THE DEMAND FOR CIGARETTES IN NIGERIA, 1950 - 1971: AN ECONOMETRIC STUDY

BY

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Dedicated to my Parents,

Anne and Rachel.

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ABSTRACT

Cigarette, besides being an important source of Excise tax revenue to many countries, has interesting theoretical implications mainly because of the very peculiar consumer needs it satisfies and because it has no exact direct substitute, except substitution among the different brands that exist. Over the years, the consumption of cigarettes in Nigeria has increased remarkably despite all the medical, social and religious campaigns against smoking.

This study attempts at explaining the observed variations in the National consumption of cigarettes within the period 1950-71 as influenced by some variables, the strength of which the study tries to measure by applying econometric methods. The variables considered are economic and demographic factors; the economic factors include income and prices while the demographic variable is changes in the proportion of smokers in the population. The study therefore estimates the elasticities of demand for cigarette with respect to income, average price of cigarettes, price index of all other commodities and the demographic factor.

The single equation model is adopted to analyse the annual time-series used in the study. National aggregates as well as per capita data formulations were tested. For the dependent variable (i.e. quantity of cigarettes consumed) aggregation logically means the assumption that cigarettes are homogeneous. The function adopted is non-linear in the original data but linearized in logarithms, the

parameters of which were derived by least squares. Besides these other variables, a war-year dummy was introduced in the function to take care of "erractic factors" which affected the consumption of cigarettes during the Nigerian civil-war period, 1967-70.

The analysis was carried out on two levels; the static and the dynamic approaches. While in the former the current values of the independent variables influenced the current value of the dependent variable, in the latter, a lagged variable (the quantity variable was lagged) was introduced into the function explicitly. The latter analysis - i.e. the dynamic approach - was applied to test the habit-persistence hypothesis.

The results obtained in the study are:

(a) the elasticities of demand with respect to income and an average of cigarette prices are low though the income elasticity is comparatively higher. In both cases none was up to 0.7. The price elasticity was particularly low, it was under 0.4.

(b) the cross elasticity of demand with respect to the price of all other commodities was positive and nearer 2 than 1. In other words, it was far greater than unity and thus tends to indicate that consumers were more sensitive to changes in the prices of other commodities than to cigarette prices.

(c) 'population', perhaps the changes in the proportion of smokers to non-smokers or the extension of the smoking habit to the women and members of the lower age group, is a significant factor accounting partly for variations in the National consumption of cigarettes.

(d) the habit-persistence hypothesis was supported by the results of this study, that is, the more a person has consumed cigarettes in the past, the more he will consume currently. The estimated "coefficient of adjustment' was about 0.86 which indicates a speedy adjustment of consumption to changes in prices and income.

(e) the dummy variable shows positive sign which shows that the National consumption of cigarettes increased during the civil-war despite the temporary loss of the Eastern market. It was suggested from the above result that during major political upheavals the consumption of cigarettes will increase ceteris-paribus. This increase might have been due partly, to the high tension and depressive mood that engulfed the country and, of course, the military consumption.

In conclusion, the economic and policy implications of the results were discussed. To the Government, cigarette is one of the products to tax to raise revenue. To the firms engaged in the Tobacco Industry, it might be profitable to pursue a relatively stable retail price policy in view of the high sensitivity of consumers to changes in the prices of other commodities.

CHAPTER ONE

1. INTRODUCTION

Cigarette consumption in Nigeria has shown a steady increasing trend over the years despite medical reports on the dangers of smoking, the religious as well as the social oppositions. In 1937, when the first full-scale cigarette manufacturing plant was built at Ibadan, a total of about 300 million cigarettes was consumed in the country. This figure rose to about 1,400 million by 1950, and to about 9,400 million by 1971[1]; an average annual increase of 18.4% between 1937 and 1971.

