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C.R. Frank Jr.
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AN ANALYSIS OF THE DEMAND FOR SUGAR IN EAST AFRICA

This EDRP paper is the basis for one of the chapters in a monograph dealing with some problems in the development of the sugar industry in East Africa. The purpose of this paper is to attempt to measure the effects of various variables on sugar consumption in East Africa and to project consumption to 1970 by an analysis of time series data.

The economic literature is filled with attempts to measure demand and supply elasticities using time series data for the more developed economies. To the author's knowledge no such attempt has been made using East African data. The analysis of sugar consumption in this paper illustrates the many problems which are likely to arise in an analysis of the consumption of any commodity in East Africa. The major problems occur because of the limited choice of different types of price indicies, the unreliablity of data, and the relatively short span of time for which any consistent time series are available. Two conspicuous constraints on many types of analysis are the lack of a consistent series for gross domestic product before 1954 and the lack of any series for disposable income for any of the East African countries.

The demand for sugar in East Africa is more amenable to statistical analysis than the demand for many other commodities in East Africa because of the existence of a fairly reliable series on consumption and because of the nature of the supply function. In East Africa the supply of sugar effectively has been perfectly elastic with respect to price. The governments have always stood ready to import sugar from outside of East Africa and sell it in the local market at the prevailing (fixed) internal price. Thus all changes in East African can be attributed to factors affecting the demand schedule for sugar consumption.[1]

The factors affecting the demand for sugar can be grouped into three categories: (1) per capita disposable incomes, (2) the retail price of sugar, and (3) miscellaneous factors which result in a rising time trend of sugar consumption. Despite the fact that data on these factors are sparse and cover only a relatively short period of time, it was felt that a useful attempt could be made to measure the strength and relative effects of the various factors affecting sugar consumption.

A. The Data and the Model.

The gross domestic product at factor cost for the three East African countries for the years 1954 - 1963 is shown in Table III. In order to arrive at disposable income we subtracted all direct taxes, import duties, and excise taxes from gross domestic product at factor cost. The justification for subtracting export and import duties is that these duties have their incidence directly upon the

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1. Technically, this means that the sugar demand schedule for East Africa is identifiable. See T.C. Koopmans, "Identification Problems in Economic Model Construction," Econometrica, Vol. 17 (1949), pp. 125-144.

TABLE III-1

Price and Income Data: East Africa.

Year	Gross Domestic Product[a] (£ mill.)	Disposable Income[b] (£ mill.)	Retail Price Index	Population ('000)	Disposable Income per Capita(£)		Retail Sugar Price	
					Deflated	Non-deflated	Deflated	Non-deflated
				UGANDA				
1954	128.73	119.71	139	5,749	14.98	20.82	37	52
1955	140.18	129.79	115	5,896	19.14	22.01	50	57
1956	141.58	131.11	113	6,046	19.19	21.69	45	51
1957	146.72	136.20	103	6,199	21.33	21.97	64	66
1958	146.39	134.67	103	6,356	19.80	21.19	56	60
1959	148.97	136.61	107	6,513	19.60	20.97	56	60
1960	152.12	139.12	98	6,677	21.26	20.84	61	60
1961	157.33	143.97	123	6,845	17.10	21.03	49	60
1962	156.71	142.97	98	7,016	20.79	20.23	64	63
1963	176.10*	158.12*	100	7,190	21.99	21.99	63	63
				KENYA				
1954	158.02	140.25	90	6,783	22.97	20.68	70.	58
1955	180.54	160.14	95	6,993	26.02	22.90	69	61
1956	193.15	171.42	97	7,209	26.43	23.78	62	56
1957	205.91	184.32	100	7,432	26.67	24.80	70	65
1958	208.10	185.52	100	7,652	26.11	24.24	62	58
1959	214.79	191.60	101	7,880	25.87	24.31	63	59
1960	225.51	203.06	103	8,115	26.34	25.02	62	59
1961	224.70	201.90	105	8,353	24.92	24.17	64	62
1962	244.09	219.10	108	8,595	25.49	25.49	65	65
1963	259.96*	233.73	108	8,847	26.42	26.42	65	65
				TANGANYIKA				
1954	141.65	129.17	114	8,304	16.20	15.56	57	55
1955	146.74	133.99	113	8,454	16.68	15.85	63	60
1956	152.42	141.55	111	8,605	17.69	16.45	70	65
1957	162.36	150.90	119	8,759	17,23	17.23	70	70
1958	167.09	155.28	125	8,916	16.59	17.42	64	67
1959	177.11	164.14	116	9,076	18.64	18.09	66	64
1960	186.22	172.46	127	9,237	17.45	18.67	56	60
1961	188.66	174.88	126	9,421	17.51	18.56	58	61
1962	203.28*	188.07*	127	9,607	18.30	19.58	60	64

