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DETERMINANTS OF HOUSEHOLD EXPENDITURE IN RURAL KENYA

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Determinants of Household Expenditure in Rural Kenya

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Introduction.

This paper contains an analysis of the determinants of expenditure by rural households in the former Central Province of Kenya. In particular, expenditure elasticities are estimated for 18 groups of goods and services. The study is based on budget study data forming part of the Central Province Survey, which was recently conducted by a United Nations team for the Kenya Government.

The economic literature abounds with analyses of budget survey data collected in the United States, Britain, and other economically advanced countries. However little research has been conducted on consumer behavior in Africa, and notably in East Africa. The three East African Governments have for some time collected budget survey data. But they have thus far found insufficient time to perform statistical analyses of consumer behavior based on these data, as is done here.

There are several reasons for undertaking this type of research. Perhaps the principal reason is to provide a better understanding of how households in the rural areas of a less developed country spend their income, and how their patterns of expenditure are related to household income, household size, and other social and economic variables. There is virtually no information on the determinants of expenditure patterns in East Africa.

In addition to filling in some of the gaps in our understanding of consumer behavior in a less developed country, the statistical analysis will hopefully provide some basis for demand projections. Per capita income is beginning to rise rapidly in Kenya, and this rise in income will be accompanied by major shifts in the composition of consumer demand for goods and services. For example, as a household's income rises, at least beyond some point, one can expect the household to spend a smaller proportion of its income on staple food items and a larger proportion on

certain luxury goods. One of the purposes of the present study is to be able to quantify this shift in the composition of demand and to be able to state with greater precision which items are "necessities" and which items are "luxuries." This information may prove to have a useful role in economic planning.

It should be borne in mind that an analysis of the sort undertaken here has many limitations. For one thing, an income elasticity estimated from cross-section data (as is the case here) can provide only imperfect information about the corresponding intertemporal income elasticity. This fact is well known, and there is no need to dwell on it here. Second, the present study is based only on rural households, and only those in one part of Kenya. However, there is some reason to believe that the results will have some applicability to households in other rural areas in Kenya.

Consumer behavior in urban areas can be expected to differ sharply between urban and rural areas, and it would be a mistake to apply the results obtained here to an analysis of households in the cities. However, a comparable analysis[1] is currently being prepared of middle-income African households in Nairobi and we shall compare the Nairobi and the Central Province results.

The Sample.

The sample data were obtained from the Central Province Survey, conducted in the former Central Province of Kenya, over a one-year period beginning in mid-February 1963. The Central Province cannot be regarded as fully representative of rural Kenya as a whole. In particular, land consolidation and the introduction of cash crops have taken place earlier in the Central Province, and as a consequence the agricultural income of the province is undoubtedly above average. In 1962, the Province contained 21 percent of the total African population of Kenya.

A 2-stage stratified random sample was used. The first stage involved the random selection of sublocations within the Central Province. Households in the sublocations were stratified into three groups according to acreage operated. Finally 45 primary locations with 24 households each were chosen randomly, thus providing a total sample of 1080 households.

A team of 55 enumerators and 5 supervisors, backed up by 2 United Nations experts, conducted the field work. Enumerators made fortnightly visits to each household throughout the year. In addition, daily visits were made to each household for a two-month period, both to check on the accuracy of the fortnightly data and to provide detailed information on subsistence consumption of food items.

The stratified random sampling resulted in a substantially higher percentage representation of households with larger acreage -- and accordingly with higher income. The sample contained 468 households with under 4 acres, 2.8 percent of the population; 300 households with 4 - 8 acres, 6.9 percent of the population, and 312 households with over 8 acres, 17.1 percent of the population. The sample contained 4.7 percent of the households in the sublocations chosen, and 0.39 percent of the households in the Province as a whole.

Although the sample is heavily biased toward larger farms, this does not invalidate the use of regression analysis. Indeed, by spreading observations on the regressors more evenly over their ranges, more efficient estimates will be obtained.

Some of the 1080 households in the original sample were rejected by the United Nations team as unreliable. We rejected other households where the figures appeared inconsistent. For example, in two primary sublocations, many of the households reportedly consumed from own production substantially more than they produced. As there is unlikely to be much storage from the previous year, these figures suggested inaccurate recording of the data, and provided a sound basis for rejecting the observations. The pattern of inconsistencies throughout the sample as a whole suggested that the major part of the recording errors were due to a few enumerators who did not perform their job properly.

Tables 1 - 4 present summary descriptive statistics on the sample. Because unweighted means were employed, without correcting for the bias toward households with greater acreage, many of the figures are biased upward. But while these figures would be biased estimates of the corresponding population parameters, they are nevertheless of some interest in summarizing the sample itself, which forms the basis of the regression analysis.

Looking briefly at Table 1, we see that the average farm size is 6.75 acres, the average number of consumer units (adults, plus children weighted by one-half) is 4.7, that 50 percent of the heads of household are literate, and that 20.7 percent have at least 4 years schooling.

Table 2, containing income and expenditure data, is perhaps more interesting. Where available, the official figures (weighted means, which are unbiased estimates of the population parameters) are presented as well, for comparison. First, to summarize the important figures, we see that gross income is shs.2500, of which shs.513 is business expenses. It seems likely that business expenses are overstated, as they are defined to include all forms of capital investment, such as purchase of livestock, farm improvements, and investment in fixed capital. On the other hand, no allowance is made for depreciation, so that on balance the extent of overstatement made not be too great for the sample as a whole. Obviously, though, any one farm may be carrying out a large investment (or disinvestment) program during the survey year. Thus we conclude that while the net income figures may be more meaningful for the average farm, the gross income figures are likely to be more meaningful for the individual farm.

Net farm income is shs.1987, 33.7 percent of which is from agriculture (including livestock), the remainder from wages, sales of nonogricultural goods, and other forms of income; moreover, nonagricultural income includes unearned income mainly in the form of remittances received from wage earning members of the family living away, but also including bride price payments received.

The imputed value of firewood was included in the net income figures but we unfortunately were unable to record this for individual households. This necessitated making some assumption as to what part of income consists of this item, and we arbitrarily assumed the value to be shs.100. This figure was then added to subsistence food income to obtain total subsistence income which appears in Table 2, and which in turn is equal to subsistence expenditure.