The demand function for cigarettes has considerable theoretical interest. Cigarettes have no direct substitutes, except among other types of tobacco manufactures, mainly because of the extraordinary nature of the need which cigarettes fulfil. Cigarette smoking is said to be a sign of modernity; it is said to accord social prestige and extra boldness. It is also said to be an inducer of toilet, sleep antidote, mood and anger reliever, a necessary adjunct after meal, etc. There are many smokers who rarely feel satisfied with their meals without a cigarette after meal. Some increase their rate of smoking when in depressed or angry mood perhaps to effect some

1. Figures from: (a) Federal Office of Statistics, Lagos; and (b) Kilby, P. (1969); Industrialization in an Open Economy: Nigeria, 1945-1966. Cambridge University Press, London. The figures include both domestic production and imports but exclude smuggled cigarettes which in 1960/61 fiscal year alone was over 20 million. Smuggling activity was more widespread in the periods before 1960 when the strength and efficiency of the Customs and Excise Department was limited.

relief. Yet some others feel smoking is prestigeous and is a cure for their inherent nervousness and lack of confidence. All these 'extra-ordinary' ideas make most smokers addicts. Although there is no exact direct substitute for cigarettes, there is generally a sort of shift in expenditure, in the sense that all commodities purchased by the consumer compete for part of his income. There is even a greater substitution among the various brands of cigarettes. But these types of substitution are of a different form from the direct substitution of one different commodity for the other, both of which satisfy the same need. There are, therefore, strong theoretical and practical implications as to the price and income elasticities of demand for cigarettes. Furthermore, cigarette is such an important source of tax revenue to many countries[2] that these elasticities assume considerable importance in policy making.[3]

Even though cigarette may be considered a "luxury" compared with the more basic necessities like food, accommodation, drink, etc., especially in a low per capita income country like Nigeria, the consumption of cigarettes seems to be far more widespread than that of most other "luxuries". The smoking habit can be found in all income groups, and it is generally recognized that for many

2. Between 1938-1964 the U.K. obtained $\frac{1}{5}$ of its Central Government Revenue from Tax on Tobacco. In Nigeria cigarette is the third largest contributor of Revenue to the Government. By 1966, tax on tobacco (cigarette is about 90% of "Tobacco") accounted for 10% of all public Revenue. See Kilby, P., op. cit., p. 86.

3. See, The Federal Minister of Finance (The Hon. Sam Okotie-Eboh), "The Six Budget Speeches", Federal Ministry of Finance, Lagos, 1964, p. 190.

people the habit is extremely difficult to break. Habitual smoking, therefore, is one of the reasons why the price and the income elasticities of demand for cigarettes may be much smaller than those for other "luxuries". In recent times in Nigeria, the smoking habit has extended more among women and 'spread' into the members of the lower age group such as students because of the relatively new trend of permissiveness in the society.

1.1. OBJECTIVES OF THE STUDY

The main aim of this inquiry is to explain the variation in the National consumption of cigarettes and to measure the strength of the different influences at work. That is to say, the study aims at answering such question; assuming that the national consumption of cigarettes is influenced by a given number of factors, to what extent have variations in these factors been associated with variations in the consumption of cigarettes? The purpose of the study, therefore, is to apply econometric methods to investigate economic and demographic factors that have affected consumer demand for cigarettes within the period 1950-1971.[4] Economic factors include variations in prices and incomes, and the demographic factor is changes in the size of proportion of smokers in the population. In order to measure the effects of these variables, it

4. The period (1950-1971) was chosen because of data constraints. See chapter three for further explanations.

is necessary to estimate the demand function for cigarettes and derive the elasticities of demand with respect to income and prices, and the effect of the demographic variable. The estimated elasticities would be used to test the consistency of the empirical findings with the theoretical expectations which are set out in chapter four. Since cigarette is an important source of tax revenue to Nigeria, the study will discuss the policy and economic implications of the parameters to be derived with reference to excise tax revenue.

The objectives of the study can, therefore, be summarized as follows:

(a) to estimate price elasticities, income elasticities and to compare the results with the theoretical expectations which are outlined in chapter four,

(b) to measure the effect of changes in the size of proportion of smokers on the consumption of cigarettes, and,

(c) to analyse the usefulness of the estimated parameters in policy making.

