ECONOMETRIC ANALYSIS OF AGGREGATE DEMAND FOR MEAT IN IMO STATE, NIGERIA

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ABSTRACT
This study was designed to isolate the determinants of aggregate demand for meat and analyze the demand elasticities of meat in Imo State. Time series data were collected with structured questionnaire alongside personal observations from 120 stratified randomly selected households for the period 2000-2003. Data were collected on per capita meat demand, retail price of meat, retail price of dried fish, retail price of iced fish and per capital income, and analyzed using the ordinary least squares (OLS) regression technique. Results show that aggregate demand for meat in Imo State is generally price inelastic. Beef and poultry were found to be normal goods. Dried fish was also found to be close substitute to beef. If the demand for poultry in the State can be projected and appropriate programmes designed to boost local production of poultry, it is expected that in a short while, Imo State would be able to produce adequate quantities of this source of animal protein at affordable prices thereby improving the level of protein intake by the populace.

Key words: Aggregate Demand, Meat

INTRODUCTION
Nutritional scientists have repeatedly drawn attention to the gross imbalance between animal protein availability and human need for such protein in Nigeria. Oyenuga (1987) was one of the early researchers to evaluate the animal protein supply: demand ration. He estimated the mean daily requirement of Nigeria’s reference person at 61gm. This represents a shortfall of 10gm (16.4%). It is plausible to suggest that, currently this situation may have deteriorated even further in spite of an apparent increase in the nation’s animal production. This situation can be remedied through increased intake of protein rich plant food increased consumption of animal products such as beef, lamb, Pork, Mutton, chevon, milk, fish, and poultry. Prices of animal products are beyond the reach of the average Nigerian owing to the increases in the production and maintenance costs of farm animals. Despite those rising cost of animal products, the demand is still believed to increase annually with increase in population and level of income (Fabiyi, 1985), and coupled with the fact that animal protein intake is needed by humans to sustain life.

Although several empirical studies have been conducted on the structure of demand for certain commodities including meat products (Oyenuga, 1987; Fabiyi, 1985, Mba, 1998, Fatunla et al, 1999; Allison-Oguru, 1992), there has not been any such empirical study to determine the structure of aggregate meat demand in Imo State despite the fact that the State has the largest meat markets in South Eastern Nigeria.

This study is therefore designed to identify the factors that determine aggregate demand for meat in the State, and to determine price, income and cross-price elasticities of demand for meat in the State.

METHODOLOGY
This study was conducted in Imo State. The State presently comprises three agricultural zones, Owerri, Orlu and Okigwe, further sub divided into 27 Local Government Areas (LGAs). The state was stratified into the existing three agricultural zones, and two LGAs, consisting of one rural and one Urban, were purposively selected from each zone. Two communities were randomly selected from each chosen LGA, and 10 households were
randomly selected from each chosen community giving a sample size of 120 households. The resident extension agents, community leaders and key informants assisted in the preparation of the sampling frame and identification of the selected households.

Primary data were supplemented with information (secondary data) obtained from Federal Office of Statistics, livestock department of the Federal and State Ministries of Agriculture and Natural Resources, text books, Journals, Seminar and Conference papers. Time series data on annual observation on meat demand, retail price of meat, retail price of dried fish, retail price of iced Fish and per capita income in Imo State for the period 2000-2003. The data were collected through the use of structured questionnaire and personal observations. Data were analyzed using ordinary least Square (OLS) regression technique. It is postulated in this study that aggregate demand for meat in Imo State is determined by factors such as own price, price of dried fish, price of iced fish and per capita income, ceteris paribus.

The above functional relationship can be stated respectively for beef, poultry; and beef and poultry pooled as follows:

\[ Q_b = f(X_1, X_2, X_3, X_4) \]  
\[ Q_p = f(X_1, X_2, X_3, X_4) \]  
\[ Q_{b+p} = f(X_1, X_2, X_3, X_4) \]

Where

- \( Q_b \) = per capita demand for beef
- \( Q_p \) = per capita demand for poultry
- \( Q_{b+p} \) = per capita demand for meat generally (beef and poultry pooled)
- \( X_1 \) = Retail price of meat
- \( X_2 \) = Retail price of dried fish
- \( X_3 \) = Retail price of iced fish
- \( X_4 \) = Per capita income

The power functional form used by Allison-Oguru (1997) was specified in this study for the purpose of empirical estimation of the required demand coefficients as follows:

\[ Q_b = ax_1^{b_1} x_2^{b_2} x_3^{b_3} x_4^{b_4} e \]  
\[ Q_p = ax_1^{b_1} x_2^{b_2} x_3^{b_3} x_4^{b_4} e \]  
\[ Q_{b+p} = ax_1^{b_1} x_2^{b_2} x_3^{b_3} x_4^{b_4} e \]