No figures were available on the division of business expenses between agricultural and nonagricultural income, so we arbitrarily allocated 75 percent to agricultural income, and the remainder to

TABLE 1: Summary Descriptive Material

Land operated (acres)	6.75	
Value of livestock (shs.)	576	
Household size		
adults	2.8	
children	3.5	
consumer units	4.7	
Heads of household that are literate (%)		50.0
Heads of household with at least 4 years education(%)		20.7
Households in Kiambu	202	
% of sample		24.2
Households in Fort Hall	202	
% of sample		24.2
Households in Embu	138	
% of sample		16.5
Households in Nyeri	111	
% of sample		13.3
Households in Meru	183	
% of sample		21.8
Total number of households	836	

TABLE 2: Summary Income and Expenditure Data

	Sample	Official
Gross income	2500	1887
Business expenses	513	283
Net income	1987	1604
Gross agricultural income	1054	838
Net agricultural income	669	616
Percent of net income	33.7	38.4
Gross nonagricultural income	1446	1059
Net nonagricultural income	1318	988
Percent of net income	66.3	61.6
Subsistence income	645	538
Percent of net income	32.5	33.5
Net cash income	1342	1065
Percent of net income	67.5	66.5
Disposable income	1959	1582
Disposable cash income	1314	1044
Total expenditure	1681	1313
Percent of disposable income	85.8	83.0
Subsistence expenditure	645	538
Percent of total expenditure	38.4	41.0
Cash expenditure	1036	775
Percent of total expenditure	61.6	59.0
Percentage of disposable cash income	78.8	74.2
Saving + transfers	278	269
Percentage of disposable income	14.2	17.0
Percentage of disposable cash income	21.2	25.8

nonagricultural income, thus obtaining net figures. Using these figures, the percentage of net income derived from agriculture is 33.7. This, it should be noted, includes subsistence as well as cash production. The figure is rather lower than one would expect. However, it must be remembered that nonagricultural income does include transfer payments made to the household, and in particular, remittances.

Subsistence income constitutes 32.5 percent of net income, the remainder consisting of cash income. Taxes, which may have been under-recorded, amount to only shs.28, so that there is little difference between net and disposable income. 85.8 percent of disposable income was spent; and 38.4 percent of expenditure was in the form of subsistence expenditure. Saving amounts to 14.2 percent of disposable income, and 21.2 percent of disposable cash income.

Comparing our figures with the official figures, it can be seen that the largest discrepancies concern gross income and business expenses. Business expenses rise much more than proportionately with income (gross or net), so that the bias toward the larger income households results in a very large upward bias in business expenses. For example, if the households are ordered by gross income, and arranged into 38 groups of 22 households each, as was done here,[2] the first five groups (110 households) have a mean gross income of shs.2424, and mean business expenses of only shs.113, whereas the last 5 groups have a mean gross income of shs.43566 and business expenses of shs.13660, much higher as a percentage of gross income. The heavy representation of the higher income households doubtless explains why our figures for business expenses and gross income are so much higher than the official figures.

Otherwise, our figures do not differ too greatly from the official figures. As is to be expected, our income figures are higher, and are especially so for nonagricultural income. And our total expenditure figures are correspondingly higher. Perhaps the only surprise is that the saving ratio is higher in the official than in our figures. One would expect the reverse, as higher-income households are likely to save more than lower-income households. However, as already noted, the households with higher incomes tended also to spend considerably more on business expenses which, as also noted, includes capital expenditure.

It follows that the larger a household's recorded business expenditures, the more the household is likely in fact to have spent on capital investment. And, on the other hand, the low-income households, with small recorded business expenditures are more likely to be disinvesting in their farms. If allowance is made for this, the saving figures make more sense. They suggest that higher income households directly invested a larger proportion of their saving.

Table 3 presents more detailed expenditure figures, again comparing our figures with the official figures (where available). There is not a great deal of discrepancy between the two sets of figures. Using our figures, food emerges as by far the most important expenditure item, accounting for more than half of total expenditure. Clothing, fuel/light, and transportation/other services are (in that order) next in importance. It should be remembered that 75 percent of the fuel/light figure consists of the imputed value of firewood, the remainder of purchased fuels, mainly paraffin.

Table 4 contains a finer breakdown of food expenditure. The principal items, in order of importance, are cereals, roots, and milk. Total food includes shs.32 expenditure on miscellaneous food items such as spices. The items shown in the table thus constitute 96.6 percent of total food expenditure.

The Dependent Variables.

As Tables 3 and 4 indicate, the survey contains information on 18 expenditure groups: 8 foods, total food, 3 nonfood nondurables, 4 durables, and 2 services. These groups are defined in Table 5. For some of these groups, disaggregated information has also been collected, and these items are now being processed; the results of this further research will be reported in a few weeks.

For most food items, information was collected separately on cash expenditure and on subsistence expenditure -- i.e., consumption from own production. This study focuses on total expenditure -- i.e., the sum of cash and subsistence expenditure. The reason for this is that as households move progressively further into the cash economy and

TABLE 3: Summary Expenditure Figures

	Sample		Official	
	Expenditure	% of total expenditure	Expenditure	% of total expenditure
Food	944	56.1	746	56.8
Tobacco and beverages	90	5.4	54	4.1
Fuel and light	134	8.0	137	10.4
Soap	28	1.6	...	...
Clothing	152	9.0	128	9.7
Furniture	30	1.8	48	3.7
Equipment	24	1.4		
Housing	73	4.3	48	3.7
Education and recreation	91	5.4	154	11.7
Transportation and other Services	115	6.8		
Total expenditure	1681	100.0	1313	100.0

TABLE 4: Expenditure on Food Items

	Expenditure	% of total food expenditure	% of total expenditure
cereals	194	20.6	12.3
pulses	124	13.1	7.8
roots	155	16.4	9.7
sugar	84	8.9	5.3
vegetables	72	7.6	4.5
milk	145	15.4	9.2
meat	98	10.4	6.3
fats and oils	40	4.2	2.5
total food	944	100.0	59.7

TABLE 5: Expenditure Groups

FOODS

cereals: 90 percent maize, 5 percent wheat, 5 percent rice.

pulses.

roots: 80 percent English potatoes, 12 percent sweet potatoes, 8 percent other roots and tubers.

sugar: includes confectionary, sweets, jams, etc.

vegetables and fruit.

milk: includes butter, ghee, other milk products.

meat and eggs: 15 percent eggs, the remainder meat.

fats and oils.

total food: sum of items above plus miscellaneous food items.

NONFOOD NONDURABLES

tobacco and beverages: 20 percent beer, 28 percent tea and coffee, 31 percent cigarettes and tobacco, 17 percent local beer.

fuel: paraffin, excludes imputed value of firewood collected.

soap: includes miscellaneous small items such as thread, totalling 5 percent of expenditure in this category.

DURABLES

clothing: includes cloth and tailoring.

furniture: includes furnishings and bedding.

equipment: household utensils and equipment.

housing: mainly housing materials and paid labor, excluding value of household labor.

SERVICES

education: mainly school fees; category also includes recreation (2 percent) and other expenditures (2) percent)

other services: 32 percent transportation, 30 percent medical services, 38 percent other services.

produce a larger part of their output for the market, they will accordingly tend to purchase more of their needs in the market. For this reason, one may conjecture that total expenditure, which reflects basic tastes, will be more stable than cash expenditure, which reflects both tastes and the structure of production. Moreover, cash expenditure, because it does reflect in part the structure of production, will exhibit a less meaningful relationship to income.

One could, of course, relate cash expenditure on each item to cash income, or to cash and subsistence income separately. However, this would yield biased and probably meaningless results. Subsistence income is not in any sense an "independent" variables, but is determined jointly with subsistence expenditure on each food item. It is unlikely that a household regards subsistence income as given, then choosing to allocate this income among items. The level of subsistence income itself reflects the household's preference for food items that can most conveniently be grown on the farm.

