INCOME DISTRIBUTION, CONSUMPTION PATTERNS AND CONSUMPTION LINKAGES IN RURAL SIERRA LEONE

by

Robert P. King and Derek Byerlee

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AFRICAN RURAL ECONOMY PROGRAM

The African Rural Economy Program was established in 1976 as an activity of Michigan State University's Department of Agricultural Economics. The African Rural Economy Program is a successor to the African Rural Employment Research Network which functioned over the 1971-1976 period.

The primary mission of the African Rural Economy Program is to further comparative analysis of the development process in Africa with emphasis on both micro and macro level research on the rural economy. The research program is carried out by faculty and students in the Department of Agricultural Economics in cooperation with researchers in African universities and government agencies. Specific examples of ongoing research are, "Poor Rural Households, Income Distribution and Technical Change in Sierra Leone, Ethiopia and Ghana," "Rural and Urban Small-Scale Industry in West Africa," "Dynamics of Female Participation in the Economic Development Process in West Africa," and "The Economics of Small Farmer Production and Marketing Systems in the Sahelian Zone of West Africa."

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FOREWORD

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PREFACE

This paper has been developed as part of a two-year study of income distribution among rural households in Africa financed under a United States Agency for International Development Contract (AID/ta-C-1328) with Michigan State University. The data collection in Sierra Leone was carried out as part of the Rural Employment Research Project at Njala University College, Sierra Leone, financed by a United States Agency for International Development contract from Michigan State University (AID/csd 3625) and by the Rockefeller Foundation.

Numerous individuals have aided in this study. Particular thanks is due to the field staff in Sierra Leone, to Michigan State University computer programmers Mike Dege and Linda Buttel and to Janet Munn for secretarial help. Valuable comments on earlier drafts of this paper were received from Victor Smith, Carl Eicher, Carl Liedholm, Peter Matlon, Robert Stevens, Thomas Poleman, Lester Manderscheid and David Price. Remaining errors and omissions are of course the responsibility of (and sometimes the result of the obstinacy of) the authors.

1. INTRODUCTION

Knowledge of consumption patterns has long been recognized as a major input into economic planning and policy analysis in African countries. To date, however, empirical research on consumer behavior has been limited in scope, focusing on particular commodities, usually food, or on particular groups of the population, usually urban consumers. Household budget studies have been conducted in many African countries, but often the information has been used only in the construction of consumer price indices--a rather limited objective. At the same time, projections of consumer demand for even major commodities are often based on "general" estimates of income elasticities such as those provided by the Food and Agricultural Organization (FAO). Moreover, where reliable estimates of income elasticities are available for major commodities, elasticities are not available for commodities of less importance, although such information could be quite valuable in policy and project design. For example, despite increasing interest in appropriate technology and particularly in small-scale industry, little is known about the nature of consumer demand for the products of small-scale industrial firms.

Recently there has been considerable interest in the relationships between income distribution and the pattern of consumer demand and their implications for growth and employment in the total economy. Researchers are beginning to consider consumption based linkages as an important factor in the development process. Broadly, two interrelated sets of

consumption linkages are useful in understanding the effect of income distribution on sectoral growth and employment.

First, there are the factor intensities of an observed consumption pattern--that is, the amount of labor, capital and foreign exchange resources directly and indirectly used to produce the goods and services which make up that consumption pattern. Much of the literature concerned with the factor intensity of consumer demand has focused on the widely accepted hypothesis[1] that the labor intensity of goods consumed decreases as incomes rise while the capital intensity of consumption and the demand for imports increases. The implications for economic planning and development strategies of this intuitively attractive idea are great. It implies there need be no tradeoff between equity on the one hand and growth and employment on the other, since a redistribution of incomes at the margin is expected to result in higher employment and less demand for goods using scarce capital and foreign exchange resources. Only a few empirical studies have been undertaken to test this hypothesis. Soligo [1973] in Pakistan and Sunman [1974] in Turkey do provide supporting evidence, but Ballentine and Soligo [1975], by examining both direct and indirect capital and labor requirements of consumption patterns in Columbia show that the validity of the hypothesis in the long run may be questionable. In Africa there have been no empirical tests of this hypothesis to date.

The second set of consumption-based linkages can be called locational linkages, since they are indicative of where the impacts of rural consumption expenditures are felt. Locational linkages can be defined in terms of three basic dichotomies: home produced versus purchased goods,

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[1] First explicitly stated in Towards Full Employment [1970], the I.L.O. study on Columbia.

rurally produced versus urban produced goods, and domestically produced versus imported goods. These locational impacts are a basic factor in the creation of intersectoral linkages, which are important in Mellor's [1976] view of the development process. Mellor sees new food grain technologies as a major impetus for growth and employment in the food grain sector and rural consumption expenditures as the primary means by which the multiplier effects of this growth are realized in other sectors of the economy. The strength of these locational linkages is dependent on income distribution. For example, Mellor shows that in India high income rural consumers tend to foster these linkages by spending a greater proportion of their increased incomes on nonagricultural goods and services. Unfortunately, Mellor is not able to establish the extent to which increased demand for nonagricultural goods and services would affect household production, rural nonagricultural activities, the demand for urban produced goods and services, or the demand for imports.

Locational linkages of consumer expenditures are also explicitly discussed by Hymer and Resnick [1969], who focus on the effect of rural nonagricultural activities--Z activities--on marketed surplus and the integration of rural and urban economies. They show that if the income elasticity of demand is high for manufactured goods while that for Z goods and services is low or negative, an increase in the price of agricultural products relative to that of manufactured goods will lead to an increase in marketed surplus and in the consumption of products manufactured in urban areas. On the other hand if the income elasticity of Z goods and services is relatively high, a policy of increased agricultural prices and the concomitant rise in rural incomes may lead rural producers to devote more time to Z activities, resulting in less marketed surplus and less

demand for goods manufactured outside of rural areas. To date there has been little empirical research conducted to test the validity of the Hymer-Resnick model and none which analyzes the impact of income distribution on the effects investigated within the model.

In rural Sierra Leone--the focus of this study--there has been little research on consumption patterns. Household budget studies have been undertaken by the Central Statistics Office throughout the country, which provide a general description of household expenditure patterns [Central Statistics Office, 1968, 1971a, 1971b, 1971c, 1972a]. Only the data for the Freetown survey have been analyzed to derive income elasticities of demand [Snyder, 1971 and Levi, 1976]. However, there is no reason to believe that these elasticities are applicable to the rural population which comprises 70 percent of the country's population.

In view of the need to explore the relationship between income distribution and consumption linkages in general and to estimate income elasticities of demand for important commodities in rural Sierra Leone there are three main objectives for this study: (1) to describe consumption patterns and to estimate income elasticities for use in the projection of consumer demands for specific commodities in rural Sierra Leone; (2) to analyze the impact of consumption patterns at different income levels on labor, capital and foreign exchange requirements; and (3) to determine the nature and strength of consumption based locational linkages.

In the next section, the data collection procedures for this study are described with particular attention given to the influence of research objectives on the choices of the survey methodology. Economic and demographic characteristics of the sample population are described in Section 3. Income classes and commodity groups to be used throughout the study

are defined and income distribution for the sample households is described. Budget shares for each commodity are presented and seasonal patterns of consumer expenditures are analyzed.

In Section 4, estimates of total expenditure elasticities and marginal propensities to consume for a disaggregated set of commodity groups are presented for each income class. Particular attention is given to the choice of functional form used in the estimation procedure.

Factor intensities of rural consumption patterns at different levels of income are estimated in Section 5, and the results are analyzed to determine the employment, capital, and foreign exchange requirements of both current and projected rural consumer demand.

Finally, these results are used along with information on the breakdown by origin of goods consumed in each income class to identify potential locational linkages based on rural consumer demand. The results of the study are summarized in the final section and additional research requirements are outlined.

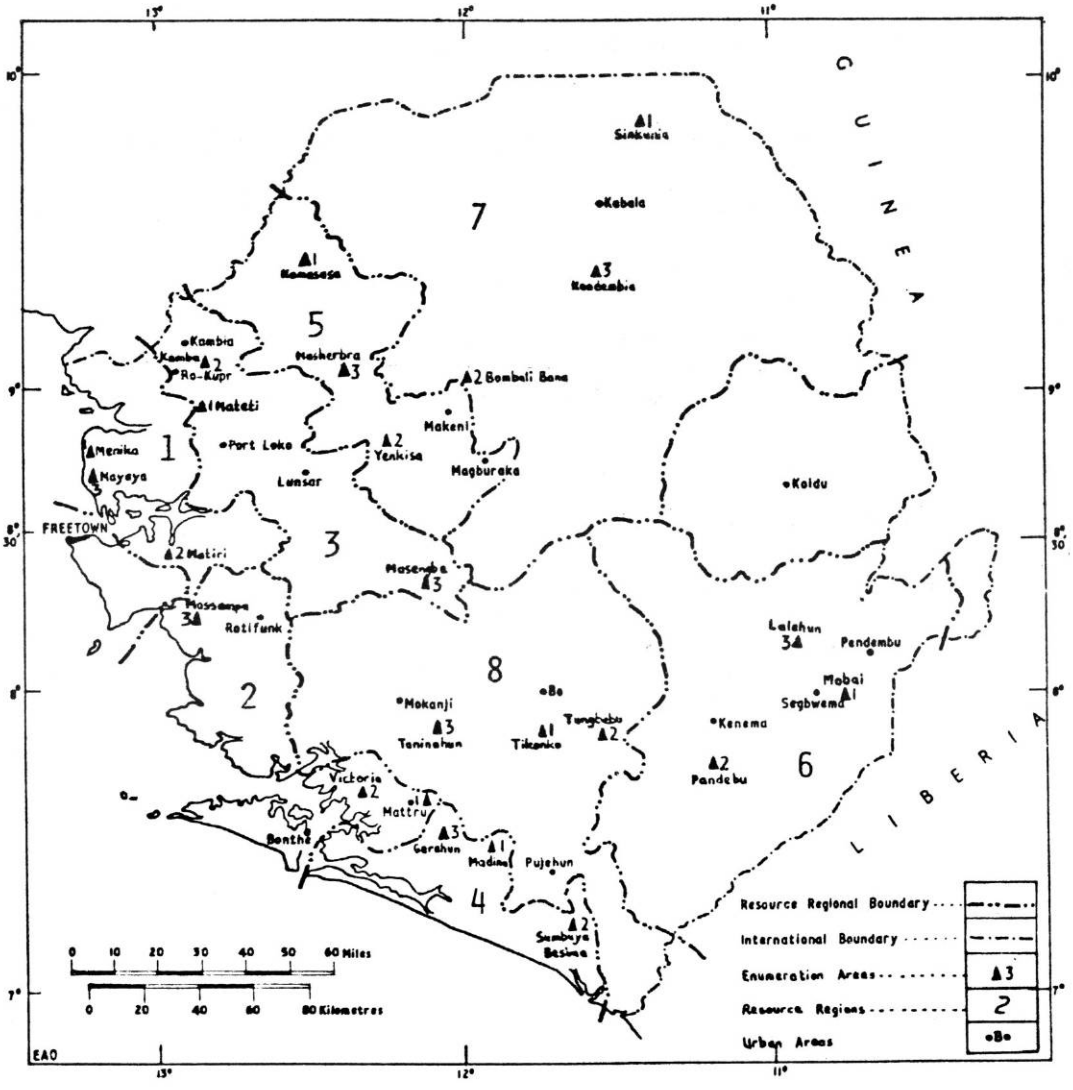
2. SURVEY METHODOLOGY

The basis for this study is cross-sectional data collected in a national rural household budget survey of Sierra Leone conducted between March 1974 and May 1975. Expenditure data were collected for a highly disaggregated set of commodities and information concerning the origin of purchased goods (used in the classification of goods by factor intensity and in the analysis of locational impacts) was also included in the data set. In this section we briefly review the sampling procedure and interview scheduling used in this survey.

2.1. Sampling Procedures

The rural consumption survey in Sierra Leone was part of a larger integrated rural household[1] survey designed to collect information on farm and nonfarm production, consumption and migration. In this survey, three census enumeration areas were randomly chosen in each of the eight resource regions indicated in Figure 2.1. Within each enumeration area 20 primarily farm and 4 primarily nonfarm households were randomly chosen to give a total of over 500 households. These households were interviewed twice weekly over a year to obtain daily data on labor inputs, outputs, etc., for farm and nonfarm enterprises. One-half of the households in each survey enumeration area were chosen at random for the consumption study in

[1] A household is defined as a group of persons who eat from the same pot.



(1) Scarcies; (2) Southern Coast; (3) Northern Plains,
(4) Riverain Grasslands; (5) Boliland; (6) Moa Basin;
(7) Northern Plateau; (8) Southern Plains

FIGURE 2.1
SIERRA LEONE RURAL RESOURCE REGIONS

which cash expenditures on consumption items were also recorded.[1] This unified sampling approach of including both production and consumption information facilitated the estimation of the value of subsistence production, which has proved difficult in other surveys.

A number of the initial sample of 250 households were dropped from the sample prior to analysis due to inadequacies in data, deaths, or movement of the respondent from the region, leaving a final sample of 203 households.

2.2. Reference Periods for Survey Interviews

The accuracy of consumption expenditure data is dependent on the length of the reference period used in the survey questionnaires--that is, the length of time over which respondents are required to recall events from memory. The ability to remember events, such as consumption expenditures, diminishes as the length of the reference period increases. This problem of reduced recall capacity is more severe for events that occur frequently, such as the purchase of food, tobacco, beverages, and regularly consumed household goods.

Another source of bias is what Prais and Houthakker [1971] call the "end period effect". This occurs most often for durables and other less frequently purchased commodities for which respondents tend to include expenditures from earlier time periods in their reporting of consumption, especially for items for which there has been no expenditure during the

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[1] For the purposes of the consumption study, stratification by income group to allow the separation of income effects from those attributable to regional factors would also have been desirable. Such stratification was not possible, however, since comprehensive data on household income or even proxy variables, such as farm size, were not available prior to the initiation of the study.

time period under inquiry. Therefore, short reference periods can lead to some overestimation of expenditures for infrequently consumed goods.

In order to reduce biases caused by these effects, two questionnaires with different reference periods were used. A questionnaire with a reference period of four days was used to record all consumption expenditures made by a household within the recall period. This questionnaire was intended as a source of data on daily expenditures for food, beverages, tobacco, and other commonly purchased items. The second questionnaire had a reference period of one month and was used to record only expenditures during a month on durables and less frequently purchased goods.

In both the four day and monthly questionnaires, information on commodity purchased, its origin, the place of purchase, quantity, and cost were collected. Both survey forms were partially pre-coded by commodity to remind enumerators to ask about certain commonly purchased items. Origins were grouped into four categories: rural areas, large urban areas,[1] small urban areas,[2] and imported. This information was gathered for the analysis of the locational impacts of rural consumption patterns. All quantities were measured in local units.

Enumerators were instructed to be as specific as possible concerning the nature of commodities by including, for example, brand names where possible. In this way, the consumption of commodities grouped with respect to factor intensity and origin could be estimated.

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[1]Large urban areas are defined as those with a population greater than 100,000.

[2]Small urban areas are defined as those with a population between 2,000 and 100,000.