In order to facilitate empirical estimation of the demand coefficients (bi’s) in equation (4) through (6), the variables in these equations were transformed into logarithms as follows:

\[ \ln Q_b = \ln a + b_1 \ln x_1 + b_2 \ln x_2 + b_3 \ln x_3 + b_4 \ln x_4 + e \]  
\[ \ln Q_p = \ln a + b_1 \ln x_1 + b_2 \ln x_2 + b_3 \ln x_3 + b_4 \ln x_4 + e \]  
\[ \ln Q_{b+p} = \ln a + b_1 \ln x_1 + b_2 \ln x_2 + b_3 \ln x_3 + b_4 \ln x_4 + e \]

The coefficients in equation (7) through (9) were estimated using the ordinary least squares (OLS) method of multiple regression analysis. All the assumptions underlying this method of estimation are assumed to hold in this study. It is expected \textit{a priori} that own price \( x_1 \) would be negatively related with per capita demand for all types of meat. Conversely, price of iced fish \( x_3 \) are expected to be positively related with per capita demand for meat, ceteris paribus.

The approach adopted in this study is similar to that of Allison-Oguru (1997), in his study on Econometric Analysis of Aggregate Demand for fish in Rivers State.
RESULTS AND DISCUSSION

Estimated Demand Functions

Table 1 presents the result of the estimated coefficients of the demand functions specified in equation (7) through (9). This result yields the following demand equations.

$$\ln Q_b = \ln 1.196 + 0.095 \ln x_1 + 0.511 \ln x_2 + 0.631 \ln x_3 + 0.381 \ln x_4$$  \hspace{1cm} (10)

$$\begin{align*}
(3.182) \\
(2.192) \\
(3.066) \\
(1.843) \\
(1.371)
\end{align*}$$

$$\ln Q_b = \ln 1.387 + 0.523 \ln x_1 - 0.879 \ln x_2 - 0.791 \ln x_3 - 0.603 \ln x_4$$  \hspace{1cm} (11)

$$\begin{align*}
(2.891) \\
(3.513) \\
(-4.891) \\
(-1.349) \\
(-1.882)
\end{align*}$$

$$\ln Q_{b+p} = \ln 1.752 + 0.337 \ln x_1 + 0.413 \ln x_2 - 0.328 \ln x_3 - 0.194 \ln x_4$$  \hspace{1cm} (12)

$$\begin{align*}
(2.116) \\
(1.106) \\
(1.573) \\
(-1.569) \\
(-1.573)
\end{align*}$$

All the demand coefficients in equation (12) have their expected signs except own price (x_1) and price of Iced fish (x_3).

Table 1  Regression Coefficients On Aggregate Demand For Meat In Imo State

<table>
<thead>
<tr>
<th>Types of Meat</th>
<th>Explanatory Variables and Important statistics</th>
<th>Beef (Q_b)</th>
<th>Poultry (Q_b)</th>
<th>Beef and Poultry (Q_{b+p})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td></td>
<td>1.196</td>
<td>1.387</td>
<td>1.752</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.182)</td>
<td>(2.891)</td>
<td>(2.116)</td>
</tr>
<tr>
<td>Retail price of meat (x_1)</td>
<td></td>
<td>0.095</td>
<td>0.523</td>
<td>0.337</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.192)</td>
<td>(3.513)</td>
<td>(1.106)</td>
</tr>
<tr>
<td>Retail Price of Dried Fish (x_2)</td>
<td></td>
<td>0.511</td>
<td>-0.879</td>
<td>0.413</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.066)**</td>
<td>(-4.891)**</td>
<td>(2.573)*</td>
</tr>
<tr>
<td>Retail price of Iced fish (x_3)</td>
<td></td>
<td>0.631</td>
<td>-0.791</td>
<td>0.328</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.843)</td>
<td>(-1.349)</td>
<td>(1.569)</td>
</tr>
<tr>
<td>Per Capita Income(x_4)</td>
<td></td>
<td>0.381</td>
<td>-0.603</td>
<td>-0.194</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.371)</td>
<td>(-1.882)</td>
<td>(-1.528)</td>
</tr>
<tr>
<td>R²</td>
<td></td>
<td>0.852</td>
<td>0.903</td>
<td>0.813</td>
</tr>
<tr>
<td>F</td>
<td></td>
<td>120</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figures in parenthesis are t-ratios

* $t$-ratios significant at 0.05 level
** $t$-ratios significant at 0.01 level.

Source: Summarized from computer output, 2004

The coefficient of own price has a positive sign implying that per capita demand for beef increases with increase in its price. The coefficient of price of iced fish (x_3) is negative implying that as the retail price of iced fish increases, per capita demand for poultry also decreases. The sign of the per capita income coefficient suggests that beef and poultry are normal goods. This is expected as growth in per capita income tends to increase consumption of non-starchy foods like meat (Idachaba, 1997).

