# Chapter 4

# RESEARCH METHODS

## Section 4.1 Clarification of Concepts and Issues

### 4.1.1 Scope of the study

The selection of the study areas is based on the current endemicity of malaria in Cameroon. Therefore, the study covers 8 malaria endemic districts distributed in 4 eco-epidemiologic stratums which correspond to different bio-climatic areas in Cameroon. In each eco-epidemiologic stratum two districts are selected : one rural and one urban to represent the endemic region.

First, the coastal industrialized areas where the biggest city is Douala with about 1,200,000 inhabitants. The climate is both hot and humid; temperature varies between 28 to 30 degree and, the rainfall is greater than 1500 mm. Douala metropolitan has a rainfall of about 4000 mm. The malaria transmission is permanent in these areas. The vectors are both An gambiae and An nili. The chemo-resistance to chloroquine, RI+RII, varies between 18% and 30% in this region.

Second, the forest areas of south Cameroon. The climate is warm and humid; the temperature varies between 25 and 28 degrees and the rainfall is higher than 1500 mm. The transmission of malaria is also continuous. The main vectors are : An gambiae; An nili; and An moucheti. The chemo-resistance to chloroquine, RI+RII, varies between 9% and 28%.

Third, the Savannah areas where the climate is warm and relatively dry; the rainfall varies between 500 and 1000 mm. The transmission of malaria is mostly seasonal longer. The vectors are both An gambiae and An funestus. The chemo-resistance to chloroquine, RI+RII, varies between 6% and 15%

Fourth, the sahelian areas of northern Cameroon, where the climate is hot and dry; the temperature varies between 30 and 37 degrees; the rainfall is less than 500 mm. The transmission season of malaria is short and episodic with the possibility of epidemics. The vectors are both An gambiae and An funestus. The chemo-resistance to chloroquine, RI+RII, varies between 7% and 20%.

### 4.1.2 – The Design of the study

The design of this study is a **methodological-descriptive cross-sectional survey** with the aim to explore the problems of judging ability to pay for health care expenditures. To establish if family is able to pay for health care, factors influencing expenditures decisions require a methodological-descriptive analysis to give the most realistic empirical applications. Some of the issues are described in this chapter, but other detailed methodological are discussed in the next chapters.

### 4.1.3 – Malaria case definition in this study

In many malaria endemic districts in Cameroon there is both stable and intense malaria transmission, except in sahelian areas. It is generally considered that a high level of immunity acquired early in life results in a high prevalence of asymptomatic infections. About 97% of these are due to Plasmodium falciparum and there is limited correlation between the level of parasitaemia and the clinical condition of the patient. In these situations, microscopy may not be particularly useful in defining a case of malarial disease. In some of these districts, malaria is virtually indistinguishable from other febrile illnesses at the community level, in the absence of adequate laboratory support. Malaria case definition needs to take into account the disease consequences of malaria and the interpretation of malarial disease in the presence of other disease. Severe anaemia in children and pregnant women, low birth weight and high rates of splenomegly have been used here as indicators of inadequately controlled malaria in the

districts. In these districts where several diseases are prevalent, and there is a need to focus on disease management in general, rather than specific malaria management, a disease indicator may be adopted that covers all the commonly seen diseases forming part of the differential diagnosis. This indicator might be called ''acute febrile illness''. It could, for instance be applied to a child who has developed a sudden illness characterized by fever, with or without respiratory symptoms or diarrhoea.

### 4.1.4 - The meaning of family ability to pay for malaria treatment in Cameroon

The ability to pay for malaria treatment has become a critical policy issue in Cameroon because families are expected to contribute more from their own pockets as a result of health sector financing reforms which introduced or increased user fees in all publicly provided health services.