1.2. THE ECONOMIC STRUCTURE OF THE TOBACCO INDUSTRY

Nigeria's modern Tobacco Industry developed from a basis of import trading in the early 1920's. By 1970, there were four cigarette manufacturing firms in the industry; the Nigerian

Tobacco Company (N.T.C.), the Philip Morris Nigeria Ltd., the Premier Tobacco Company and the Victory Tobacco Company. Viewed as it is, the Nigerian Tobacco Industry is an oligopolistic industry with much product differentiation. The industry has a dominant firm, the N.T.C., which controls over 85%[5] of the market. It is the oldest firm (founded in 1951 and took over the assets of the BAT group of Company) in the Industry and had, until 1964 when other firms entered the Industry, a monopoly of the market. Behind a wall of effective protection in addition to the overwhelming share of the market under its control, the NTC sets the ruling price in the industry.

1.2.2. ECONOMIC RELATIONS OF THE INDUSTRY

Production and distribution of tobacco products can be divided into three levels as shown in figure 1 (see next page); Firm, Wholesale and Retail. The items under each of the three divisions mainly, influence the ultimate activity at that level. Thus the cost of labour, price of raw materials, cost of other manufacturing and processing activities and the existing Customs and Excise tax rates influence decisions on production at the firm level. Decisions in the other divisions (levels) are also influenced inter-alia by those factors shown under them.

The arrows show the direction of influence of the various explanatory variables. For a normal commodity under normal market

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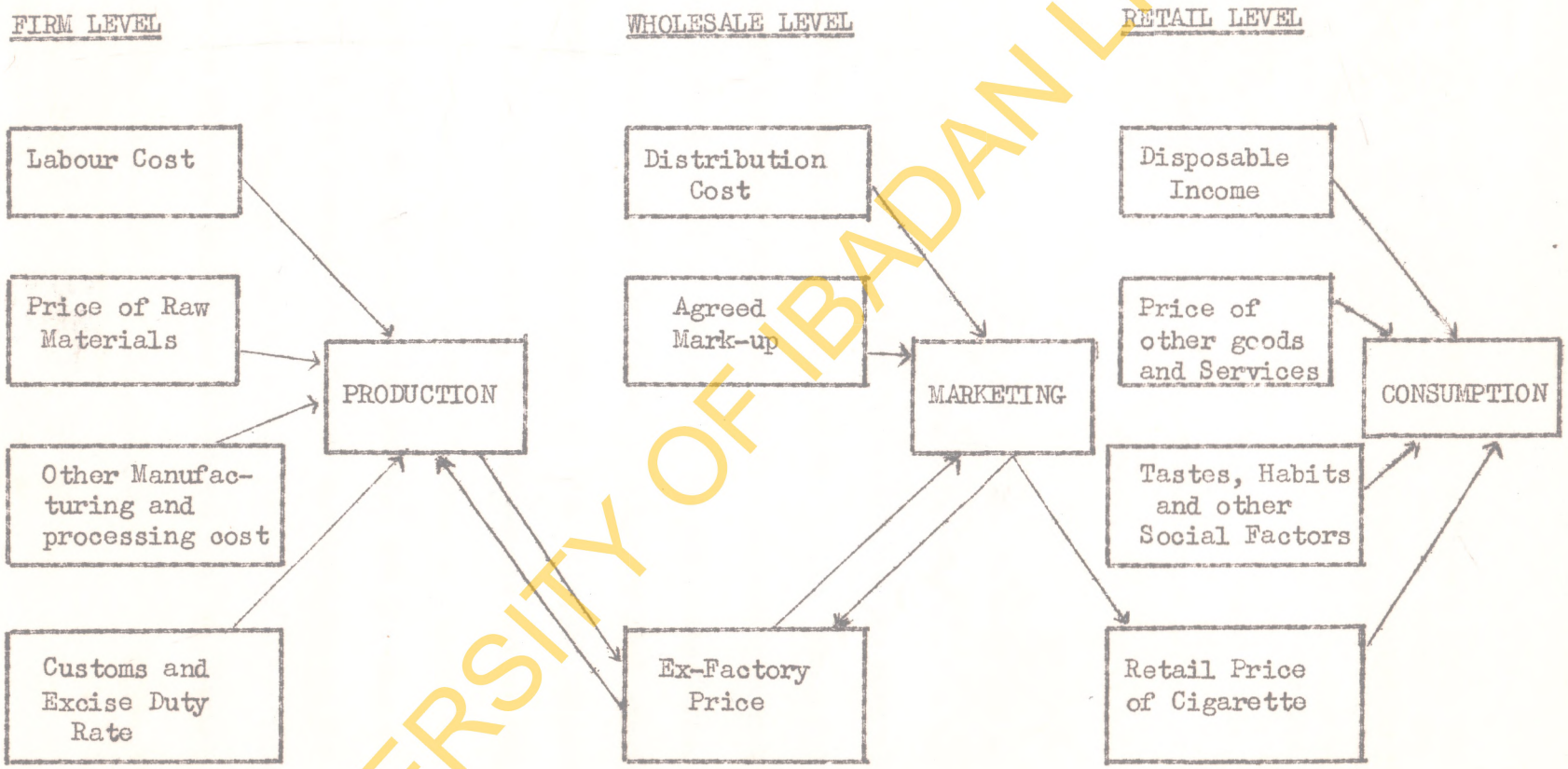
5. Figure derived from sales figures of the firms engaged in the Industry.