a. Monetary and Non-monetary Gross Domestic Product at Factor Cost.

b. Obtained by subtracting direct taxes, import duties, and export duties from GDP. Since the fiscal year in all three East African countries runs from June to June, it was assumed that the amount collected during each of the calendar years spanned by a fiscal year was one half of that collected during the fiscal year.

* Provisional estimates

Sources:

(1) Retail price indicies from the Economic and Statistical Review (Quarterly), Table G.2

(2) Retail sugar prices for 1963 supplied by the East African Common Services Organization, The Treasury.

(3) Tanganyika estimates of Gross Domestic Product, export and import duties and direct taxes for 1961 and 1962 from Government of Tanganyika. Budget Survey 1963-1964, Dar-es-Salaam, 1963, pp. 3 and 20.

Sources (cont'd)

(4) Kenya estimates of Gross Domestic Product, export taxes, direct taxes, and import duties for 1962 and 1963 from Government of Kenya, Economic Survey 1964, Nairobi, 1964 pp. 5 and 50.

(5) Uganda estimates of Gross Domestic Product, export taxes, import duties and direct taxes for 1962 and 1963 from Uganda Government, Background to the Budget, 1964-65, Entebbe, 1964, pp. 1 and 40.

(6) All other data for Uganda from Uganda Government, Statistical Abstract (Annual), Tables UB2, UM9, UN2, and UC4.

(7) All other data for Kenya from Government of Kenya, Statistical Abstract (Annual), Tables 12, 124(a), 131(a), and 136.

(8) All other data for Tanganyika from Government of Tanganyika, Statistical Abstract (Annual), Tables C.2, P.1, P.17, Q.1, and R.2.

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consumer and thus theoretically must be regarded as having a similar effect on consumption patterns as direct taxes. In the case of import duties, it is generally true that the world supply of exports is in elastic supply with respect to the relatively small East African market while demand tends to be relatively inelastic with respect to price. With exports it seems reasonable to assume that the overall supply of exports is relatively inelastic with respect to price (although the supply of individual export commodities may not be so) and that demand is relatively elastic, the price of exports being set in most cases by the world market independently of East African supplies.

One should also subtract corporate savings and depreciation and net transfer payments by households from gross domestic product at factor cost in calculating disposable income. Unfortunately, however, no reliable data on the magnitude of these items exist, and they were not taken into account.

The disposable income estimate should be deflated by some sort of price index to arrive at an estimate of real disposable income. The only appropriate price indices which are available are:

(1) The cost of living index (excluding rent): Kampala,

(2) The index of retail prices in African markets: Kampala,

(3) The price index for gross domestic product at factor cost: Uganda,[2]

(4) The cost of living index (excluding rent): Nairobi,

(5) The wage earner's index of consumer prices (retail price index): Nairobi,

(6) The wage adjustment index: Nairobi,

(7) The cost of living index (excluding rent): Dar-es-Salaam,

and

(8) The retail price index of goods consumed by wage earners in Dar-es-Salaam.

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2. See Uganda Government, The Real Growth of the Economy of Uganda. 1954 - 1962, Entebbe, Government Printer, 1964, p. 46.

The disposable income estimates were not deflated by the cost of living indices ((1), (4), and (7) above) nor by the wage adjustment index ((6) above) - which is merely the Nairobi cost of living index with the effects of price increases on alcohol and tobacco removed - because much of the rise in these indices may be attributed to increased import duties and to a rise in the cost of services. Since the effects of import duties on disposable income is taken into account by subtracting duties from gross domestic product at factor cost, it would not be appropriate to further deflate income by this factor. The calculation of the cost of living indeces does not allow for changes in the quality of services although much of the rise in the cost of these services may be attributed to improvements in quality. For these reasons, the cost of living indices would tend to over-deflate disposable income. Another objection to the cost of living indices is that they are based largely on the expenditure patterns of middle income range European civil servants. The bulk of the income earned in Uganda and Tanganyika is earned by peasant farmers with very different expenditure behavior.