In this study, the concept of ability to pay concerns the family's capacity to mobilize resources at times of malaria illness. In this context, consumption per capita becomes another critical variable for measuring ability to pay for health care. There are both conceptual and pragmatic reasons why consumption expenditure estimates available from family surveys might be preferred for the purpose of ability to pay analysis to a variable such as family income in Cameroon. It is argued, for example, that consumption expenditures reflect not only what a family is able to command based on its current income, but also whether that family can access credit markets or family savings at times when current incomes are low or even negative (due perhaps to seasonal variation or harvest failure). In this way, consumption is thought to provide a better picture of a family's longer run standard of living than a measure of current income. Further, calculating consumption expenditures is often easier than calculating family incomes, particularly for the poor. While poor families are probably purchasing and consuming only a relatively narrow range of goods and services, their total income may derive from a myriad of different activities with strong seasonal variation and with associated costs that are not always easily assigned. Getting an accurate cash income figure

for families can be frustatingly difficult. Where consumption information is collected, an additional advantage is that not only are consumption expenditures available, but an ability to pay profile based on poverty line can often be derived from the same survey, thereby strengthening the link between the welfare variable used in the analysis and the threshold determined to separate the poor from the nonpoor. Obviously, even if consumption (including education as well) is taken as a major variable of well-being in this study of ability to pay for health care, it is very important to complement the analysis with other dimensions currently used in judging a family ability to pay for health care in order to grant the fee exemptions.

This conceptual approach aims to provide more information about the significance of variables which should be used accurately by policy makers to improve equity access to health care for the poor in Cameroon, especially for the poor families seeking malaria treatment at various public health facilities.

## Section 4.3 - The variables of the models

### 4.3.1 - Some basic principles for selecting and measuring the variables

The overall analysis of ability to pay aims to arrive at sensible and meaningful criteria for the policy of fee exemptions in Cameroon. What is critical in pursuing this objective is that the multinomial logit model which is being developed could accurately rank families by their probability of being able to afford health care expenditures on malaria treatment. While this requirement can be difficult to satisfy at one hundred percent, it is important to note that developing a model of ability to pay does not hinge critically on the power to measure precisely by how much ability to pay of one family differs from that of another; it is sufficient in the policy making process to say whether one family is ranked higher than another family or whether both of them are equally well off. This observation is quite helpful because, it is in the quest for variables that the strongest and most controversial assumptions are not often necessary. There is much greater scope

for widespread agreement on underlying methodologies when the goal is restricted to analyze the ability to pay for social services.

The process of selecting variables is guided by a number of additional principles. First of all, as the variables are supposed to proxy total ability to pay, there is an interest in having as comprehensive a set of variables influencing ability to pay as possible from the information available. The variables of family's ability to pay which are narrowly defined below (cf. 4.2.2) would imply, for the purpose of deciding relative ability to pay levels, that excluded variables do not contribute in any way to ability to pay. Or alternatively, that while certain variables are excluded and are important to ability to pay, they are distributed across families of the sample population in such a way that they do not affect rankings. The extent to which these implicit assumptions seem reasonable varies with the specific variables of ability to pay in question, but as a general rule one would want to include as many variables of ability to pay as is feasible. However, it is often not possible to include all variables in an equally straightforward manner. For several variables it becomes necessary to introduce additional assumptions, and this can add the complexity of the exercise and can threaten the transparency of the process.

### 4.2.2 - Operational definition of Variables

- Costs of malaria treatment or $C_{mt}$ are measured in monetary units. They are concerned with both direct and indirect costs of the treatment of all malaria cases experienced in the family during the last twelve (12) months. They are used as proxy of families' expenditures on malaria treatment. Drugs are only one element in the cost of treatment. The health service costs of administering malaria treatment and the time and travel costs borne by families seeking treatment are two other important components. Both of these are quite high in Cameroon. Thus, the total treatment costs to patients includes:
  - Costs of diagnosis and laboratory tests;
  - Costs of both consultation and medical procedures;
  - Costs of drugs;

- Costs of transportation;
- Opportunity costs of seeking treatment.

