A STATISTICAL ANALYSIS OF DEMAND FOR BEEF, MUTTON/ GOAT, PORK AND CHICKEN IN KENYA, 1961-1991

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This study examines the demand for beef, mutton/goat, pork and chicken in Kenya for the period 1961 to 1991. A log linear function was used to estimate direct, cross and income elasticities. The analysis reveals that the demand for beef and mutton/goat is elastic while the demand for pork and chicken is inelastic. The results of further analyses indicate that mutton/goat is a substitute to beef while pork and chicken are complements to it. In the mutton/goat equation, beef is a substitute to mutton/goat while pork and chicken are complements to it. Both the beef and the mutton/goat equations indicated an income elasticity of more than one. High income elasticities for these two types of meat perhaps indicate that if improvements can be made in both production and marketing, more of these meat types would be consumed at every increase in income. In both the pork and chicken equations, beef and mutton/goat are found to be complements of these meat types. Pork and chicken are substitutes to each other.

SAMEVATTING: 'N STATISTIESE ANALISE VAN DIE VRAAG NA BEESVLEIS, SKAAP/BOKVLEIS, VARKVLEIS EN HOENDERVLEIS IN KENIA, 1961-1991

Hierdie studie ondersoek die vraag na beesvleis, skaap/bokvleis, varkvleis en hoendervleis in Kenia vir die periode 1961 tot 1991. 'n Log-lineêre funksie is gebruik om direkte, kruis- en inkome-elastisiteite te skat. Die analise toon dat die vraag na beesvleis en skaap/bokvleis elasties is terwyl die vraag na vark- en hoendervleis onelasties is. Die resultate van verdere analises toon dat skaap/bokvleis 'n substituut vir beesvleis is terwyl hoender- en varkvleis komplemente daarvan is. In die skaap/bokvleisvergelyking is beesvleis 'n substituut vir skaap/bokvleis terwyl vark- en hoerdervleis komplemente daarvan is. Beide die beesvleis en skaap/bokvleis vergelykings het inkome-elastisiteite groter as een getoon. Hoë inkome-elastisiteite vir hierdie twee vleissoorte dui miskien daarop dat indien beide die produksie en bemarking daarvan verbeter kan word, meer van die twee vleissoorte met elke inkomsteverhoging verbruik sal word. In beide die vark- en hoerdervleisvergelykings word bevind dat beesvleis en skaap/bokvleis komplemente van die twee vleissoorte is. Vark en hoendervleis is substitute vir mekaar.

1. INTRODUCTION

In Kenya, priority is given to food production to achieve self-sufficiency and to generate surpluses for export. One strategy to achieve this goal is to improve and expand the meat industry primarily to meet the domestic demand and secondarily to provide for export (sessional paper no 1, 1981). The meat industry

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is important as a source of protein to consumers and income to producers. It is also a source of employment and foreign exchange.

In the last three decades, meat production in Kenya has exhibited surpluses and deficits. Consumption of meat, on aggregate, has been rising because of population increase. During the decades various natural and policy changes have affected the production and consumption of meat. These include drought, changes in income and price, price control, price decontrol, etc. In addition, inefficient livestock management system and diminishing grazing land have been indicated as problems contributing to the reduced per capita supply of meat for domestic consumption.

Kenya's meat production is dependent mainly on cattle, sheep, goat, pig and poultry. Although data are scanty, fish is popular in some parts of Kenya. Though the consumption pattern of meats (beef, mutton, goat, pork and chicken) has not been known with certainty, beef seems to be the most preferred one by most Kenyans. In Kenya, over 50% of protein generated from the various types of meat comes from beef (sessional paper no. 1, 1981).

As of 1993, Kenya's population was increasing at a rate of 3.3% per annum (UNDP, 1993). This, together with urbanisation, rising income and other social factors such as improved health and education, led to growing demand for all foodstuff, including meat. It is, therefore, of national interest to understand how the meat industry was performing to meet the demand for meat, at least in the recent past.