The Uganda price index for gross domestic product at factor cost would be inappropriate since it is heavily weighted to show the changes in export prices. In view of these difficulties with the various other price indices, we elected to use the retail price indices in Kampala, Nairobi, and Dar-es-Salaam for the respective countries of Uganda, Kenya and Tanganyika. These indices, shown in Table III-1, are heavily weighted in favor of locally produced food crops. One of the disadvantages of these indices is that they measure urban retail price fluctuations which may not reflect rural price changes. In view of these difficulties, we decided to calculate estimates of both deflated and non-deflated per capita disposable incomes. These are also shown in Table III-1.

TABLE III-2

Sugar Excise Duty: Uganda.

(Sugar excise duties have been the same in Kenya and Tanganyika as those in Uganda except for very brief periods)

From	To	Duty per Cwt. (112 pounds)	Duty per pound
1946	April, 1954	Shs. 2/24	Shs. /02
April, 1954	May, 1957	5/60	/05
May, 1957	Jan. 1958	16/80	/15
Jan. 1958	May, 1958	15/14	/13.5
May, 1958	May, 1961	8/96	/08
May, 1961	July, 1962	12/23	/11
July, 1962	June, 1963	15/86	/14.2
June, 1963	-	17/92	/16

Sources: Laws of Uganda - 1953, Ordinance No.18;
1954, Ordinance 9; 1957, Ordinance No.12;
1958, Ordinance Nos. 10 and 25; 1961, Ordinance No.10;
1962, Ordinance No ; 1963, Act No. 40.

The retail prices of sugar in the urban centers, Kampala, Nairobi, and Dar-es-Salaam, of the three East African countries shown in Table III-1 indicate a similar pattern of change. This has been most due to similar changes in the excise duty on sugar (See Table III-2). Retail prices in rural areas differ from those in the urban centers by an amount depending on the distance from the nearest sugar factory or, in the case of Kenya, depending on the distance from the nearest railhead, but increases and decreases in rural retail prices correspond in magnitude to those of urban prices. Economic theory tells us that the demand for a commodity is not dependent so much on the absolute price but rather the price of that commodity relative to the prices of all other commodities which compete for the consumer's purchases. Accordingly, the price of sugar was deflated by the retail price indices (See Table III-1).

The miscellaneous factors other than prices and income which affect the demand for sugar are difficult to measure. They include improvements in transportation and distribution facilities, changing habits, and increased knowledge. It was assumed that these factors would evidence themselves in a general overall rising trend of sugar consumption apart from changes in price and income. Accordingly, the basic equation used to determine the demand for sugar consumption was

$$x = a_1 + a_2 \cdot z_2 + a_3 \cdot z_3 + a_4 \cdot z_4$$

where

x is a measure of per capita sugar consumption

z_2 is the natural logarithm of the per capita deflated disposable income

z_3 is the natural logarithm of the deflated retail price

z_4 is a time variable (1954: $z_4 = 0$; 1963: $z_4 = 9$)

Two different assumptions were tested: (1) that the price and income elasticities of demand for sugar decrease with increasing levels of per capita sugar consumption and the increasing trend in sugar consumption due to miscellaneous factors results in a constant absolute increase in per capita sugar consumption per unit of time, and (2) that the price and income elasticities of demand are constant and the trend factors result in a constant percentage increase in sugar consumption per unit of time. These two assumptions are equivalent to (1) x is per capita sugar consumption, and (2) x is the natural logarithm of per capita sugar consumption, respectively.[3]

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3. Let

y = per capita sugar consumption

w_2 = " " deflated disposable income

w_3 = deflated retail price of sugar

Then the demand equation may be written

(a) $$y = a_1 + a_2 \text{Log } w_2 + a_3 \text{Log } w_3 + a_4 z_4$$

under assumption (1), above, and

(b) $$\text{Log } y = a_1 + a_2 \text{Log } w_2 + a_3 \text{Log } w_3 + a_4 z_4$$

under asumption (2) above.