- Cash Income or $I_c$ is measured in monetary units. It represents the balance of all types of incomes and transfers of a family during the last twelve (12) months. It includes :

-Wages (from wage earning activities);
-Bonuses and benefits from wage earning activities;
-Medical and maternal allocations (from wage earning activities);
-Income from self-employment (income of non farm family enterprises);
-Scholarships (for education if any);
-Student allocations ( for education if any);
-Income from rental of land or housing (if any);
-Income from various kinds of pensions (occupational status);
-Dividends to shareholders (if any);
-In-kind payments (from wage earning activities);
-Income from farming (farm production);
-Income from selling cattle (if any);
- Other incomes (if any).

- Savings or $S_{av}$ include the moneys a family saved either in the formal financial institutions (e.g. banks) or informal banking schemes ( e.g. informal family's saving schemes). They include also food stores and non-food crops (surplus farm produce).

- Government user fee exemptions or $F_{ge}$ is measured in percentage of expenditures. It represents a family's successful claims on the government provided health services. The question is asked about how much in monetary units user fees exemptions were granted to a family facing payment difficulties for malaria treatment during the last twelve months. They include (if any):

- Fee exemptions for diagnosis;
- Fee exemptions for consultations;
- Fee exemptions for drugs;
- Fee exemptions for follow-up;
- Other fees exemptions.

- Insurance co-payment or $P_s$ is measured in percentage of expenditures. The question is asked about how much if any, health insurance schemes contributed to pay for family health care expenditure on malaria treatment during the past twelve months. It includes all kinds of insurance co-payment to every family member.

- Per capita consumption of non health goods or $C_{pc}$ is measured in monetary units. It is defined as food plus basic non-food spending (including education and excluding health care) divided by the family size. The numerator is made up of two components : one representing the family's expenditure on basic food necessities; and a second component representing essential non-food expenditure based on consumption patterns reflected in the available family budget. It constitutes the main variable derived from foregoing both consumption and human investment in education. It is not usually feasible (nor particularly appealing) to specify actual non-food items which are to be regarded as essential. Rather, the common approach is to ask what share of their budget families spend on non-food items, and then adjust the consumption expenditure accordingly ( Ravallion and Chaudhuri, 1994; Zhao et al, 1995). In fact, differences in opinion exist on how one should pose the question of what amount poor families can devote to non-food expenditure. One approach, known as the ''Cost of Basic Needs'' approach (CBN), asks what fraction of their budget those families which could in principle have met their food needs if they had devoted their entire expenditure to food, actually devote to non-food items. The notion is that as they are actually sacrificing ''essential'' food intakes to purchase such non-food items these expenditures must surely be regarded as essential. Another approach, the ''Food Energy Method'' (FEM), asks instead what fraction of their budget those families which are in fact just spending on food the equivalent of the food poverty line typically devote to non-food items. Ravallion (1995) suggests that the ''true'' indicator of family poverty profile with regard to food and non-food consumption must lie somewhere in the range between the CBN and FEM poverty lines. The family's per capita consumption is considered to be relatively more accurate.

With regard to both education and health care, inclusion of education expenditures in the consumption is unlikely to lead to double counting as the returns from this particular investment will probably not be reflected in current consumption levels. Current practice typically treats education as consumption item, but it is obviously a matter of judgment. But the exclusion of health care expenditures is justified by the fact that its variations cannot be directly linked to the value the consumer attaches to the quality and quantity of the service. Some families are spending little on health because they have access to subsidized public service; others spend little because they cannot afford private health care and are excluded from publicly provided service; and yet others spend a lot because they can afford and choose for higher quality private health care service. Thus health expenditures should be treated separately vis-à-vis other consumption items to more adequately reflect welfare levels of families (Hentschel and Lanjouw, 1996).

On the other hand, when considering this variable, the idea of ability to pay is used there regarding the consumption of other goods. If they forego consumption which is mostly of luxury goods such as alcohol and tobacco, it is judged that family is able to pay for medical care. But, if they forego consumption mostly in the form of essential goods such as food and safe water, it is concluded that the family is not able to pay for health care expenditure (Gertler and der Gaag, 1990). These issues are to be considered carefully in the analyses of ability to pay. The details need more qualitative in-depth investigation which is acknowledged to be a complementary method to the econometric model here developed.