In the past, a livestock and meat industry development study has indicated that Kenya can produce enough meat for the domestic as well as export markets (Chemonics International, 1977). However, in the 1970's there was an indication that supply of beef was less than demand. For instance, the study by Kivunja (1978), indicated that supply and demand for beef were almost equating to each other between the period 1960 and 1968 but that since 1969 demand has outstripped supply. The immediate effect of this was that Kenyan beef exports diminished.

Kivunja (1978) has also conducted an empirical investigation into the economic interrelationships between beef consumption per capita, income and prices for beef and other meats such as goat meat, mutton and pork. His study, covering the time period 1960 to 1974, concluded that the demand for Kenyan beef was highly income elastic and relatively price inelastic. The study further indicated that the substitution effects of changes in other meat prices on per capita beef demand was insignificant with very low cross price elasticities.

This study, though similar to that of Kivunja's (1978), is designed to examine the influences which determine beef, mutton/goat, pork and chicken consumption,

particularly price and income for the period 1961 to 1991. In other words, the central problem with which this article is concerned is to analyse the price-quantity and income-quantity relations for beef, mutton/goat, pork and chicken at retail level in Kenya. It is hoped that a detailed analysis of the consumption patterns of the meat types mentioned above will help planners and policy makers to derive appropriate strategies in the nation's food consumption and production plans.

2. RESEARCH METHOD

Research studies by Tryfos and Trphonoulous (1973); Funk, Meike and Huff (1977); Wahlgenant and Han (1982); Johnson, Hassan and Green (1984); La France (1984); Philips (1984); and Huller (1986) suggest that beef and other meat consumption are influenced by a combination of social and economic factors. Due to lack of data on social factors this study deals only with the economic factors. Consumption and retail price data for various meat types in Kenya for the period 1961-1991 have been collected from various sources. Data on consumption for beef, mutton/goat pork and chicken as well as retail prices of these commodities were collected from various governmental, non-governmental and international organisations. Per capita income and consumer price index (1985 = 100) for the study period were also obtained from the same sources. The per capita income and price data were adjusted for population growth, and changes in the general level of prices..

2.1 The demand model

For the analysis of the data a demand model was used. The quantities of beef, mutton/goat, pork and chicken consumed per head of population in Kenya can be hypothesised as being functions of the price of beef, the price of mutton/goat, pork and chicken, income per capita, time and a disturbance term. Thus, the market demand models for the four types of meats can be presented as follows:

$$C_B = f(P_B, P_{MG}, P_P, P_C, Y, T, U) \quad (1)$$
$$C_{MG} = f(P_{MG}, P_B, P_P, P_C, Y, T, V) \quad (2)$$
$$C_P = f(P_P, P_B, P_{MG}, P_C, Y, T, W) \quad (3)$$
$$C_C = f = (P_C, P_B, P_{MG}, P_C, Y, T, X) \quad (4)$$

Where:

C_B = Per capita consumption of beef (kg)
C_{MG} = Per capita consumption of mutton/goat (kg)
C_P = Per capita consumption of pork (kg)
C_C = Per capita consumption of chicken (kg)
P_B = Price of beef (ksh/kg)
P_{MG} = Price of mutton/goat (ksh/kg)
P_P = Price of pork (ksh/kg)
P_C = Price of chicken (ksh/kg)
Y = Income per head (ksh)
T = Time in years (1961 = 1)
U, V, W & X = Disturbance terms

2.2 Specification of variables

The variables considered in this study are briefly discussed below:

(i) The dependent variable

Annual consumption of beef per capita (C_B), consumption of mutton/goat per capita (C_{MG}), consumption of pork (C_P) and consumption of chicken (C_C) at the national level were each divided by the estimated population to obtain per capita consumption.

(ii) Independent variables

The price data used for beef (P_B), mutton/goat (P_{MG}), pork (P_P) and chicken (P_C) were the annual averages for the nation. These prices were deflated by the consumer price index (all food items) to account for changes in money values. Income per head (Y) was obtained by dividing the Gross Domestic Product (GDP) by the estimated population, and was also deflated by the consumer price index. Time (T) is measured in years with 1961 as 1 and 1991 as 31. Time is included to account for omitted variables which affect demand, e.g. changes in taste).