The 18 expenditure groups form a set of dependent variables; interhousehold variation in each of these variables is explained, in the analysis below, in terms of a set of independent variables.

Income and Total Expenditure.

In explaining household expenditure, principal interest focuses on the income elasticity of the items consumed by the households in the sample. This is in part because household income is regarded by economic theory -- and by many empirical studies conducted throughout the world -- to be the major determinant of a household's expenditure pattern. Also, in a developing country like Kenya, income is one of the most rapidly changing variables, so that it is of particular interest to be able to predict what effect increasing household income will have on a household's expenditure pattern.

However, there are difficulties inherent in the use of income as an explanatory variable. First, there are many different definitions of income, and it is far from clear which best corresponds to the concept of income that appears in economic theory. For example, there is gross,

net, and disposable income: and there is subsistence and cash income. Also, there are transfer payments such as remittances and bride price received. How should those be handled?

Probably a more serious objection to the use of income as an explanatory variable is that it is invariably measured with error. For example, in obtaining net income, farm expenses were deducted from gross earnings (including remittances received). There is some question, though whether these expenses correspond to the economic concept of operating costs, for capital investment in the farm was treated as an expense, on the one hand, and on the other hand no allowance was made for depreciation. Thus income (and saving) will be overstated if gross investment exceeds depreciation, and will be understated if gross investment falls short of depreciation.

There is some indication that taxes were not adequately recorded, so that disposable income is likely to be even less reliable than net income.

The valuation of subsistence production always poses a conceptual problem. Should produce grown and consumed on the farm be valued at the buying or the selling price, or at some intermediate price? In the present case, the wholesale price was used. But this will tend to understate the income of a household producing more for subsistence, as compared with a household that is more committed to the market economy.

Finally, it should be pointed out that most of the data are based on fortnightly visits to the households; respondents were asked to keep records of expenditures and earnings between visits by the enumerator. It is inevitable that some respondents will be unable to remember or to record accurately their income during this period.

These points seem to establish beyond reasonable doubt that income is measured with error. It is well known that least squares estimators will be biased (even asymptotically) if a regressor (in this case, income) has a stochastic component. Thus, if income is used as an explanatory variable, it would be necessary to use an alternative form of estimation, and this does not seem feasible here.

To get around this problem, the investigator sometimes uses total expenditure instead of income as an explanatory variable. Total expenditure moves closely with income, so that it can reasonably be regarded as a proxy for income. Moreover although this procedure yields estimates of total expenditure (rather than income) elasticities, the one can be converted to the other if one is prepared to make some assumption about the income elasticity of total expenditure.

However, we are not out of the woods yet. Total expenditure, like income, is measured with error; this error can not reasonably be assumed to be independent of the disturbance term in the regression equation; and so least squares estimators will still be asymptotically biased. It has been shown that this bias may be substantial, as much as 50 percent.

But, with total expenditure as an explanatory variable, there is a method that can conveniently be used, and that yields asymptotically unbiased (and consistent) estimates of the expenditure elasticities. This requires using income as an instrumental variable. This procedure is used here, and will be explained below.

Expenditure items can be split into three groups: (1) luxuries, (2) necessities, (3) inferior goods. Luxuries are typically regarded as items whose expenditure elasticity exceeds unity, so that expenditure on these items increases more than proportionately with an increase in total expenditure. Necessities have an expenditure elasticity not exceeding unity and not less than zero: an increase in total expenditure results in a less than proportionate increase in expenditure on these items. Finally inferior goods have an expenditure elasticity less than zero, so that expenditure on these goods decreases absolutely as total expenditure rises. One of the objectives of this study is to classify the 18 expenditure items into the three categories.

Household Size.

The second explanatory variable to be considered is household size. We have separate information on the number of adults and children in each household. Although these could be used as separate independent variables, we decided instead to use a measure of adult-equivalents

residing in the household. Children are weighted as one-half an adult. An adjustment was made for absences during the year. One would expect larger households to spend more on inferior goods and on most necessities, but less on luxuries. However, there may be some exceptions to this.

Total expenditure (or income) and household size are the variables most commonly used in expenditure studies. In the present study, in addition, we consider (1) education of the head of household, (2) district in which the household is located, (3) source of income, and (4) acreage. These are discussed in turn.

Table 1 notes that 20.7 percent have at least 4 years of formal education. One would expect that, net of income, the educational level of the head of household would have an influence on the household's expenditure pattern, with households headed by better educated persons tending to consumer a higher quality diet (as opposed to the traditional diet) and perhaps spending more on school fees, furniture, and soap. We have accordingly included a dummy variable, S, which equals unity if the household has at least 4 years education, and zero otherwise.

Interregional Effects.

A household's expenditure pattern is influenced by relative prices of goods and services consumed by the household. In an area as large and heterogeneous (agriculturally) as the Central Province of Kenya, there are likely to be regional price differences. This is particularly the case because the inadequate and expensive transport and the relatively small market combine to restrict the interregional flow of some commodities, thus permitting price differentials to exist. The regulation of the marketing of some commodities may also contribute to the inter-regional price spread. If one area has a surplus and another area a shortage of some commodity, restrictions on the flow of the commodity between the areas limit the extent of equalization in its price.

While it is obvious that the price of an item will influence cash expenditure on the item, it should be equally clear that subsistence production is price elastic as well. Given the high marketing and distribution costs interregionally, the price of an agricultural good in any region is a reflection of the demand for the good and its cost of

production. Let us assume that there is no interregional difference in tastes. Then an item's price will be a reflection of its cost of production. Interregional differences in production cost will be influenced by agronomic factors such as rainfall, soil type, altitude, as well as by factor costs (or factor proportions).