- Land and others productive assets or $L_{pa}$ is measured as qualitative variable. The finding is to determine if families own land and other productive assets. They include : livestock, cattle, forest threes, farm inputs, equipment, or business assets. Families used to sell their productive assets to pay for health care expenditures on malaria treatment. But we don't intend to estimate the overall value of these assets.

- Family size represents the number of people living in the family during the last twelve months or $F_z$. Some categories such

as : number of children under five or $F_{zc5}$; Number of pregnant women or $F_{zpw}$; and others are derived from this definition.

- Family perception of malaria or $M_{pf}$ is measured as a qualitative variable. The perception seems to be an important determinant of family health care expenditure on malaria treatment in Cameroon. When faced with a sudden contingency like malaria disease, the cost and sacrifices incurred by a family will depend on how it perceives the malaria illness itself. The dummy variable will be represented by : (a) very serious illness = 1; (b) other = 0 .

- Frequency of malaria in the family is equal to total number of malaria cases experienced during the last twelve months divided by the family size or $M_f$. Thus, the frequency there means, the proportion of family members infected with malaria illness.

- Number of employed family members represents all persons defined as family members who are employed or self-employed in the activities generating income to the family as a whole ( $E_m$ ).

- Sex of the head of family is defined to represent the woman or man designed by family members as their head. It is a qualitative variable ( $X_{sh}$ ). Female = 1 ; Male = 0.

- Principal source of income is a qualitative variable representing the main activity which generates income to family ( $S_{ip}$ ). Agricultural or farm = 1; others = 0.

- Residence or $R_s$ is a qualitative variable . Rural = 1 ; and urban = 0.

- Preventive measure or $P_{mes}$ is a qualitative variable. The preventive measure is concerned with the use of impregnated bednet in the family. If the impregnated bednet is used = 1 ; otherwise = 0.

### 4.2.3 - Variables and their measurement

The variables are measured through one or more specific questions in the family's questionnaire. Table 4 presents different variables and from which specific questions they are estimated. Independent variables are attributes of either $R_{ij}$ or $D_i$.

Table 6 : Variables and their measurement

| Specific Objectives | Variables | How to measure | Model required |
|---|---|---|---|
| - To develop an appropriate methodology for identifying the determinants of family ability to pay for health care expenditures on malaria treatment in Cameroon and -Health Policy design | Dep. Var. $H_{ai}$ = 1 or 0 | Questionnaire: Qs.32;40 - 41 | Probability Choice Multinomial Logit Model |
| | Inden.Var ($R_{ij}$ or $D_i$) | | |
| | - $C_{mt}$ | Q.31 | |
| | - $I_c$ | Q.50 | |
| | - $S_{av}$ | Qs.44;51;61-62 | |
| | - $F_{ge}$ | Q.42 | |
| | - $P_s$ | Q.42 | |
| | - $C_{pc}$ | Q.52 | |
| | - $L_{pa}$ | Q.51 and Q.61 | |
| | - $F_z$ | Qs.44 and Q.62 | |
| | - $F_{zc5}$ | Q.13 | |
| | - $F_{zpw}$ | Q.13 | |
| | - $M_{pf}$ | Q.13 | |
| | - $M_f$ | Q.21 | |
| | - $E_m$ | Q.26 | |
| | - $X_{sh}$ | Q.13 | |
| | - $S_{ip}$ | Q.12 | |
| | - $R_s$ | Q.53 | |
| | - $P_{mes}$ | Q.10 | |
| | | Q.27 | |