2.3. The Schedule of Interviews

Interviewing for the consumption study was conducted over an entire cropping year. Enumerators interviewed in each household on a twice weekly basis to obtain production data, but it was felt that such repetitive collection of consumption data might quickly lead to fatigue on the part of both enumerators and respondents, which could have resulted in standardization of responses.[1] To avoid this problem, the short reference period questionnaire was administered only twice each month for successive four-day reference periods.

The scheduling of consumption interviews was established by grouping the sample for each enumeration area into four groups, each corresponding to a week of the month. In general, each group consisted of three households. For a given week of a month the three households in the associated group were administered the short reference period questionnaire. The long reference period questionnaire was administered to each household in the sample during the last week of the month.[2] In this way, the enumerator's work load was was distributed evenly throughout the month and continuous data within each enumeration area were obtained.

2.4. The Estimation of Subsistence Consumption

The data collected through the above two survey questionnaires measure only cash expenditures of the household. Data on output and sales from the farm management survey were used to estimate households' consumption of home produced goods. This subsistence consumption was defined simply

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[1] Unlike production data which is continually changing over the year with the farming calendar, consumption data tends to be relatively monotonous.

[2] Observations that were obviously recorded on both questionnaires were screened at the time of coding to avoid duplication.

as the difference in the value of what a household produced and what it sold. Both output and sales were valued at farm gate prices. This method of estimation caused some difficulties since sales data were apparently underestimated in a number of cases.[1] Furthermore, storage losses and year-to-year changes in inventories are ignored in this measure. In general, however, this approach seems to have yielded satisfactory results. For example, per capita consumption of rice--a commodity consumed largely out of own production--is close to the national average when estimated by this method. Total consumption expenditure for a given commodity, then, was defined as the sum of cash expenditures and the value of subsistence consumption for that good.

2.5. Preparation of the Data for Analysis

Because the purchases of commonly consumed goods were recorded for only one week in four, it was necessary to "puff up" the data. This was done under the assumption that consumption of these goods is relatively consistent from day to day. Therefore, if data were available for seven days out of thirty in a given month, recorded expenditures for a particular good were multiplied by 30/7 to estimate expenditures for that good for that month.

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[1] For example, subsistence consumption of coffee and cocoa, which are not generally consumed in rural households in any quantity, was estimated to be quite high by this method. Similar problems were encountered with small-scale industry products, such as tailoring and woodwork which are generally marketed. Because of these obvious difficulties, subsistence consumption for these goods was set at zero.

Missing data were also a problem in some cases. When the amount of data present for a household met certain minimum standards,[1] an indexing procedure described in Appendix 1 was used to obtain an annual estimate of consumption for that household.

[1] At least three months of consumption data, a valid month being defined as having at least three days of data from the short reference period questionnaire and the presence of the long reference period questionnaire.

3. A DESCRIPTIVE ANALYSIS OF RURAL CONSUMPTION PATTERNS

3.1. Definition of Income Classes and Income Distribution

Consumption expenditure, Y, is the measure of income used in this study. This measure was chosen over an alternative measure, net household income,[1] since consumption expenditure is considered a better indicator of permanent income which Modigliani and Brumberg [1954] and Friedman [1957] hypothesize to be the more important determinant of consumption behavior.[2]

For purposes of interpreting and presenting results and for analyzing income distribution, we define six income classes. Following Kuznets [1976, p. 87], these income classes are defined on the basis of *per capita* household expenditure rather than total household expenditures.[3] The first

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[1] Net household income, I, is defined as I = S + M - F + W where S is the value of subsistence consumption, M is the value of households' produce sales, F is the value of production inputs and W is wages received from off-farm employment. Total consumption expenditure is given by Y = S + C where C is the value of cash expenditures. In fact, both measures of income in this sample are highly correlated, since subsistence consumption is approximately half of household income and is common to both measures. Furthermore, C is approximately equal to M - F + W unless there are substantial *net* loans, gifts or savings which in fact is not the case for most households.

[2] Prais and Houthakker [1971] note that in surveys conducted over a very short period, a single expenditure on a major durable may cause total expenditures to grossly overrepresent permanent income. Since households in this survey were observed over an entire year, this should not be a problem here.

[3] Conceptually consumer equivalent scales should be used to compute expenditure per consumer equivalent. However, in practice such scales must be arbitrarily determined [Currie, 1972]. Furthermore, from a policy and planning viewpoint, per capita income is more readily understandable and more widely used in estimating measures of income distribution.

and sixth income classes, comprise, respectively, the lower and upper 10 percent of households ranked by per capita consumption expenditures. Classes two through five are made up, respectively, of households in the second and third, fourth and fifth, sixth and seventh, and eighth and ninth deciles of the ranked sample population. This classification accentuates the difference between the highest and lowest income class.

Economic and demographic characteristics of the households in each income class are shown in Table 3.1. Average per capita expenditures are 116 Leones per year or approximately $128 (U.S.) based on a conversion rate of Leone 1.00 = $1.10 (U.S.). There is a consistent decline in both household size and the percentage of children in a household as per capita income rises.[1] A simple economic explanation for this inverse relationship is that the labor productivity of children, and therefore their income generating capacity, is less than that of adults. Hence, households with a larger percentage of children (households which also tend to be larger) are expected to have lower per capita incomes.

To a large extent, differences between income classes are related to regional differences. Fifteen of the nineteen households in the highest income class are located in the southern portion of Sierra Leone, where incomes are higher because of tree crop cultivation and where households are relatively small and nucleated.[2] Thirteen of the twenty households in the lowest income class, on the other hand, are located in the poorer northern regions where incomes are lower and where households are composed of extended families rather than nuclear units. These generally accepted

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[1] Kuznets' [1976] results indicate a similar pattern for households in the United States, Germany, Israel, Taiwan, and the Philippines.

[2] See Spencer and Byerlee [1977] for a discussion of regional differences in Sierra Leone.

TABLE 3.1
DEFINITION OF INCOME CLASSES AND THEIR ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS

Income Class	Number of Households	Mean Annual Per Capita Expenditure (Leones)	Lower Expenditure Bound (Leones)[a]	Upper Expenditure Bound (Leones)	Average Household Size	Percentage Children	Subsistence Ratio[b]
1. Lower deciles	20	33.62	20.46	42.99	10.4	.50	.51
2. Second and third deciles	42	55.61	43.00	68.99	9.7	.44	.49
3. Fourth and fifth deciles	41	88.89	69.00	103.99	7.5	.37	.52
4. Sixth and seventh deciles	40	122.02	104.00	142.99	5.3	.29	.47
5. Eighth and ninth deciles	41	171.69	143.00	209.99	5.2	.28	.48
6. Upper decile	19	264.88	210.00	432.31	3.2	.11	.38
Entire sample	203	116.28	20.46	432.31	6.9	.34	.48

[a] 1 Leone = $1.10 U.S. in 1974/75.

[b] Percentage of total consumption expenditure attributable to goods produced and consumed in the household.

regional differences are confirmed in Table 3.2. Clearly average per capita income tends to be higher in the southern region (i.e., the Southern Coast, the Riverain Grasslands, the Moa Basin, and the Southern Plains), while household size and the percentage of children per household are higher in the northern region (i.e., the Scarcies, the Northern Plains, the Bolilands, and the Northern Plateau). The income classification used in this study, then, is not free of regional effects. In the estimation of marginal propensities to consume and expenditure elasticities of demand, however, allowance for these effects will be made by the introduction of regional dummy variables in the regression equation.

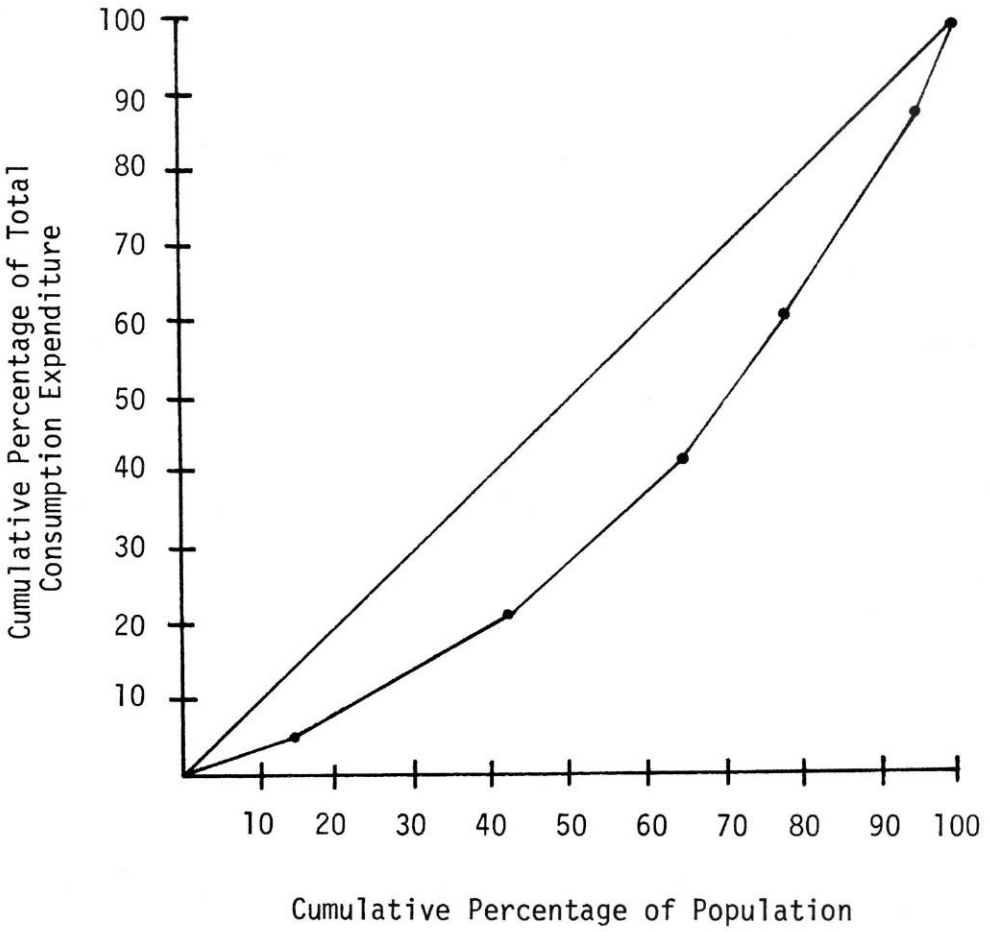
Figures in Tables 3.1 and 3.2 also show the importance of subsistence consumption for households in all income classes and all regions. The subsistence ratio (i.e., subsistence consumption as a percentage of total consumption) is 48 percent in the entire sample, or nearly one-half. There is a tendency for this percentage to be higher for households in the lower income classes. This figure is somewhat higher than recorded in other African surveys. For example, in rural Kenya the estimated subsistence ratio is 32 percent [Massell, 1969]; in the north of Nigeria, 26 percent [Simmons, 1976]; in rural Ghana, 25 percent [Dutta-Roy, 1969] and only 16 percent in the east of Nigeria [Hay, 1966]. Higher estimates of the subsistence component of consumption for Sierra Leonean households may reflect greater accuracy in measuring subsistence consumption due to the integration of the consumption and agricultural production surveys as well as behavioral differences.

A Lorenz curve was constructed as a measure of income distribution in rural areas of Sierra Leone (see Figure 3.1) using the average per capita consumption expenditure and the sample population size for each

TABLE 3.2
DEMOGRAPHIC AND ECONOMIC CHARACTERISTICS OF SAMPLE HOUSEHOLDS GROUPED BY REGION

Region[a]	Number of Households	Mean Per Capita Consumption Expenditure	Average Household Size	Average Percentage Children	Subsistence Ratio
1. Scarcies	10	108.62	8.3	.37	.23
2. Southern Coast	33	149.15	6.9	.33	.52
3. Northern Plains	21	105.10	8.0	.44	.39
4. Riverain Grasslands	24	158.45	4.8	.21	.50
5. Bolilands	34	72.17	9.4	.41	.66
6. Moa Basin	31	114.87	5.4	.35	.44
7. Northern Plateau	21	100.06	6.9	.33	.38
8. Southern Plains	29	119.71	6.4	.29	.48
All Regions	203	116.28	6.9	.34	.48

[a]See the map of Sierra Leone, Figure 2.1, for the delineation of regional boundaries.



NOTE: Gini coefficient = .32.

FIGURE 3.1
LORENZ CURVE OF INCOME DISTRIBUTION
FOR RURAL HOUSEHOLDS

income class. The associated Gini ratio of .32 is relatively low[1] for developing countries and is considerably lower than Paukert's [1973] estimated figure of .56 for all Sierra Leone. This reflects the uniformity of income distribution in rural areas relative to that in urban centers, due largely to the fact that access to land is not severely constraining and most farmers use similar traditional technologies. Furthermore, urban per capita incomes tend to be appreciably higher than those in rural areas.[2]

3.2. Description of Expenditure Patterns

Data on cash expenditures were recorded in the field survey at a very disaggregated level to preserve distinctions concerning the factor intensity and origin of commodities. For purposes of analysis, commodities had to be grouped. In carrying out this commodity grouping, an effort was made to preserve homogeneity within groups with respect to *a priori* judgments of demand characteristics, factor intensities and origin. For example, cloth was disaggregated into two commodity groupings with locally made "tie dye" cloth being included as a group of small-scale industry products while imported cloth was preserved as a separate grouping.

The result of this aggregation process is the set of twenty-seven mutually exclusive and exhuastive commodity groups shown in Table 3.3. These preserve distinctions in factor intensity and, at the same time, are roughly comparable to categories used in other African consumption studies.

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[1]The Gini ratio is slightly underestimated when a linear approximation is used, as Riemenschneider [1976] points out.

[2]Fatoo [1977] estimates per capita income in large and small urban areas to be Le 282 compared to only Le 116 for our rural sample. It is also likely that income distribution is more unequally distributed in urban areas further increasing the country Gini ratio.

TABLE 3.3
AVERAGE BUDGET SHARES BY COMMODITY

Commodity Group	Percentage of Total Expenditure at the Mean Income Level
Rice	39.4
Cereals and root crops	8.2
Fruits and vegetables	2.9
Palm oil	7.5
Imported salt and condiments	1.4
Meat and livestock products	1.6
Fish	8.4
Processed and other food	0.6
All food	70.0
Rural beverages and tobacco	1.9
Urban and imported beverages and tobacco	1.7
All beverages and tobacco	3.6
Bread	0.1
Metal work (SSI)[a]	0.2
Wood work	0.3
Gara cloth	0.8
Tailoring	0.4
Other household and personal goods (SSI)[a]	0.5
All small-scale industry products	2.3
Fuel and light	3.1
Metal work (LSI)[b]	1.4
Clothing	1.9
Imported cloth	3.0
Shoes	0.9
Other household and personal goods (LSI)[b]	3.1
All large-scale industry products	13.4
Transport	2.2
Services and ceremonial	4.3
Education	1.4
Osusu saving[c]	1.0
Miscellaneous	1.8
Total	100.0

[a]SSI indicates small-scale industry.

[b]LSI indicates large-scale industry.

[c]Osusu are traditional savings associations.

Because locational distinctions could not be perfectly preserved by this classification of goods, a separate grouping of expenditures by origin was also performed.