2.3 Estimating procedure

Various functional forms can be used in demand analyses. The advantages and limitations of these various forms are discussed in detail by Goreux (1960). In this study, linear, double-log, semi-log and inverse-log functions were tried. Only the double-log function satisfied the theoretical expectations regarding signs of the estimated coefficients. These functional forms for beef, mutton/goat, pork and chicken are presented below.

$$\ln C_B = a_o + a_1 \ln P_B + a_g \ln P_{MG} + a_3 \ln P_p + a_4 \ln P_C + a_5 \ln Y + a_6 T \quad (5)$$

$$\ln C_{MG} = b_o + b_1 \ln P_{MG} + b_2 \ln P_B + b_3 \ln P_p + b_4 \ln P_C + b_5 \ln Y + b_6 T \quad (6)$$

$$\ln C_P = c_o + C_1 \ln P_p + C_2 \ln P_B + C_3 \ln P_{MG} + C_4 \ln P_C + C_5 \ln Y + C_6 T \quad (7)$$

$$\ln C_C = d_o + d_1 \ln P_C + d_2 \ln P_B + d_3 \ln P_{MG} + d_4 \ln P_p + d_5 \ln Y + d_6 T \quad (8)$$

Where the variables are as defined earlier and a's, b's, c's and d's are parameters to be estimated.

The above equations were solved by using the ordinary least square (OLS) multiple regression technique. It was assumed that storage, as such, does not greatly affect prices, in other words, that meat moves direct from the abattoir (slaughter house) to local butchery shops where consumers buy meat day by day. The assumption of a predetermined supply places beef, mutton/goat, pork and chicken, due to their perishability, on a framework in which price fluctuations within any given year could only result from changes in supply, rather than from changes in demand.

3. RESULTS AND DISCUSSIONS

The results of the four functions in equations 5 to 8 are presented in Table 1. As can be seen from Table 1, the adjusted coefficients of multiple determination (R^2) are reasonably high for the beef, mutton/goat, pork and chicken functions. Furthermore, the coefficients for all the variables except the trend variable in all equations are statistically significant at 5% level. The Durbin-Watson (DW) Statistic varies between 1,88 and 2,12 indicating that there is no serious auto-correlation problem.

Table 1: The demand for beef, mutton/goat, pork and chicken : Estimates of the complete set of elasticities using the double logarithmic model[a]

	Dependent Variable			
	C_B	C_{MG}	C_P	C_C
P_B	-1,618 (0,240)	0,297 (0,131)	0,401 (0,132)	-0,545 (0,241)
P_{MG}	0,343 (0,141)	-1,212 (0,061)	-0,578 (0,231)	-0,392 (0,201)
P_P	-0,265 (0,122)	-0,561 (0,220)	-0,201 (0,091)	+0,534 (0,230)
P_C	-0,295 (0,140)	-0,450 (0,210)	+1,052 (0,262)	-0,587 (0,221)
Y	1,525 (0,051)	1,485 (0,061)	0,183 (0,092)	0,219 (0,091)
T	0,046 (0,030)	0,020 (0,050)	0,197 (0,031)	0,122 (0,080)
Constant	1,039 (0,510)	-0,760 (0,39)	-0,575 (0,401)	0,602 (0,290)
R^2	0,79	0,76	0,81	0,94
DW	1,98	2,12	1,88	1,94

[a] Numbers in parenthesis are standard errors of estimates. The subscripts, B, MG, P and C represent beef, mutton/goat, pork and chicken

The correlation matrix shown in Appendix 1 indicates some multi-collinearity problem. However, the presence of multi-collinearity does not invalidate estimates as long as the main interest is in forecasting rather than determination of structure (Johnston, 1963, Leser, 1969).

Table 2 shows the price, cross and income elasticities derived from the beef, mutton/goat, pork and chicken equations. In log functions, the estimates are direct elasticities. It would appear from the results (Table 2) that the demand for beef and mutton/goat is relatively elastic while the demand for pork and chicken is relatively inelastic.