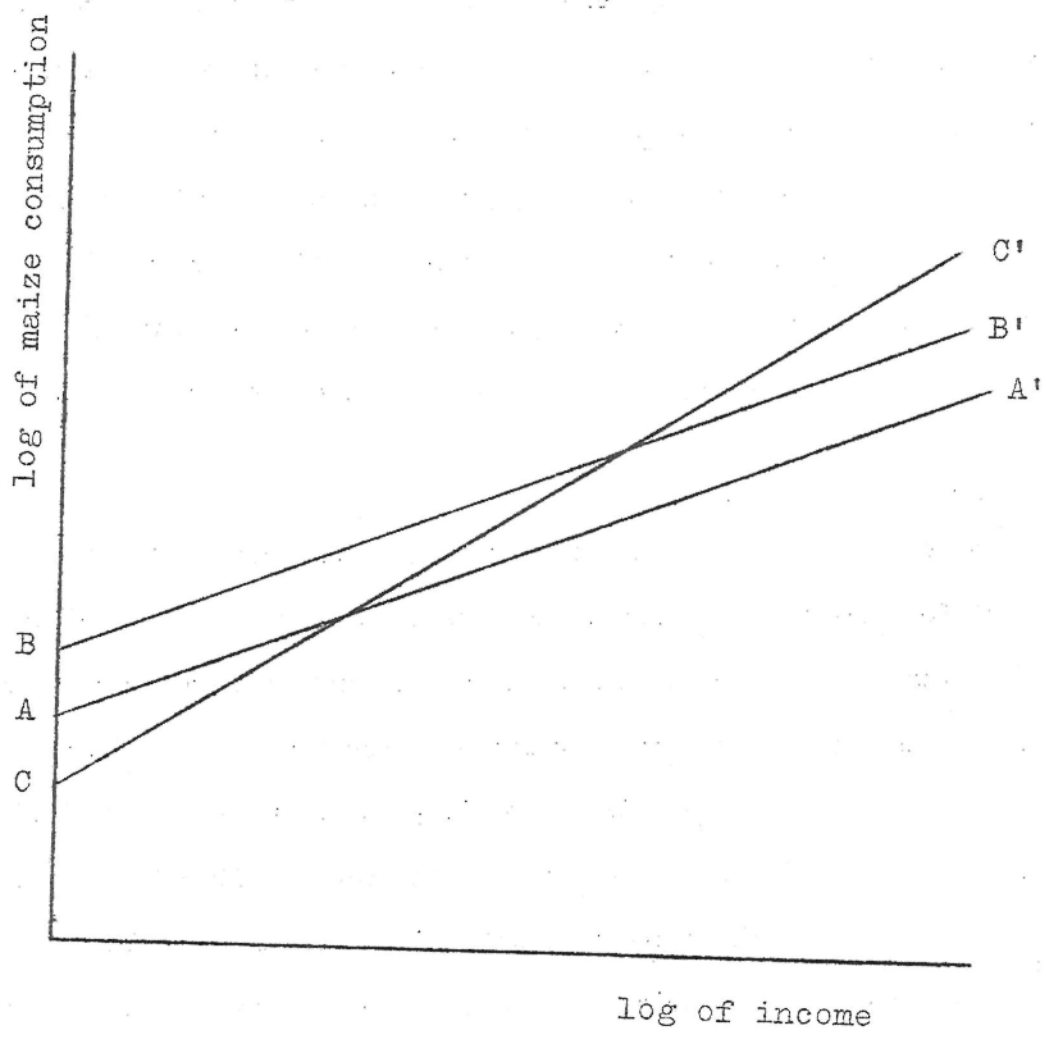
For example, assume that households are indifferent (at the margin) between rice and maize, that rice is cheaper to grow in area A and maize in area B, that incomes are the same in both areas, and that both areas are closed to trade in agricultural goods. Then households in A will consume more rice and those in B will consume more maize. This difference in consumption patterns will be due to the price difference.

In general, if the price of (say) maize is higher in area B than in area A, one would expect more maize to be consumed in A, all other factors equal. This would be true among households with high income as well as those with low income. Of course, other factors will not be equal, but there will nevertheless be a tendency for more maize to be consumed in the lower-price area B. If area B has not only a lower maize price than area A, but also a higher average income, the estimated income elasticity will be biased upward.

This can be seen in figure 1. Line AA' relates maize consumption in area A to income; and BB' is the corresponding line for area B. If one pools data from the two areas and estimates a single income elasticity, the result will be a line CC' which cuts across the other two lines. It can be seen that CC' has a higher slope than AA' or BB'. Of course, in general the estimated elasticity can be biased upward or downward.

Typically, in estimating income elasticities, the dependent variable is measured in value terms. This is the case in the present study. This modifies the argument above, which refers to quantity consumed, in physical terms, as a function of price. If the price falls, the value consumed may rise, fall, or remain unchanged, depending on the price elasticity. A bias will still be present unless the price elasticity is unity, but the magnitude of the bias will be smaller when consumption is measured in value than in quantity terms.

FIGURE 1



In addition to interregional differences in production costs, there may also be differences in tastes, adding a further source of bias. However, the people who live in the Central Province can be assumed to have reasonably uniform tastes from one district to another, so that differences in expenditure patterns are likely to be due primarily to price differences.

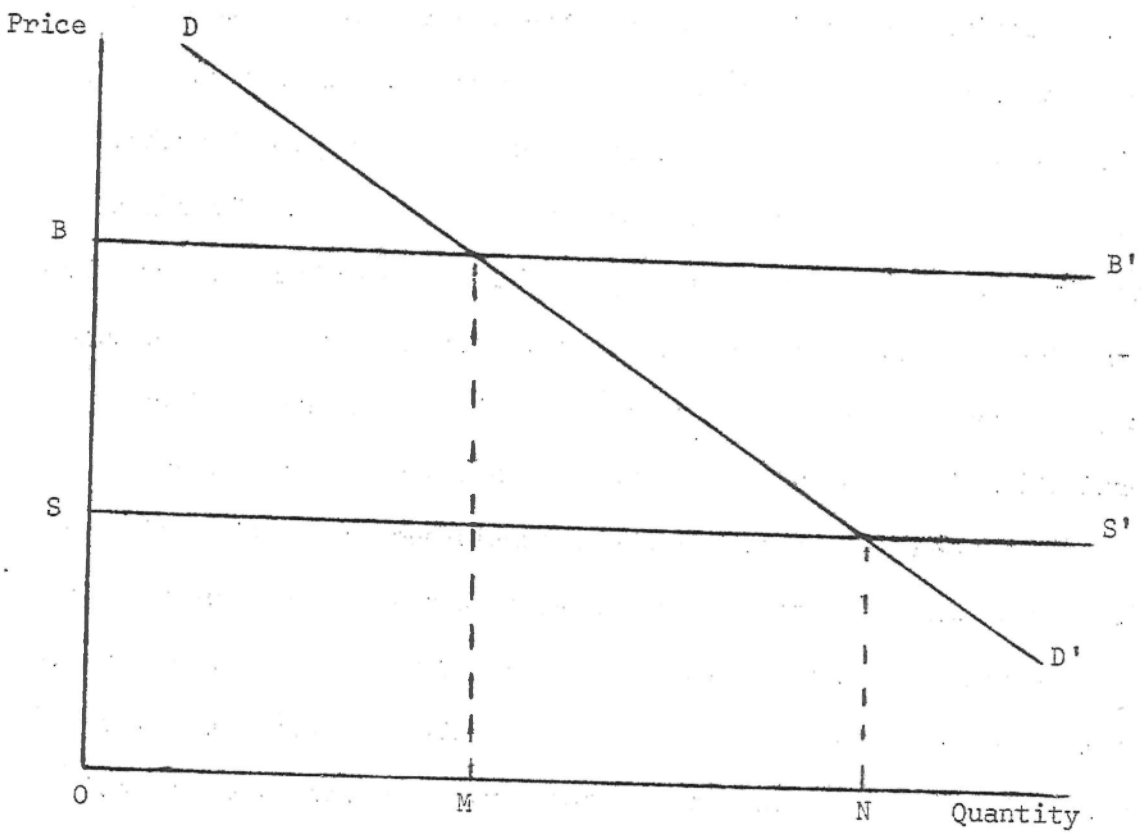
To eliminate price differences due to interregional differences, one can use dummy variables, one for each area. Assuming that the inter-district price differentials, where they exist, shift curves like AA' and BB' iso-elastically, the use of dummy variables will eliminate the bias. In the absence of further information, this assumption appears reasonable. For example, a double log expenditure relationship will be unchanged in slope if the price elasticity is independent of income.