Average budget shares for each commodity group are presented in Table 3.3. As expected, expenditures on food items are a major part of consumption expenditure, representing 70 percent of the total. Rice is the staple food in Sierra Leone accounting for 40 percent of all expenditures and over half of all food expenditures. Large-scale industry products, most of which are imported, represent the second largest aggregate component of rural expenditure. Within this larger group, expenditures on fuel and light (mostly kerosene), cloth, and household and personal goods are of particular importance.

Budget shares for commodities grouped by origin are givin in Table 3.4. More than three-quarters of consumption expenditures made by rural households are allocated to goods produced in rural areas. Subsistence consumption accounts for about two-thirds of consumption of rurally produced goods. In addition slightly more than half of all *cash* purchases are made for goods of rural origin. The largest category of non-rurally produced goods in the average household budget are imports, which account for 13.3 percent of total consumption expenditures and slightly more than 25 percent of total *cash* purchases. In contrast budget shares for products from small and large urban centers are relatively low, reflecting the small size of the Sierra Leonean industrial sector.

TABLE 3.4
AVERAGE BUDGET SHARES FOR COMMODITIES GROUPED BY ORIGIN

Origin Classification	Percentage of Total Expenditures at the Mean Income Level
Rural subsistence food products[a]	47.9
Rural purchased food products[a]	21.1
All rural food Products	69.0
Rural nonfarm goods	1.2
Rural services and ceremonial[b]	7.6
All rural products	77.8
Small urban products[c]	3.8
Large urban products	5.1
Imported products	13.3
Total	100.0

[a]Includes beverages and tobacco produced in rural areas.

[b]Includes education and Osusu saving as well as rural services and ceremonial.

[c]Includes transport, most of which is operated by small entrepreneurs.

3.3. Seasonal Variation in Cash Expenditure Patterns

Because households were observed for an entire year, it is possible to examine seasonal variation in *cash* expenditure patterns. Monthly indices of cash expenditures on rice, other food, and nonfood items are shown in Figure 3.2.

Purchases of rice are uniformly high during the cultivation season and in the months immediately prior to harvest (May through September). They drop to a much lower level in November, when the harvest is well underway, and in the five months which follow. During this period household rice stocks can be maintained at a higher level, since dry weather facilitates storage, and households consume rice from their own harvested reserves rather than rice purchased in markets. It should also be noted, however, that because the graph in Figure 3.2 is based on indices of cash expenditures (i.e., the product of price and quantity), part of the change in rice expenditure patterns is attributable to price changes rather than quantity changes. In particular, the price of rice purchased in the post harvest period is lower than in the cultivation and preharvest seasons which tends to reduce total value of expenditures.[1]

Variation in expenditures on other food items is much less pronounced, primarily due to the diverse nature of the commodities in this category, which include other cereals and root crops, palm oil, condiments, meat, fish, and processed food. There is a rather large increase in expenditures on these commodities in January, a month of greater ceremonial activity, and in July, when the lack of private rice reserves and the higher market price of rice may cause households to substitute other foods for their primary food in the rural diet.

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[1]For seasonal changes in rice prices see Spencer and Byerlee [1977].

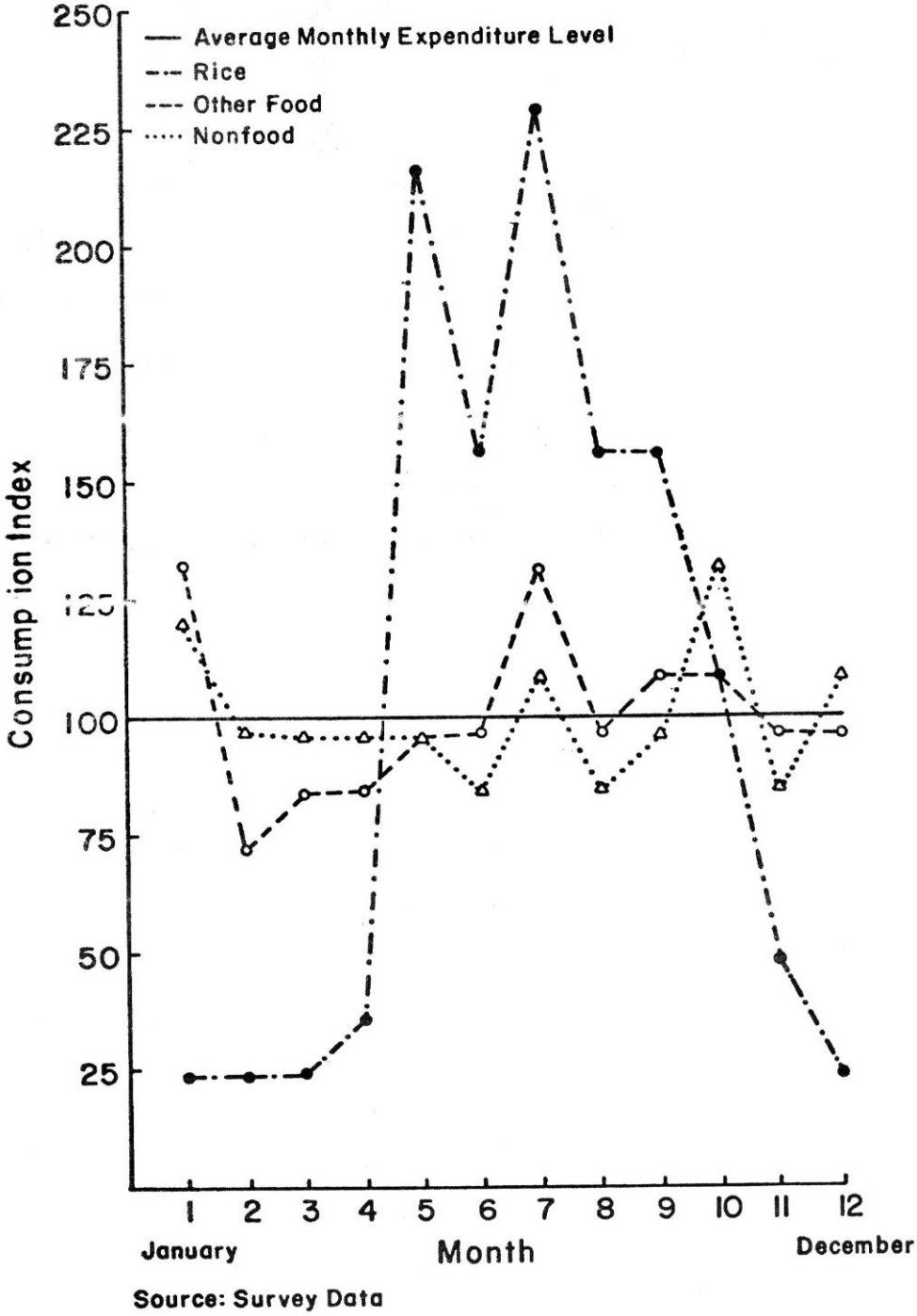

FIGURE 3.2
SEASONAL VARIATIONS IN CASH EXPENDITURE ON RICE,
OTHER FOOD, AND NONFOOD COMMODITIES

Expenditures on nonfood items also exhibit fairly uniform seasonal patterns attributable in part to aggregation. However, there is a tendency for expenditures on nonfood items to be higher in the post harvest and ceremonial period, particularly during October and January. Overall, then, cash expenditures in rice are the major source of seasonal variation in total cash expenditures.

4. THE ESTIMATION OF EXPENDITURE ELASTICITIES AND MARGINAL PROPENSITIES TO CONSUME

We turn now to a statistical analysis of the consumption patterns of our survey households in order to estimate expenditure elasticities of demand and marginal propensities to consume. Because of the special objectives of this study, which include the analysis of factor intensities and locational linkages of consumption patterns by income class, considerable care was taken to ensure that the choice of functional form was appropriate for these purposes. Issues concerning the specification of the functional form are first discussed followed by presentation of the estimated parameters.

4.1. Variables Included in the Analysis

The central relationship in any analysis of household budgets is the income-consumption relationship with consumption of a particular commodity or group of commodities as the dependent variable and income or total expenditure as the independent variable. Both variables in this study include the value of subsistence consumption.

In addition to total consumption expenditures, household size is generally considered to be an important determinant of a household's level of expenditure on a particular commodity. Other factors being equal, a large household's expenditure on food, for example, is expected to be greater than that of a small household. The household size variable used in the analysis of expenditure patterns should ideally be adjusted for compositional factors, such as the ratio of children to adults or males

to females. Several consumer equivalent scales have been used in African consumption studies,[1] but, as Prais and Houthakker [1971] note, consumer unit scales should be commodity specific. While commodity specific scales can be constructed, their use complicates estimation procedures considerably and results in a definition of the average consumer which may not be in accordance with that of policy makers and planners. This technique, then, was not used in the analysis which follows. The household size independent variable was defined simply as the number of persons present.[2]

The subsistence ratio was included as an independent variable in the analysis because a household's pattern of consumption is related to its orientation toward the consumption of home-produced goods or toward goods purchased in the market. Regional binary variables were also included in the model because they reflect differences in taste, the availability of goods, and the prices of goods. For example, fish is readily available in the southern coastal areas while beef is more plentiful in the drier northern areas.

4.2. The Choice of Functional Form

The choice of functional form depends on the theoretical and empirical hypotheses to be tested, on the nature of the data under analysis, and on the goodness of fit obtained with a given form. The focus in this study on rural consumption patterns by income class leads to informational needs

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[1] Massell [1969] treats all adults, males and females, as equal consumer units and weights and children at one-half a consumer unit. Howe [1966] uses the following weights: males, sixteen years and older, 1.0; females, sixteen and older, 0.8; and children under sixteen, 0.6.

[2] The ratio of the number of children in a household to household size was also included as an independent variable in early model specifications, but trial regressions showed that it was consistently insignificant at even the 30 percent level and it was not included in the final model.

somewhat different from those of most other African consumption studies. In particular, because the factor intensity and locational linkages of consumption patterns were estimated, marginal propensities to consume as well as expenditure elasticities were required for the analysis. Expenditure elasticities and marginal propensities to consume for all commodity groups, including both food and nonfood items consumed by households, were estimated and hence a functional form or set of functional forms sufficiently flexible to represent the income-consumption relationship for a wide range of commodities was required. Furthermore, because of our interest in the effect of income distribution on consumption patterns, the ability of a functional form to represent consumption behavior at the extremes of income was a criteria for choice. For example, a functional form that mathematically allows rising, falling, or constant marginal propensities to consume over the range of income levels is desirable for this analysis.

A function's conformability with the criterion of additivity was also an important consideration. To be internally consistent the sum of the marginal propensities to consume for all commodities should equal unity since the set of commodity groups for which parameters are estimated in this study is exhaustive of total household expenditures. Comparatively little attention has been given to additivity in the consumption literature. Prais and Houthakker [1971, pp. 84-85] show that the additivity criterion is automatically met when the function specified includes a direct linear relationship between expenditure on a particular good and total consumption expenditure. There is no restriction on the other independent variables of the function, and they may include logarithmic

or other transformations of total expenditure.[1] Although Prais and Houthakker [1971] also note that any functional form which provides a reasonably good fit should satisfy the additivity criterion approximately at the *mean* expenditure level, the analysis in this study also requires additivity at the extreme income levels--a much more restrictive requirement.

Households which failed to purchase any items in a particular commodity group occurred frequently in our sample because of the low average income and the relatively disaggregated commodity groupings. These zero observations cause considerable difficulties when the dependent variable of a function is specified in logarithmic form, since the logarithm of zero is undefined. Although zero observations can be eliminated by aggregating commodity groups, it was necessary to preserve a disaggregated commodity grouping to maintain factor intensity and locational distinctions.[2] Therefore the extent to which a function is affected by the presence of zero observations was an important factor in the choice of an appropriate income-consumption relation.

Finally, important and more commonly recognized criterion such as goodness of fit, the significance of parameter estimates, and the extent to which the effects of household size, subsistence consumption, and

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[1] One implication of the theorem referred to above is that if an additive function form is chosen, it must be used for each commodity grouping if the additivity criterion is to be met exactly. This rules out the common practice of fitting several functions to the data for each commodity and choosing the one which provides the best fit.

[2] Grouping of households is also a commonly used means for eliminating zero observations. In our sample, however, grouping was complicated by the existence of important regional differences and by the wide variation in household size. In addition, without grouping the sample into only a few groups, zero observations could not have been eliminated for all commodities.

regional location could be adequately described were considered in specifying the statistical model used in this study.

4.3. Specification of the Model

In light of the requirements of this study outlined above, the ratio semi-log inverse function (RSLI) as specified in Table 4.1 was selected as the basic functional form to be used in the statistical analysis of the relationships between consumption and income. The RSLI function, first proposed by Leser [1963] meets the additivity criterion exactly at all income levels and, at the same time, is flexible enough to allow increasing, decreasing, or constant marginal propensities to consume for a given commodity. In addition, because the dependent variable is not specified in logarithmic form, the RSLI function is not as adversely affected by zero observations as are functions with logarithmic dependent variables.

Three more commonly used functional forms--the semi-log, log-log, and log-log inverse--were also considered for use in this study. The specification and relevant characteristics of each of these are given in Table 4.1. None of these three functions meets the additivity requirement in a strict sense, but the semi-log function clearly leads to serious additivity problems at extreme levels of income, since the marginal propensity to consume always decreases except for inferior goods. In addition, it is rather inflexible with respect to the behavior of both marginal propensities to consume and total expenditure elasticities across the range of incomes. Therefore, it was rejected for use in analyses which focused on variations in consumption behavior among the households in different income classes.

The log-log functional form has been widely applied in African consumer surveys (e.g., Hay [1966], Levi [1976], Massell [1969], and

TABLE 4.1
MATHEMATICAL CHARACTERISTICS OF FUNCTIONAL FORMS FOR ANALYZING THE CONSUMPTION-INCOME RELATIONSHIPS

Functional Form	Specification[a]	Marginal Propensity to Consume $MPC = \frac{\partial C}{\partial Y}$	Expenditure Elasticity $\varepsilon = \frac{\partial C}{\partial Y}\cdot\frac{Y}{C}$	Effect of Income Changes on MPC (i.e., $\frac{\partial^2 C}{\partial Y^2}$)	Effect of Income Changes on ε (i.e., $\frac{\partial \varepsilon}{\partial Y}$)	Additivity
Ratio semi-log inverse	$\frac{C}{Y} = a + b_1 \ln Y + \frac{b_2}{Y}$	$a + b_1 + b_1 \ln Y$	$(a + b_1 + b_1 \ln Y)\frac{Y}{C}$	Monotonically increasing when $b_1 > 0$, decreasing when $b_1 < 0$, constant when $b_1 = 0$	Indeterminant	Perfectly additive at all income levels
Semi-log	$C = a + b \ln Y$	$\frac{b}{Y}$	$\frac{b}{C}$	Monotonically decreasing except for inferior goods	Monotonically decreasing	Not perfectly additive--serious problems at high and low income levels
Log-log	$= a + b \ln Y$	$\frac{bC}{Y}$	b	Monotonically increasing when $b > 1$ or $b < 0$, constant when $b = 0$ or 1 decreasing otherwise	Constant	Not perfectly additive
Log-log inverse	$= a + b_1 \ln Y + \frac{b_2}{Y}$	$\frac{b_1 C}{Y} + \frac{b_2 C}{Y^2}$	$b_1 + \frac{b_2}{Y}$	Indeterminant	Monotonically increasing when $b_2 < 0$, constant when $b_2 = 0$, decreasing when $b_2 > 0$	Not perfectly additive

[a] C = total expenditure on a particular commodity; Y = total consumption expenditure.