Footnote cont'd.

Let $\delta y/\delta w_2$, $\delta y/\delta w_3$, and $\delta y/\delta z_4$ represent partial derivatives.

From equation (a) one obtains the following:

$$\text{Income Elasticity} = \frac{\delta y}{\delta w_2} \cdot \frac{w_2}{y} = \frac{a_2}{y}$$

$$\text{Price Elasticity} = \frac{-\delta y}{\delta w_3} \cdot \frac{w_3}{y} = \frac{-a_3}{y}$$

$$\text{Rate of increase of per capita sugar consumption per unit of time} = \frac{\delta y}{\delta z_4} = a_4$$

From equation (b) one obtains the following:

$$\text{Income Elasticity} = \frac{\delta y}{\delta w_2} \cdot \frac{w_2}{y} = a_2$$

$$\text{Price Elasticity} = \frac{-\delta y}{\delta w_3} \cdot \frac{w_3}{y} = -a_3$$

$$\text{Percentage rate of increase of per capita sugar consumption per unit of time} = \frac{\delta y}{\delta z_4} \cdot \frac{1}{y} = a_4$$

The demand equation was fitted using conventional least squares regression techniques for each country under both of the above assumptions. Ten observations were available in the case of Uganda and Kenya. Only nine observations were available in the case of Tanganyika since the 1963 sugar consumption in Tanganyika, which was abnormally low because of serious disruptions in the distribution system,[1] was excluded. The results of these regressions are outlined in Table III-3

The price and income elasticities in every case are quite low.

4. The new Kilombero factory in Tanganyika unexpectedly found it necessary to shut down in February of 1963 due to lack of supplies of ripe cane. The Tanganyika government, caught off guard, attempted to make up the deficit by importation through its co-operative marketing organization Cosata. There were substantial delays in delivery until June. In the meantime, reserve stocks were depleted and many consumers, especially in southern Tanganyika went without sugar for long periods of time.

Table III - 3

Demand for Sugar: East Africa

Regression Results I

(If a regression coefficients are significant at the 5 per cent level or at the 1 per cent level,* then the level of significance is indicated in parenthesis)

Dependent Variable

x = per capita sugar consumption
(falling price and income elasticities)

	a_1	a_2	a_3	a_4	1962 Income Elasticity $= a_2/x$	1962 Price Elasticity $= -a_3/x$	Coefficient of Determination R^2	Correlation Coefficient R
Uganda	27.8 (.01)	2.1	-3.6	.36	.10	.17	.52	.74
Kenya	29.6	4.5	-6.5	.96 (.01)	.18	.25	.95	.97
Tanganyika	1.7	4.9	-1.5	.46 (.01)	.36	.11	.95	.97

Dependent Variable

x = natural logarithm of per capita sugar constumption
(constant price and income elasticities)

	a_1	Income Elasticity a_2	Price Elasticity $-a_3$	Annual Percentage Increase $a_4 \times 100$	Coefficient of Determination R^2	Correlation Coefficient R
Uganda	3.3	.14	.18	.1.6	.51	.71
Kenya	.27	.70	.07	4.7 (.01)	.95	.97
Tanganyika	1.9 (.05)	.19	.05	4.4 (.01)	.94	.96

* Significance was tested using the t - test. See A. Mood, Introduction to the Theory of Statistics, New York, McGraw Hill, 1950, pp. 296 and 304.

In fact the only independent variable which has a significant regression coefficient is the time variable in the case of Kenya and Tanganyika. The trend factors affecting consumption are highly significant while the effects of retail price and income are relatively weak and cannot be said to have a significant influence on the demand for sugar at least on the basis of the limited amount of information at our disposal.

The best fits are obtained in the case of Kenya and Tanganyika when constant income and price elasticities are assumed In these cases, the fit is quite good with the coefficient of determination close to unity. This is mainly due to the good correlation between per capita sugar consumption and time. In the case of Uganda, the fit is not nearly so good under either of the two alternative assumptions. About 70 per cent of the variation in per capita sugar consumption can be explained in terms of the variation in retail price, per capita incomes and trend factors for Uganda while over 95 per cent of the variation can be explained in the case of Kenya and Tanganyika under both assumption

In order to test whether of regression coefficients were biased and whether the t-tests of significance were invalid because of serial correlation, we used the von-Neuman ratio to test for serial correlation.[1] The results were negative in all cases. Thus serial correlation cannot be regarded as a serious problem.