The Demand and Supply Structure for Cigarettes at Firm, Wholesale and Retail Levels

Fig. 1



Note: Arrows show the direction of influence

forces, equilibrating influences (i.e. double arrows) are expected between consumption and retail price of cigarette; between retail price and marketing; between marketing and ex-factory price, and between ex-factory price and production. In other words variations in consumption levels of cigarette should affect production levels through the price system. However, the supply and demand of cigarettes in Nigeria do not follow strictly this theoretical expectation. Changes in the output of the industry are not due to changes in demand signalled by changes in retail price but are due to the ever extending market for cigarettes and the monopolist control of the market, especially by the N.T.C. Since 1939 the domestic production of cigarettes has been expanding rapidly as shown by table I below. As seen in the table the Tobacco Industry prospered, enjoying virtually uninterrupted growth in output from 173 million cigarettes in 1939 to 9,364 million in 1971. From 1950 to 1971 alone, the increase in output was over 900%.

Cigarettes are sold in varied brands[6] and prices. An interesting aspect of the economic relation of the industry is the "price-setting mechanism". All things equal, prices of cigarettes would fluctuate in response to changes in demand and in Excise

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6. See Appendix A for some of the brands.

Table 1

The Growth of Domestic Cigarette Production (Million Cigarettes)

Year	Domestic Production[a]	Imports	Year	Domestic Production	Imports
1939	173	285	1955	2,506	79
1940	-	149	1956	2,650	44
1941	271	224	1957	2,188	64
1942	303	219	1958	2,953	78
1943	411	172	1959	2,749	61
1944	459	160	1960	2,871	104
1945	522	178	1961	3,353	108
1946	559	282	1962	3,488	73
1947	697	430	1963	4,040	104
1948	729	363	1964	4,124	74
1949	739	454	1965	4,783	54
1950	901	494	1966	5,421	76
1951	1,397	247	1967	5,142	154
1952	1,932	75	1968	5,768	8.4
1953	2,126	92	1969	6,989	7.3
1954	2,250	64	1970	8,502	10.8
			1971	9,364	6.0

(a) Excludes home-made and smuggled cigarettes.