Buying-Selling Price Spread.

As shown in Table 2, a substantial part of household income consists of food grown on the farm. Most households grow the major part of the food that they consume. A household's expenditure on a food item -- say, maize -- is hypothesized to be related to the household's income and to the price of maize (as well as possibly to other variables, such as education). The price of maize grown on the farm is taken to be the opportunity cost, i.e., the price at which this maize can be sold. In a frictionless world characterized by perfect markets, the amount of maize grown on the farm would not influence maize consumption. But in a less developed country, like Kenya, where markets are imperfect and are characterized by considerable friction, this is not the case. The price a farm can get for its maize is likely to be less than what it would have to pay to buy maize, because of transport and other frictional costs (including marketing restrictions).

Consider Figure 2. DD' is the household's demand curve for maize, SS' is the selling price, and BB' the buying price. Regardless of how much is produced on the farm, at least OM and no more than ON will be consumed. (These limits depend on the household's income.) But between these two limits, the expenditure on maize will depend on the household's own production.

FIGURE 2



Consider two households with the same tastes, each growing only maize, and each planting the same number of acres. Due to a combination of stochastic factors (weather, timing, luck, etc.) one farm obtains higher yields than the other and consequently a larger maize output. It is likely that the farm growing more will also consume more. Specifically, this will be the case unless either both households produce more than ON or both produce less than OM. And because maize production is assumed to be the only source of income, the household with the larger maize output also has the higher income. The higher consumption of maize is due not only to the income difference, but also to the price effect of the higher output. Although this is an extreme case, it serves to illustrate a source of bias in estimating income elasticities from a sample of households in a developing country.

If income consists solely of subsistence production, then the price effect will tend to bias income elasticities of home-grown foods upward -- and accordingly other elasticities downward. However, if, as is the case here, subsistence output forms only the minor part of total income, the bias may go in either direction, depending on the relationship between subsistence and total income.

It does not matter whether one refers to quantity consumed or the value of consumption -- the effect will be the same. This is so because the same price is used to value each foodstuff grown in the area.

If differences in crop output could be attributed to random forces only, then it would be possible to estimate price and income elasticities separately. However the problem is complicated by the fact that production decisions -- how many acres to plant to beans rather than to maize or potatoes -- are influenced by tastes.

Probably the best solution is, for each food item, to divide the sample into three groups: (1) net sellers of the item; (2) net buyers; (3) others. Groups (1) and (2) can then be pooled, using a dummy variable to distinguish between them, and an unbiased estimate of the elasticity obtained. However, we do not have the detailed production information required for this procedure.

An alternative, that is used here, is to introduce a variable relating to source of income -- specifically, the proportion of total income derived from operation of the farm. As we saw in Table 2, 34 percent of net income is derived from agriculture, the balance coming from nonfarm sources. This proportion of course varies greatly from one household to another. One might hypothesize that nonfarm and farm income will tend to be spent differently, and that a larger proportion of farm income will tend to be spent on food items grown on the farm. If so, then inclusion of this ratio as a separate explanatory variable may eliminate or reduce the bias due to the spread between the buying and selling price.

One could of course use net or gross agricultural production as the additional explanatory variable, but this is likely to be highly multicollinear with total income. Accordingly we used the ratio of gross agricultural product to gross income. Gross figures were used rather than net because we believe the data on business expenses to be unreliable, as explained above.

Acreage.

Acreage may be an important variable in explaining the pattern of food expenditure, particularly with respect to the subsistence component of expenditure. For example, a household operating a larger farm is likely to consume more of items that are land-intensive in production. It is also likely to consume relatively more out of subsistence. Thus acreage may serve the same role as the source of income variable, discussed above. In addition to this effect, acreage may serve as a "wealth" variable.

The Model.

The most frequently used model in estimating expenditure elasticities, and the one to be used here, is the double log, written,

$$\log(E_{ij}) = a_{1i} + a_{2i}\log(E_j) + a_{3i}\log(N_j) + u_{ij} \qquad (1)$$

where E_{ij} = expenditure on item i by household j, E_j = total household expenditure, the a_{ki} are parameters to be estimated, and u_{ij} = a disturbance term. Other regressors can be added to equation (1), individually or in combination. The regressors considered in this study are: the four district dummy variables: D_1, D_2, D_3, D_4; the education dummy variable: S; log(T), where T = acreage; and A = the proportion of income originating in agriculture.

Equation (1) has the advantage of simplicity. The parameters a_2 and a_3 denote respectively the total expenditure and household size elasticities. The model also is usually found to satisfy the homoscedasticity assumption underlying the use of least squares estimators (or, as in the present case, instrumental variable estimators).

Some disadvantages, however, are that (1) the model assumes that the elasticities are constants, i.e., that they are not functions of total expenditure or of household size. (2) Some positive amount is assumed to be spent on each item, regardless of how low the level of income. This raises problems (discussed below) if there are zero observations on any variable. (3) The additivity criterion is not satisfied, so that the weighted sum of the estimated expenditure elasticities need not equal unity.

Sometimes the variables E_i and E are expressed on a <u>per capita</u> or per adult equivalent basis, and the household size regressor, log(N), is deleted from (1). However, it appears best not to deflate by household size, for two reasons. First, the model is less restrictive if household size is included in (1) as a separate explanatory variable; deflation by household size assumes that $a_1 + a_2 = 1$. Second, deflating by household size may introduce spurious correlation. Whether or not this is the case depends on the distributions of the variables E_i, E, and N; but the likelihood of spurious correlation is sufficiently great to make deflation not worth the risk.[3]

Estimation.

We have already noted that the method of instrumental variables will yield consistent estimates of the parameters in equation (1). If income is used as the instrumental variable, the resulting estimators are known to be relatively efficient (that is, they have relatively small standard errors).[4]

We can write the model in general terms, using matrix notation

$$Y_i = B_i X + u_i \qquad (2)$$

where Y_i is the vector of observations on the i^{th} regressand. X is the matrix of observations on the set of regressors, B_i is the vector of coefficients, and u_i the vector of disturbance terms.

If we define a matrix Z which is equal to X with the column of observations on total expenditure replaced by a column of observations on income, the instrumental variable, then consistent estimates of the B_i vector are given by

$$b_i = (Z'X)^{-1}Z'Y_i \qquad (3)$$

A special case of instrumental variables is the method of grouping the observations by an instrumental variable. Grouping provides estimators that are less efficient, but it is obviously computationally easier and less expensive to proceed in this way. Moreover, in the present study, grouping the data was made essential by the fact that there are a large number of zero observations on many of the variables. If the original observations were used, the zero values would have to be replaced by small positive constants, a not altogether satisfactory procedure. The choice of constant would affect the estimate of the elasticity, and this choice would be purely arbitrary. Thus it was decided to group the data.

