elasticities are vital parameters in developing models for policy analysis, have been used in applied models frequently based on subjective judgment, but not supported by quantitative and empirical evidence (Mdafri and Brorsen, 1993). Adegeye (1988) estimated price elasticities of demand for beef, poultry, and fish products, such as freshwater fish. Unfortunately, he adopted provincial elasticities and failed to aggregate based on the most recent policy analysis. It is well known that partial measures, commonly used in a single-equation context are not valid for obtaining elasticities among endogenous variables in a system framework because indirect effects are not accounted for by standard partial measures. This applies to elasticities with respect to exogenous variables but does not apply to structural elasticities.

2. The Almost Ideal Demand System

Following the important paper by Diewert (1971), several demand system estimation models, known as "flexible functional form", have been developed. The basic method is to approximate the direct utility function, indirect utility function or the cost function by some specific functional form. One of these approaches is Christensen et al's (1975) indirect translog model:

$$U = \alpha_0 + \sum \alpha_k \log(P_k / X) + \tfrac{1}{2} \sum_k \sum_j \beta_{kj} \log(P_k / X) \log(P_j / X), \tag{1}$$

where k, j are goods. The demand function from equation (1) is complicated and clumsy to estimate while the direct translog model is usually estimated under the practically nonsensical assumption that, for all goods, prices are determined by quantities rather than the other way round.

Deaton and Muellbauer (1980) started not from an arbitrary preference ordering, but from a specific class of preferences, by which the theorems of Muellbauer (1975, 1976) permit exact aggregation over consumers: the representation of market demands as if they were the outcome of decisions by a rational representative consumer. They proposed that the cost or expenditure function, which defines the minimum expenditure necessary to attain a specific utility level, can be used to represent consumer preferences, known as the price-generalized logarithmic (PIGLOG) class:

$$\log c(u, P) = (1 - u) \log\{a(p)\} + \log\{b(P)\}. \tag{2}$$

With some exceptions, u lies between 0 (subsistence) and 1 (bliss) so that the positive linearly homogeneous function $a(P)$ and $b(P)$ can be regarded as the costs of subsistence and bliss, respectively. Next they take specific functional forms for $\log a(P)$ and $\log b(P)$:

$$\log a(P) = \alpha_0 + \sum \alpha_k \log P_k + \tfrac{1}{2}\sum_k \sum_j \gamma_{kj}^* \log P_k \log P_j, \tag{3}$$

$$\log b(P) = \log a(P) + \beta_0 \prod_k P_k^{\beta_k}. \tag{4}$$

After the selection of a specific functional form, the cost function in the AIDS model can be written as:

$$\log c(u,P) = \alpha_0 + \sum \alpha_k \log P_k + \tfrac{1}{2}\sum_k \sum_j \gamma_{kj}^* \log P_k \log P_j + \beta_0 \prod_k P_k^{\beta_k}. \tag{5}$$

The demand functions can be derived directly from equation (2). It is a fundamental property of the cost function that its price derivatives are the quantities demanded $\partial c(u,P)/\partial P_i = q_i$: Multiplying both sides by $P_i / c(u,P)$ we find:

$$\frac{\partial \log c(u,P)}{\partial \log P_i} = \frac{p_i q_i}{c(u,P)} = w_i, \tag{6}$$

where w_i is the budget share of good *i*. Hence, logarithmic differentiation of equation (5) gives the budget shares as a function of prices and utility:

$$w_i = \alpha_0 + \sum_j \gamma_{ij} \log P_j + \beta_i u \beta_0 \prod_k P_k^{\beta_k}, \tag{7}$$

where

$$\gamma_{ij} = \tfrac{1}{2}\left(\gamma_{ij}^* + \gamma_{ji}^*\right), \tag{8}$$

for a utility-maximizing consumer, total expenditure X is equal to $c(u\ ,P)$ and this equality can be inverted to give u as a function of P and X, the indirect utility function. Solving equation (5) and (7) and eliminating u, we obtain the budget shares as a function of P and X. These are AIDS demand functions in budget share form:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log P_j + \beta_i \log\{X/P\}, \tag{9}$$

where w_i is the expenditure share of commodity i, P_j is the commodity price, X is the total expenditure of the selected goods, and P is overall price index, which is defined by:

$$\log P = \alpha_0 + \sum_k \alpha_k \log P_k + \tfrac{1}{2}\sum_k \sum_j \gamma_{kj} \log P_k \log P_j, \tag{10}$$