Simmons [1976]. It is closely related to the log-log inverse function which reduces to the log-log form when the coefficient of 1/Y is equal to zero. The log-log inverse function is quite flexible and provides a good fit for nearly all commodities. Serious biases caused by zero observations, however, and the failure of both these functions to even approximately satisfy the additivity criterion at extreme income levels, led to their rejection. A fuller discussion of this problem of zero observations is provided in Appendix 2.

The model was first specified in per capita terms in accordance with the use of per capita consumption expenditure as a basis for defining income classes. That is,

$$\frac{\bar{c}_{ij}}{\bar{y}_i} = a_i + b_{1i}\ln\bar{y}_j + \frac{b_{2i}}{\bar{y}_j} + u_{ij} \quad , \tag{4.1}$$

where $\bar{c}_{ij}$ is per capita total expenditure on commodity i by household j; $\bar{y}_j$ is per capita total consumption expenditure by household j; a_i, b_{1i}, and b_{2i} are parameters to be estimated for the i^{th} commodity; and u_{ij} is the disturbance term.

Implicit in any income-consumption relation which is specified in per capita terms is the assumption that economies and diseconomies of scale in consumption do not exist. If there are economies of scale in the consumption of a particular commodity, at a given level of income per person, larger households will tend to have a smaller expenditure per person in that commodity [Prais and Houthakker, 1971, p. 148]. This is equivalent to saying that the elasticity of household consumption expenditure on a good with respect to household size, derived by holding per capita total expenditure constant, is less than unity when economies of scale are experienced and greater than unity when there are economies of

scale. Household goods such as cooking ware and services such as household repairs are examples of expenditure items which are expected to exhibit economies of scale.

In order to allow flexibility with respect to economies of scale the model must be transformed from a per capita form to one which represents consumption for the entire household and includes household size as an independent variable. This is done by first multiplying both $\bar{c}_{ij}$ and $\bar{y}_j$ in the dependent variable by N_j, the number of people present in household j. Household size can then be introduced as an independent variable by multiplying both sides of the equation by Y_j, total consumption expenditure by household j. The result is equation 4.2:

$$C_{ij} = a_i Y_j + b_{1i} Y_j \ln\bar{y}_j + b_{2i} N_j + u_{ij} \ , \qquad (4.2)$$

where C_{ij} is total consumption expenditure on good i by household j; a_i, b_{1i}, and b_{2i} are again parameters to be estimated; u_{ij} is a disturbance term; and other variables are defined as above.

Finally, adding the subsistence ratio for household j, S_j, in its logarithmic form and a set of regional binary variables,[1] R_{hj} being one if household j is in region h and zero otherwise, the model takes its final form:

$$C_{ij} = a_i Y_j + b_{1i} Y_j \ln\bar{y}_j + b_{2i} N_j + b_{3i} \ln S_j + \sum_{i=1}^{8} g_{hi} R_{hj} + u_{ij} \ . \qquad (4.3)$$

Expressions for the marginal propensity to consume and the total expenditure elasticity derived from this model are given in equations 4.4 and 4.5:

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[1] Because as specified in Equation 4.2 the function passes through the origin, all eight regional binary variables are included.

$$\frac{\partial C_{ij}}{\partial Y_j} = a_i + b_{1i} + b_{1i} \ln \bar{y}_j \tag{4.4}$$

$$\frac{\partial C_{ij}}{\partial Y_j} \cdot \frac{Y_j}{C_{ij}} = (a_i + b_{1i} + b_{1i} \ln \bar{y}_j) \frac{Y_j}{C_{ij}} \tag{4.5}$$

As indicated in Table 4.1, the marginal propensity to consume will be monotonically increasing or decreasing or constant, as income rises, depending on the sign of b_{1i}. The behavior of the expenditure elasticity is undetermined, and it is possible for it to rise and then fall or vice versa. The expression for the total expenditure elasticity with respect to household size (derived, as stated above, holding per capita total expenditure constant) is given in equation 4.6:

$$\frac{\partial C_{ij}}{\partial N_j} \cdot \frac{N_j}{C_{ij}} = a_i \left(\frac{Y_j}{C_{ij}}\right) + b_{1i} \left(\frac{Y_j}{C_{ij}}\right) \ln \bar{y}_j + b_{2i} \left(\frac{N_j}{C_{ij}}\right) \tag{4.6}$$

The parameters of the model specified in equation 4.3 were estimated for each commodity group and for commodities grouped by origin using ordinary least squares regression (OLS). Two stage least squares (TSLS) regression was considered as an estimation technique, as suggested by Massell [1969] to deal with the problem, first noted by Summers [1959], of correlation between independent variables and the disturbance term when total consumption expenditure is used as an independent variable. For the use of TSLS to be justified, however, Massell is forced to assume that consumption and production decisions are independent[1]--a tenuous assumption when subsistence consumption represents a major portion of a household's

[1] See Massell [1969, p. 138, footnote 6].

total consumption expenditure. Therefore, the OLS model was considered adequate for this study.

Nevertheless, biases are likely to be introduced by the correlation of independent variables and the error term described above. In a comment to the Summers article, Prais [1959] shows that for an additive function, such as that used here, the expenditure elasticity of any given commodity will be biased toward unity, and that the size of the bias will be larger the greater the budget share for the commodity in question. The marginal propensities to consume and expenditure elasticities presented below should, then, be interpreted with these facts in mind, particularly for commodities such as rice with large budget shares.

4.4. Estimation of Expenditure Elasticities and Marginal Propensities to Consume

Parameter estimates and their standard errors for individual commodities are given in Table 4.2. The coefficients of household size and the subsistence ratio merit a brief comment before marginal propensities to consume and total expenditure elasticities are examined. As they appear in Table 4.2, the household size parameters are difficult to interpret. Total expenditure elasticities with respect to household size, as defined in equation 4.6 above are given in Table 4.3 for aggregate commodity groups. Most household size elasticities are close to unity, indicating neither economies nor diseconomies of scale exist. Beverages and tobacco show strong economies of scale (i.e., elasticity less than unity), while strong diseconomies (i.e., elasticity over unity) are indicated only for services. In both cases compositional, as well as household size, effects appear to be reflected in the household size elasticities. Large households are expected to expend less per person on beverages and tobacco

TABLE 4.2
PARAMETER ESTIMATES BY COMMODITY GROUP

Commodity Group	Coefficient of				R^2
	Y	$Y\ln\bar{y}$	N	lnS	
Rice	.7475 (.333)[a]	-.0636 (.058)	-4.1226 (6.170)	45.5279 (12.231)	.678
Cereals and root crops	.4407 (.183)	-.0636 (.032)	-4.7824 (3.402)	10.2637 (6.743)	.387
Fruits and vegetables	.0753 (.062)	.0090 (.011)	-.5978 (1.143)	5.6147 (2.265)	.359
Palm oil	.1187 (.130)	-.0060 (.022)	-.5799 (2.401)	-11.9078 (4.760)	.399
Imported salt and condiments	-.0399 (.025)	.0081 (.004)	.7828 (.456)	-.3952 (.904)	.227
Meat and livestock products	-.1836 (.053)	.0357 (.009)	3.1608 (.979)	1.3258 (1.942)	.247
Fish	.2863 (.127)	-.0373 (.022)	-1.7032 (2.346)	-1.3201 (4.649)	.480
Processed and other food	.0053 (.012)	-.0004 (.002)	.0930 (.229)	.0358 (.937)	.661
All food	1.4502 (.264)	-.1361 (.046)	-7.7493 (4.892)	49.1449 (9.696)	.908
Rural beverages and tobacco	-.0988 (.068)	.0185 (.012)	1.2376 (1.250)	6.1287 (2.477)	.164
Urban and imported beverages and tobacco	-.0182 (.028)	.0039 (.005)	.1512 (.516)	-.7515 (1.023)	.194
All beverages and tobacco	-.1170 (.072)	.0224 (.013)	1.3889 (1.340)	5.3771 (2.656)	.152
Bread	.0055 (.006)	-.0088 (.001)	-.0594 (.117)	-.4245 (.232)	.147
Metal work (SSI)[a]	.0069 (.014)	-.0010 (.002)	-.1844 (.263)	-.2628 (.521)	.051
Wood work	-.0217 (.019)	.0047 (.003)	.4750 (.353)	-1.2331 (.699)	.201
Gara cloth	.0148 (.022)	-.0016 (.004)	-.1650 (.412)	-1.3666 (.817)	.266
Tailoring	.0175 (.010)	-.0024 (.001)	-.1821 (.192)	-.0427 (.380)	.224
Other household and personal goods (SSI)[a]	.0036 (.024)	-.0001 (.004)	.0098 (.451)	-.7642 (.895)	.044

TABLE 4.2 - CONTINUED
PARAMETER ESTIMATES BY COMMODITY GROUP

Commodity Group	Coefficient of				R^2
	Y	$Y\ln\bar{y}$	N	lnS	
All small-scale industry products	.0265 (.044)	-.0011 (.008)	-.1060 (.818)	-4.0938 (1.621)	.288
Fuel and light	.0469 (.026)	-.0062 (.005)	-.5541 (.485)	-3.4921 (.962)	.293
Metal work (LSI)[b]	.0390 (.032)	.0045 (.006)	-.2834 (.600)	-2.8389 (1.190)	.265
Clothing	.0001 (.038)	.0016 (.007)	.5730 (.700)	-4.8570 (1.387)	.233
Cloth	-.0016 (.066)	.0085 (.012)	.1427 (1.230)	-5.4737 (2.438)	.425
Shoes	.0634 (.023)	-.0096 (.004)	-.9831 (.425)	-3.2815 (.842)	.245
Other household and personal goods (LSI)[b]	.1142 (.095)	-.0108 (.017)	-1.2747 (1.766)	-5.0091 (3.500)	.299
All large-scale industry products	.2619 (.149)	-.0211 (.026)	-2.3797 (2.767)	24.9523 (5.485)	.558
Transport	-.0626 (.060)	.0162 (.010)	.5274 (1.111)	-6.3032 (2.201)	.279
Services and ceremonial	-.4985 (.112)	.1006 (.019)	7.4250 (2.081)	-6.2136 (4.124)	.455
Education	-.0398 (.052)	.0083 (.009)	1.0678 (.969)	-5.5387 (1.921)	.149
Osusu saving	.1123 (.090)	-.0180 (.016)	-1.9689 (1.671)	-1.8247 (3.313)	.072
Miscellaneous	-.1331 (.094)	.0288 (.016)	1.7947 (1.740)	-5.5957 (3.4492)	.157

[a]SSI indicates small-scale industry.

[b]LSI indicates large-scale industry.

TABLE 4.3
HOUSEHOLD SIZE ELASTICITIES FOR AGGREGATE COMMODITY GROUPS

Aggregate Commodity Group	Household Size Elasticity
Food	1.033
Beverages and tobacco	.111
Small-scale industry products	1.045
Large-scale industry products	1.022
Transport	.906
Services and ceremonial	1.697
Education	.805
Osusu saving	.624
Miscellaneous	1.288

because they tend to have a higher proportion of children, who do not generally use tobacco or alcoholic beverages. Similarly, such households may spend more per person on services, mostly ceremonial, because they are more likely to be involved in baptism, initiation, and marriage ceremonies.

The subsistence ratio parameters in Table 4.2 are more easily interpreted. A positive sign for a particular commodity group indicates households with high subsistence ratios, *ceteris paribus*, will spend more on these goods, while a negative sign indicates they will spend less. As expected, food items produced and consumed within households have positive parameter estimates, and those which must be purchased have negative coefficients. In most cases the effect of subsistence orientation is significant at the 5 percent confidence level.

Marginal propensities to consume and total expenditure elasticities derived from the parameter estimates at the mean expenditure level for each income class are given in Tables 4.4 and 4.5. As expected, the estimated marginal propensities to consume confirm the importance of expenditures on food in all income classes, although the fact that the coefficient of $Y\ln\bar{y}$ is negative and significantly different from zero at the .05 level indicates that food expenditures at the margin fall significantly as incomes rise.[1] Other changes in the marginal propensity to consume, significant at the .30 level of significance, include increases for imported salt and condiments, meat, beverages and tobacco, transport, services and ceremonial, and miscellaneous items and decreases for rice, other cereals and root crops, fish, fuel and light, and shoes. These variations conform

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[1] As indicated in Table 4.1, the marginal propensity to consume derived from the RSLI function declines monotonically when $b_{ij} < 0$, increases monotonically when $b_{ij} > 0$, and is constant when $b_{ij} = 0$.

TABLE 4.4
MARGINAL PROPENSITIES TO CONSUME BY INCOME CLASS FOR COMMODITY GROUPS

Commodity Group	Marginal Propensity to Consume						
	Mean Expenditure Level	Income Class					
		Lowest Decile	Second and Third Deciles	Fourth and Fifth Deciles	Sixth and Seventh Deciles	Eighth and Ninth Deciles	Highest Decile
Rice	.381	.460	.428	.398	.378	.356	.329
Cereals and root crops	.074	.153	.121	.091	.071	.049	.022
Fruits and vegetables	.024	.035	.030	.026	.023	.020	.016
Palm oil	.084	.092	.089	.086	.084	.082	.079
Imported salt and condiments	.007	-.003	.001	.005	.007	.010	.013
Meat and livestock products	.022	-.022	-.004	.013	.024	.036	.051
Fish	.071	.118	.099	.081	.070	.057	.041
Processed and other food	.003	.003	.003	.003	.003	.003	.003
All food	.666	.836	.767	.703	.660	.613	.554
Rural beverages and tobacco	.008	-.015	-.006	.003	.009	.015	.023
Urban and imported beverages and tobacco	.004	-.001	.002	.003	.004	.006	.008
All beverages and tobacco	.012	-.016	-.004	.006	.013	.021	.031
Bread	.001	.002	.001	.001	.001	a	a
Metal work (SSI)[b]	.001	.002	.002	.002	.001	.001	a
Wood work	.005	-.001	.002	.004	.005	.007	.009
Gara cloth	.006	.008	.007	.006	.006	.005	.004
Tailoring	.003	.007	.005	.004	.003	.003	.002
Other household and personal goods (SSI)[b]	.004	.004	.004	.004	.004	.004	.004
All small-scale industry products	.020	.022	.021	.021	.020	.020	.019
Fuel and light	.011	.019	.016	.013	.011	.009	.006
Metal work (LSI)[c]	.013	.019	.016	.014	.013	.011	.009
Clothing	.010	.007	.008	.009	.010	.010	.011
Imported cloth	.047	.037	.041	.045	.048	.051	.054

TABLE 4.4 - CONTINUED
MARGINAL PROPENSITIES TO CONSUME BY INCOME CLASS FOR COMMODITY GROUPS

Commodity Group	Marginal Propensity to Consume						
	Mean Expenditure Level	Income Class					
		Lowest Decile	Second and Third Deciles	Fourth and Fifth Deciles	Sixth and Seventh Deciles	Eighth and Ninth Deciles	Highest Decile
Shoes	.008	.020	.015	.010	.007	.004	a
Other household and personal goods (LSI)[c]	.052	.065	.060	.055	.051	.047	.043
All large-scale industry products	.141	.167	.156	.146	.140	.132	.123
Transport	.030	.010	.018	.026	.031	.037	.044
Services and ceremonial	.081	-.044	.007	.054	.086	.120	.164
Education	.008	-.002	.002	.006	.008	.011	.015
Osusu saving	.009	.030	.022	.013	.008	.002	-.006
Miscellaneous	.033	-.003	.011	.025	.034	.044	.056
Total	1.000	1.000	1.000	1.000	1.000	1.000	1.000

[a]Indicates MPC too small to report.