The data were grouped according to gross income which, as we have noted, is probably recorded more accurately than net or disposable income. Sample size was reduced from 1080 to 836, after deleting suspicious and inconsistent observations. The 836 observations were then divided into 38 groups of 22 households each. The 38 groups were used as input for the regression analysis.

Empirical Results.

Table 6 presents the results for the set of regressions in which total expenditure and household size are the only two independent variables. A single and double asterisk denote, respectively, significance at the .05 and .01 level. It is noteworthy that the determination coefficients are all significant at the .01 level, using an F-test: they range in value from .826 (housing) to .993 (total food). Thus in all cases the two independent variables explain more than 80 percent of the total variance in the regressand.

The expenditure elasticities are also all significant at the .01 level, using a two-tail t-test. Turning first to the foods, pulses and cereals have the lowest elasticities: .341 and .378 respectively. Meat (1.354), sugar (1.237), and fats/oils (1.157) are relatively income elastic, and can be regarded as luxuries for this income range. The other food items occupy a more intermediate position.

With respect to the nonfood items, durables have the highest elasticity (2.594), followed by housing (1.853), tobacco/beverages (1.373), and transportation (1.368). These are all luxuries. Among the nonfood items, education/recreation is the least income elastic (.895). As we noted above, this consists mainly of school fees, and it is not surprising to find this as a relatively income inelastic form of expenditure. In general, the figures present no surprises.

The household size figures are considerably less relaable, with only 3 of the 18 estimates significant at the .01 level, and an additional 2 at the .05 level. The results suggest that larger families consume relatively more milk, pulses, and cereals, and relatively less sugar, meat, vegetables, and fats/oils. Only in the case of milk does the elasticity exceed unity; the high elasticity for milk (2.169) is hard to explain.

TABLE 6: Estimated Elasticities: Set 1

	Total expenditure		Household size		R^2
Cereals	.378	(.063)	.494**	(.155)	.954
Pulses	.341	(.115)	.762*	(.284)	.885
Roots	.808	(.160)	-.001	(.395)	.863
Sugar	1.237	(.114)	-.464	(.282)	.955
Vegetables and fruits	.756	(.134)	-.281	(.331)	.853
Milk and products	.895	(.290)	2.169**	(.715)	.900
Meat and eggs	1.354	(.101)	-.315	(.248)	.974
Fats and oils	1.157	(.105)	-.214	(.259)	.963
Total Food	.829	(.036)	.109	(.088)	.993
Tobacco and beverages	1.373	(.119)	-.757*	(.293)	.954
Fuel	1.003	(.193)	.526	(.476)	.906
Soap	1.108	(.098)	-.147)	(.241)	.966
Clothing	.993	(.068)	.133	(.167)	.983
Furniture	.932	(.182)	-.082	(.449)	.858
Durables	2.594	(.333)	-2.464**	(.822)	.864
Housing	1.853	(.474)	.564	(1.170)	.826
School fees	.895	(.296)	1.378	(.729)	.854
Transportation and services	1.368	(.160)	-.168	(.395)	.943
	(all significant at .01 level)		(all significant at .01 level)		

Larger families naturally tend to spend more on education/recreation, as well as on fuel/light, but they spend less on tobacco/beverages and on durables. These last two are luxury items, and the results suggest that the demands of a larger family must compete with the demand for these luxury goods.

Next, in addition to total expenditure and household size, acreage was included as an explanatory variable. Only 3 of the acreage coefficients were significant: vegetables, meat, and fats/oils. The results appear in Table 7.

Nearly all of the acreage coefficients are negative, including the three significant ones. The only positive coefficients are those for housing, transport, durables, and cereals. However the insignificance of the majority of the coefficients prevents us from attaching too much attention to these results.

The inclusion of acreage has only a small effect on the determination coefficients, and on the significance of the other two explanatory variables. Moreover, the values of the other coefficients (particularly those that are significant) are little affected by adding acreage to the regressions. The results suggest that acreage is not an important explanatory variable.

The next variable to be tried was the percentage of income originating in agriculture. These results are presented in Table 8. The income ratio was significant in 4 cases. With respect to transport, the results suggest that households deriving a larger part of their income from the farm spend less on transportation. This is to be expected. Wage earnings constitute a major source of nonfarm income; and a wage earner is likely to incur some expense travelling to his place of employment. The other three significant coefficients, all positive, were for total food, pulses, and vegetables. On balance, the coefficients tend to be positive for foods and negative for other items. The results suggest that a household that derives the bulk of its income from the farm is likely, as one might expect, to devote a larger proportion of its total expenditure to food items.

TABLE 7: Estimated Elasticities: Set 2

	Total expenditure		Household Size		Acreage		R^2
Cereals	.371	(.065)	.462*	(.171)	.032	(.069)	.954
Pulses	.343	(.120)	.768*	(.314)	-.007	(.127)	.885
Roots	.874	(.160)	.289	(.418)	-.295	(.169)	.874
Sugar	1.294	(.112)	-.213	(.292)	-.256	(.118)	.961
Vegetables and fruits	.837	(.128)	.070	(.333)	-.357*	(.135)	.878
Milk and products	.909	(.303)	2.229*	(.790)	-.061	(.320)	.900
Meat and eggs	1.406	(.098)	-.087	(.256)	-.232*	(.104	.977
Fats and oils	1.211	(.103)	.020	(.268)	-.238*	(.108)	.968
Total Food	.841	(.037)	.157	(.095)	-.049	(.039)	.994
Tobacco and beverages	1.420	(.119)	-.552	(.312)	-.208	(.126)	.953
Fuel	1.065	(.197)	.800	(.513)	-.278	(.208)	.911
Soap	1.140	(.100)	-.006	(.260)	-.143	(.105)	.968
Clothing	1.010	(.070)	.206	(.182)	-.074	(.074)	.984
Furniture	.946	(.190)	-.019	(.496)	-.064	(.201)	.859
Durables	2.579	(.348)	-2.530*	(.908)	.067	(.367)	.865
Housing	1.763	(.491)	.170	(1.282)	.401	(.519)	.829
School fees	.960	(.305)	1.664*	(.797)	-.291	(.322)	.857
Transportation and services	1.341	(.166)	-.287	(.434)	.120	(.175)	.944
	(all significant at .01 level)						(all significant at .01 level)