Of the demand coefficients in the equation only that of price of dried fish is statistically significant at the 1 percent level implying that price of dried fish is the most
important and reliable factor that accounts for variation in per capita demand for meat. The F
value in the equation is statistically significant at the 1 percent level implying that the joint
influence of all the explanatory variables on per capita demand for beef is very strong.

In equation (10), only the demand coefficient of the Iced fish \(x_3\) has its expected
positive sign. This implies that per capita demand for meat increases with increase in price of
Iced fish. The income coefficient in this equation is negative suggesting that iced fish is an
inferior good. This is expected given the stigma consumers in the state attach to the
consumption of iced fish. All the other explanatory variables in the equation have
coefficients that are statistically significant at 1\% \((x_1,x_3)\) or 5 \% \((x_2)\) level. Also the F-value of this equation indicates that the joint influence of all the explanatory variables on per
capita demand for meat is strong.

In equation (11), all the demand coefficients have their expected sign except that of
own price and per capita income. The coefficient of per capita income suggests that per
capita demand for meat and poultry pooled (or meat generally) is negatively related with per
capita income. Of these demand coefficients only that of price of iced fish is statistically
significant at 5 \% level. The F-value is also statistically significant at 1 \% level.

These results suggest that aggregate demand of meat in Imo State is jointly
determined by factors such as own price, price of related commodities like dried fish and iced
fish, and per capita income.

For purposes of predicting future demand for meat in the state; own price, price of
dried fish and price of iced fish are the most important and reliable explanatory variables that
determine per capita demand for beef or poultry.

In the case of beef, it is only price of dried fish that is a relevant variable while per
capita demand for beef and poultry pooled is determined by price of dried fish. All the
estimated demand equations show positive relationship between own price and per capita
demand of types of meat. This result conforms to a priori expectation, and is similar to the
findings of previous studies conducted by Allison-Oguru (1992), Fatunla et al (1997) and
Fabiyi (1985). The positive sign exhibited by the demand coefficient of own price could be
attributed to shortfall in meat supply or excessive meat demand.

**Demand Elasticities**

The estimated own price elasticity coefficients for beef, poultry, beef and poultry
pooled are 0.095, 0.523 and 0.337 for price levels ranging between N500/kg and N700/kg
(Table 2). These price elasticity coefficients indicate that a 1 percent increase in price of any
of the types of meat studied induces a less than proportionate increase in per capita demand
for that type of meat. This implies that demand for all types of meat in Imo State is price
inelastic.

**Table 2: Estimated Demand Elasticities For Meat in Imo State**

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Price Elasticity</th>
<th>IncomeCross-Price Elasticity</th>
<th>Dried Fish</th>
<th>Iced Fish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef (In (Q_b))</td>
<td>0.095</td>
<td>0.381</td>
<td>0.511</td>
<td>0.631</td>
</tr>
<tr>
<td>Poultry(In (Q_p))</td>
<td>0.523</td>
<td>0.603</td>
<td>-0.879 0.791</td>
<td></td>
</tr>
<tr>
<td>Beef and Poultry(In (Q_{bp}))</td>
<td>0.337</td>
<td>0.194</td>
<td>0.413 0.328</td>
<td></td>
</tr>
</tbody>
</table>

Source: Summarized from Demand Equations.

Income elasticity of demand coefficients of beef, Poultry, beef and Poultry pooled are 0.381,
0.603 and 0.194 respectively for levels of per capita income ranging between N68,000-
N265,000 per annum. These results imply that beef, poultry, and beef and poultry pooled are normal goods. Cross price elasticity coefficients of dried fish and iced fish with each type of meat indicates that dried fish is a substitute for beef and a complement for poultry, which suggest that both commodities are substitutes of meat generally. This result also indicates that an increase in the relative prices of dried fish and iced fish would induce increased per capita demand for meat in the State, ceteris paribus.

CONCLUSION

The result of this study shows that aggregate demand for meat is generally price inelastic in Imo State. Beef and poultry are found to be normal goods with positive income elasticity coefficients. Therefore, as level of per capital income increases in the state, per capital demand for beef and poultry is expected to increase. This also suggests that meat consumers in the state have similar preference for beef and poultry. It is therefore suggested that government encourages poultry production through subsidies on poultry production and maintenance inputs.

Dried fish was found to be a close substitute to beef in the state. Consumers can therefore shift their preference from one to the other depending on their relative prices. Beef and poultry production should be given equal share in the state’s agricultural improvement programmes and the farmers need to be encouraged to produce enough to satisfy consumers demand. If the demand of meat particularly poultry, in the state can be projected and appropriate programmes designed to boost local production of poultry, it is expected that in a short while, Imo State would be able to produce adequate quantities of this source of animal protein at affordable prices thereby improving the level of protein intake by the populace.

REFERENCES

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