ELSEVIER

Agricultural Economics 26 (2001) 135–147

AGRICULTURAL ECONOMICS

www.elsevier.com/locate/agecon

Analysis of household attitudes toward the purchase of livestock products and fish in Cameroon

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Received 1 March 1998; received in revised form 26 July 2000; accepted 16 August 2000

Abstract

The need for additional information on household demand for meat and fish in Cameroon is addressed. Probit analysis involving the Heckman selectivity correction procedure is used to estimate the effects of individual and household characteristics on demand for beef, chicken, pork and fish. Results indicate that fish is a relative necessity in Cameroon and is often substituted for beef and chicken by households whose profiles include being of low income levels, having large household sizes, are of middle age and are less educated. Whereas chicken and pork substitute each other, they are each complementary to beef. The profiles of households likely to purchase beef include being married, middle age, educated and of the Muslim faith. Profiles for households most likely to increase their purchases of chicken include being of high income levels and are public sector employed. Some policy implications are provided.

Keywords: Cameroon; Meat; Fish; Probit; Marginal probabilities; Selectivity bias

1. Introduction

In sub-Saharan Africa, market-oriented livestock production is an important focus for smallholder livestock development and has a good potential for contribution to economic development. Realizing this potential depends on a steady market for livestock products and an increase in production. The extend to which livestock producers will increase production however, depends on how they perceive demand for their products. In the Republic of Cameroon, it has been shown that one of the factors limiting intensification of livestock production is inadequate information on market demand for specific livestock products (MINEPIA, 1993). For producers to ensure a steady supply of livestock products to the Cameroonian market, a better understanding of household consumption behavior is needed. This requires that those factors that influence household attitudes toward purchases of the products be identified and their effects quantified. From the estimated effects, household profiles can be constructed as a basis for predicting demand for each product.

This study addresses the need for additional information on household demand for meat and fish in Cameroon. Specifically, it uses probit analysis to evaluate the effects of individual and socio-economic factors that influence the attitudes of households toward the purchase of beef, chicken, pork and fish in Cameroon. Implications drawn from the findings should be useful to livestock producers as they attempt to target specific segments of the population and expand their markets.

Following this introduction, is a description of meat and fish consumption patterns in Cameroon. Previous

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0169-5150/01/$ – see front matter
PII: S0169-5150(00)00120-1

related research on household demand for livestock products is then reviewed. The analytical model is specified along with data requirements. Next, results and discussions are provided, followed by conclusions and implications.

2. Meat and fish consumption patterns

Cameroonians consumed a total of 217,000 metric tonnes (MT) of meat in 1998. Ninety-eight percent of this was from domestic production while the remaining 2% was imported. Beef is the most important meat consumed, followed by mutton and goat meat, pork and poultry in that order. Other meats, including offals and game meat, are also important and account for more than one-fifth of total meat consumption (Table 1). Total meat consumption increased by 80% (4.4% per year) from 1980 to 1998. The largest absolute increase of more than 40,000 MT was in beef consumption. Poultry meat consumption increased by more than three times while mutton and goat meat consumption more than doubled during the same time period. Meat consumption in Cameroon varies by province. In 1995 for example, households in the Center and Littoral Provinces consumed 43% of total beef while those in the Adamaoua, North and Far North Provinces consumed 27%. Households in the West and Northwest Provinces consumed 18% of the total beef while the remaining quantity was consumed in the East and Southwest Provinces (MINEPIA, 1996).

While total meat consumption grew more rapidly for each of the different types of meats consumed in Cameroon, growth in per capita consumption was less rapid during the time period 1980–1998. Per capita consumption of all meats increased by only 1.2 kg during this time period. Like total consumption, per capita consumption of poultry meat also increased rapidly, more than doubling from 1980 to 1998. Beef, mutton and goat meat increased by about 10 and 30%, respectively (Table 1). Not all meats however, witnessed an increase in per capita consumption. Per capita consumption of pigmeat and other meats decreased by 18 and 15%, respectively. Almost all of the increase in per capita consumption of all meats occurred from 1980 to 1988 after which consumption began to decrease, due mainly to a ban on meat imports instituted in the later part of 1988. Following the ban, per capita imports of beef and poultry dropped from 1.2 kg in 1985 to 0.1 kg in 1990.

Total consumption of fish in Cameroon increased by more than 24,000 MT from 104,300 MT in 1980–1998 (Table 1). Unlike total meat consumption, total fish consumption only increased from 1980 to

Table 1
Total and per capita consumption of meat and fish in Cameroon, 1980–1998[a]

Product	1980	1985	1990	1995	1998	% Change, 1980–1998
Total consumption (1000 MT)						
All meats	120.7	162.3	183.3	201.4	217.0	80.0
Beef	49.7	69.2	74.6	83.3	89.6	80.3
Poultry	7.9	20.1	18.6	20.9	26.6	236.7
Pork	14.8	16.5	18.0	20.0	19.8	33.8
Mutton and goat meat	14.8	15.2	27.0	30.6	31.1	110.1
Other meats	33.5	41.3	45.1	46.6	49.9	48.9
Fish	104.3	140.0	139.7	139.6	128.6	23.3
Per capita consumption (kg)						
All meats	14.0	6.3	16.0	15.3	15.2	8.6
Beef	5.7	6.9	6.5	6.3	6.3	10.5
Poultry	0.9	2.0	1.6	1.6	1.9	111.1
Pork	1.7	1.6	1.6	1.5	1.4	−17.6
Mutton and goat meat	1.7	1.5	2.4	2.3	2.2	29.4
Other meats	4.0	4.3	3.9	3.6	3.4	−15.0
Fish	12.1	14.0	12.2	10.6	9.0	−25.6

[a] Food and Agriculture Organization (1998).