TABLE 8: Estimated Elasticities: Set 3

	Total expenditure	Household size	Proportion of Income from Agriculture	R^2
Cereals	.371 (.069)	.497 (.157)	-.090 (.323)	.954
Pulses	.453 (.118)	.721 (.267)	1.314* (.548)	.902
Roots	.899 (.173)	-.034 (.391)	1.068 (.805)	.870
Sugar	1.265 (.126)	-.474 (.285)	.333 (.587)	.956
Vegetables and fruits	.876 (.139)	-.325 (.316)	1.398* (.649)	.871
Milk and products	.750 (.315)	2.222 (.713)	-1.701 (1.466)	.904
Meat and eggs	1.359 (.111)	-.317 (.252)	.067 (.518)	.974
Fats and oils	1.101 (.114)	-.194 (.257)	-.663 (.529)	.965
Total Food	.878 (.034)	.091 (.076)	.572* (.156)	.995
Tobacco and beverages	1.363 (.131)	-.753* (.298)	-.128 (.612)	.954
Fuel	.855 (.204)	.580 (.462)	-1.728 (.950)	.915
Soap	1.080 (.108)	-.136 (.244)	-.326 (.501)	.967
Clothing	.958 (.073)	.147 (.166)	-.424 (.342)	.984
Furniture	.927 (.202)	-.081 (.457)	-.052 (.939)	.858
Durables	2.625 (.368)	-2.475* (.835)	.356 (1.176)	.865
Housing	1.708 (.521)	.617 (1.181)	-1.697 (2.427)	.828
School fees	.727 (.319)	1.439* (.723)	-1.965 (1.485)	.861
Transportation and services	1.138 (.147)	-.085 (.332)	-2.698* (.683)	.961
	(all significant at .01 level)			(all sig. at .01 level)

Expenditure elasticities net of household size and income source were again all significant. And the values of these elasticities were not greatly affected by the inclusion of the additional variable. On balance, inclusion of income source in the regressions tends to raise the expenditure elasticities for the food items and to lower the expenditure elasticities for nonfood items. This suggests that failure to include income source as an independent variable will bias the expenditure elasticities downward for foods and upward for other items; however the effect is not pronounced. It should be noted that the ratio of farm to total income is negatively correlated with total expenditure, with a simple correlation coefficient of -.740.

The next variable to be tried was education of the head of household. The results, shown in Table 9, reveal that education is significant in 7 regressions. Of some interest, households headed by educated persons appear to consume less food as a whole and less of each individual food item. The coefficients are significantly negative in the case of total food, roots, sugar, vegetables.

Surprisingly, educated people tend to spend less on education. This may be due to the large interdistrict differences in expenditure on education, discussed below. They tend to spend more on durables and furniture (both significant) and on tobacco/beverages, clothing, housing, and transportation. One can generalize by saying that households whose heads are better educated spend a smaller proportion of their income on food and a larger proportion on nonfood items, particularly durables.

The household size coefficients are not greatly different with education included in the regressions; household size is significant in six regressions.

Total expenditure is again significant in all regressions. Most of the coefficients are little affected by the inclusion of education. However, roots/tubers and education have higher elasticities when taken net of education, because of the tendency for educated people to consume less of these items. Furniture and durables, both consumed more by educated people, have lower total expenditure elasticities when taken net of education. Thus part of what appears as an income effect when education is left out of the regression is in fact due to the effect of education.

TABLE 9: Estimated Elasticities: Set 4

	Total expenditure	Household size	Education of Head of Household	R^2
Cereals	.379 (.075)	.494* (.158)	-.002 (.186)	.953
Pulses	.369 (.137)	.747* (.290)	-.131 (.340)	.886
Roots	1.100 (.167)	-.154 (.352)	-1.361* (.413)	.896
Sugar	1.378 (.129)	-.538* (.272)	-.658* (.319)	.960
Vegetables and fruits	.977 (.144)	-.397 (.304)	-1.026* (.357)	.882
Milk and products	.990 (.346)	2.120* (.729)	-.443 (.856)	.901
Meat and eggs	1.448 (.117)	-.365 (.246)	-.440 (.288)	.976
Fats and oils	1.252 (.122)	-.264 (.257)	-.439 (.302)	.965
Total Food	.886 (.039)	.079 (.082)	-.262* (.096)	.994
Tobacco and beverages	1.270 (.138)	-.702* (.291)	.484 (.342)	.957
Fuel	.957 (.231)	.550 (.487)	.213 (.571)	.907
Soap	1.110 (.117)	-.148 (.247)	-.012 (.290)	.966
Clothing	.931 (.079)	.166 (.166)	.294 (.195)	.984
Furniture	.668 (.201)	.055 (.424)	1.225* (.498)	.880
Durables	2.007 (.352)	-2.157* (.741)	2.730* (.869)	.895
Housing	1.603 (.563)	.695 (1.185)	1.163 (1.341)	.829
School fees	1.263 (.334)	1.185 (.703)	-1.713* (.825)	.870
Transportation and services	1.316 (.191)	-.141 (.402)	.244 (.472)	.943
	(all significant at .01 level)			(all sig. at .01 level)

District Variables.

The results thus far have taken no account of possible inter-district differences in expenditure patterns. There may be little reason to expect differences in expenditure on most nonfood items but, as noted above, there is good reason to expect differences in expenditure on food-stuffs.

Five dummy variables were defined - one for each district. One of these dummy variables -- Meru -- was subsequently deleted, to avoid a singular moments matrix. A set of regressions was run with the remaining four district variables, plus total expenditure and household size; the results appear in Table 10.

For each regression in the set, we tested whether the district classification as a whole (the inclusion of the four additional variables) makes a significant contribution to explaining the variance of the regressand. An F test was used. The district classification was significant for only one nonfood item -- school fees -- but for several of the foods: cereals, roots, sugar, milk, and total food. Two of these (roots and sugar) were significant at the .01 level.

All of the expenditure elasticities shown in Table 10 are significant. The elasticities are in some cases altered considerably by the inclusion of the district variables. The elasticities in Table 10 are in effect covariance (within-district) elasticities, whereas the sets of elasticities presented earlier are regression elasticities that combine within-district and between-district effects. When the district classification is not statistically significant, the regression elasticities are preferable. However, when the district classification is significant, the covariance elasticities are more meaningful.

With the district variables included, the expenditure elasticities are higher for cereals, pulses, and milk and are lower for roots, sugar, vegetables, and meat. These differences are easy to explain. For example, although roots have a low elasticity within any one district, they are consumed in large amount in Nyeri, a high-income district. Thus the expenditure elasticity appears higher when no account is taken of this

TABLE 10: Estimated Elasticities: Set 5

	Total Expenditure	Household Size
Cereals	.476** (.087)	.308 (.180)
Pulses	.542** (.163)	.557 (.337)
Roots	.583** (.182)	-.186 (.378)
Sugar	1.084** (.142)	-.546 (.294)
Vegetables	.555* (.203)	-.141 (.421)
Milk	1.153* (.401)	1.058 (.833)
Meat	1.061** (.141)	.040 (.293)
Total Food	.808** (.048)	.070 (.100)
Fats and Oils	1.046** (.154)	-.125 (.320)
Tobacco and Beverages	1.270** (.185)	-.465 (.384)
Fuel and Light	1.155** (.274)	.068 (.569)
Soap	1.001** (.150)	-.105 (.312)
Clothing	1.097** (.105)	.038 (.218)
Furniture	.969** (.281)	.051 (.583)
Durables	2.744** (.523)	-2.268*(1.085)
Housing	1.760* (.709)	.896 (1.471)
Education	.843* (.409)	.710 (.849)
Transportation and Services	1.303** (.252)	-.157 (.522)