Our conclusions regarding the high signficance of time trend factors and the low signficance of price and income factors collinearity among the independent variables. For example, if there were a rising time trend to per capita disposable income, then it would be impossible to seperate out statistically the effects of per capita disposable income and time. A high regression coefficient for the time variable may in fact be due to rising per capita incomes over time rather than due to the trend factors. It would be invalid to test whether either the time variable or income variable coefficients were significant. The only valid procedure would be to test whether time and income together were significant.

As a partial test of multicollinearity, we computed the correlation coefficients for all possible combinations of the independent variables. We also tested to see whether non-deflated per capita disposable income, if substituted for deflated per capita disposable income, would result in multicollinearity.

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1. The von Neuman ratio is $N.\Sigma(\Delta u_t)^2/(N-1)\,u_t^2$, where u_t is the deviation of observation t from, the regression lire. The value of the ratio is $2N/(N-1)$ if there is no serial correlation in the residuals. The distribution of the von-Neuman ratio depends on the value of N. Tables may be found in B.I. Hart, "Significance Levels for the Ratio of the Mean Square Successive Difference to the Variance," Annals of Mathimatical Statistics, Vol.13 (1942), p.446, and are reprinted in R. Ferber and P.J. Verdoorn, Research Methods in Economics and Business, New York, the Macmillan Company, 1962, Appendix, Table A5, P.556

The results, shown in Table III - 4 indicate that significant multi-collinearity exists only with respect to retail price and deflated per capita disposable income in the case of Uganda and with respect to non-deflated disposable income and time in the case of Kenya and Tanganyika.

Table III - 4

Demand for Sugar: East Africa

Correlations between the Independent Variables

(If correlations are significant * at the 5 per cent level or the 1 per cent level, the level is indicated in parenthesis)

Variables Correlated	Correlation Coefficient	Uganda	Kenya	Tanganyika
Log deflated per capita disposable income and log deflated retail price	$r_{z_2 z_3}$	.92 (.01)	-.13	.35
Log deflated per capita disposable income and time	$r_{z_2 z_4}$	.0005	.0003	.0005
Log deflated retail price and time	$r_{z_3 z_4}$	.0007	-.30	-.003
Log non-deflated per capita disposable income and log deflated retail price	$r_{z_2' z_3}$	.04	-.24	-.22
Log non-deflated per capita disposable income and time	$r_{z_2' z_4}$	-.27	.85 (.01)	.96 (.01)

* For test of significance correlation coefficient r was transformed to the normal variate $Z = \frac{1}{2} \log_e (1+r)/(1-r)$ with $\sigma = 1/\sqrt{N-3}$.

Since the correlation coefficients between per capita deflated disposable income and deflated retail price are relatively high and, in the case of Uganda, significantly different from zero, it would seem advisable also to run regression with deflated retail price or per capita deflated disposable income excluded from the demand equation. In eliminating the retail price from the equation, we ran two sets of regressions, one where the per capita disposable income was deflated and one where it was not deflated to see which gave a better fit[5]. The resulting regression coefficients are contained in Table III-5. A comparison of the coefficients of determnation in Table III-5 with those in Table VII indicates that in eliminating retail price, the amount of variation in per capita sugar consumption explained by income and time is in every case nearly equal to that explained by income, time, and retail price. A similar statement may be made concerning the effects of eliminating the income variable from the demand equation. The coefficients of determination in Table III-5 indicate that the fits for Uganda are relatively poor compared to the very good fits obtained in the case of Kenya and Tanganyika. The fits obtained by using non-deflated per capita disposable income are slightly better for Uganda and Tanganyika and as good or worse for Kenya. Because of the better fits for Uganda using non-deflated disposable income at least one of the varibles is significant, the time variable, while in all other regressions for Uganda, none of the variables are significant. Again the effects of retail price and per capita disposable incomes are not significant in every one of the attempted regressions. Serial correlation is a problem only in the case of Tanganyika where x = (log of per capita sugar consumption.)