[b]SSI indicates small-scale industry.

[c]LSI indicates large-scale industry.

TABLE 4.5
TOTAL EXPENDITURE ELASTICITIES BY INCOME CLASS FOR COMMODITY GROUPS

Commodity Group	Total Expenditure Elasticity[a]						
	Mean Expenditure Level	Income Class					
		Lowest Decile	Second and Third Deciles	Fourth and Fifth Deciles	Sixth and Seventh Deciles	Eighth and Ninth Deciles	Highest Decile
Rice	.95	1.23	1.07	.98	.94	.91	.88
Cereals and root crops	.82	2.89	1.41	.98	.79	.61	.34
Fruits and vegetables	.83	1.11	.94	.86	.80	.75	.68
Palm oil	1.08	1.71	1.31	1.14	1.08	1.04	.99
Imported salt and condiments	.60	-.09	.05	.37	.62	.95	1.18
Meat and livestock products	1.84	-.74	-.30	1.28	1.92	2.03	1.87
Fish	.81	1.43	1.07	.89	.80	.71	.60
Processed and other food	.56	.28	.39	.50	.58	.66	.77
All food	.93	1.25	1.07	.97	.93	.89	.85
Rural beverages and tobacco	.58	-.20	-.22	.18	.67	1.15	1.51
Urban and imported beverages and tobacco	.28	-.37	.08	.17	.29	.53	.83
All beverages and tobacco	.43	-.17	-.08	.18	.48	.86	1.25
Bread	.69	1.08	.56	.63	.70	b	b
Metal work (SSI)[c]	.50	.68	.76	.89	.51	.60	b
Wood work	1.61	-.28	.83	1.53	1.56	1.70	1.62
Gara cloth	.78	.73	.74	.72	.79	.72	.66
Tailoring	.72	2.98	1.32	.95	.73	.78	.61
Other household and personal goods (SSI)[c]	.83	.43	.71	.79	.83	.86	.89
All small-scale industry products	.88	.79	.83	.89	.88	.92	.90
Fuel and light	.39	.30	.35	.39	.47	.40	.35
Metal work (LSI)[d]	.89	1.49	1.10	.94	.90	.80	.72
Clothing	.59	.19	.31	.47	.61	.69	.84
Imported cloth	1.49	b	2.34	1.66	1.48	1.37	1.27

TABLE 4.5 - CONTINUED
TOTAL EXPENDITURE ELASTICITIES BY INCOME CLASS FOR COMMODITY GROUPS

Commodity Group	Total Expenditure Elasticity[a]						
	Mean Expenditure Level	Income Class					
		Lowest Decile	Second and Third Deciles	Fourth and Fifth Deciles	Sixth and Seventh Deciles	Eighth and Ninth Deciles	Highest Decile
Shoes	.76	4.38	1.55	.92	.68	.44	b
Other household and personal goods (LSI)[d]	1.42	b	3.72	1.74	1.36	1.15	1.01
All large-scale industry products	1.02	1.56	1.22	1.07	1.01	.96	.92
Transport	1.42	.57	1.09	1.38	1.44	1.46	1.43
Services and ceremonial	2.38	-1.05	.37	2.32	2.37	2.15	1.90
Education	.67	-.06	.10	.44	.68	.98	1.26
Osusu saving	.71	b	2.06	.99	.64	.20	-1.05
Miscellaneous	2.09	-.32	1.47	2.14	2.05	1.90	1.71

[a]Total expenditure elasticities are based on MPCs in Table 4.4 and APCs computed from estimated regression parameters.

[b]Indicates that elasticity cannot be calculated due to small MPC or APC.

[c]SSI indicates small-scale industry.

[d]LSI indicates large-scale industry.

with expectations, since all the commodity groups with declining marginal propensities to consume are comprised of staple goods, while those in commodity groups with rising marginal propensities to consume can be considered luxuries.

Expenditure elasticities for the total food group and for rice are quite high. Both approach unity at the mean income level and exceed 0.8 for even the highest income group. To a certain extent, these high food expenditure elasticities may reflect increasing quality rather than quantity of food consumed. Nonetheless there is some substantial substitution among various food items. For example, the elasticity of demand for cereals and root crops (largely cassava) decreases dramatically as incomes rise. Likewise the decline in the marginal expenditures for fish for the highest income group is compensated by an increase in the marginal propensities to consume meat. In interpreting food expenditure elasticities, it should be recalled that there is a likely bias toward unity for the rice and total food categories which have large budget shares, because of the correlation between total consumption expenditure and the disturbance term.

Comparison of estimated expenditure elasticities from this study with those reported in other African consumption studies is difficult because commodity groupings differ and because the elasticities in this study are derived from a rural sample. The expenditure elasticity for food of 0.93 is, however, within the range of other African rural consumption studies which estimate food elasticities of 1.27 in Eastern Nigeria [Hay, 1966], in Ruanda-Urundi [Leurquin, 1960], and only 0.37 in the north of Nigeria [Simmons, 1976]. There is, however, a substantial difference between the expenditure elasticity of demand for rice of .03 estimated by Snyder [1971]

for urban consumers in Sierra Leone and the elasticity for rural households at even the highest income levels reported in this study.

Among nonfood items, the expenditure elasticity for all small-scale industry products rises through the lower range of incomes, then begins to fall slightly at the highest level of expenditure, but the range of these variations--from .79 to .92--is not large. The elasticity for all large-scale industry products is uniformly higher than that for small-scale industry products and is greater than unity for the first four income groups. It falls consistently, however, and in the highest income class it is only slightly higher than the elasticity for small-scale industry products. Within the aggregate category of large-scale manufactured goods, elasticities for both household essentials, such as fuel and light, and for personal goods, such as cloth and household and personal goods, fall across the range of incomes. Elasticities for service oriented sectors--transport, services and ceremonial, and education--rise from very low levels for the first income class to levels well above unity for the upper income class. This indicates an increasing preference for services--some, such as ceremonial services, closely associated with traditional culture while others, such as transport and education, are indicative of the modernizing influences on rural life--as incomes rise.

Expenditure elasticities were also estimated for *cash* expenditures alone. Results given in Appendix 3 indicate that for nonsubsistence goods cash expenditure elasticities are reasonable approximations of total expenditure elasticities. This indicates that when time and other resources are limited useful estimates of expenditure elasticities may be obtained without undertaking the difficult and expensive task of measuring subsistence consumption.

Parameter estimates for commodities grouped by origin are given in Table 4.6 and MPC's and elasticities derived from these parameters are given in Tables 4.7 and 4.8. In most cases, variation in the MPC's by income group is not significant as shown by the standard errors of the parameters of the income variables. However, food commodities which are produced within the household for consumption (i.e., subsistence consumption) have a strongly and significantly declining MPC while services have an increasing MPC. The sharp decline in subsistence expenditures at the margin indicates a stronger orientation to the market as incomes rise.

The estimated expenditure elasticities for commodities grouped by origin are also revealing. The income elasticity for all rurally produced goods is unity[1] and moreover is quite constant over all income groups. Imported goods have an elasticity slightly above unity which again is quite uniform over all income groups. Goods produced in small urban areas (largely transportation, services and small industrial products) have a high elasticity, while goods produced in large urban areas have a very low expenditure elasticity reflecting the dominance of fuel (kerosene) in this group. The locational linkages associated with these consumption patterns and the effect of income distribution on them are more fully discussed in the next section.

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[1] In part this is due to the correlation between total consumption expenditure and the disturbance term, which was discussed above on page 35.

TABLE 4.6
PARAMETER ESTIMATES FOR COMMODITIES GROUPED BY ORIGIN

Origin Classification	Coefficient of				R^2
	Y	$Y\ln\bar{y}$	N	lnS	
Rural subsistence food products	1.5556 (.307)[a]	-.1930 (.053)	-11.9226 (5.685)	108.2474 (11.270)	.819
Rural purchased food products	-.0758 (.207)	.0506 (.036)	3.3676 (3.827)	-52.5338 (7.586)	.728
All rural food products	1.4798 (.275)	-.1423 (.048)	-8.5550 (5.086)	55.7135 (10.081)	.899
Rural nonfarm goods	.0225 (.030)	-.0020 (.0051)	-.1660 (.548)	-.8581 (1.087)	.199
Rural services and ceremonial	-.5781 (.153)	.1198 (.027)	8.4604 (2.833)	-14.7721 (5.617)	.490
All rural products	.9243 (.226)	-.0245 (.039)	-.2607 (4.189)	40.0833 (8.303)	.944
Small urban products	-.0147 (.100)	.0168 (.017)	.4216 (1.859)	-12.8134 (3.685)	.309
Large urban products	.0142 (.043)	.0010 (.007)	-.3960 (.793)	-5.4285 (1.571)	.260
Imported products	.1040 (.162)	.0065 (.028)	.2180 (2.995)	-21.7191 (5.937)	.518

[a]Figures in parentheses are standard errors.

TABLE 4.7
MARGINAL PROPENSITIES TO CONSUME BY INCOME CLASS FOR COMMODITIES GROUPED BY ORIGIN

Origin Classification	Marginal Propensity to Consume						
	Mean Expenditure Level	Income Class					
		Lowest Decile	Second and Third Deciles	Fourth and Fifth Deciles	Sixth and Seventh Deciles	Eighth and Ninth Deciles	Highest Decile
Rural subsistence food products	.445	.684	.588	.497	.436	.370	.286
Rural purchased food products	.216	.153	.178	.201	.218	.235	.257
All rural food products	.661	.837	.765	.698	.654	.605	.543
Rural nonfarm goods	.011	.013	.012	.011	.011	.010	.009
Rural services and ceremonial	.112	-.036	.023	.080	.117	.158	.211
All rural products	.784	.814	.801	.789	.782	.773	.763
Small urban products	.055	.034	.043	.051	.056	.062	.069
Large urban products	.020	.019	.019	.020	.020	.021	.021
Imported products	.141	.133	.137	.140	.142	.144	.147
Total	1.000	1.000	1.000	1.000	1.000	1.000	1.000

TABLE 4.8
TOTAL EXPENDITURE ELASTICITIES BY INCOME CLASS FOR COMMODITIES GROUPED BY ORIGIN

Origin Classification	Total Expenditure Elasticity[a]						
	Mean Expenditure Level	Income Class					
		Lowest Decile	Second and Third Deciles	Fourth and Fifth Deciles	Sixth and Seventh Deciles	Eighth and Ninth Deciles	Highest Decile
Rural subsistence food products	.87	1.67	1.18	.97	.87	.79	.68
Rural purchased food products	1.06	.65	.85	.99	1.06	1.11	1.15
All rural food products	.93	1.29	1.08	.97	.93	.89	.84
Rural nonfarm goods	.92	1.08	1.00	.92	1.00	1.10	1.22
Rural services and ceremonial	2.00	-.39	.43	1.48	1.77	1.82	1.73
All rural products	1.00	1.08	1.03	1.01	1.00	.99	.98
Small urban products	1.62	2.00	1.65	1.55	1.44	1.38	1.33
Large urban products	.39	.17	.26	.37	.44	.55	.66
Imported products	1.07	1.10	1.09	1.07	1.06	1.06	1.05

[a]Total expenditure elasticities are based on MPCs in Table 4.9 and APCs calculated from parameter estimates.

4.5. The Demand for Small-Scale Industry Products

The demand for small-scale industry products is of particular interest from both a theoretical and a policy point of view. Hymer and Resnick [1969] focus on the effect of nonagricultural goods and services produced and consumed within the rural village--Z goods--on marketed surplus, and on the demand for manufactured goods, be they imported or produced in urban centers within the same country. Small-scale industry products fall into this category of Z goods.[1] The strength of consumer demand for Z goods as rural incomes increase is a crucial factor in their model. If goods manufactured outside of rural areas are not substituted for Z goods as rural incomes rise, the strengthening of market linkages that Hymer and Resnick and later Mellor [1976] consider crucial to the development process is slowed appreciably. On the other hand these nonagricultural activities have potential for employment generation and have relatively low capital and foreign exchange requirements. This potential can be realized, however, only if there is adequate demand for rural nonagricultural goods.

Hymer and Resnick [1969, p. 498] state that Z activities are likely to be inferior goods. The results presented in Table 4.5 show that small-scale industry products, which comprise a large portion of the *marketed* Z goods, all have an estimated expenditure elasticity greater than zero. These results are based, however, in regression parameters which, for the most part, are not significant at even the .30 level. In order to reach

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[1]The Hymer-Resnick definition includes goods and services produced for households' own consumption--e.g., sleeping mats and house repairs--and goods and services produced and traded within rural areas--e.g., small-scale industry products and ceremonial services.

a more definite conclusion concerning the elasticities, regressions were run using the semi-log model given in equation 4.8.[1]

$$C_{ij} = a_i + b_{1i}\ln Y_j + b_{2i}\ln N_j + b_{3i}\ln S_j + \sum_{n=1}^{7} g_{hi}R_{hj} + u_{ij} \qquad (4.8)$$

where a_i, b_{1i}, b_{2i}, b_{3i}, and the g_{hi}'s are parameters to be estimated for the i^{th} commodity and other variables are defined as above. Parameter estimates for this model and marginal propensities to consume and total expenditure elasticities computed at the mean level of income are given in Table 4.9. The coefficient upon which the marginal propensity to consume and the total expenditure elasticity are based, b_{1i}, is positive and significantly different from zero at the .05 level for all regressions except those for bread and metal work.

Clearly these figures, especially the elasticity of .849 for small-scale industry products, indicate that the products of small-scale industrial firms are not inferior goods. In fact, small-scale industry goods and services produced largely for the local rural market appear to have moderate growth potential and in some cases such as wood work have a very favorable demand outlook. From a Sierra Leone policy viewpoint, the demand for tailoring, wood work, metal work, and locally dyed cloth should continue to expand and provide potential for generating employment in rural and small urban areas.

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[1] In general the semi-log and log-log functional forms provided parameter estimates with significance levels on the income term higher than for the RSLI function. However, the semi-log and log-log functions are only suitable for estimating elasticities and marginal propensities to consume at the mean income level. Due to large numbers of zero observations for small-scale industry commodities, a semi-log model was employed here. It should also be noted that estimated expenditure elasticities are strikingly similar for both the semi-log and RSLI model.

TABLE 4.9
MARGINAL PROPENSITIES TO CONSUME AND TOTAL EXPENDITURE ELASTICITIES
FOR SMALL-SCALE INDUSTRY PRODUCTS BASED ON THE SEMI-LOG MODEL

Commodity Group	Coefficient of			R^2	MPC[a]	Elasticity[a]
	lnY	lnN	lnS			
Bread	.4893[b] (.338)	.1944 (.330)	-.4089 (.229)	.148	.001	.606
Metal work	1.1662 (.759)	-.7360 (.741)	-.2891 (.513)	.057	.002	.919
Wood work	3.2139 (1.035)	.2526 (1.011)	-1.4013 (.700)	.178	.005	1.354
Gara cloth	3.7616 (1.200)	-.2091 (1.172)	-1.3584 (.812)	.259	.006	.715
Tailoring	1.7631 (.579)	.3521 (.565)	.0673 (.391)	.155	.003	.719
Other household and personal goods	2.8005 (1.308)	.1017 (1.277)	-.8084 (.885)	.042	.004	.829
All small-scale industry products	13.1946 (2.410)	-.0443 (2.355)	-4.1987 (1.631)	.261	.020	.849

[a]Calculated at the mean level of total expenditure.