The signs of the estimated parameters for cross elasticities indicate the extent to which the four types of meat are substitutes or complements of each other. It appears that mutton/goat is a substitute for beef while pork and chicken are complements to it. In the mutton/goat equation beef is a substitute to mutton/goat while chicken and pork are complements to mutton/goat. The complementary effects of pork and chicken to beef and mutton are not contrary to expectations. Pork and chicken are not part of the day to day diet of people in Kenya. A large part of the quantity of both meats is consumed on special occasions. This is also the reason for the low price elasticity of demand coefficients estimated for pork (- 0,201) and chicken (-0,587). In the pork and chicken, equations both beef and mutton/goat appear to be complements to pork and chicken. Pork and chicken are substitutes to each other. For beef and mutton/goat equations, income is elastic and significant at 5% level of significance.

Table 2: Elasticity estimates from the double logarithmic model

Product	Elasticity with respect to the price of				Elasticity with respect to income
	Beef	Mutton/Goat	Pork	Chicken	
Beef	-1,618	0,343	-0,265	-0,295	1,525
Mutton/Goat	0,297	-1,212	-0,561	-0,450	1,485
Pork	-0,401	-0,578	-0,201	+1,052	0,183
Chicken	-0,545	-0,392	+0,534	-0,575	0,219

4. SUMMARY AND CONCLUSION

In this study. an attempt has been made to spotlight the influence of prices, income and time on the consumption for beef, mutton/goat, pork and chicken in Kenya for the period 1961 to 1991. Demand equations were estimated to determine the significance of price of the meat type, its substitutes and complements, as well as income of the people and changes in tastes and preferences as captured by the trend variable. For all estimated equations. the variables were correctly signed and the elasticities confirm to expectations of orthodox theory with respect to behaviour patterns. The regression models explained a reasonable proportion of the variability in the dependent variables in all equations. That other non-quantifiable and/or omitted variables explained. Only 21% of variability in beef consumption, 24% in mutton/goat consumption, 19% in pork consumption and 6% in chicken consumption can be ascribe to other non-quantifiable and/or omitted variables. In both the beef and mutton/goat equations, responses to own price and income were found to be relatively elastic. However, own price and income responses were found to be relatively inelastic in the pork and chicken equations.

In conclusion the following policy recommendations are made. Firstly as the present analysis is very much aggregated with the study being done on a

national basis, it is recommended that a disaggregated analyses on regional basis should be carried out.

The high income and price elasticities of beef and mutton/goat appear to indicate that if both production and marketing can be improved, more of these two types of meat would be consumed as incomes increase. Expanding the meat supply is critical if the nutritive needs of a growing population is to be met at reasonable cost. Improvement in the marketing system, including market information dissemination, should be a key component of livestock industry strategies to expand the meat supply sector. Such strategy must focus on reduction of losses in the transfer of meat commodities from producers to consumers and the creation of an economic environment within which producers and consumers both can make decisions to maximise their benefits.

NOTES:

1. Mutton/goat are defined in a single category. Though the two may differ preferentially, the study assumes little fundamental difference between the two due to their similar retail pricing.

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Appendix 1: Correlation Matrix

	C_B	C_{MG}	C_P	C_C	P_B	P_{MG}	P_P	P_C	Y	T
C_B	1									
C_{MG}	-0,35	1								
C_P	0,44	0,64	1							
C_C	0,63	0,57	0,67	1						
P_B	-0,52	0,69	0,75	0,54	1					
P_{MG}	0,57	-0,57	0,70	0,61	0,69	1				
P_P	-0,64	-0,67	-0,75	0,72	0,68	0,63	1			
P_C	0,60	-0,71	0,73	-0,78	0,71	0,72	0,64	1		
Y	0,62	0,23	0,19	0,21	0,74	0,65	0,24	0,39	1	
T	0,70	0,76	0,78	0,68	0,69	0,68	0,65	0,63	0,48	1