Source: United Nations, Statistical Yearbook, various years; Federal Office of Statistics, Trade Reports, Nigerian Trade Summary (various years) and Returns of the Firms.

duties.[7] But over the years the retail price of most cigarettes especially the low grade brands have remained considerably stable (see chart I on page 35). For instance, while the output of the industry between 1950 and 1971 increased by over 900%, price increased, at the most, by 100% and that was for the high grade types such as Craven 'A'. For the low grade types such as Bicycle cigarettes, there has been little or no increase in price over the years.

The "price-setting mechanism" of the industry functions to cushion off most of the possible causes of retail price fluctuations. In effect, most of the potential causes of retail price instability such as increases in Excise tax are absorbed between the firm and the wholesellers. Generally, expected profit margin for wholesellers is decided upon before hand. Wholesale mark-up ranges from about 5 - 10% of the price offered to retailers depending, of course, upon the grade of cigarette. For the retailers, the mark-up is about 8 - 12% per packet of the retail price,[8] again depending upon the grade. Though the mark-up too fluctuates occasionally, it rarely affects the retail price which is predetermined. Fluctuations in

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7. Excise duties on cigarette were relatively stable until 1955/56 fiscal year when the ad-valorem duty system was introduced. See Federal Nigeria Official Gazette Extraordinary (Supplement), No. 16, vol. 43 of 24th March, 1956; No. 17, vol. 46 of 31st January, 1959; No. 28, vol. 51 of 9th March, 1964. The impact of these changes upon retail price of most cigarette brands was not significant.

8. Figures got from the firms in the Industry.

the mark-up are to a large extent restricted to the firm and the wholeseller in order to keep retail price relatively stable over time.

1.2.2. GOVERNMENT REVENUE

In Nigeria, about 64% of the ex-factory price of cigarette represents "value added" by import and excise duties. The comparable component of import tariff in landed cost for the imported cigarette is about 80%. Tobacco taxation has historically accounted for about 12 - 15% of Customs and Excise duties or on the order of 10% of all public revenue.[9]

Cigarettes contribute the greatest share of Excise tax Revenue. In the fiscal year 1952/53, Excise tax revenue from cigarette accounted for 98.23% of total Excise Revenue. By 1960/61 the share was 74.36% and in 1969/70 it was about 26%.[10] The relative decline of the share of cigarette Excise tax revenue does not affect the absolute share vis-a-vis other exciseable products. For instance in 1968/69 fiscal year, Excise revenue from cigarette was ₦14,732,760 (£7,366,380) out of a total Excise Revenue of ₦56,303,356 (£28,151,678). This was larger than Excise revenue realised from any other single taxable product. Furthermore, the N.T.C. alone paid about ₦30 million in 1970 for Customs and Excise duties and Reconstruction surcharge.

9. See P. Kilby, op. cit., p. 86.

10. See Federal Republic of Nigeria; Report of the Accountant-General of the Federal, various years. Federal Ministry of Information.

Since tobacco taxation has been a certain source of public revenue, the Federal Government has been, unfortunately, less concerned with the economic efficiency of the industry and its contribution qua industry to the economy's development than it has been with maximizing tax Revenue.[11]

1.3. PREVIOUS STUDIES

It was not possible to find an earlier study on the demand for cigarettes in Nigeria. A study which considered "Tobacco" in some form is that of Adamu.[12] Although his work is different from this study, in purpose and approach, he considered a group of commodities titled "Kola and Tobacco" in his "One-way classified data" analysis. He came up with the following conclusion; "In general, the estimates for 'Kola and Tobacco' have wrong signs and the R^2 is reasonably small as revealed by table 7. This probably means that it has no significant relationship with income, or the results are due to the usual under-estimation of this item in most sample surveys connected with family budgets".[13] Adamu, in his study explained the expenditure pattern of consumers in selected urban areas using, mainly, a "Two-way Classified data approach" based upon family budget

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11. See The Federal Minister of Finance, The Six Budget Speeches, Federal Ministry of Finance, Lagos, 1964.

12. S.O. Adamu (1972); An Econometric Study of Expenditure Patterns of Consumers in Selected Urban Areas in Nigeria; (Ph.D. Thesis, University of London).