C. Interpetation of the Elasticities

Little confidence can be placed in the actual numerical values of the estimates of price and income elasticities. In every case the estimates are so low that 95 per cent confidence limits placed about them would include negative elasticities. As it is highly unlikely that sugar is an inferior good in East Africa, there is no reason to expect negative income and price elasticities.

The price and income elasticities are subject to several sources of downward bias which may account in part for the conclusion that the price and income elasticities are not significantly different from zero. First the estimates are likely to suffer from downward bias due to errors in the independent variables. Least squares estimates are not biased only if all errors occur in the dependent variable.

Certainly, there are fairly significant errors in the estimates of per capita disposable income, one of the independent variables. The errors in deflated retail price are probably not as important but are likely to result in some downward bias in the estimates of price elasticity.

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5. The use of non-deflated per capita disposable income does not introduce any serious biases due to general inflationary movements. Fitting semi-log trend line to estimate the constant percentage rate of increase in the retail price index gives a rise of .4 percent per annum for Tanganyika, a rise of 1.5 per cent per annum for Kenya and a fall of 1.7 per cent per annum for Uganda between 1954 and 1963.

Table III - 5

Demand for Sugar: East Africa

Regression Results II

(If regression coefficients are significant at the 5 per cent level or the one per cent level, then the level is indicated in parenthesis. y is per capita sugar consumption and y' is the natural logarithm of y.)

	Dependent Variable	a_1	a_2	a_3	a_4	Coefficient of Determination R^2	Correlation Coefficient R	Test for Serial Correlation
Deflated Retail Price Excluded from Demand Equation Per Capita Disposable Income Deflated								
Uganda	y	26.4 (.05)	-2.1	x	.30	.49	.70	Neg.
	y'	3.208 (.01)	-0.07	x	.013	.47	.69	Neg.
Kenya	y	2.8	4.3	x	1.01 (.01)	.93	.96	Neg.
	y'	.59	.69	x	.05 (.01)	.94	.96	Neg.
Tanganyika	y	1.0	2.8	x	.49 (.01)	.94	.96	Neg.
	y'	1.449	.27	x	.044 (.01)	.94	.96	Pos. (.05)
Deflated Retail Price Excluded From Demand Equation Per Capita Disposable Income Not Deflated								
Uganda	y	-18.2	12.5	x	.284 (.05)	.55	.14	Neg.
	y'	1.340	.54	x	.013 (.05)	.54	.73	Neg.
Kenya	y	-11.9	9.3	x	.86 (.05)	.93	.96	Neg.
	y'	-.611	1.11	x	.029 (.01)	.94	.96	Neg.
Tanganyika	y	29.9	-7.6	x	.69 (.02)	.95	.97	Neg.
	y'	3.103	-.32	x	.054 (.05)	.95	.97	Neg.
Per Capita Disposable Income Excluded from Demand Equation								
Uganda	y	28.5	x	-2.2	.340	.51	.72	Neg.
	y'	3.322	x	-0.82	.015	.50	.71	Neg.
Kenya	y	45.7	x	-6.8	.982 (.01)	.95	.97	Neg.
	y'	2.586	x	.06	.050 (.01)	.91	.95	Neg.
Tanganyika	y	10.1	x	-.3	.511 (.01)	.94	.96	Neg.
	y'	2.064	x	.04	.046 (.01)	.94	.96	Neg.

Secondly, the nature of the retail price index may contribute to downward bias in the estimates of price and income elasticity. These indicies are subject to wide fluctuations due to temporary shortages of food in the major towns. There is reason to believe that fluctuations in prices in the rural areas are not nearly so great. If this is so, then per capita incomes and retail prices would be overdeflated when the retail price index is high and under-deflated when the retail price index is low. The fluctuations in deflated incomes and retail prices would be exagerated.

Even if these sources of bias were eliminated completely, the income and elasticity estimates would likely still not be significantly different from zero. The estimates are subject to fairly large variances because the limited number of observations allow for very few degrees of freedom. The poorness of fit in the case of Uganda also contributes to a large variance.