[b]Figures in parentheses are standard errors.

5. FACTOR INTENSITIES AND LOCATIONAL LINKAGES OF CONSUMPTION PATTERNS

In this section we use expenditure-income relationships estimated in the previous section to analyze consumption based linkages of different income classes in Sierra Leone. Two types of linkages are examined. First, the factor intensities of consumption patterns at different income levels--the requirements of labor, capital and foreign exchange for the production of goods embodied in a particular consumption pattern--are estimated to test the hypothesis that low income classes consume goods and services which require less of the scarce factors--capital and foreign exchange--and more of the abundant factor--labor. Second, locational linkages defined in terms of three basic dichotomies--home produced versus purchased goods, rural produced versus urban produced goods, and domestically produced versus imported goods--are analyzed to permit further examination in a broader context of the Hymer-Resnick hypothesis as well as an empirical test of the relevance of Mellor's [1976] findings in India, which indicate that consumption linkages to the nonagricultural sectors are stronger for higher income rural households. The factor intensity and the nature of locational linkages associated with consumption patterns are, of course, interrelated to the extent that urban produced goods usually require more capital and less labor than rurally produced goods.

It should be noted that our analysis is partial. Only consumption linkages are explored and other important input-output and factor market linkages are not considered. Likewise the analysis only considers direct

effects and not the indirect or multiplier effects of an increase in consumer expenditure.[1]

5.1. The Factor Intensity of Rural Consumption Patterns

Average and marginal propensities to consume for individual commodity groups derived from the regression analysis in the previous section,[2] when combined with information on the relative labor and capital requirements of the production process in each sector of the economy, are used to calculate the direct domestic labor and capital requirements per unit of consumption expenditure--the factor intensity of consumption--at a given income level.[3] In addition, average and marginal propensities to consume for imported goods are measures of the direct foreign exchange requirements embodied in a unit of consumption expenditure.[4]

Estimates of both *average* and *marginal* factor intensities computed at the mean level of total expenditure for each income class are presented below. Average factor elasticities are used to describe factor requirements as they currently exist, while marginal factor intensities are used to analyze the effect of a change in income on factor requirements.

Symbolically these measures of factor intensity can be expressed as:

$$F_j^a = \sum_i \frac{C_i}{Y} \cdot f_{ij} \qquad (5.1)$$

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[1] A more detailed examination of intersectoral linkages in Sierra Leone is contained in Fatoo [1977] although he does not analyze the impact of income distribution on these linkages.

[2] Derived average propensities to consume were used so that household size and regional effects could be eliminated.

[3] Imported goods are netted out before computing factor intensities.

[4] Only direct effects are measured. Foreign exchange embodied in capital equipment, for example, is not included.

$$F_j^m = \sum_i \frac{\partial C_i}{\partial Y} \cdot \Delta f_{ij} \qquad (5.2)$$

where F_j^a and F_j^m are the average and marginal factor intensities respectively for factor j, C_i/Y and $\partial C_i/\partial Y$ the average and marginal propensity to consume the i^{th} good and f_{ij} and Δf_{ij} the units of factor j required to produce one unit of output i at the average and margin respectively. In the case of capital and labor, f_{ij} represents sectoral capital-output and labor-output ratios. In the case of foreign exchange, f_{ij}, is unity since average and marginal propensities to consume are estimated for imports as a separate class of commodities. In the following analysis it is assumed that the marginal capital-output and labor-output ratios are the same as the average capital-output and labor-output ratios--that is increases in output will employ production techniques of the same capital and labor intensity as currently exist.

The capital output and labor output ratios used to determine the factor intensity of consumer demand were derived from a number of sources. Labor and capital requirements for the production of various agricultural commodities were calculated from survey data and from information given in Spencer and Byerlee's [1977] analysis of incomes and productivity in rural areas of Sierra Leone.[1] Results from a nationwide industrial survey of Sierra Leone by Liedholm and Chuta [1976] were used to calculate

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[1] In cases where only data on the capital stock for a sector were available, the conversion to a flow of capital services was made using the following capital recovery formula [Liedholm and Chuta, 1976]:

$$R = \frac{rV}{1 - (1 + r)^{-n}}$$

where R is the constant annual service flow, V is the original market value of the capital asset, r is the interest rate, and n is the expected life of the asset. In all cases r was set at .20. *A priori* estimates of an aggregate value of n were made for each sector.

labor-output and capital-output ratios for the large and small-scale industrial sectors. Finally, data given in The National Accounts of Sierra Leone, 1964/65 to 1970/71 [1972b] were the basis for the determination of economic ratios for the transport and education sectors. The service and ceremonial and miscellaneous components of consumption expenditure, because they represent expenditures on goods from all sectors, were assumed within an income class to have labor-output and capital-output ratios equal to the average value of these ratios over all other sectors.

Table 5.1 shows the final estimates of labor-output and capital-output ratios for each sector. In all cases the labor-output ratio is expressed in terms of hours worked per Leone of output, and the capital output ratio is given in terms of the annual cost of capital per Leone of output.

Estimates of average and marginal labor, capital, and foreign exchange requirements per Leone of expenditure in each income class are given in Tables 5.2 and 5.3. Average labor requirements rise and then fall as incomes increase. They are lowest for expenditures made by the lowest income class. Capital requirements fall monotonically as incomes rise. Both of these trends run counter to the expected decrease in labor intensity and increase in capital intensity as incomes rise. Foreign exchange requirements, on the other hand, rise monotonically as expected. From a policy point of view the marginal factor intensity figures are more relevant. As shown in Table 5.3, marginal labor requirements decline and foreign exchange requirements increase across the range of sample incomes in conformance with the hypothesized relationship between income and factor intensities. Capital requirements fall slightly as incomes increase, however, which is the opposite of what is expected. To some extent, the drop in capital requirements can be explained by the fact that high income

TABLE 5.1
LABOR-OUTPUT AND CAPITAL-OUTPUT RATIOS FOR SECTORS
OF THE SIERRA LEONIAN ECONOMY

Commodity Group	L/O[a]	K/O[b]
Rice	12.75	.017[c]
Cereals and root crops	16.56	.017[c]
Fruits and vegetables	9.89	.017[c]
Palm oil and other rural oil	5.16	.017[c]
Meat and livestock products	4.80	.017[c]
Fish	5.30	.227
Rural beverages and tobacco	10.79	.017[c]
Small-scale industry products[d]	5.95	.178
Large-scale industry products[e]	.28	.267
Transport	1.16	.310
Education[f]	1.71	.026

SOURCE: Survey data, Liedholm and Chuta [1976], Spencer and Byerlee [1977], Central Statistics Office [1972b].

[a]Person-hours per Leone of output.

[b]Annual cost of capital per Leone of output.

[c]Capital-output ratios are identical for agricultural products because it was not possible to disaggregate capital use by crop. The costs of tree plantation, livestock herds, etc. which are the direct embodiment of labor are not included in the determination of annual capital costs.

[d]Includes processed and other food, most of which originates in rural and small urban locations.

[e]Includes beverages and tobacco produced in large urban areas.

[f]These economic ratios derived from public administration and services data.

TABLE 5.2
AVERAGE LABOR, CAPITAL, AND FOREIGN EXCHANGE REQUIREMENTS PER LEONE OF EXPENDITURE BY INCOME CLASS

Income Class	Labor (Person-Hours)	Capital (Leones)	Foreign Exchange (Leones)	Corrected for Import Substitution	
				Labor (Person-Hours)	Capital (Leones)
Lowest decile	8.14	.062	.121	8.17	.094
Second and third deciles	8.56	.058	.126	8.59	.092
Fourth and fifth deciles	8.67	.055	.131	8.71	.090
Sixth and seventh deciles	8.68	.059	.134	8.72	.095
Eighth and ninth deciles	8.59	.052	.136	8.63	.088
Highest decile	8.39	.050	.140	8.43	.087
Mean Income Level	8.67	.054	.132	8.71	.089

TABLE 5.3
MARGINAL LABOR, CAPITAL, AND FOREIGN EXCHANGE REQUIREMENTS PER ADDITIONAL LEONE OF EXPENDITURE BY INCOME CLASS

Income Class	Labor (Person-Hours)	Capital (Leones)	Foreign Exchange (Leones)	Corrected for Import Substitution	
				Labor (Person-Hours)	Capital (Leones)
Lowest decile	9.20	.051	.133	9.24	.087
Second and third deciles	9.02	.050	.137	9.06	.087
Fourth and fifth deciles	8.74	.049	.140	8.78	.086
Sixth and seventh deciles	8.52	.048	.142	8.56	.086
Eighth and ninth deciles	8.12	.047	.144	8.16	.085
Highest decile	7.59	.044	.147	7.63	.083
Mean Income Level	8.52	.048	.141	8.56	.086

classes, with a higher marginal propensity to consume imports, substitute imported goods for capital intensive domestically produced goods. Furthermore, since capital requirements are quite small relative to foreign exchange the total capital and foreign exchange requirements increase over the income range. The results, then, tend to support the hypothesis under consideration for marginal changes in incomes.

Marginal labor requirements decrease over the range of sample incomes by 18 percent. Capital requirements fall by 14 percent and foreign exchange requirements increase by 11 percent. The magnitude of these changes is not as great as in Asian and Latin American studies. In Pakistan, for example, Soligo [1973] found an increase of 82 percent in marginal capital intensity and a decrease in marginal labor intensity of 56 percent over the range of incomes in rural areas. To a large extent the relative homogeneity of consumption patterns in the rural areas of Sierra Leone can be attributed to the comparative uniformity of the income distribution. Moreover the capital intensity of consumption patterns in Pakistan is appoximately five times higher than in Sierra Leone indicating the predominance of small-scale agriculture, fishing and industry as well as imports in providing consumer goods to the Sierra Leone rural population.

Capital and labor requirements that could result from a policy of total import substitution are given in the last two columns of Tables 5.2 and 5.3. These figures were calculated under the assumption that imports compete most directly with or eliminate the need for domestically produced large-scale industry products and that the entire substitution is effected through a rapid expansion of domestic large-scale industry. This assumption roughly corresponds to the historical import substitution policy. These computations indicate that an import substitution policy of

this sort would have only a minor effect on labor requirements, while capital requirements would increase substantially. Moreover, these results do not consider the indirect foreign exchange requirements for implementing such a policy.

In order to further investigate how differences in the distribution of incremental consumer incomes may affect factor requirements, the total labor, capital, and foreign exchange requirements associated with a 10 million Leone increase in rural incomes were computed for the current income distribution and one which strongly favors the poorest rural households.[1] These two distributions are given in Table 5.4. Despite the extreme differences between these two distributions, estimated labor requirements increased by only 3.7 percent, capital requirements income by only 2.6 percent, and foreign exchange requirements fell by only 2.5 percent as a result of a shift to the hypothesized distribution. A more relevant distinction is likely to be between the factor intensity of rural and urban consumption patterns, since the widest income disparities in Sierra Leone occur between rural and urban areas. Future research may show that factor requirements in Sierra Leone are much more sensitive to changes in the distribution of income between rural and urban areas than to distributional changes within rural areas.

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[1]Ten million Leones is a rough estimate of the annual growth in GDP attributable to rural areas which might be allocated to consumption expenditure.

TABLE 5.4
CURRENT AND HYPOTHETICAL DISTRIBUTIONS
OF INCREMENTAL INCOME

Income Class	Share of Total Increment in Rural Incomes	
	Current Distribution	Hypothetical Distribution
1. Lowest decile	.053	.400
2. Second and third decile	.166	.200
3. Fourth and fifth decile	.201	.100
4. Sixth and seventh decile	.190	.100
5. Eighth and ninth decile	.270	.100
6. Highest decile	.120	.100
Total	1.000	1.000

5.2. Locational Linkages

Locational linkages based on rural consumption patterns are analyzed in this section through examination of average and marginal propensities to consume for commodities grouped by origin--that is, commodities (a) produced and consumed in the household, (b) produced in rural areas but purchased by the household, (c) produced in small urban areas, (d) produced in large urban areas, and (e) imported. These figures are based on regression analysis for the commodity groups estimated in Section 4.4 and are presented in Table 5.5. Because they are more relevant for policy decisions, our discussion focuses primarily on marginal rather than average expenditure patterns.

We examine first households' allocation of consumption expenditures between home-produced and purchased goods. The marginal propensity to consume subsistence goods drops dramatically as incomes increase. In the lowest income households, almost 70 percent of any increase in expenditure is allocated to subsistence food consumption while only 29 percent of incremental expenditures for the highest income households is allocated to subsistence goods. To some extent, these figures represent a declining marginal expenditure for food, but there is also a switch from subsistence produced food to food purchased in the market as incomes rise.

The average propensity to consume home-produced agricultural products--the subsistence ratio--follows an inverted U-shaped pattern across the range of incomes, rising slightly as incomes rise to the mean level and then falling. Generally it is expected that higher income households will have a lower subsistence ratio, since the proportion of expenditures allocated to food, the main subsistence good, declines with incomes. The low subsistence ratio for low income households reported here may be due to (a) greater

TABLE 5.5
AVERAGE AND MARGINAL PROPENSITIES TO CONSUME BY INCOME CLASS FOR COMMODITIES GROUPED BY ORIGIN

Origin Classification	Average Propensity to Consume							Marginal Propensity to Consume						
	Mean Expenditure Level	Income Class						Mean Expenditure Level	Income Class					
		Lowest Decile	Second and Third Deciles	Fourth and Fifth Deciles	Sixth and Seventh Deciles	Eighth and Ninth Deciles	Highest Decile		Lowest Decile	Second and Third Deciles	Fourth and Fifth Deciles	Sixth and Seventh Deciles	Eighth and Ninth Deciles	Highest Decile
Rural subsistence agricultural products	.511	.410	.498	.513	.500	.471	.419	.445	.684	.588	.497	.436	.370	.286
Rural purchased agricultural products	.203	.238	.210	.203	.205	.212	.224	.216	.153	.178	.201	.218	.235	.257
All rural food products	.714	.648	.708	.716	.705	.683	.643	.661	.837	.765	.698	.654	.605	.543
Rural nonfarm goods	.012	.012	.012	.012	.011	.011	.011	.011	.013	.012	.011	.011	.010	.009
Rural services	.056	.092	.054	.054	.066	.087	.122	.112	-.036	.023	.080	.117	.158	.211
All rural products	.782	.752	.774	.782	.782	.781	.776	.784	.814	.801	.789	.782	.773	.763
Small urban products	.034	.017	.026	.033	.039	.045	.052	.055	.034	.043	.051	.056	.062	.069
Large urban products	.052	.110	.074	.054	.045	.038	.032	.020	.019	.019	.020	.020	.021	.021
Imported products	.132	.121	.126	.131	.134	.316	.140	.141	.133	.137	.140	.142	.144	.147
Total	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

participation in off-farm cash generating activities or (b) the necessity to sell food grain after harvest to meet cash requirements, as observed by Matlon [1977] in Nigeria.