13. Ibid., p. 127.

data and a range of commodity groups. In the above method, he grouped "Tobacco" with drinks on the argument that all are basically stimulants, thus made it impossible to compare the findings in this study with his. However, his finding on the relationship between Income and "Tobacco"[14] in the 'One-way Classified data' analysis is of some interest.

Other available studies[15] are those by sociologists, geographers and agricultural economists whose focuses were on the psycho-social and agricultural aspects of tobacco-leaf production. In effect, there is no known direct earlier work on the demand for cigarettes in Nigeria. The experience drawn upon for this inquiry is mainly from studies on cigarette done in other countries, [Congrad (1955); Koutsoyannis, (1963); Stone, (1945); Summer, (1971); Maier, (1955); Wiseman, (1968)].

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14. Tobacco is used here instead of "Kola and Tobacco" because Tobacco index is about 90% of the index for "Kola and Tobacco" in Federal Office of Statistics publications.

15. The studies are:

(i) O.O. Oluwole (1970), "The Economics of Flue-cured Tobacco Production under Peasant Agricultural conditions in the Western State of Nigeria", (M.Sc. thesis in Agricultural Economics, University of Ibadan).

(ii) D.A. Oyeleye, (1969); "The Impact of Tobacco Cultivation on the Agricultural Economy of Oyo Division", (M.A. thesis in Geography, University of Ibadan).

(iii) A. Akiwowo and A.C. Basu, (1969); "Tobacco Growers in Northern Oyo division and Adoption of new farming ideas and practices". (Paper prepared for the Functional Literacy Programme of the Department of Adult Education, University of Ibadan).

CHAPTER TWO

DEMAND FUNCTION FOR CIGARETTES: THEORETICAL SETTING

2.1 Theoretical Derivation of the Individual Demand Curve

The prime use of theoretical economic analysis is to place restrictions on the parameters of behavioural functions.[1] These restrictions are then used in empirical studies to test whether actual behaviour is consistent with that anticipated by theory. If the empirical results failed to satisfy the theoretical restrictions, then either the restrictions or the estimation procedures employed were incorrect, or both were at fault. In order to minimize the first of these possibilities in any particular study, it is necessary that the theoretical analysis should be based upon realistic and accepted assumptions.[2]

The consumer's demand curve for a given commodity can be derived from the analysis of utility maximization. Classical static theory of consumer behaviour begins with a utility function which makes an

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1. R.W. McShane, "Demand Function Restrictions for Empirical Studies," Australian Economic Paper, vol. 10, No. 17, December, 1971. pp. 161-174.

2. The assumptions normally made are:
   (a) maximizing behaviour of consumers,
   (b) that for all possible pairs of alternative commodity bundles A and B the consumer knows whether he prefers A to B, or B to A, or whether he is indifferent between them.
   (c) that only one of the three possibilities in (b) is true for any pair of alternatives.
   (d) If the consumer prefers A to B and B to C, he will prefer A to C. This last one ensures that the consumers preferences are consistent or transitive. For full discussion, See: P. Newman, The Theory of Exchange, (Englewood Cliffs, N.J.: Prentice-Hall Inc. 1965). Chapters 1-3.

individual's level of satisfaction depend on the quantity of commodities he consumes.

Let a consumer's ordinal utility function be

$$u = u(q_1, q_2, \ldots, q_n) \qquad (2.1.1)$$

where $q_1, q_2, \ldots, q_n$ are the quantitites of the different commodities consumed in a single time period, and $u(q_1, q_2, \ldots, q_n)$ is a joint function of the quantities of all goods. It is assumed that the utility function in (2.1.1) is not only an increasing and continuous function of each of the quantitites, but is also twice differentiable.