By taking three sets of restrictions on the parameters of the AIDS equation (7),

$$\sum_{i=1}^{n} \alpha_i = 1,\ \sum_{i=1}^{n} \gamma_{ij} = 0,\ \sum_{i=1}^{n} \beta_i = 0,\ \sum \gamma_{ij} = 0,\quad \gamma_{ij} = \gamma_{ji}. \tag{11}$$

Provided equation (11) holds, equation (9) represents a system of demand functions which add up to total expenditure $\sum w_i = 1$ are homogenous of degree zero in prices and total expenditure taken together, which satisfy Slutsky symmetry. When there is no change in relative price and X/P the budget shares are constants. Changes in relative prices take effect through γ_{ij}. Changes in expenditure operate through the β_i coefficients, which are summed to zero and are positive for luxuries and negative for necessities (Deaton and Muellbauer, 1980).

An important feature of the AIDS model is that the expenditure levels are allowed to impact the distribution of shares. It is of flexible functional form, allowing testing of theoretical restrictions on demand equations. The AIDS model in share form for a group of n commodities can be written as:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \ln P_j + \beta_i \ln(X/P), \qquad i = 1, 2, \ldots, n \tag{12}$$

where w_i is market share, X is total expenditure, $i = j$, is the number of products in the demand system, and P_j is the price of product j in the system. α_i, γ_{ij}, and β_i are parameters. ln$P$ is defined as:

$$\log P = \alpha_0 + \sum_k \alpha_k \ln P_k + \tfrac{1}{2} \sum_k \sum_j \gamma_{kj} \ln P_k \ln P_j . \tag{13}$$

In practice, equation (12) is difficult to estimate because of its nonlinearity. A common alternative is to estimate a linear approximation version of the AIDS model. That is, instead of estimating the complete AIDS model in equation (12), its linear approximation is employed by replacing ln$P$ with lnP^*, where lnP^* is the Stone's Index defined as:

$$\ln P = \sum_i w_i \ln P_i, \qquad i = 1, 2, \ldots, n. \tag{14}$$

Therefore, (13) becomes:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \ln P_j + \beta_i \ln\{X/P\}. \tag{15}$$

Marshallian and Hicksian measures of elasticities may be computed from the estimated coefficients of the AIDS model as follows:

$$\varepsilon_{ii} = -1 + \gamma_{ij}/w_i - \beta_i , \tag{16}$$
$$\varepsilon_{ij} = \gamma_{ij}/w_i - \beta_i (w_j/w_i), \tag{17}$$
$$s_{ii} = -1 + \gamma_{ii}/w_i + w_i , \tag{18}$$
$$s_{ij} = \gamma_{ij}/w_i + w_j , \tag{19}$$

where ε and s denote Marshallian and Hicksian elasticities respectively. The expenditure elasticities can be obtained from the estimated coefficients as well:

$$\eta_i = 1 + \beta_i/w_i . \tag{20}$$

In the case of Nigeria, the meat demand system to be estimated includes beef, pork, chicken, and fish. Furthermore, time trends in a more appropriate manner would be incorporated into the model more appropriately by interacting each variable in the model with time period variable (Pollak and Wales, 1981).

3. Data Estimation And Procedure

Very few demand meat estimates have been obtained for Nigeria, the earliest dating back to 1965. One reason is the absence of adequate data in terms of both quality and duration of the time period covered. The official source of data on meat and fish in Nigeria is the Statistics Division of the Ministry of Livestock, Fisheries and Animal Industrial, which publishes information on herd inventories and livestock slaughtered numbers. Divisional data are aggregated first into provincial and then national data, and later reported by Nigeria Federal office of Statistics, Economic and Social Statistics in Lagos. Data were obtained from the Nigeria Federal Office of Statistics, Economic and Social Statistics (Lagos: FOS, various years) and the Central Bank of Nigeria. The data are Nigerian time series data on meats and fish categories from 1980 to 2001. The price data are in index form and are constructed so that 1990 = 100 (Base year).