With respect to the allocation of consumption expenditures between goods and services produced in rural areas and those originating from small and large urban centers, the figures in Table 5.5 show clearly the predominance of rural-produced goods in the expenditure patterns of rural consumers at all income levels. The marginal propensity to consume rurally produced goods falls only slightly as incomes rise, and even households in the highest income group allocate more than 75 percent of total consumption expenditure to these goods. Although market orientation does increase as incomes rise, very little of this increased market activity extends out of the local rural economy. Of particular interest is the strong shift to increased marginal expenditures on rural services and ceremonial--still another set of Z activities--as incomes rise. Marginal propensities to consume products from both small and large urban centers are relatively low. To some extent this reflects the small urban industrial base in Sierra Leone which provides only a limited range of consumer goods. However, it is significant that the share of expenditures allocated to small urban areas almost doubles from the lowest to the highest income group reflecting increasing demands for transportation services and small-scale industry goods and services produced in small towns serving the nearby rural areas. Although the percentage of increased rural incomes allocated to small urban goods and services is not high, the rural population because of its large share of total population constitutes an important source of demand for the growth of small urban centers.

Finally, consumers may allocate expenditures between domestic and imported goods and services. As shown in the discussion of factor intensities and in Table 5.3, there is a tendency for higher income households to allocate an increasing proportion of incremental incomes to imported goods but the effect is not large. Significantly, in Sierra Leone at the present time, a larger share of incremental rural incomes is being allocated to imported commodities than to urban produced commodities.

As in the preceding section on factor intensities, the effects of an increase in rural incomes of Le 10 million under the current and a hypothetical pattern of income distribution in Table 5.4 were examined to determine the sensitivity of locational linkages to changes in the distribution of incomes. The results given in Table 5.6 indicate that among products from each of the four aggregate locational areas, a sizeable change in incremental demand is seen only for goods from small urban centers. Demand for these products induced by the increase in incomes drops by 16 percent when the distribution of incremental incomes shifts to the pattern which favors consumers in the lower income classes.

Although the demand for rural products under the hypothetical is only 2 percent higher than under the current distribution, major changes in the composition of rural goods demanded do occur. In moving to the hypothetical distribution, incremental consumption of subsistence food products increases by 22 percent, which implies a substantial drop in induced marketable surplus. The incremental demand for purchased food products falls by only 12 percent, and that for all food products increases by 11 percent, which indicates that not only do households' induced marketable surpluses fall sharply under a distribution of incremental income favoring low income households, but also that the additional amount of food

TABLE 5.6
EFFECT OF ALTERNATE DISTRIBUTIONS OF A LE 10 MILLION INCREASE IN RURAL CONSUMPTION EXPENDITURES ON LOCATIONAL LINKAGES

	Current Income Distribution	Hypothesized Distribution
	Increased Expenditure (Le Million)	
Rural subsistence food products	4.508	5.501
Rural purchased food products	2.138	1.879
All rural food products	6.646	7.380
Rural nonfarm goods	.108	.117
Rural services	1.082	.468
All rural	7.836	7.965
Small urban	.548	.460
Large urban	.202	.196
Imported	1.414	1.379
Total	10.000	10.000

available for consumers in urban locations may be expected to fall. The other important changes which occur in moving to a distribution of incremental income favoring low income households are the 57 percent drop in incremental demand for rural services and the rise of only 8 percent in incremental demand for rural nonfarm goods. The total incremental demand for rural nonfarm goods and services falls by 68 percent, which indicates that off-farm employment opportunities in rural areas would be reduced substantially under the hypothetical distribution.

These results, then, indicate that the effect of a change in the distribution of incremental income on demand for goods at the margin changes the pattern of demand for the aggregate origin categories very little. Rather substantial effects, however, can be seen in the composition of incremental demand for products within the rural category.

6. SUMMARY AND CONCLUSIONS

The principal aims of this study were to describe and analyze statistically the relationships between income and consumer demand in rural areas of Sierra Leone and to analyze the effect of income distribution on factor intensities and locational linkages of rural consumption patterns at different income levels. Throughout, emphasis has been directed toward the testing of hypotheses designed to further theoretical and empirical understanding of the development process, as well as toward the more conventional focus of describing consumer behavior and estimating expenditure elasticities for use in the projection of consumer demand.

Data for this study were taken from a nationwide rural survey of 203 households which were visited twice weekly over a year to obtain daily data on production. These data were used to estimate subsistence consumption. The same households were also visited twice a week for one week each month to obtain data on cash expenditures. Descriptive analysis of the survey data indicates that incomes are low, averaging approximately $128 U.S. per capita and income distribution is rather uniform, the estimated Gini coefficient for the sample being .32. This contrasts with the comparatively unequal distribution of incomes in Sierra Leone as a whole and with the higher degree of income disparity in rural areas of some Asian and Latin American countries. Almost half of all rural consumption expenditures in Sierra Leone are allocated to subsistence consumption items. To a large extent, this reflects the fact that food expenditures account

for over half of each Leone spent in even the highest income class. The rural economy of Sierra Leone, then, is an economy based on subsistence consumption which does not have a sharply defined class structure.

Income-consumption relationships were estimated through regression analysis employing the ratio semi-log inverse function. This function was found most appropriate for the needs of this study because (a) it allowed flexibility in the income-consumption relationship over a range of incomes, (b) it ensured that the sum of the marginal propensities to consume was equal to unity at even extreme income levels and (c) it avoided some problems of zero observations for the dependent variables when logarithmic functions are employed.

Estimated expenditure elasticities of demand at the mean income level were quite high (0.9) for food commodities and for the staple food--rice. The estimated elasticity for meat was particularly high (1.8) while palm oil also had an elasticity above unity indicating that supplies of these food items will have to expand rapidly to keep pace with domestic demand in the future. A unique aspect of this study was the disaggregation of commodities that allowed the estimation of elasticities for small-scale industry products--an important factor in the design of labor intensive rural development strategies. The results of this study indicate that the products of small-scale firms do have a moderate potential for growth through increased demand, although their expenditure elasticities are generally less than that for similar goods produced by large-scale firms or imported.

Although there are important variations in consumption patterns at different income levels, these variations are not as pronounced as in other developing regions where income distribution is more highly skewed.

In general, variation in demand patterns follows expected trends with basic items such as food staples, cloth and small-scale industry products having a declining marginal propensity to consume while "luxury" goods such as meat, clothing, wood work products, transportation and services and ceremonial activities have increasing marginal propensities to consume.

Current consumption patterns in rural Sierra Leone are quite labor intensive since 84 percent of all increases in consumer expenditures are for goods produced in small-scale agricultural, fishing, industrial and service sectors. These results imply that increases in rural incomes are an effective means of creating additional employment. Moreover, the labor, capital and foreign exchange requirements of an additional unit of expenditure do not vary greatly by income level, though there is a definite tendency for the labor requirements to decrease and foreign exchange requirements increase as incomes rise. Contrary to expectations, capital requirements fall with increasing incomes. This seems to reflect a substitution of imported goods for capital intensive domestic goods--that is a substitution of one scarce factor for another rather than the substitution of scarce capital for relatively abundant labor, but it is also the result of the high marginal propensity to consume services at higher income levels. The results of the analysis of the factor intensity of rural consumption patterns indicate that there need be no inherent conflicts among employment, and income distribution objectives, since a more equitable distribution of income leads to little change in combined marginal requirements for the scarce factors, capital and foreign exchange and a clear increase in employment, which would reinforce improvements in the income distribution.

A major proportion of increased rural incomes is spent on commodities produced in rural areas. The next most important source of goods for rural consumers is from imports. This implies that the multiplier effects of rural consumption patterns will largely be felt in rural areas. Rural consumption linkages with urban sectors are relatively minor with the most important potential demand linkages being for goods and services from small urban areas which act as market towns for rural areas. Goods and services produced by large-scale firms located in Freetown, the largest urban area, are scarcely being consumed in rural areas. The products of large-scale industrial firms consisting largely of items such as beer, soft drinks, biscuits, suitcases, and ready-made cigarettes are largely oriented toward the higher income urban consumer. Clearly, however, the rural population is an essential source of demand for rapid industrialization and efforts should be made to promote industries, both small and large scale, in both rural and urban areas which produce goods for rural consumers. Presently rural demands for such items as cloth, shoes, and cooking ware are largely being met by imports.

A more complete picture of the role of consumption patterns and consumption linkages in the development process can only be obtained by analysing *both* rural and urban consumption patterns. Higher income urban consumers are important sources of demand for large urban produced products and it is likely that their capital and foreign exchange requirements are considerably higher and employment generated lower than for rural consumers. These rural-urban differences in consumption patterns could have important implications for the design of development strategies and particularly for the allocation of resources between small-scale rural sectors and large-scale urban sectors.

APPENDIX 1

INDEXING PROCEDURE USED TO FILL IN MISSING DATA

Where observations on a household's consumption expenditure patterns for a particular month were absent or insufficient,[1] the indexing procedure given below was used to estimate expenditure levels for various commodities. Households that failed to meet the minimum data requirements of three months' data from both long and short reference period questionnaires, RER/C2 and RER/C1 respectively, were dropped from the sample before indexing was performed. At the time of indexing, the data file contained observations on expenditures by each household on each of 112 commodity-origin categories and the number of days in each month for which data from the short reference period questionnaire were present. Data from RER/C1 and RER/C2 were separate. To lessen computational expense, the 112 commodity-origin categories were grouped into three large categories: rice, other food, and nonfood; and within each of these, the seasonal pattern of expenditure was assumed to be the same for all commodities. Sets of monthly indices for the relevant year[2] were calculated for each large commodity category for each resource region for both RER/C1 and RER/C2 data.

The first step in the indexing procedure was to "puff up" the data from RER/C1 so that they represented monthly expenditure levels. If, for

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[1] Data for a month were considered insufficient if data from RER/C1 covered less than three days or if RER/C2 data were missing.

[2] May 1974 - April 1975.

example, seven days' expenditures were recorded in September for a household, the sum of observed expenditures for that month for each commodity was multipled by 30/7, while the quantity 30/5 would be used for a household with only five days of observation. By puffing up the data, expenditure totals were given in monthly terms and were comparable for all households. This process was not necessary for RER/C2 data since they were already in monthly form.

Next, the indices for each commodity group were calculated in the following manner. First, the average expenditure on a commodity group for the j^{th} month in the i^{th} region, $\bar{e}_{ij}$, was determined using the formula:

$$\bar{e}_{ij} = \left(\sum_{h=1}^{N_{ij}} e_{hij} \right) / N_{ij} \qquad \text{(A.1.1)}$$

where

e_{hij} = expenditure on the commodity group in question by the h^{th} household in the i^{th} region during the j^{th} month, household h being one for which valid data are present

N_{ij} = is the number of households in region i for which valid data is present for month j.

Monthly average expenditures were then summed over the year as in equation A.1.2,

$$E_i = \sum_{i=1}^{12} \bar{e}_{ij} , \qquad \text{(A.1.2)}$$

to obtain the average annual expenditure on the commodity group in regior i, E_i. Monthly indices for the i^{th} region, I_{ij}, were then calculated using equation A.1.3:

$$I_{ij} = \bar{e}_{ij} / E_i \qquad \text{(A.1.3)}$$

The procedure used constrains the sum of monthly indices to equal unity.

The determination of the adjusted total expenditure on a particular commodity-origin category by the h^{th} household in region i, T^*_{hi}, for households with missing data was the next step in the process. T^*_{hi} was calculated using equation A.1.4,

$$T^*_{hi} = \left[1/(1 - \sum_{j=1}^{k} I_{ij}) \right] T_{hi} , \qquad (A.1.4)$$

where

T_{hi} = unadjusted total expenditure on the commodity by household h in region i

$\sum_{j=1}^{k} I_{ij}$ = the sum of the indices for the appropriate large commodity group for months with missing or inadequate data.

Finally the estimated value cash expenditure on the commodity in question for missing month m by household h in region i, t^*_{him}, was calculated using equation A.1.5:

$$t^*_{him} = T^*_{hi} I_{im} . \qquad (A.1.5)$$

APPENDIX 2

THE EFFECTS OF ZERO OBSERVATIONS

Because the logarithm of zero is undefined, the presence of households with expenditure levels of zero for the goods in a particular commodity group leads to difficulties when functional forms with logarithmic dependent variables, such as the log-log and log-log inverse functions, are used in analyzing consumer expenditure. Under the commodity grouping used in this study, substantial numbers of zero observations occur. In this appendix the effects of zero observations on parameters estimated with a log-log inverse model are examined.

A number of ways of dealing with zero observations have been proposed. Massell [1969], among others, suggests that households be grouped by income level to reduce zero observations. In his study of rural consumption patterns in Kenya, he found that by grouping the sample of 816 households into 136 groups of 6 households each, zero observations could be eliminated without decreasing degrees of freedom to a critical level. Grouping of this sort was considered for this study, but it was observed that the zero observation problem persists for some commodities, even when the number of groups becomes relatively small.

Another solution to the problem is to simply drop households with zero observations in a particular commodity group from the analysis of expenditures on that set of goods. While the parameters estimated after eliminating households with zero observations are unbiased and efficient, the sample itself has been altered and information which may be relevant

is ignored. Snyder [1971] uses this technique in conjunction with a linear probability of purchase model in his analysis of consumption expenditures in Freetown, but it was not considered for use in this study.

A third technique used in dealing with zero observations for a dependent variable expressed in logarithmic form is to replace zero observations with some arbitrary small number. Prais and Houthakker [1971] note that this is equivalent to assuming zero observations are the result of errors in measurement. They also observe that such a substitution can lead to sizeable biases in parameter estimates. Despite its drawbacks, especially for major durable items, this method is frequently used in consumer budget surveys. Simmons [1976], for example, eliminates large numbers of zero observations in this way. It is the workability of this technique that is explored in detail below.

The size of the bias introduced by substituting arbitrary values for zero observations cannot be measured, since parameter estimates cannot be computed unless zero observations are altered. The sensitivity of parameter estimates to changes in the substituted value, however, can be investigated. Furthermore, by examining the additivity properties of marginal propensities to consume at the mean expenditure level a rough estimate of the seriousness of the biases introduced by substitution can be made. Greater deviations from perfect additivity imply larger biases if approximate conformance with the additivity criterion can be assumed at the mean level of total expenditure.

Test regressions were run using the log-log inverse specified in equation A.2.1.

$$\ln C_{ij} = a_i + b_{1i}\ln\bar{y}_j + \frac{b_{2i}}{\bar{y}_j} + b_{3i}\ln N_j + b_{4i}\ln S_j + \sum_{h=1}^{7} g_{hi}R_{hj} + u_{ij} , \qquad (A.2.1)$$

where C_{ij} is total expenditure by household j on commodity i, $\bar{y}_j$ is per capita total consumption expenditure by household j, N_j is the number of persons present in household j, S_j is the subsistence ratio for household j, and the R_{hj}'s are a set of regional dummy variables. The commodities used in these tests were chosen so that a wide range of frequencies of zero observations would be represented. To determine the effect of different substituted values on the additivity of marginal propensities to consume,[1] test regressions were run for all commodity groups in the aggregate food category. Four different values were substituted for zero expenditure levels in the experiments: .000025, .0025, .01, and .25. In most cases, the magnitude of even the largest of these values represents only a very small percentage of the average annual expenditure on a commodity, though, in the case of small-scale metal work items, average annual expenditure is only Le 1.27.