Kiambu	Fort Hall	Embu	Nyeri	R^2
.017 (.010)	.025 (.010)	.020 (.010)	-.004 (.010)	.366
-.050 (.019)	-.009 (.020)	.000 (.019)	-.005 (.018)	.912
.005 (.021)	.035 (.022)	-.023 (.021)	.092 (.020)	.932
.044 (.017)	.048 (.017)	.040 (.017)	.072 (.016)	.974
.008 (.024)	-.001 (.025)	-.015 (.024)	.036 (.023)	.871
-.004 (.047)	.090 (.049)	-.053 (.047)	.034 (.045)	.927
.040 (.017)	-.001 (.017)	.011 (.017)	.035 (.016)	.980
-.002 (.006)	.006 (.006)	.001 (.006)	.017 (.005)	.995
.044 (.018)	.022 (.019)	.029 (.018)	.020 (.017)	.969
.007 (.021)	-.020 (.022)	.007 (.022)	-.006 (.021)	.957
.058 (.032)	.068 (.033)	.030 (.032)	-.006 (.031)	.927
.010 (.018)	.002 (.018)	-.018 (.018)	.011 (.017)	.970
.007 (.012)	.002 (.013)	.007 (.012)	-.013 (.012)	.985
.032 (.033)	-.026 (.034)	.009 (.033)	-.002 (.031)	.871
.056 (.061)	-.055 (.063)	-.006 (.061)	-.050 (.058)	.872
.098 (.083)	.003 (.086)	.004 (.083)	-.091 (.079)	.850
.040 (.048)	.076 (.050)	-.061 (.048)	.041 (.046)	.892
.009 (.029)	.000 (.030)	-.025 (.029)	-.006 (.028)	.946 (all sig. at .01 level)

interdistrict difference in expenditure. Similarly, pulses are consumed in small quantity in Kiambu, another high-income district, tending to reduce the regression expenditure elasticity below the corresponding covariance elasticity.

When estimated net of total expenditure and the district variables, household size is significant in only one regression: durables, where it is highly negative. High intercorrelation between household size and the other explanatory variables increases the standard errors, accounting for the low degree of significance.

Table 11 shows in summary form the interdistrict differences in expenditure. It is important to bear in mind that these differences are net of differences in total expenditure and household size. Thus the plus entry for Meru under equipment does not indicate an absolutely higher level of expenditure in Meru, but a level of expenditure on equipment that is higher after allowing for differences in the other explanatory variables. In this case, the distinction is important, as total expenditure is well below average in Meru. A single or double asterisk in the final column of Table 11 indicates that the district classification is significant at the .05 and .01 levels respectively.

The table indicates that households in Nyeri tend to spend more on food. Specifically, expenditure is higher on sugar, vegetables, meat, and (especially) roots, but lower on cereals. The high level of food expenditure may be in part a reflection of the larger proportion of income in Nyeri that derives from agriculture, coupled with the relative remoteness of markets, as compared with Kiambu and Fort Hall. The low expenditure on cereals probably reflects the fact that cereals do not grow especially well in the damp Nyeri climate, whereas roots do grow well, thus causing some shift in expenditure from the former to the latter.

Kiambu tends to spend more on cereals, meat, and fats, and less on pulses. Fats are of course entirely purchased in the market. The greater expenditure in Kiambu may reflect both the greater proximity to markets (and notably, Nairobi) and the larger proportion of nonfarm income --

TABLE 11: Interdistrict Differences in Expenditure, Net of Total Expenditure and Household Size

	Kiambu	Fort Hall	Embu	Nyeri	Meru	Significance of District Classification
Cereals	+	+	+	-	-	*
Pulses	-					
Roots		+	-	++		**
Sugar				+	-	**
Vegetables				+		
Milk		+	-			*
Meat	+			+		
Fats	+				-	
Total Food				+		*
Fuel	+	+		-	-	
Equipment					+	
Housing	+			-		
School Fees	+	++	--	+	-	*

notably wage income. The greater expenditure on cereals may be due to either or both of two factors. First, cereals grow well in Kiambu. Second, one might expect a larger proportion of cereals expenditure in Kiambu to be flour purchased in the market at a relatively high price. Thus in part this higher level of expenditure probably represents a quality effect.

Fort Hall tends to spend more on cereals, roots, and milk. The explanation for the above-average cereals expenditure may be similar to that for Kiambu. The higher milk expenditure has no obvious explanation.

Turning to the nonfood items, education is the only one for which the inter-district differences are significant. The high expenditure in Fort Hall, which has a lower income than Kiambu and Nyeri, reflects the relative unimportance of income in explaining differences in expenditure on education. The low expenditure in Meru and (especially) Embu, even relative to the low average income of these areas, is due to the fact that these are relatively remote areas without a well developed school system. Thus there is not the opportunity for schooling that exists in the other three districts.

Housing is also of some interest, although the district effect is not statistically significant. The greater expenditure in Kiambu and lower expenditure in Nyeri, two districts with approximately the same income, is a result of the way housing expenditure is defined: only cash expenditure is included. One would guess that cash expenditure would form a larger part of total housing expenditure in Kiambu, because of the larger cash income there. In Nyeri, on the other hand, a larger proportion of the income is in the form of subsistence foods, and there is accordingly less scope for paying cash for housing materials and labor.

There is a similar problem of definition with respect to fuel. Our figures relate to purchased fuel (paraffin) only, and exclude imputed value of firewood collected. The larger expenditure in Kiambu and Fort Hall, relative to the other districts, reflects in part the greater difficulty of collecting firewood in the areas closer to Nairobi, as well as the greater ability to pay cash for fuel. Thus, quite apart from differences in income, there is a tendency to shift toward purchased fuel as one moves closer to Nairobi.

To sum up the results of this section, there are important differences in expenditure patterns from one district to another, quite apart from (or net of) differences in total expenditure and household size. Some of these differences can be explained in terms of the agricultural characteristics of the area or its proximity to markets (and to Nairobi in particular). Some of the differences appear to be due to differences in the proportion of income originating in agriculture -- perhaps subsistence agriculture, in particular. To separate the district effects from the source of income effects, we shall examine a set of estimates with both sets of variables included. This material will be included in the final version of this report, to be completed in the next few weeks. Also included in that report will be a discussion of the determinants of expenditure on individual components of some of the 18 expenditure groups considered here (e.g., maize, wheat, beer, and tobacco).

NOTES

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1. B. F. Massell and J. U. Heyer, "Household Expenditure in Nairobi: A Statistical Analysis of Consumer Behavior," Discussion Paper No. 48, Institute for Development Studies, Nairobi.

2. See below for explanation.

3. See A. Madansky [15].

4. See N. Liviatan [13].

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