All prices are the retail level and all quantities are per capita and based on retail cuts. Disposable income per capita will be used in the estimation to determine the income effect on meat consumption. Time series data were obtained for meat consumption of meats (demand for all meats), the price level (price index), disposable income per capita, and expenditures on meat products.

4. Results And Analysis Of The Almost Ideal Demand System For Nigeria Meat Demand Systems

Parameter estimates for Nigeria meat demand system were obtained using the Deaton-Muellbauer iterative procedure. Most of the parameter estimates were significant at the 10 and 15 percent level of significance (Table 1.1). The principal goal of the study, however, was to estimate Nigerian demand elasticities for beef, chicken, demersal fish, and freshwater fish and analyze the effects of expenditures on household meat consumption behavior in Nigerian. Thus, the Marshallian and Hicksian elasticities are reported in Table 1.2 and Table 1.3 respectively with all expenditure elasticities having positive signs as expected. However, the magnitudes of these elasticities are different for the six commodities. The expenditure elasticities for chicken, freshwater fish, and demersal fish are greater than one, implying that they are luxury goods. However, demersal fish has the greatest expenditure elasticity of 2.389 compared with other meat products. This suggests that demand for demersal fish would increase greatly when per capita expenditure rises. The magnitudes of expenditure elasticities for beef and other meat are similar, although they are relatively lower compared to those of demersal fish and freshwater fish. These findings are reasonable given the position that beef holds as the dominant and traditional meat in the diet for most Nigerians. These elasticities also imply that beef and chicken are luxury goods, while other fish and demersal fish are normal goods for Nigeria households consistent with the findings of previous studies.

With the exception of some cross-price elasticities, the majority of the price elasticities exhibit the expected signs and magnitudes. Uncompensated own-price elasticities presented in Table 1.2 have negative signs in accordance with economic theory. However, the magnitudes of own-price elasticities of demand vary for different types of meat. Own-price elasticities for beef are much higher than those for other meats and less than one. This indicates that demand for beef and other meat Nigeria is very price elastic.

The magnitudes of own-price elasticities for beef and chicken meat consumption are between -0.224 and -0.118 respectively for the Marshallian elasticities illustrated in Table 1.2 and –1.632 and –0.411 for Hicksian elasticities illustrated in Table 1.3. Furthermore, some of the cross-price elasticities have negative signs, but the magnitudes are very small. In general, the results suggest that own-prices as well as incomes are the predominant factors determining consumer choice and meat consumption patterns in Nigeria rather than relative prices.

The results of this estimation broadly coincide within the range of income elasticities (0.57 - 1.0) and price elasticities (0.34 - 1.04) in South Korea and Japan from previous studies such as Hayes et al., (1990) and Hayes et al. (1991). The Hayes et al. studies were based on 1961-1987 and 1947-1978 average data in South Korea and Japan respectively and also employed an LA/AIDS model. Therefore, it appears that meat demand and consumption in Nigeria in the past decade may, in part, be comparable to that in South Korea and Japan during 1960s and 1970s.

5. Conclusions

Nigeria is not only one of the largest meat producing countries in Africa but also one of the largest meat consumers in this region of the world. The empirical results of this study suggest several points of interest for researchers, policy makers, planners and traders with involvement in Nigerian food production and marketing. First, expenditure elasticities for demersal fish and freshwater fish are highly elastic suggesting that Nigeria households will consume more demersal fish and freshwater fish as incomes increase. In terms of beef, the expenditure elasticity is also highly elastic, implying that Nigeria consumers with low incomes will increase their consumption of beef as their incomes rise. Second, own-price elasticities of all meat items are fairly elastic. This suggests that any changes in meat prices could bring about a significant shift in meat consumption patterns. Third, given the emergence of large unemployment in Nigeria, a major challenge confronting the government is how to design appropriate policies for the relative enhancement of low-income groups. Identifying elasticities for different income groups would enable Nigerian decision-makers to gauge more precisely the impact of their policies on various income groups, and more effectively design policies targeted at low-income groups.