Estimated parameters from the four sets of regressions are given in Table A.2.1. These estimates demonstrate that the size of the substituted parameter can have a substantial effect on parameter estimates. The effects are greatest for commodities having a high frequency of zero observations, such as small-scale metal work items and institutional saving; but they are also quite pronounced for commodities with only a few zero observations, such as palm oil, fruits and vegetables and clothing. In general,

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[1] The mathematical form of the log-log inverse function does not insure perfect additivity.

TABLE A.2.1
PARAMETER ESTIMATES FOR TEST COMMODITIES IN ZERO OBSERVATION EXPERIMENTS

Commodity Group	Number of Zero Observations	Average Total Expenditure (Leones Per Year)	Coefficient Of								R^2			
			$\ln\bar{y}$				$1/\bar{y}$							
			Substituted Value				Substituted Value				Substituted Value			
			.000025	.0025	.01	.25	.000025	.0025	.01	.25	.000025	.0025	.01	.25
Rice	0	263.13	.907[a] (.19)[b]				-9.821 (13.35)				.635			
Cereals and root crops	9	54.75	.964 (.91)	.983 (.66)	.984 (.60)	.881 (.48)	-99.547 (64.00)	-54.547 (47.20)	-41.332 (42.81)	-16.556 (33.95)	.470	.535	.552	.566
Fruits and vegetables	2	19.20	1.102 (.59)	1.151 (.51)	1.166 (.49)	1.200 (.46)	-17.439 (42.31)	-5.029 (36.06)	-1.293 (34.74)	7.381 (32.94)	.449	.487	.494	.494
Palm oil	7	50.17	2.306 (.92)	1.904 (.67)	1.783 (.59)	1.502 (.45)	-9.683 (65.70)	-10.250 (47.39)	-10.421 (42.34)	-10.818 (32.31)	.295	.333	.348	.386
Rural salt and other oil	67	1.73	-3.226 (1.80)	-1.758 (1.07)	-1.316 (.86)	-.290 (.44)	-256.187 (128.54)	-140.129 (76.08)	-105.192 (60.97)	-24.071 (31.31)	.197	.210	.218	.248
Imported salt and condiments	2	9.37	1.401 (.56)	1.337 (.45)	1.317 (.42)	1.272 (.38)	32.276 (39.58)	31.299 (31.71)	31.005 (29.88)	30.322 (27.02)	.274	.313	.322	.328
Meat and livestock products	33	10.86	1.637 (1.64)	1.384 (1.07)	1.308 (.91)	1.131 (.59)	-61.243 (117.14)	-35.278 (76.44)	-27.463 (64.95)	-9.314 (42.12)	.197	.220	.230	.248
Fish	0	56.16	.892 (.21)		.464 (.75)	.586 (.44)	4.723 (15.10)				.577			
Processed food	63	2.08	.236 (1.57)	.411 (.93)			-100.566 (112.16)	-47.637 (66.23)	-31.704 (53.44)	5.292 (31.16)	.371	.402	.417	.419
All food	0	467.46	.873 (.07)				-12.084 (4.90)				.925			

TABLE A.2.1 - CONTINUED
PARAMETER ESTIMATES FOR TEST COMMODITIES IN ZERO OBSERVATION EXPERIMENTS

Commodity Group	Number of Zero Observations	Average Total Expenditure (Leones Per Year)	Coefficient Of								R^2			
			$\ln\bar{y}$				$1/\bar{y}$							
			Substituted Value				Substituted Value				Substituted Value			
			.000025	.0025	.01	.25	.000025	.0025	.01	.25	.000025	.0025	.01	.25
Metal work (SSI)[c]	137	1.27	2.206 (1.69)	1.189 (1.02)	.883 (.833)	.172 (.54)	113.399 (120.24)	61.781 (72.34)	46.242 (59.35)	10.162 (38.20)	.164	.109	.082	.103
Clothing	9	20.25	1.920 (1.00)	1.345 (.70)	1.172 (.62)	.771 (.46)	21.468 (71.15)	.981 (49.67)	-5.186 (43.83)	-19.507 (32.70)	.191	.220	.232	.263
Osusu saving	95	6.69	-1.710 (1.91)	-.882 (1.23)	-.632 (1.04)	-.053 (.64)	-197.391 (135.94)	-108.379 (87.67)	-81.583 (73.89)	-19.366 (45.94)	.306	.269	.249	.173

[a]When no zero observations are present, parameter estimates remain the same and will not be repeated.

[b]Numbers in parentheses are standard errors of the estimated coefficients. These can be used in computing the t statistic, used in testing hypotheses concerning the magnitude of estimated parameters.

[c]SSI indicates small-scale industry.

the substitution of larger values leads to parameter estimates which are closer to zero and to higher values of R^2, the coefficient of determination, though this is not always the case. Specific effects for a given commodity also depend on the average level of expenditures on that commodity and on the relative income level of households with zero observations.

Expenditure elasticities and marginal propensities to consume derived from the parameters estimated in the test regressions are given in Table A.2.2. Again, quite substantial differences are associated with variation in the value substituted for zero observations. For example, the expenditure elasticity and marginal propensity to consume of palm oil, a major commodity with only seven zero observations, are reduced approximately one-third over the range of substituted values. Because of variations of this magnitude in marginal propensities to consume, additivity properties are also affected. The test regression for the aggregate food category indicates that, at the mean expenditure level, .684 of each additional leone of total expenditure is allocated to food. The sum of marginal propensities to consume for the individual food commodity groups, however, ranges from .872 to .730, depending on the size of the value substituted for zero observations. Substitution of larger values yields sums of marginal propensities to consume closer to that derived from the aggregate relationship. In all cases, however, there is an upward bias in marginal propensities to consume for disaggregated commodities and in no case is their sum close enough to the aggregate marginal propensity to consume to allow it to be said that the additivity problem is eliminated.

The results of these test regressions indicate that the zero observation problem is a serious one and that parameter estimates based on the

TABLE A.2.2
ESTIMATED EXPENDITURE ELASTICITIES AND MARGINAL PROPENSITIES TO CONSUME
FOR COMMODITIES IN ZERO OBSERVATION EXPERIMENT

Commodity Group	Elasticity[a]				MPC			
	Substituted Value				Substituted Value			
	.000025	.0025	.01	.25	.000025	.0025	.01	.25
Rice	.992	.992	.992	.992	.385	.385	.385	.385
Cereals and root crops	1.820	1.452	1.339	1.023	.149	.119	.110	.084
Fruits and vegetables	1.252	1.194	1.177	1.137	.036	.034	.034	.033
Palm oil	2.389	1.992	1.873	1.595	.179	.150	.141	.120
Rural salt and other oil	-1.023	-.553	-.411	-.083	-.003	-.001	-.001	.000
Imported salt and condiments	1.123	1.068	1.050	1.011	.016	.015	.015	.014
Meat and livestock products	2.164	1.687	1.544	1.211	.035	.027	.025	.020
Fish	.851	.851	.851	.851	.072	.072	.072	.072
Processed food	1.101	.821	.737	.541	.003	.003	.002	.002
All food	.977	.977	.977	.977	.684	.684	.684	.684
Sum of disaggregated MPCs for food					.872	.804	.783	.730
Metal work (SSI)[b]	1.231	.658	.485	.085	.002	.001	.001	.000
Clothing	1.735	1.337	1.217	.939	.033	.025	.023	.018
Institutional saving	-.012	.050	.070	.114	.000	.001	.001	.001

[a]All elasticities and MPCs are calculated for the mean levels of expenditure in the sample.

[b]SSI indicates small-scale industry.

log-log inverse or log-log model must be interpreted with caution when zero observations are present in the data. These results do not point to a "best" value which, when substituted for zero observations, will both minimize the bias introduced by such a substitution and reduce the additivity problem. In fact, they indicate that when zero observations are present, other functional forms which do not have logarithmic dependent variables should be used whenever possible.

APPENDIX 3

USE OF CASH EXPENDITURES FOR ESTIMATING INCOME ELASTICITIES OF DEMAND FOR NONSUBSISTENCE GOODS

The analyst designing a survey of rural consumption patterns is faced with the difficult problem that a large part of rural consumption is comprised of goods produced and consumed within individual households. This makes the estimation of reliable income elasticities more complex and considerably more expensive than in urban areas since the subsistence consumption component is difficult to measure and to value in monetary terms.[1]

In this appendix, we demonstrate that, at least for non-subsistence oriented commodities, cash expenditure elasticities of demand (i.e., the elasticity of cash expenditures on a commodity with respect to total cash consumption expenditure) may serve as a reasonable approximation of total expenditure elasticities.[2] Cash expenditures are relatively easy to measure since they are already expressed in monetary units and are also more readily recalled.

Following Mukhrjee [1967] the total expenditure elasticity of demand for commodity i, e_i^t, can be decomposed into elements containing the cash expenditure elasticity, e_i^m, and the subsistence expenditure elasticity, e_i^s, as in equation A.3.1.

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[1] In West Africa cassava is an example of an important subsistence item which is simply dug from established stands on a daily basis for household consumption so that even well defined local units of measures do not exist.

[2] Total expenditure is defined as the sum of cash expenditures and the value of subsistence consumption for any commodity or group of commodities.

$$e_i^t = \frac{M_i}{C_i} n_m e_i^m + \frac{S_i}{C_i} n_s e_i^s \qquad (A.3.1)$$

where M_i is cash expenditure on commodity i, S_i is subsistence expenditure on commodity i, C_i is total expenditure on commodity i (the sum of M_i and S_i), and n_m and n_s are, respectively, elasticities of *total* cash and *total* subsistence expenditures both with respect to total consumption expenditure.[1] The total expenditure elasticity of demand for a commodity, then, can be viewed as a weighted average of the cash expenditure elasticity, e_i^m, and the subsistence expenditure elasticity, e_i^s, where the weights are determined by the relative importance of cash and subsistence expenditures on the commodity in question and by the size of elasticities of demand for all cash goods and all subsistence goods.

Equation A.3.1 reduces to

$$e_i^t = n_m e_i^m \qquad (A.3.2)$$

for commodities which households do not themselves produce, since in this case $M_i/C_i = 1$ and $S_i/C_i = 0$. If n_m is close to unity the cash expenditure elasticity will serve as a good approximation of the total expenditure elasticity. n_m is an indicator of the direction of change in the proportion of cash expenditures to total consumption expenditure as total expenditures increase. Because higher income households in rural areas tend to have a stronger market orientation, we expect n_m to be greater than unity. In cases where differences in the degree of commercialization are not pronounced, however, n_m may be quite close to one.

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[1] Algebraically, $e_i^t = (dC_i/dC)\ (C/C_i)$, $e^m = (dM_i/dM)\ (M/M_i)$, $e_i^s = (dS_i/dS)\ (S/S_i)$, $n_m = (dM/dC)\ (C/M)$, and $n_s = (dS/dC)\ (C/S)$, where C, M, and S are respectively total consumption, total cash, and total subsistence expenditure.

The proposition that cash expenditure elasticities serve as reasonable approximations of total expenditure elasticities was tested by estimating both elasticities using household budget data collected from this study. Cash expenditure parameters were estimated using an analogous function,[1]

$$M_{ij} = a_i M_j + b_{i1} M_j \ln \bar{m}_j + b_{i2} N_j + \sum_{h=1}^{8} g_{hi} R_{hj} + U_{ij} \qquad (A.3.3)$$

where M_{ij} is cash expenditure on commodity i, M_j is total cash expenditure, $\bar{m}_j$ is per capita cash expenditure, N_j is household size, R_{hj} are the regional dummy variables and N_{ij} is the disturbance term.

Estimates of total expenditure and cash expenditure elasticities are given in Table A.3.1. In all cases the cash expenditure elasticity is of the same order of magnitude as the total expenditure elasticity. For non-food items the difference is usually less than 10 percent. The largest differences occur for commodities with very low elasticities (e.g., fuel and light and clothing) or very high elasticities (e.g., services and ceremonial). Total expenditure and cash expenditure elasticities are remarkably similar for aggregate commodity categories such as all small-scale and all large-scale industry products. The similarity of these estimates can be explained by the fact that for our sample the elasticity of demand for *all* cash items, n_m, is quite close to unity ($n_m = 1.044$). For nonsubsistence items, then, equation A.3.2 implies that the cash expenditure elasticity can be expected to underestimate the total expenditure elasticity by about 4 percent.

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[1] The subsistence ratio was not included because total expenditure data must be used to compute it.

TABLE A.3.1
COMPARISON OF CASH EXPENDITURE AND TOTAL EXPENDITURE ELASTICITIES BY COMMODITY

Commodity Group	$\frac{M_i}{C_i}$	Elasticity	
		Cash Expenditure	Total Expenditure
Rice	.21	.92	1.00
Cereals and root crops	.08	1.21	1.05
Fruits and vegetables	.27	.81	.88
Palm oil	.62	1.35	1.13
Meat and livestock products	.47	1.06	.95
Fish	.73	.62	.93
Other food	.98	.62	.41
All food	.33	.91	.99
Rural beverages and tobacco	.36	.52	.23
Urban and imported beverages and tobacco	1.00	.31	.21
All beverages and tobacco	.66	.37	.22
Small-scale industry products	1.00	.87	.88
Fuel and light	1.00	.43	.40
Metal work	1.00	1.02	.99
Clothing	1.00	.76	.48
Cloth	1.00	1.30	1.53
Other household and personal goods	1.00	1.56	1.58
All large-scale industry products	1.00	1.07	1.08
Transport	1.00	1.33	1.25
Services	1.00	1.31	1.43
Education	1.00	.81	.45
Miscellaneous	1.00	1.42	1.42

Evidence that these results may be generalizable is obtained from figures given by Mukhrjee and Rao [1972], who investigated the effects of decomposing expenditures into subsistence and cash components in order to obtain better estimates of total expenditure elasticities of demand. Using Indian national data they estimate the elasticity for all cash purchases, n^m, to be 1.097, which is quite close to our figure for Sierra Leone. For the aggregate category of nonfood goods, for which only 21.3 percent of total consumption comes from households' own production, the estimated cash expenditure elasticity of 1.31 is quite close to the total expenditure elasticity of 1.36. In the Indian case, however, there were quite substantial differences between cash and total expenditure elasticities for food items, for which the ratio of subsistence to total expenditure is high. While lending support to the proposition that cash expenditure elasticities provide a good approximation for total expenditure elasticities of nonsubsistence items, the results of Mukhrjee and Rao indicate that cash expenditure elasticities for subsistence items may not reliably reflect actual observed behavior, although in the Sierra Leone study, total and cash expenditure elasticities were quite close for many food items.

We conclude that useful approximations of expenditure elasticities of demand for nonsubsistence items can be obtained by analyzing only cash purchases of rural households. The great advantage of this approach is that it eliminates the need to undertake the difficult task of measuring and valuing subsistence consumption. Estimates of elasticities from rural expenditure data in Sierra Leone and India indicate that the margin of error in using this approach is quite low. Of course where food consumption which is largely subsistence produced is of interest both cash and subsistence expenditures should be recorded. We anticipate that these

results will be particularly useful to planners and project analysts who wish to quickly project the demand outlook for specific commodities whose increased production is being contemplated.

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