Considering the sources of bias and the large variance of the estimates, it is still unsafe to say the influence of price and income are not significant. The elasticity estimates are just so low that it would be fairly hard to reach any other conclusion. The only cases where the elasticity estimates are greater than 0.5 are the estimates of incomes elasticity when price is excluded from the demand equation and incomes are non-deflated for Uganda and Kenya (See Table III-5). The Kenya results are suspect because of the high degree of multicollinearity between non-deflated per capita disposable incomes and time. Furthermore, the elasticity estimates may also be subject to upward bias. The estimates of gross domestic product include estimates of income from subsistence activity. Subsistence activity in East Africa in 1962 accounted for 31.8 per cent of the combined gross domestic products of Kenya, Uganda, and Tanganyika. The estimates of subsistence activity are based to a large extent on population growth and an assumption of a relatively constant output per head. This makes these estimates rather unreliable with respect to short term fluctuations in subsistence output. Although long term trends in subsistence production make be revealed by the official estimates, the estimates tend to be too high in good crop years and too low in poor crop years. This tends to impart upward bias in the estimates of income elasticity.

D. Projections

A projection based on a regression equation will not necessarily be as unreliable and have the same biases to which the individual elasticity coefficients are subject. A lack of reliability due to multi-collinearity for example, is not nearly so important in making projections since although it might be difficult to separate out the effects of each of two or three variables in an equation, the total effect is estimated much more accrately. A projection based on a regression with multicolinnearity present will be relatively accurate if the variables are expected to move approximately at the same relative rates in the future as has been the case in the past. If the regression coefficients for price and income are under-estimates because increases and decreases in the estimates of prices and income exceed variations in the actual values of prices and incomes, then that part of the variation in consumption which should be attributed to income and price will actually be attributed partly to the time variable. If the time variable is included in the projection equation, these effects will be included to some extent in the projections.

The projections, however, will be subject to the same biases as the regression coefficients if there are errors in the independent varibles These biases may tend to cancel out among the different coefficients or they may reinforce each other in making projections.

For example, if price and income elasticities are both subject to downward bias, then if income is expected to rise and price is expected to rise, the biases will tend to cancel each other out. Since the projections below are based on an assumption of rising incomes and a rising retail price of sugar, and since the income and price elasticity estimates are probably biased downward if anything, the projections are probably not subject to any reinforcement of the biases of the individual regression coefficients.

In order to make projections of the total consumption of sugar for Kenya, Uganda, and Tanganyika, we made the following assumptions:-

(1) Gross domestic product will increase at an annual rate of 6.5 per cent in terms of current prices;

(2) Population rates of growth per annum will be

(a) 2.5 per cent in Uganda

(b) 3.0 per cent in Kenya, and

(c) 2.2 per cent in Tanganyika;[6]

(3) The retail price indicies will rise at the rate of 1 per cent per annum in all three East African countries.[7]

(4) Because of gradual increases in excise taxes, the retail price of sugar will rise at the rate of 2 per cent per annum in all three countries.

(5) The sum of export duties, import duties, and direct taxes (x) will rise along with GDP according to the following regression equations:

(a) $x = 17.064 + .804$ GDP for Uganda, and

(b) $x = -6.738 + .924$ GDP for Kenya and Tanganyika,[8]

where all taxes and GDP are measured in £millions.

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6. The rate of population growth assumed in the Kenya six-year development plan (1964-70) is 3.1 per cent, and that assumed in the Tanganyika is 2.2 per cent. See Government of Kenya, Development Plan, 1964-70, Nairobi, 1964, p.129 and The United Republic of Tanganyika and Zanzibar, Tanganyika Five Year Plan for Economic and Social Development, Dar-es-Salaam, 1964, p.8. The rates above also compare with the intercensal rates of population growth of 2.5 per cent in Uganda (1948-59), 3.2 per cent in Kenya (1948-62), and 1.75 per cent in Tanganyika (1948-57) as estimated by J. G. C. Blacker, "Population Growth in East Africa," Economic and Statistical Review, No. 8, September 1963, pp. vii-xii.

7. A 65 per cent rate of growth in gross domestic product with a 1 per cent rate of growth in prices implies roughly a 5.5 per cent rate of growth in real incomes. The Kenya plan (op.cit., p.129) envisions a rate of growth in real output of 5.7 per cent and in the Tanganyika plan (op.cit. p.8) a rate of growth of 6.7 per cent.