1985, declining continuously thereafter. Although per capita consumption shows a similar pattern, overall, per capita consumption dropped by about 25% from 12 kg in 1980.

The important implication of the changes in consumption patterns for meat and fish in Cameroon is that a strong demand, driven by increasing urbanization and income growth, would encourage smallholder livestock development. How much of this will occur however, will be conditioned by the changes that occur in household socio-economic circumstances.

3. Previous research

Demand analyses of livestock products in Cameroon have been limited both in number and scope. Studies on household demand for livestock products and fish by Tambi (1996, 1998), Atouga (1992), Njinkue (1992), Tambi and Vabi (1991), and Holtzman (1988) virtually exhaust the literature. Using a complete almost ideal demand system (AIDS) model incorporating habit formation with and without homogeneity imposed on the system, Tambi (1998) analyzed the consumption patterns of meat, fish and dairy products in Cameroon. The results classified meat and dairy products as relative luxuries and fish as a relative necessity. Changes in money income were shown to significantly influence budget shares for meat and fish but not dairy products. The study by Tambi (1996) employed static and dynamic demand models to estimate household demand for beef with specific concerns on the short- and long-run price and income effects and the period of adjustment for habit formation. Household income, lagged consumption, own and cross prices were jointly important in explaining beef consumption behavior in Cameroon. Atouga's study focused on the impact of import taxation on meat consumption under various scenarios of price change (Atouga, 1992). For a 15% tax increase in the price of meat, budget shares allocated to meat decreased by 1.9%, resulting in an annual per capita decrease in consumption of 3.4 kg by each low income household. While Holtzman's (1988) study of beef consumption in northern Cameroon focused principally on the effects of price policy distortions, Njinkue's (1992) focus was on household food consumption behavior in Cameroon. His analysis of data from a household consumption survey led to the conclusion that fish was an inferior good which low income households increased its consumption while high income households reduced its consumption.

Several studies conducted out of Cameroon have demonstrated that demographic and socio-economic factors are important explanatory factors in household consumption behavior. Using a moment-generating function to estimate the effects of income changes on demand for livestock products in the US, Hahn (1988) found beef to be a normal good while pork and chicken were inferior goods. Applying a dynamic linear expenditure system to time series data for 22 sub-groups of commodities in Japan, Sasaki and Fukagawa (1987) found the consumption of fish to be significantly affected by changes in own-price and the cross price of meat. In Korea, Ingco (1990) reported budget shares to be strongly responsive to changes in food prices, with beef being a relative luxury good while pork, chicken and fish were relative necessities. By incorporating habit and urbanization parameters in the AIDS model, Ingco found that consumption of beef, pork and chicken were influenced by changes in habit while the effect of urbanization was to decrease expenditures on fish and increase expenditures on beef, pork and chicken.

Using probit and truncated regression coefficients, Popkin et al. (1989) simulated the probabilities of women consuming low, medium and high fat meat and poultry products given changes in a set of demographic and socio-economic characteristics. The results showed that for women with average characteristics, the probability of consuming low-fat red meat increased from 0.23 in 1977 to 0.39 in 1985 while the probability of consuming high-fat red meat decreased from 0.68 to 0.24 during the same period. A study by Capps et al. (1988) also employed probit analysis to test hypotheses that individual, demographic and psychographic characteristics influenced consumer decisions to try lean meat products. The conclusions were that age, residency, education, household size and predisposition to buying low-fat foods were important factors affecting consumer decisions. Another study by Cheng and Capps (1988) reported expenditures on fishery products to be more sensitive to changes in household size than to changes in income. However, the cross-price effects between beef and poultry were not statistically significant in that study. In estimating

demand relationships for meat, cereals, vegetables and other food and non-food items in Burkina Faso, Savadogo and Brandt (1988) found price, income and household composition, education, marital status and urbanization to jointly influence household expenditure allocations. In Sierra Leone, Strauss (1983) used survey data from King and Byerlee's (1977) study to estimate a household-firm model for five food items. Results revealed that even though consumption of fish and animal products increased with income, average expenditure shares of fish and animal products decreased for high expenditure goods.

The weakness of the household consumption studies conducted in Cameroon is that they do not address the problem of sample selection bias; a problem commonly encountered in analysis involving survey data. In household consumption studies that use cross-sectional survey data, it is possible that households making food purchases at any one time are a non-random subset of all potential buyers in the market. If this is the case, ordinary least squares (OLS) estimation may provide estimates that are biased and inconsistent. For example, Cheng and Capps (1988) have found sample selection bias as a factor having a significant effect on estimates for fish in the US. In order to provide consistent and efficient estimates, probit analysis has been used in this study along with the Heckman two-step procedure to correct for any possible sample selection bias. The procedure produces a correction term that is incorporated in the final estimating equation to measure the degree of selectivity bias.

4. Methodology

4.1. Model and estimation

Analyses of consumption data obtained from cross-sectional surveys that involve expenditure–income (Engel) relationships often encounter binary responses because of the categorical nature of the decisions made by household heads. As pointed out by Cheng and Capps (1988), household heads do not face the same prices at the same time, preferences for a particular commodity are not usually the same across households and some households may have sufficient inventories such that further purchases may not be necessary. If a commodity is narrowly defined and the survey period is relatively short, the consequence is that some households report no expenditures for the commodity. To fulfill household food needs, a household head is confronted with a marketing decision to which he/she reacts positively by making a purchase (expenditure) or negatively by not making a purchase (no expenditure). When no expenditure is incurred, the response takes on a single value of zero amount spent on consumption. When an expenditure is incurred however, the observation takes on the characteristic of a continuous variable such as the amount spent on consumption. The resulting effect of these responses is a limited dependent variable that is partly qualitative and partly quantitative.