Given the utility function in (2.1.1), the theory assumes that a rational consumer aims at maximizing (2.1.1) with respect to the q's subject to a budget constraint, namely,

$$\sum_{i=1}^{n} p_i q_i = y. \qquad (2.1.2)$$

The prices, $p_1, p_2, \ldots, p_n$ and income, y, are exogeneously determined for the consumer and satisfy the following conditions:

$$p_i > 0 \ (i = 1, 2, \ldots, n) \text{ and } y > 0. \qquad (2.1.3)$$

Since the maximization of (2.1.1) subject to (2.1.2) is a simple constrained maximum problem, the consumer's consumption pattern must obey the following conditions if he is to maximize 'u',

$$U_i - \lambda p_i = 0 \ (i = 1, 2, \ldots, n)$$

$$\sum_{i=1}^{n} q_i p_i - y = 0 \qquad (2.1.4)$$

where: $U_i = \frac{\partial u}{\partial q_i}$

λ is the Lagrange multiplier usually interpreted in economic terms as marginal utility of income because,

$$\frac{\partial u}{\partial y} = \lambda.$$

From (2.1.4), it follows that

$$\frac{U_i}{U_j} = \frac{P_i}{P_j} \quad (i,j = 1,2, \ldots, n) \qquad (2.1.5)$$

and also that

$$\frac{U_i}{P_i} = \lambda \quad (i = 1,2, \ldots, n) \qquad (2.1.6)$$

Thus, in equilibrium, the ratio of the marginal utilities of two commodities is equal to the ratio of their prices; that is, the marginal utilities are proportional to the prices.

Equations (2.1.2) and (2.1.4) provide $(n + 1)$ relationships which permit the $(n + 1)$ unknowns, λ and q_i $(i = 1,2, \ldots, n)$ to be expressed as functions of y and p_i $(i = 1, 2, \ldots, n)$. The solution yields the following demand functions:

$$q_i = f_i (P_1, P_2, \ldots, P_n, y) \qquad (2.1.7)$$

$$(i = 1, 2, \ldots, n).$$

In other words, (2.1.7) states that consumer demand for the ith good depends on income and the prices of all commodities.

It is assumed that equal proportionate changes in prices and income do not affect the constraint in (2.1.2) and thus will not affect the utility maximizing values of the q's. Adopting this property of zero degree homogeneity, equation (2.1.7) can be written as

$$q_i = f_i \left(\frac{P_1}{p}, \frac{P_2}{p}, \ldots, \frac{P_n}{p}, \frac{y}{p}\right) \qquad (2.1.8)$$

$$(i = 1,2, \ldots, n),$$

where P is a general price index. Equation (2.1.8) states that the demand for q_i is a function of relative prices of all commodities and real income.

Besides prices and income, other factors, such as population, tastes, habit etc., determine consumer demand. The factors determining preferences may be denoted by x_j, where $j = 1, 2, \ldots, n$. In this study, the x's refer to such factors as proportion of smokers in the population and a catch-all trend variable. Thus, the demand equation for an individual consumer can be written in the form;

$$q_i = f_i\left(\frac{p_1}{p}, \frac{p_2}{p} \ldots, \frac{p_n}{p}, \frac{y}{p}, x_1, x_2, \ldots, x_n\right) \quad (2.1.9)$$

$$(i = 1, 2, \ldots, n).$$

There are some restrictions imposed on these equations. By differentiating the first - order maximization conditions of (2.1.4) with respect to income and the prices which are now treated as parameters in (2.1.7) we have, using matrix notation for brevity;

$$\begin{bmatrix} u & -p \\ -p' & 0 \end{bmatrix} \begin{bmatrix} Q & q_y \end{bmatrix} = \begin{bmatrix} \lambda I & \underline{0} \\ q' & -1 \end{bmatrix} \quad (2.1.10)$$

where $U = \begin{bmatrix} U_{11} & U_{12} & U_{13} & \cdots & U_{1n} \\ U_{21} & U_{22} & U_{23} & \cdots & U_{2n} \\ \vdots & \vdots & \vdots & & \vdots \\ U_{n1} & U_{n2} & U_{n3} & \cdots & U_{nn} \end{bmatrix}$, $P = \begin{bmatrix} P_1 \\ P_2 \\ P_3 \\ \vdots \\ P_n \end{bmatrix}$