The strength of this study relative to previous meat demand studies in Nigeria and other West African countries is the use of observations pertaining to expenditure share rather than average income estimates for the population as a whole. Further partitioning of income groups with time series data of greater duration and incorporating socio-demographic variables would enhance the accuracy of results. Caution should be taken, however, when interpreting those empirical results because the statistical information on consumption data in Nigeria is rather scarce, incomplete and controversial. The described data problems limit strong interpretation of empirical findings. Nevertheless, this study opens up discussion on the important issue of consumption patterns for different meat and fish products in Nigeria. Further studies will enhance the potency of these preliminary findings. 🕮

References

1. Adegeye, A., "A Statistical Analysis of Demand for Beef in the Western State of Nigeria", *Readings in the Agricultural Marketing*. University of Ibadan, Nigeria 1988.
2. Central Bank of Nigeria. *Annual Reports and Statement of Accounts*. Lagos: Central Bank, various years.
3. Deaton, A and J. Muellbauer. "An Almost Ideal Demand System", *American Economic Review.* 70(1980): pp. 312-326.
4. Diewert, W. E. "An Application of the Shepherd Duality Theorem: A Generalized Leontieef Production Function", *Journal of Political Economy* 79 (1971): pp. 481-507.
5. Hayes, D.J.; H. Ahn, and C. P. Baumel. "Meat Demand in South Korea: A Systems Estimate and Policy Projections" *Agribusiness* v7, n5 (September 1991): pp. 433-446.
6. Hayes, D.J.; T. I. Wahl, and G.W Williams. "Testing Restriction on a Model of Japanese Meat Demand", *American Journal of Agricultural Economics* v72, n3 (August 1990): pp. 556-566.
7. Johnson, J., *Econometric Methods*. New York: McGraw-Hill Publishing Company, 1984.
8. Maddala, G. S., *Econometrics.* New York: McGraw-Hill Book Company, 1977.
9. Mdafri, A and B. W. Brorsen " Demand for Red Meat, Poultry, and Fish in Morocco: An Almost Ideal Demand System", *American Journal of Agricultural Economics* 9 (December 1993): pp. 155-163.
10. Muellbauer J. "Identification and Consumer Unit Scales", *Econometrica* v43, n4 70 (July 1975): pp. 807-809.
11. Muellbauer J. "Community Preference and the Reprehensive Consumer", *Econometric* v44, n5 (September 1976): pp. 979-999.
12. Nigeria, Federal Office of Statistics. *Economic and Social Statistics Bulletins* (special Series) (January 1999).
13. Pollak, R. A., and T. J. Wales. "Demographic Variables in Demand Analysis. " *Econometrica*, 49(1981): pp. 1533-1558.
14. Tambi, E., "Price Elasticities of Demand for Beef, Poultry and Fish in Bamenda, North-West Province", *Institute of Animal Research*, Bambui, 1991.

Table 1. 0: Comparison Of Price And Income Elasticities For Beef In Nigeria, By Various Authors

Author	Product	Type of Model	Price	Income
Adegeye (1988)	Beef	Linear	-2.367	0.470
		Log-linear	-2.675	0.457
Tambi (1991)	Beef	3SLS[a]	-0.411	0.596
Present Study	Beef	Double-log	-0.118	0.327[b]

[a] Three-stage least squares. [b] Expenditure elasticity.

Table 1. 1: Parameter Estimates For Nigeria Meat and Fish Demand System Using an Almost Ideal Demand System Model, 1980-2001

	Dependent Variables (The budget share of per capita wheat import of:)							
Independent Variables	**Beef**	**Chicken**	**Other Meat**	**Demersal Fish**	**Freshwater Fish**	**Other Fish**	**Expenditure**	R^2
Beef	0.163**	-0.1704**	0.062**	-0.050**	-0.057*	0.080**	0.143*	0.91
	(0.048)	(0.031)	(0.001)	(0.001)	(0.014)	(0.010)	(0.041)	
Chicken	-0.111*	0.133*	0.084*	0.133*	-0.042*	-0.079*	0.025*	0.842
	(0.023)	(0.022)	(0.050)	(0.022)	(0.031)	(0.004)	(0.009)	
Other Meat	0.007**	-0.112*	0.081*	-0.023**	-0.024**	0.029	0.021*	0.851
	(0.001)	(0.010)	(0.009)	(0.001)	(0.001)	(0.003)	(0.005)	
Demersal Fish	0.007*	-0.005**	-0.062*	0.050*	-0.057*	0.077**	0.262**	0.956
	(0.001)	(0.011)	(0.019)	(0.015)	(0.007)	(0.004)	(0.018)	
Freshwater Fish	0.163*	-0.171*	0.012**	-0.036*	-0.422*	0.072*	0.143**	0.947
	(0.018)	(0.032)	(0.008)	(0.001)	(0.012)	(0.005)	(0.019)	
Other Fish	0.007*	-0.480*	0.062**	-0.006*	-0.011*	0.047*	0.016**	0.957
	(0.001)	(0.029)	(0.011)	(0.001)	(0.002)	(0.009)	(0.007)	