The traditional methods used in this type of analyses have been OLS or Tobit analysis if a large proportion of households decide to make no purchases. Because of the discrete nature of such decisions however, qualitative choice models are a useful analytical tool. The models include the probit model (Anim and Lyne, 1994; Capps et al., 1988; Fletcher and Terza, 1986), the logit model (Jones et al., 1989; Press and Wilson, 1978), and the linear probability model (Falusi, 1976). These models use different distributional assumptions to determine the probability that Y_i is 0 or 1. However, the linear probability model has three important weaknesses: the error term may exhibit properties of heteroscedasticity; [1] it may also possess elements of non-normality; and the predicted value of the dependent variable may fall outside the unit interval. Jones et al. (1989) show that while generalized least squares (GLS) may circumvent the problem of heteroscedasticity, truncating the value of the dependent variable through logit analysis does not resolve the problem. Probit is used in this study for a number of reasons. First, probit has the ability to generate bounded probability estimates for each observation (Anim and Lyne, 1994). Second, the probit estimator assumes that the underlying error term follows

[1] Heteroscedasticity (unequal variance) occurs when the ordinary least squares (OLS) assumption that all disturbance terms have the same variance is violated. When this occurs, OLS generates estimates that are biased, inefficient and may lead to incorrect statistical tests. Alternative approaches for obtaining unbiased estimates in the presence of heteroscedasticity include the generalized least squares (GLS) and maximum likelihood estimation (MLE). For details on these estimation procedures, see Judge et al. (1985) and White et al. (1993).

a normal distribution which is the same distributional assumption typically made for continuous variables.

The probit model which was estimated for fish and three livestock products — beef, chicken and pork — was specified as follows:

$$Y_{zj} = \alpha_j + \beta_j \sum_{k=1}^{s} X_{zjs} + e_{zj} \quad (1)$$

where the X_{zjs} are vectors of s explanatory variables of the jth household purchasing the zth product, and Y_{zj} is a vector of binary variables such that $Y_{zj} = 1$ if the jth household purchases the zth livestock product and 0 otherwise. In the model, the X_{zjs} are assumed to be stochastic and independent of the zero mean random variable e_{zj}. Since Y_{zj} can only assume two different values for each z product, 1 or 0, the expected probability can be defined as follows:

$$E(Y_{zj}) = E\left[\alpha_j + \beta_j \sum_{k=1}^{s} X_{zjs} + e_{zj}\right]$$

$$= \alpha_j + \beta_j \sum_{k=1}^{s} X_{zjs} E(X_{zj}) \quad (2)$$

Eq. (2) which defines the proportion of households with characteristics (X_{zj}) likely to purchase a given livestock product can further be written as

$$E(Y_{zj}) = 0 < \alpha_j + \beta_j \sum_{k=1}^{s} X_{zjs} < 1 \quad (3)$$

such that the larger the proportion, the more likely it is that a decision to purchase a product will be made and vice versa.

The empirical model is specified as follows:

$$\begin{aligned} \mathrm{EXP}_{zj} = {} & \beta_0 + \beta_1 \ln(\mathrm{PB}_{zj}) + \beta_2 \ln(\mathrm{PC}_{zj}) \\ & + \beta_3 \ln(\mathrm{PP}_{zj}) + \beta_4 \ln(\mathrm{PF}_{zj}) + \beta_5 \ln(\mathrm{IN1}_{zj}) \\ & + \beta_6 \ln(\mathrm{IN2}_{zj}) + \beta_7 \ln(\mathrm{IN3}_{zj}) + \beta_8 \ln(\mathrm{HS}_{zj}) \\ & + \beta_9(\mathrm{AG1}_{zj}) + \beta_{10}(\mathrm{AG2}_{zj}) + \beta_{11}(\mathrm{ED1}_{zj}) \\ & + \beta_{12}(\mathrm{ED2}_{zj}) + \beta_{13}(\mathrm{ED3}_{zj}) + \beta_{14}(\mathrm{OC1}_{zj}) \\ & + \beta_{15}(\mathrm{OC2}_{zj}) + \beta_{16}(\mathrm{OC3}_{zj}) + \beta_{17}(\mathrm{R1}_{zj}) \\ & + \beta_{18}(\mathrm{R2}_{zj}) + \beta_{19}(\mathrm{MR1}_{zj}) + \varepsilon_{zj} \end{aligned} \quad (4)$$

where variables are as defined in Table 2. The dependent variable is household's purchasing decisions as defined by Eq. (1). The explanatory variables comprised both the continuous and binary variables. A priori, the following variables are hypothesized as a positive function of household purchases of livestock products: IN_{zj}, HS_{zj}, $\mathrm{ED2}_{zj}$, $\mathrm{ED3}_{zj}$, $\mathrm{HS3}_{zj}$, $\mathrm{OC1}_{zj}$, $\mathrm{OC2}_{zj}$, $\mathrm{OC3}_{zj}$, and MR_{zj}. The variables PB_{zj}, PC_{zj}, PP_{zj}, PF_{zj}, $\mathrm{AG1}_{zj}$, $\mathrm{AG2}_{zj}$, $\mathrm{ED1}_{zj}$ are expected to be negatively related to household purchases whereas the variables $\mathrm{RE1}_{zj}$ and $\mathrm{RE2}_{zj}$ could be positively or negatively related to household purchases.

Eq. (4) was estimated using the maximum likelihood (ML) command of the SHAZAM econometric computer program (White et al., 1993). ML estimation maximizes the value of the probability density function $f(X, \beta)$ and assumes normality of the disturbance term (Kmenta, 1971). ML estimates, therefore, are consistent and asymptotically normally distributed. The β coefficients determine the changes in the probability of purchasing a particular livestock product given a unit change in the explanatory variable.