C'tnued - Table 6 : Variables and their measurement

| Specific Objectives | Variables | How to measure | Model required |
|---|---|---|---|
| -To determine how limited resources of families are allocated to malaria treatment needs of individuals, especially women and children | <u>Dep.Var.</u><br>- $C_{mt}$<br><u>Indep.Var</u><br>- $I_c$<br>- $S_{av}$<br>- $F_{ge}$<br>- $P_g$<br>- $M_{pf}$<br>- $C_{uf}$<br>- $W_{pm}$<br>- $M_f$<br>- $P_{mes}$ | <u>Questionnaire</u>:<br>Q.31<br><br>Q.50<br>Qs.44;51;61-62<br>Q.42<br>Q.42<br>Q.21<br>Q.23<br>Q.23<br>Q.26<br>Q.27 | Least Square Multiple Regression Model |

## Section 4.3 - Data and sampling

### 4.3.1 - Designing the questionnaire for data collection

#### A - Principles of the questionnaire's design

The basic principles in designing the final questionnaire are both relevancy and accuracy :

- Questionnaire relevancy : In this study, the questionnaire is relevant if no unnecessary information is collected and if the information that is needed to solve the research problem is obtained.
- Questionnaire accuracy : The criterion of accuracy is the primary concern of this questionnaire. Accuracy means that the information is reliable and valid. While it is generally believed that research should use simple, understandable, unbiased, unambiguous, non-irritating words, no step-by-step

procedure to ensure accuracy in question writing can be generalized to this study.

- Including questions are the following :
  - Determinant-choice question;
  - Frequency-determinant question;
  - Checklist question;
  - Simple-dichotomy question;
  - Fixed-alternative question.

- Excluding questions :
  - Open-ended response question

B - **Questionnaire format**

* **Analytical issues of the questionnaire** :

First, this questionnaire collects data on family coping strategies and ability to pay for malaria treatment(would families have enough of income/resources, especially lower income groups, to pay the increasing health care expenditures on malaria treatment? Would they be able to convert their resources to whatever form - cash or in kind - is required for payment? Do poor families sacrifice other essential consumptions(including education) in order to cope with the health care expenditures? If special allowances (e.g. fee exemptions) were made for the poor, how that affect conclusions for family's ability to pay for health care?)

Second, this family questionnaire aims to collect data on how family membership or demographic structure, occurrence of malaria illness in the family, family perception of malaria affect the family health care expenditures on malaria treatment.

* **Units of observation** : The choice of the unit of observation is largely determined by the information's expected analytic use. For example, it is preferable to gather separately items for each category of sources of income and transfers and then aggregate them to get family cash income on the grounds that this method probably yields more accurate information than a general question on total family cash income(Grosh and Munoz, 1996).

* **Questionnaire layout** : The questionnaire is designed so that only one questionnaire is needed for each family.

* **Conceptual structure of questionnaire** : the questionnaire is divided into five sections. Each section has a unifying theme. Each section often pertains to a uniform unit of observation. The five sections are the following : (1) general information; (2) family and malaria; (3) family health care expenditures on malaria treatment; (4) family coping strategies and ability to pay for malaria treatment; (5) family cash income and expenditure patterns; (6) family resources and wealth patterns.

* **Precoding** : Potential responses to almost all questions are given numbered codes and the interviewer records only the response code on the questionnaire. Precoding requires that choices be clear, simple, and mutually exclusive that they exhaust all likely answers, that respondents will not all fall into the same category, and that categories will not contain too few respondents to be meaningful. A standard technique to ensure that codes include all possible answers is to add an ''other(specify)'' code to those questions where an explicit enumeration is impossible.

* **Skip codes** : A skip code is an indication to the interviewer to proceed to the next appropriate question. Where the skip applies only when a particular answer is given, the skip arrow is positioned directly in the next skip column in front to the family response to which it applies.

* **Respondents** : The individual designated by the family members as the head will provide responses. For some specific questions on health expenditures and coping strategies a member identified as most knowledgeable will provide the responses. Family members are defined to include "all the people who normally live and eat their meals together in the dwelling. Those who were absent more than nine of the last twelve months will be excluded, except for the head of the family and infants less than three months old ''(cf. Appendix for further details)

C - Data collection

Frequent cross-sectional data are to be collected for this study. But time constraints could not permit us to collect the real data for this purpose. However, some hypothetical data generated from different household surveys in Cameroon are used to test the credibility of the models.