8. Regression equations were determined for the three East African countries using the data from Table III-1. The rate at which taxes have been growing relative to GDP has been considerably lower in the case of Tanganyika than in the cases of Uganda and Kenya. Since the current Tanganyika plan envisions a much greater effort than that reflected in past rates of growth, it was felt that taxes would have to grow at a much faster rate than previously. Hence we used the Kenya regression to project Tanganyika's revenues from direct taxes and import and export duties.

The results of the projections using the above assumptions are shown in Table III - 6. The equations used for projections are those in Tables III - 3 and III - 5 which had the highest coefficients of determination. The projections are compared with 1963 consumptions estimates.

E. Conclusions

At least in the case of Kenya and Tanganyika, the major factors affecting the growth of per capita sugar consumption are factors which evidence themselves gradually over time rather than per capita incomes and the retail price of sugar. The regression equations fit so poorly in the case of Uganda the same conclusion is less justified although what little evidence there is tends to support that conclusion. The major trend factors influencing per capita sugar consumption are probably the following: (1) gradual improvement in communications and distribution facilities, (2) a change in the habit of using jaggery (gur) as a substitute for sugar, and (3) changing income distribution favoring low income households which tend to have higher individual income elasticities.

Table III - 6

Projected Sugar Consumption:
East Africa

	Projection Equation*	Sugar Consumption	
		1963 (Actual Tons)	1970** (Projected Tons)
Uganda	$x=-18.2+125\log w_2'+.284\ z_4$	72,700	101,600 (4.9)
Kenya	$x=29.6+4.5\log w_2-6.5\log w_3 +.96\ z_4$	96,600	157,100 (7.2)
Tanganyika	$x=1.7+4.9\log w_2-1.5\log w_3 +.46 z_4$	57,700	88,100 (5.4)

* x = per capita sugar consumption; w_2' = non-deflated disposable income; and w_3 = deflated disposable income.

** Annual percentage rate of increase between 1963 and 1970 given in parethesis.

A major stimulus to high levels of sugar consumption is continuous availability. Where roads are bad or non-existent and where railroads are non-existent, shipments into an area tend to be sporadic because trips by lorry or human porterage will only be worthwhile if a full load or near full load can be carried, if items with a high value relative to weight can be carried at the same time, or if weather conditions are favourable. Because of storage difficulties due to bulkiness and perishability neither households nor traders will carry large inventories of these items to meet the continuous demand between shipments, but find it worthwhile to stock rather more easily stored commoddities. Furthermore, consumption cannot be easily postponed as is the case with more durable types of consumer items. Besides transport communications, factors affecting the continuous availability of sugar supplies are the state of development of other sorts of communications and the number and size of distribution channels. Good communications and distribution facilities enable orders to be filled quickly if there are unexpected changes in demand or disruptions in the usual sources of supply. If there are long delays in filling such orders, some consuption will not be postponed and will be lost. Thus improvements in communications and distributions tend to increase the share of income spent on sugar and similar items even though per capita incomes may remain constant.

If the income elasticities of sugar consumption for low income earners are higher than the income elasticities of high income earners, and if the low income earners increase their share of total income then per capita sugar consumption will rise even in the absence of an increase per capita incomes. There is some evidence that such a shift in income distribution has been taking place in East Africa during the period analysed. Between 1954 and 1962, African per capita income in Kenya have increased by about 24 per cent while non-African per capita income increased by something less, about 19 per cent. For the same period in Uganda non-African per capita income decreased by about 24 per cent while African per capita income decreased by only one per cent. (African incomes comprise about 50 per cent in Kenya and about 22 per cent in Uganda of total incomes (including subsistence).[9]

The results of our analysis suggest that a policy of fostering increased sugar consumption is dependent on a policy of improvements in the system of communications and distribution. Price reductions to increase consumption are likely to be ineffective although in Uganda this may not be as true as in the other two East African countries. Uganda is a smaller country with fairly well developed communications and the effect of a change in price may be more significant. A policy of raising excise taxes should not conflict with a policy of increased consumption if the tax is levied on the consumer.

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9. See B. Van Arkadie, paper forthcoming.