4.2. Estimating marginal probabilities

Generally the non-linearity feature of probit analysis precludes one from directly interpreting the values of the coefficients as the marginal effects of the explanatory variables. This is best done through marginal probability analysis. Marginal probability analysis measures the change in the probability of a favorable response toward the purchase of a product given a unit change in a continuous variable, *ceteris paribus*. For such variables, derivatives of the probability function are evaluated at their mean values. The marginal probability is calculated as the product of the coefficient estimate (β_j^*) and the standard probability density function $n(X_j\beta_j^*)$ of the probit evaluated at the mean values of the explanatory variables. For dichotomous explanatory variables with a value of 0 or 1, the marginal probability was calculated as the difference between $n(X_j\beta_j^*)$ for $X_j = 0$ and $n(X_j\beta_j^*)$ for $X_j = 1$ in the case of the discrete variable.

4.3. Testing for selectivity bias

In household consumption studies involving binary responses, it is possible that consumption preferences may not be uniform across households. Consumption habits formed over the years may not allow an

Table 2
Description of variables

Variable	Type	Description
EXP_{zj}	Binary	1 if the jth household purchases the zth livestock product, 0 otherwise
PB_{zj}	Continuous	Price of beef in Francs CFA per kg
PC_{zj}	Continuous	Price of chicken in Francs CFA per kg
PP_{zj}	Continuous	Price of pork in Francs CFA per kg
PF_{zj}	Continuous	Price of fish in Francs CFA per kg
$IN1_{zj}$	Binary	1 if household monthly income is less than 80,000 FCFA, 0 otherwise
$IN2_{zj}$	Binary	1 if household monthly income is between 80,000 and 150,000 FCFA, 0 otherwise
$IN3_{zj}$	Binary	1 if household monthly income is between 150,000 and 300,000 FCFA, 0 otherwise
$IN4_{zj}$	Binary	Omitted category for households with monthly incomes in excess of 300,000 FCFA
HS_{zj}	Continuous	Household size defined as number of persons residing in and eating from the same house
$AG1_{zj}$	Binary	1 if household head is between 25 and 50 years, 0 otherwise
$AG2_{zj}$	Binary	1 if household head is above 50 years, 0 otherwise
$AG3_{zj}$	Binary	Omitted category for household heads less than 25 years old
$ED1_{zj}$	Binary	1 if household head has no formal education, 0 otherwise
$ED2_{zj}$	Binary	1 if household head has completed primary school, 0 otherwise
$ED3_{zj}$	Binary	Omitted category for household heads with education above high school
$ED4_{zj}$	Binary	1 if household head has completed secondary or high school, 0 otherwise
$OC1_{zj}$	Binary	1 if household head is engaged in farming, 0 otherwise
$OC2_{zj}$	Binary	1 if household head is employed in the public service, 0 otherwise
$OC3_{zj}$	Binary	1 if household head is engaged in business or commerce, 0 otherwise
$OC4_{zj}$	Binary	Omitted category for unemployed or retired household heads
$RE1_{zj}$	Binary	1 if household head is of the Christian faith, 0 otherwise
$RE2_{zj}$	Binary	1 if household head is of the Muslim faith, 0 otherwise
$RE3_{zj}$	Binary	Omitted category for household heads affiliated with other religious faiths
$MR1_{zj}$	Binary	1 if household head is married, 0 otherwise
$MR2_{zj}$	Binary	Omitted category for unmarried household heads

instantaneous shift from one product to another. It is also possible that consumers making consumption decisions at any one time are a non-random sub-set of all potential consumers, in which case survey data may be subject to significant sample selection bias (Cheng and Capps, 1988; Maddala, 1983). Direct application of OLS to a probit model using such data provides estimates that are biased and inconsistent. An estimation method that circumvents this problem has been provided by Heckman (1976). The method involves a two-step estimation procedure. In the first step, probit was applied to all observations with the dependent variable taking a value of 1 for households who made decisions to purchase a livestock product and 0 otherwise. In this first step, a variable (EC_{zj}) was generated as the inverse of Mill's ratio using the IMR = option of the SHAZAM econometric computer program. EC_{zj} is defined as follows:

$$\frac{f(X\beta)}{F(X\beta)} \quad \text{for} \quad \text{EXP} = 1 \tag{5}$$

$$\frac{f(X\beta)}{F(X\beta)} \quad \text{for} \quad \text{EXP} = 0 \tag{6}$$

where $f(\cdot)$ is the standard normal density function and $F(\cdot)$ is the cumulative standard normal density function (Maddala, 1983; Heckman, 1976). In the second step, EC_{zj} was included in the original model as an explanatory variable as follows:

$$\text{EXP}_{zj} = \alpha_j + \beta_j \sum_{k=1}^{s} X_{zjs} + \beta_j(\text{EC}_{zj}) + \varepsilon_{zj} \tag{7}$$

where EXP_{zj} is as previously defined, X_{zjs} are other explanatory variables defined in Eq. (4) and EC_{zj} is an error correction variable that measures the degree of selectivity bias in the sample. With the correction term, OLS is applied to Eq. (7).

4.4. Data

The data used in this study were collected during the 1992–1993 USAID/CAPP (US Agency for

International Development/Cameroon Agricultural Policy and Planning project) household meat and fish consumption survey (HMFCS) in Cameroon. The aim of the survey was to establish household expenditure patterns for livestock and fishery products and to quantify socio-economic factors likely to influence household demand for these products. The HMFCS selected households from stratified area probability samples in the 10 Provinces of Cameroon (see MINEPIA (1993) for further details on the sampling procedure). The structured questionnaire used in the HMFCS contained questions on whether households purchased any of the livestock and fishery products during the week preceding the survey week. For those who made purchases, they were further required to provide information on quantities purchased of each product, expenditures incurred and prices paid. In addition, they were required to provide information on personal and household characteristics (income, household size, age, education, religious affiliation, occupation and marital status) as well as preferences for each product.