The data on families resources are drawn from the Cameroon : income and consumption surveys (1996); the socio-demographic characteristics of families are generated from the Cameroon : demographic and health surveys (1991); and the data on malaria are estimated basically from a transverse survey on the financial charges of antivector control and disease at the family level for malaria disease in Yaounde - Cameroon (1992). These multi-purpose family surveys contain extensive information on many socioeconomic aspects relevant to the family ability to pay for health care. Further details about the data used are available in the referees documents.

4.2.3 - Sampling

A - Description of sampling methods

The main objective of sampling here is understanding the determinants of family ability to pay for health care expenditures on malaria treatment. The sample design determines the number and location of families to be observed in a way that best achieves these goals within both financial and organizational constraints. The following issues are considered:

- The sample is small in size, in order to balance sampling and non-sampling errors This is quite accurate because a single analytical domain is considered in this study.

- The sample is designed to represent the population of Cameroon as a whole, as well as that of subgroup of the poor families, called ''analytical domain''. To reliably depict the overall situation of the population, the selected sample should contain a sufficient number of families, scattered as much as possible throughout the country. However, to reduce the costs, simplify

management, and control the quality of the interviews, the sample size and its geographical dispersion is kept within reasonable limits for each district;

- The sample is drawn in two stages. In the first stage, 8 districts called primary sampling units are selected, with probability proportional to size, from 4 main areas of stratification based on eco-epidemiologic patterns of malaria. One rural and one urban district are selected for each stratum. In the second stage, a fixed number of families are taken from each selected district. To simplify survey design and analysis, each family in the district is giving the same chance of being chosen. Hence, both stages are random selections;

- Two-stage sampling reduces the cost and effort of the sampling and of field work compared with single-stage sampling; but at the cost of increasing the sampling error. This is a result of the so-called ''cluster effect'' in the sampling methods;

- The first stage of sampling requires developing a sample frame from census files. The second stage requires listing all families in the selected districts or primary sampling units and then choosing a random of those families for the final sample. Both Cameroon National Demographic Census (1987)and Cameroon Demographic and Health Survey (1991) provide the database for determining the sample in the all stages;

- To derive unbiased estimates from the survey, the values observed in the sample may need to be weighted. To compute the required weighting factors and correct the sampling errors, all stages of sampling must be carefully recorded and made available to the survey analysts in the survey data sets.

- Further details about sampling procedures are developed elsewhere by Gosh and Munoz (1996), Ainsworth et al. (1992), Ainsworth and Van Der Gaag (1988).

- The sampling aims to target the population of Cameroon;

- The sampling frame is the population living in the 8 selected districts of malaria endemic;

- The sampling unit is the family, and persons to be interviewed are the head of the family and/or the caretaker;

- The determination of sampling size is based on the probability approach using the technique of **Disproportional Stratified Sample**. It permits the allocation of the sample size according to the analytical considerations. For example, this probabilistic sampling technique allows the good representativity of the poor families in the sample;

- The sample question is based on the research objectives which involve the family ability to pay for health care expenditures on malaria treatment. The question is formulated as follows : What are the family dollar expenditures associated with malaria treatment in Cameroon? Figure 3 below provides more information about the measurement level and the measure of association, both of which influences the sample question.

Since it is very difficult to generate an aggregate index representing various measures of association, and based on the statistical convenience, the determination of sample size in this descriptive study is based on the confidence interval of the expected value of the index of the multiple regression model (r). The formula is the following :

$$n/\text{each district} = \left[\frac{2*Z_{ar}}{Z_u - Z_l}\right]^2 + 3$$

$$\text{Where } Z_{ar} = 1/2*\text{In}\left[\frac{1+r}{1-r}\right] \quad ; \quad CI = [u \ ; \ L]$$

Assuming that our r is perfect, suppose = 0.85;
and CI =[ .825 ; .875 ] , the computation gave about :

n/each district = 200 + 10% = 220

**n/national = 220*8 = 1760 families**

But we use only a hypothetical sample of about 500 families to test the models.