Note: The numbers in parenthesis are standard errors.
Single (*) and double asterisks (**) denote significance at the 15% and 10% level, respectively.

Table 1. 2: Marshallian Elasticities for Meat and Fish in Nigeria Using an Almost Ideal Demand System, 1980-2001

Commodity	Beef	Chicken	Other Meat	Demersal Fish	Freshwater Fish	Other Fish	Expenditure
Beef	-0.224**	-0.093**	-0.112**	0.213**	-0.911**	0.388**	1.255**
	(0.061)	(0.051)	(0.006)	(0.021)	(0.083)	(0.019)	(0.079)
Chicken	-0.189*	-0.118*	-0.103**	-0.342*	-0.623**	0.102*	0.407*
	(0.089)	(0.081)	(0.041)	(0.037)	(0.117)	(0.021)	(0.014)
Other Meat	-0.111**	-0.814*	-0.069*	-0.012**	-0.581**	0.671**	0.793**
	(0.008)	(0.102)	(0.013)	(0.001)	(0.011)	(0.087)	(0.084)
Demersal Fish	-0.295**	0.413*	-0.151*	-0.438*	0.924*	-0.734*	1.569*
	(0.016)	(0.052)	(0.032)	(0.046)	(0.163)	(0.053)	(0.051)
Freshwater Fish	0.126*	-0.452	-0.173*	-0.011*	-0.163**	0.181*	0.235*
	(0.071)	(0.097)	(0.011)	(0.045)	(0.105)	(0.075)	(0.011)
Other Fish	-0.071**	-0.032*	0.525**	-0.219**	-0.201**	-0.419*	0.141*
	(0.003)	(0.001)	(0.086)	(0.015)	(0.041)	(0.021)	(0.091)

Note: The numbers in parenthesis are standard errors.
Single (*) and double asterisks (**) denote significance at the 15% and 10% level, respectively.

Table 1. 3: Hicksian Elasticities for Meat and Fish in Nigeria Using an Almost Ideal Demand System, 1980-2001

Commodity	Beef	Chicken	Other Meat	Demersal Fish	Freshwater Fish	Other Fish
Beef	-1.632**	-0.233*	0.151**	0.421**	-0.891**	0.087*
	(0.012)	(0.011)	(0.023)	(0.062)	(0.025)	(0.001)
Chicken	-0.221*	-0.411**	0.201*	-0.178*	-0.941*	-0.911*
	(0.062)	(0.047)	(0.019)	(0.015)	(0.054)	(0.013)
Other Meat	0.241*	-0.341**	-0.012**	-0.116*	-0.321*	-0.221**
	(0.010)	(0.107)	(0.005)	(0.011)	(0.017)	(0.042)
Demersal Fish	-0.192**	0.821**	-0.215**	-0.321*	0.054	-0.307*
	(0.022)	(0.016)	(0.021)	(0.061)	(0.001)	(0.001)
Freshwater Fish	0.121*	-0.106*	-0.271*	-0.117*	-0.551*	0.052**
	(0.011)	(0.021)	(0.001)	(0.064)	(0.003)	(0.001)
Other Fish	-0.090*	-0.161*	0.511**	-0.371*	-0.851**	-0.101**
	(0.001)	(0.011)	(0.026)	(0.001)	(0.073)	(0.091)

Note: The numbers in parenthesis are standard errors.
Single (*) and double asterisks (**) denote significance at the 15% and 10% level, respectively