This study analyzed the data collected from 438 households in the Western region of Cameroon. The region has a population of 2.2 million inhabitants, 39% of whom live in urban areas (MINPAT, 1987). It accounts for 38% of the total national production of pork, 27% of poultry, 16% of beef and less than 5% of lamb and mutton (MINEPIA, 1986). Out of the total number of households interviewed in the Western region, questionnaires with missing values for relevant variables were omitted from the analysis. Overall, relevant data used in the analysis came from 88% of the households who purchased fish, 68% for beef, 55% for chicken and 51% for pork. Because of the limited number of households who purchased lamb and mutton and the large number of missing data for related variables, lamb and mutton were omitted from the analysis.

Table 2 shows the description of the variables used in the analysis while descriptive statistics for relevant variables are provided in Table 3. The age of the household head did not vary much (CV = 9.6%) from the average age of 41 years and each household

Table 3
Descriptive statistics for continuous variables influencing household purchases of livestock products and fish in Cameroon

Variable	Number of cases[a]	Mean	Coefficient of variation (%)	Minimum	Maximum
Average monthly household expenditures on (FCFA per month)					
Beef	298	5810	62.6	3400	16500
Chicken	242	3875	82.3	1100	24300
Pork	225	2490	43.6	850	6600
Fish	385	5120	13.0	2700	13800
Average price paid per kg of (FCFA/kg)					
Beef	298	548	16.1	450	1225
Chicken	242	776	33.5	400	1640
Pork	225	630	38.1	470	1100
Fish	385	343	12.2	270	650
Average monthly household income within this income bracket (FCFA)					
<80000	166	36400	22.9	18000	78950
80000–150000	103	104290	20.1	80500	150000
150000–300000	52	182755	19.8	154900	300000
>300000	17	412665	49.5	30800	650000
Years of formal education	296	6.4	14.2	0	17
Average age of household head within this age bracket (years)					
<25	34	23	15.2	20	25
25–50	216	39	4.6	26	48
>50	68	54	11.8	51	73
All age groups	318	41	9.6	20	73
Household size (no.)	368	8.4	11.4	2	13

[a] Total number of cases = 438.

head had approximately 6 years of formal education. The household size was large, averaging eight persons. Household monthly income ranged from 18,000 FCFA (US$ 36.0) to 650,000 FCFA (US$ 1300.0). Thirty-eight percent reported monthly incomes below 80,000 FCFA (US$ 160.0) compared to only 4% with incomes exceeding 300,000 FCFA (US$ 600.0). Average expenditures on beef were greater than expenditures on the other products. Variation in expenditures was highest for chicken and lowest for fish. Average prices paid per kg varied widely for pork than for the other products.

5. Results and discussions

Maximum likelihood and OLS estimates of factors that influence household decisions to purchase beef, pork, poultry and fish in Cameroon were derived using a two-step estimation procedure of the probit model. The results were used to predict the probability that a household with a certain set of characteristics would purchase any of the four products considered. The estimates and marginal probabilities are presented for each of the products analyzed.

5.1. Empirical probit estimates

Results for each of the four products appear in Table 4 as maximum likelihood estimates of the probit model. The goodness-of-fit as measured by the McFadden R^2's show that the choice of explanatory variables included in the probit model explain the variation in decisions to purchase fish, beef and chicken better than the variation in decisions to purchase pork. The likelihood ratio tests indicate that the slope coefficients are significantly different from zero at $P < 0.05$ for each of the four products.

Table 4
Maximum likelihood estimates of factors influencing household decisions to purchase beef, chicken, pork and fish in Cameroon obtained in the first stage of the probit model

Variable	Beef		Chicken		Pork		Fish	
	Coefficient	Marginal probability	Coefficient	Marginal probability	Coefficient	Marginal probability	Coefficient	Marginal probability
PB_{zj}	−0.040**	−0.272	−0.102		−0.034*	−0.201	0.581*	0.158
PC_{zj}	−0.004*	−0.150	−0.013**	−0.158	0.030		0.519	
PP_{zj}	−0.103		0.303*	0.254	−0.009**	−0.045	0.683	
PF_{zj}	0.300*	0.177	−0.001		0.182		−0.031*	−0.189
$IN1_{zj}$	−0.037		−0.003		−0.016		0.253*	
$IN2_{zj}$	0.342**		−0.212*		0.078*		0.089**	
$IN3_{zj}$	0.005		0.047*		0.121		−0.086**	
HS_{zj}	−0.009*	−0.263	−0.097*	−0.305	−0.338*	−0.370	0.001**	0.003
$AG1_{zj}$	−0.083		0.591		−0.308		−0.190	
$AG2_{zj}$	0.375*		−0.074*		0.045*		0.212**	
$ED1_{zj}$	−0.322		−0.161		−0.334		0.189*	
$ED2_{zj}$	−0.197*		0.019		0.046		0.034*	
$ED3_{zj}$	0.010**		0.115		0.175		−0.026	
$OC1_{zj}$	0.124		−0.223		−0.095		0.243	
$OC2_{zj}$	−0.177		0.041*		0.089*		−0.067**	
$OC3_{zj}$	0.296		0.025*		0.004*		0.069	
$RE1_{zj}$	−0.069*		0.066		0.338		0.463**	
$RE2_{zj}$	0.074*		0.002		n.a.		−0.086**	
$MR1_{zj}$	0.174*		−0.080**		0.174		−0.037	
Intercept	0.757		−0.355		−0.460		2.021	
Likelihood ratio test	126.007		142.312		74.238		151.156	
McFadden R^2	0.635		0.592		0.510		0.657	

* Statistically significant at the 10% level.
** Statistically significant at the 5% level.