### 4.3.3 - Data processing : Computer software required

Two software programs are used for data processing in this study.

First, EViews is used to run two binomial logit models of both stage 1 (seeking professional treatment versus self-medication) and stage 2 (family can afford the costs of malaria treatment versus family cannot afford the costs of malaria treatment. Also, EViews is used to run the multiple regression model of family health care costs as a proxy of expenditures on malaria treatment.

Second, STATA is used to run a multinomial logit model of coping strategies of stage 3 (forego education; forego food consumption; sell productive assets; and borrowing).

**A - Econometric Views Software Program**

We found that the Econometric Views or EViews 2.0 software program performs as well the logit function in order to analyze data reflecting a discrete choice between alternatives.

The logit function from EViews provides a way of qualifying the relationship between the resources available to plus characteristics of the family and the probability of adopting coping strategies. Probabilities always lie between zero and one, so the specification for the probability needs to embody this restriction.

EViews provides coefficient estimates with standard errors, t-statistics and p-values. Also presented are the value of the maximized log likelihood and the number of observations with $H_{a1}$ = 1 and with $H_{a1}$ = 0. Lastly, EViews reports the means for all of the regressor variables for the entire sample, and for the sample broken down by the value of the dependent variable.

**B - Interpretation of output from EViews' logit function**

Interpretation of the output of logit function is similar to interpretation of regression output, but analysis of the

magnitudes of the coefficients must be made with the logit functional forms in mind. Since the dependent variable is a binary indicator, the expected values of the dependent variable equal the probabilities given in the model.

Differentiating with respect to the j-th explanatory variable $R_{ij}$ yields :

$$\frac{\partial E(H_{ai}/R_{ij})}{\partial R_{ij}} = \frac{Exp.(\alpha' R_{ij} + \beta'_j D_i)}{[1 + Exp.(\alpha' R_{ij} + \beta'_j D_i)]^2} * \alpha_j$$

When weighted by the appropriate nonlinear factors, the $\alpha_j$ coefficient measures the change in the expected value (probability) in response to changes in $R_{ij}$. Positive values for $\alpha_j$ imply that increasing $R_{ij}$ will increase the probability of the response; negative values imply the opposite.

An alternative interpretation of the coefficients results from noting that the ratios of coefficients for a given model provide a measure of the relative changes in the probabilities associated with the two explanatory variables :

$$\frac{\partial E(H_{ai}/R_{ij})/\partial R_{ij}}{\partial E(H_{ai}/R_{ij})/\partial R_{ik}} = \frac{\alpha_j}{\alpha_k}$$

Forecasting from the logit model generates a series containing the fitted probability values :
Probability($H_{ai}$ = $1/R_i\hat{\alpha}$), for each observation in the sample. These fitted values provide unbiased predicators for $H_{ai}$ given the data on $R_{ij}$ . But standard errors for the forecast and a graphical display of the fitted values are not available for logit.

Estimation of logit function is performed by maximizing the likelihood function with respect to all of the coefficients. The maximization requires an iterative method, but in most cases the algorithm will operate smoothly, since the logit likelihood

function is very well behaved. By default, the maximum number of iterations is set to 100, and the convergence criterion is set to .001. Convergence is defined in terms of the maximum change in the value of the scaled coefficients.

## C - Statistics/Data Analysis or STATA Software Program

STATA has a good function of multinomial logit model. The command is ''mlogit'' which shares the features of all estimation commands. The command ''mlogit'' estimates maximum-likelihood multinomial logit models, also known as polytomous logistic regression. Constraints may be defined to perform constrained estimation.

Some researchers refer to conditional logit model as multinomial logit. Both ''mlogit'' and ''clogit'' provide almost the same estimated coefficients.

The main option consists to specify the value of dependent variable that is to be treated as the base category. The significance level is specified in percent for the confidence interval of the coefficients.