All the own-price coefficients agree with a priori expectations; meaning that an increase in the prices of meat and fish would impact negatively on a household's decision to purchase these products. An increase in the price of chicken for example, would reduce both its purchase and that of beef. The complementarity between beef and chicken is also common between beef and pork as well as between fish and chicken. However, fish appears as a close substitute to beef as is the case with chicken and pork. These results are in line with previous household consumption patterns which indicate that beef and chicken consumption in Cameroon increased with a reduction in price. Rapid growth in meat consumption in Cameroon occurred during the 1980s, mainly due to increased imports of cheaply subsidized meats from Europe. Meat imports increased from 1500 MT in 1980 to 14,300 MT in 1985. By mid 1988 over 18,000 MT of meat (mostly chicken and beef) were imported into Cameroon. In 1980, the average import prices of beef and chicken were 505 FCFA/kg (US$ 1.65) and 775 FCFA/kg (US$ 2.53), respectively. In 1985, the respective prices had dropped to 234 FCFA/kg and 260 FCFA/kg. With the imposition of a tax on meat imports in 1988, prices of imported meat went up, discouraging consumption. By 1990 the price of imported beef was 810 FCFA/kg (US$ 2.20) while the price of chicken was 1360 FCFA/kg (US$ 3.70). As a consequence, chicken consumption dropped from 20,100 MT in 1985 to 18,600 MT in 1990. At the time of this survey in 1992, the average prices of domestic beef and chicken were 548 FCFA/kg and 776 FCFA/kg, respectively.

The variable for the low income category (IN1) is statistically significant for fish only; implying that an increase in the income levels of households within this income category would have a positive effect on their decisions to purchase fish but not beef, chicken and pork. For middle income households (IN2), an increase in their money incomes would have a larger positive effect on their decisions to purchase beef than it would on their decisions to purchase pork and fish. For households classified as high income, the effect of an increase in money income is to enable them purchase more chicken and to purchase less fish. Thus, fish is an inferior good while chicken is a normal good to these households. These results show that while high income households in Cameroon place a high premium on chicken than on fish, the decisions of low income households to consume beef, chicken and pork are constrained by inadequate income. These findings are corroborated by earlier findings which reveal that over time, an increase in income led to higher budget shares devoted to meat in Cameroon (Tambi, 1998).

The size of a household is an important determinant of its food consumption decisions. The effect of an additional household member is to reduce the likelihood that it will purchase beef, chicken and pork, but will increase its purchase of fish. Age is an important determinant of food consumption decisions only for households headed by older persons. For these households however, chicken is not particularly favored, probably because of the relatively high price of chicken compared to the other products. Apart from fish and beef, education does not seem to significantly influence the decisions of households to purchase chicken and pork. Households headed by more educated persons are more likely to purchase beef than any of the other products; a fact that could be attributed to their ability to recognize the importance of beef as a high protein source. Household heads employed in either the public sector or who are engaged in business activities have a greater likelihood to purchase chicken and pork than they would purchase beef and fish. Within the Cameroon context, the case of chicken is understandable since it is regarded as a luxury good (particularly for high income households) and therefore should be consumed by households with a steady income.

Apart from explaining household choice decisions for meat and fish in Cameroon, the probit estimates help in calculating the marginal effects of a one unit change in an explanatory variable on the probability that a household head would purchase a product, holding constant all other variables at their mean level. The effects appear in Table 4 as marginal probabilities (MPs) calculated only for those continuous variables with statistically significant coefficients. As shown by Green (1990), MPs computed for binary variables are meaningless and therefore cannot, strictly, be compared with those computed from continuous variables. From the MPs in Table 4, an additional household member for example, will have a small but positive impact on the probability of that household to purchase fish. Similarly, the effect of a 1% increase in the price of pork is to increase the probability to purchase chicken by 0.25%.

Table 5
Estimates of factors influencing household purchases of beef, chicken, pork and fish in Cameroon obtained in the second stage of the probit model

Variable	Beef	Chicken	Pork	Fish
PB_{zj}	−0.302**	−0.619**	−0.273*	0.198**
PC_{zj}	−0.017*	−0.806**	0.332	0.216*
PP_{zj}	−0.227	−0.563*	−0.607**	0.018
PF_{zj}	0.313**	0.002**	−0.160	−0.401*
$IN1_{zj}$	0.048**	−0.032	−0.008	0.220*
$IN2_{zj}$	0.076*	−0.089	0.076	0.323*
$IN3_{zj}$	0.622**	0.324**	0.656*	−0.544
HS_{zj}	−0.025*	−0.075*	0.229	0.226*
$AG1_{zj}$	0.454	0.656	−0.320*	0.134*
$AG2_{zj}$	0.234*	−0.652*	0.297	−0.252**
$ED1_{zj}$	−0.120**	−0.043	0.005	0.051**
$ED2_{zj}$	−0.011	−0.006**	−0.023*	0.033
$ED3_{zj}$	0.044	0.121	0.098	−0.143
$OC1_{zj}$	0.202**	−0.028**	−0.007	0.085
$OC2_{zj}$	0.116	0.037	−0.062**	−0.088**
$OC3_{zj}$	0.166*	0.010*	0.023*	0.044*
$RE1_{zj}$	0.323	0.067*	−0.357*	0.810**
$RE2_{zj}$	0.363**	0.039	n.a.	0.789**
$MR1_{zj}$	0.082**	0.047*	−0.166	0.024**
EC_{zj}	0.219**	0.290**	0.902*	0.532**
Intercept	0.945	−0.766	−0.752	1.816
Likelihood ratio test	36.088	73.877	78.443	110.323
Adjusted R^2	0.718	0.698	0.648	0.766

* Statistically significant at the 10% level.
** Statistically significant at the 5% level.

5.2. *Empirical OLS estimates*

Estimates obtained in the second stage of the Heckman two-step procedure appear in Table 5. The measure of statistical significance is the student *t*-statistic. Correction for selectivity bias appears to improve the statistical significance of the variables. This time, 51 of the 79 coefficients are statistically significant; 26 at $P < 0.05$ and 25 at $P < 0.10$. The goodness-of-fit, measured by the adjusted R^2's are superior to the McFadden R^2's of the probit model. Together, the independent variables explain over two thirds of the variation in the probability that households will purchase meat and fish in Cameroon. The error-correction variable (EC_{zj}) is significantly different from zero ($P < 0.05$) for all four products. This suggests that if the analysis was restricted to the use of only positive responses, sample selection bias would have been introduced in the demand for livestock products and fish in Cameroon.

Having corrected for sample selection bias, the results in Table 5 indicate that the effect of an increase in the price of chicken is to reduce its purchase by about two times the reduction in the purchase of fish given an increase in the price of fish. Similarly, an increase in the price of pork would reduce it purchase by about two times the reduction in the price of beef when the latter's price goes up. The cross-price effects indicate that fish is a close substitute to beef and chicken; a result that is in agreement with that of Cheng and Capps (1988). However, the values reported in this study are larger than 0.0382 reported by Cheng and Capps for finfish and poultry and 0.0184 for finfish and red meat.

The effect of money income on household decisions to purchase meat and fish is mixed for the different income groups in Cameroon. Low and middle income households for example, exhibit a greater likelihood to purchase beef and fish than they would purchase chicken and pork. High income households exhibit a greater likelihood to purchase beef, chicken and pork

but not fish. While beef and fish are normal goods and chicken and pork inferior goods to low and middle income households, only fish is an inferior good to high income households. Using data from a household consumption survey in Cameroon Njinkue (1992) reported a similar finding that fish is a normal good to low income households and an inferior good to high income households. The implication of these results is that a policy to raise household money incomes would stimulate market demand for beef and fish but not for chicken and pork by low and middle income households. Such a policy however, would reduce market demand for fish only by households within the high income bracket.

As the size of a household increases, its purchase of beef and chicken diminishes while its purchases of pork and fish increase. An additional household member would increase the purchase of fish by 0.23% but would reduce its purchases of beef and chicken by 0.03 and 0.07%, respectively. Married households appear to increase their purchases of beef, chicken and fish and to reduce their purchases of pork. The negative association between marital status and the decision to purchase pork is in accordance with the findings of Savadogo and Brandt (1988). While middle aged household heads are associated with a greater likelihood to purchase beef and chicken, the likelihood that they would purchase pork and fish is quite small. For older household heads, the probability to purchase chicken is small compared to the other products.

Except for pork, education does seem to significantly influence demand for beef, chicken and fish. Providing formal education to household heads who have had no formal education appears to increase the likelihood that they would purchase beef and fish but not chicken or pork. An increase in formal education of household heads who have already acquired primary education will enhance their demand for beef by 0.12%. Educating further those with secondary or high school education will boost the likelihood of them purchasing beef by 0.04% and chicken by 0.12%. These findings suggests the need for increasing household awareness on the nutritional qualities of animal and fish products as a basis for increasing consumption of these products.

Except pork, households affiliated with the Christian faith appear to be associated with a greater likelihood of purchasing beef, chicken and fish. However, for Muslim households who do not consume pork, their probability of purchasing fish is quite small.

Farm-employed household heads have a greater likelihood of purchasing beef and fish but not chicken and pork. Household heads employed in the civil service tend to favor the purchase of beef and chicken but not pork and fish whereas those in business have a greater likelihood of purchasing all four products.

6. Conclusions and implications

This study has used probit analysis to evaluate the effects of individual and household characteristics on the purchase of beef, chicken, pork and fish in Cameroon. Application of the Heckman two-step procedure provided estimates that were more accurate than the normal probit estimates; suggesting that tests for selectivity bias is not merely warranted but is a necessary condition if reliable estimates are to be obtained from cross-sectional surveys carried out over a relatively short period of time. The results reveal that personal, socio-economic and demographic variables can be used not only to describe household consumption behavior, but also to predict their probability of consuming meat and fish. This has important policy implications, particularly for meat and fish producers who may use the characteristics in targeting. Not only can products be produced for a certain class of households with a set of characteristics, but all classes of consumers can be encouraged to consume more meat and fish with the appropriate policy incentives.

The results of this study indicate that fish is a relative necessity in Cameroon and is often substituted for beef and chicken by households whose profiles include being of low income levels, having large household sizes, are of middle age and are less educated. Whereas chicken and pork substitute each other, they are each complementary to beef. The profiles of households likely to purchase beef include being married, middle age, educated and of the Muslim faith. Profiles for households most likely to increase their purchases of chicken include being of high income levels and are public sector employed.

A number of implications can be drawn from the preceding profiles. First, the reduction observed in the purchase of chicken and beef due to an increase

in household size implies that the current family planning efforts which aim at smaller but healthy families would encourage greater consumption of chicken and beef in Cameroon. For this to happen however, market prices must be such that households can afford given their current income levels. Secondly, the fact that household purchases of beef, chicken and pork move in the same direction means that a high cost of production of any one product (e.g. high price of chicken production due to high feed costs or high import taxes) could impact negatively on household purchases of the other products. However, because fish is a close substitute, the price increase could encourage both the consumption and production of fish. On the other hand, any policy that is aimed at keeping (say) beef prices low would not only benefit beef consumers, but would stimulate the production of chicken and pork, assuming that the existing price levels are such that the production costs of these products are covered. Thirdly, if low income households whose purchases of beef, chicken and pork are constrained by inadequate income are to benefit from any increase in production of these products, their income levels must be adjusted upwards. Therefore, a policy to increase the monthly minimum wage which is currently estimated at 35,000 FCFA (US$ 58.0) would assist low income households to increase their purchases of beef, chicken and pork; in effect, helping to shift their consumption behavior away from fish.

References

Anim, F.D., Lyne, M.C., 1994. Econometric analysis of private access to communal grazing lands in South Africa: a case study of Ciskei. Agric. Syst. 46, 461–471.

Atouga, L., 1992. The impact of imports taxation on local meat production and consumption. In: Langham, M.R., Kamajou, F. (Eds.), Proceedings of an International Symposium on Agricultural Policy Analysis in Sub-Saharan Africa, University Center of Dschang, Cameroon, pp. 257–273.

Capps Jr., O., Moen, D.S., Branson, R.E., 1988. Consumer characteristics associated with the selection of lean meat products. Agribusiness 4, 549–557.

Cheng, H.T., Capps Jr., O., 1988. Demand analysis of fresh and frozen finfish and shellfish in the US. Am. J. Agric. Econ. 70, 533–542.

Falusi, B., 1976. Application of multi-variate probit to fertilizer use decisions: sample survey of farmers in three states in Nigeria. J. Rural Econ. Develop. 9, 49–66.

FAO (Food and Agriculture Organization), 1998. Production Yearbook, 1998 and previous years.

Fletcher, S.M., Terza, J.V., 1986. Analysis of farmers' selection of available marketing alternatives using the multivariate probit model. Can. J. Agric. Econ. 34, 243–252.

Green, W.H., 1990. Econometric Analysis. Macmillan, New York.

Hahn, W.F., 1988. Effects of income distribution on meat demand. J. Agric. Econ. Res. 40, 19–24.

Heckman, J.J., 1976. The common structure of statistical models of truncation, sample selection and limited dependent variables and a simple estimation for such models. Ann. Econ. Soc. Measure 5, 475–492.

Holtzman, J.S., 1988. Price policy induced distortions: undermining incentives to slaughter stall-fed cattle in urban areas of Northern Cameroon. ILCA-ALPAN Network Paper No. 17, pp. 1–18.

Ingco, M.D., 1990. Changes in food consumption patterns in the Republic of Korea. World Bank Working Papers WPS 506, 1–47.

Jones, E., Batte, M.T., Schnitkey, G.D., 1989. The impact of economic and socio-economic factors on the demand for information: a case study of Ohio commercial farmers. Agribusiness 5, 557–571.

Judge, G., Hill, R., Griffiths, W., Lutkepohl, H., Lee, T., 1985. Introduction to the Theory and Practice of Econometrics, 2nd Edition. Wiley, New York.

King, R.P., Byerlee, D., 1977. Income distribution, consumption patterns and consumption linkages in rural Sierra Leone. African Rural Development Paper No, 16. Department of Agricultural Economics, Michigan State University, East Lansing, MI.

Kmenta, J., 1971. Elements of Econometrics. Macmillan, New York.

Maddala, G.S., 1983. Limited Dependent and Qualitative Variables in Econometrics. Cambridge University Press, Cambridge.

MINEPIA (Ministry of Livestock, Fisheries and Animal Industries), 1986. Annual Report. Yaounde, Cameroon.

MINEPIA (Ministry of Livestock, Fisheries and Animal Industries), 1993. Analysis of meat policy decisions on domestic meat consumption and production in Cameroon. Department of Studies and Projects, Yaounde, Cameroon, pp. 1–74.

MINEPIA (Ministry of Livestock, Fisheries and Animal Industries), 1996. Annual Report. Yaounde, Cameroon.

MINPAT (Ministry of Planning and Territorial Administration), 1987. National Population Census. Yaounde, Cameroon.

Njinkue, D., 1992. Contribution a l'etude de la politique alimentaire du Cameroun: le cas des viandes. In: Langham, M.R., Kamajou, F. (Eds.), Proceedings of an International Symposium on Agricultural Policy Analysis in Sub-Saharan Africa, University Center of Dschang, Cameroon, pp. 371–398.

Popkin, B.M., Guilkey, D.K., Haines, P.S., 1989. Food consumption changes of adult women between 1977 and 1985. Am. J. Agric. Econ. 71 (4), 949–959.

Press, S.J., Wilson, S., 1978. Choosing between logistic and discriminant analysis. J. Am. Statist. Assoc. 93, 699–705.

Sasaki, K., Fukagawa, Y., 1987. An analysis of the Japanese expenditure pattern: an application of a dynamic linear expenditure system to the 1961–1982 data. Agribusiness 3, 51–68.

Savadogo, K., Brandt, J.A., 1988. Household food demand in Burkina Faso: implications for food policy. Agric. Econ. 2, 345–364.

Strauss, J., 1983. Socio-economic determinants of food consumption and production in rural Sierra Leone: application of an agricultural household model with several commodities. International Development Paper No. 5, Department of Agricultural Economics, Michigan State University, East Lansing, MI.

Tambi, E.N., 1996. The dynamics of household beef consumption in Cameroon. Agric. Econ. 14, 11–19.

Tambi, E.N., 1998. Testing for habit formation in food commodity consumption patterns in Cameroon. J. Int. Food Agribusiness Marketing 10 (1), 15–30.

Tambi, E.N., Vabi, B.M., 1991. Price and income elasticities of demand for beef, chicken and fish in Bamenda, Cameroon: Some Policy Implications for Increasing Consumption. Institute of Animal Research, Bambui, Cameroon.

White, K.J., Wong, S.D., Whistler, D., Haun, S.A., 1993. SHAZAM Econometric Computer Program — User's Reference Manual. McGraw Hill, New York, pp. 137–140.