$$Q = \begin{bmatrix} \frac{\partial q_1}{\partial p_1} & \frac{\partial q_1}{\partial p_2} & \frac{\partial q_1}{\partial p_3} & \cdots & \frac{\partial q_1}{\partial p_n} \\ \frac{\partial q_2}{\partial p_1} & \frac{\partial q_2}{\partial p_2} & \frac{\partial q_2}{\partial p_3} & \cdots & \frac{\partial q_2}{\partial p_n} \\ \vdots & \vdots & \vdots & & \vdots \\ \frac{\partial q_n}{\partial p_1} & \frac{\partial q_n}{\partial p_2} & \frac{\partial q_n}{\partial p_3} & & \frac{\partial q_n}{\partial p_n} \end{bmatrix}, \quad q = \begin{bmatrix} q_1 \\ q_2 \\ q_3 \\ \vdots \\ q_n \end{bmatrix}, \quad q_y = \begin{bmatrix} \frac{\partial q_1}{\partial y} \\ \frac{\partial q_2}{\partial y} \\ \frac{\partial q_3}{\partial y} \\ \vdots \\ \frac{\partial q_n}{\partial Y} \end{bmatrix}$$

$$I = \begin{bmatrix} 1 & 0 & \cdots & 0 \\ 0 & 1 & 0 & 0 \\ \vdots & \vdots & \vdots & \vdots \\ 0 & \cdot & \cdot & 1 \end{bmatrix}, \quad \mathbf{Q} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ \vdots \\ 0 \end{bmatrix},$$

$$U_{ik} = \frac{\partial^2 U}{\partial q_i \, \partial q_k}, \quad i, k = 1, 2, \ldots, n$$

λ, 0, 1 are scalars, while $H = \begin{bmatrix} U & -P \\ -P' & 0 \end{bmatrix}$ is the bordered Hessian matrix.

The second-order conditions for the maximization problem in (2.1.4) require the bordered Hessian determinants to alternate in sign,[3]

$$\begin{vmatrix} U_{11} & U_{12} & -P_1 \\ U_{21} & U_{22} & -P_2 \\ -P_1 & -P_2 & 0 \end{vmatrix} > 0, \quad \begin{vmatrix} U_{11} & U_{12} & U_{13} & -P_1 \\ U_{21} & U_{22} & U_{23} & -P_2 \\ U_{31} & U_{32} & U_{33} & -P_3 \\ -P_1 & -P_2 & -P_3 & 0 \end{vmatrix} < 0,$$

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3. J.M. Henderson & R.E. Quandt; Microeconomic Theory, a Mathematical Approach, (2nd Ed.); International Student Edition; McGraw-Hill Book Co., New York, 1971.

$$\ldots(-1)^n \begin{vmatrix} U_{11} & U_{12} & \ldots & U_{1n} & -P_1 \\ U_{21} & U_{22} & \ldots & U_{2n} & -P_2 \\ \ldots & \ldots & \ldots & \ldots & \ldots \\ U_{n1} & U_{n2} & \ldots & U_{nn} & -P_n \\ -P_1 & -P_2 & \ldots & -P_n & 0 \end{vmatrix} > 0$$

To assess how a consumer will react to a change in the ith price, that is to derive the main restrictions imposed on the demand functions, we differentiate the maximizing condition (2.1.4) with respect to P_i and solve or reduce (2.1.10) to,[4]

$$\begin{bmatrix} U & -P \\ -P' & 0 \end{bmatrix} \begin{bmatrix} \partial q_1/\partial p_i \\ \partial q_2/\partial p_i \\ \vdots \\ \partial q_n/\partial p_i \end{bmatrix} = \begin{bmatrix} 0 \\ \vdots \\ \lambda \\ 0 \\ 0 \\ \vdots \\ q_1 \end{bmatrix} \quad \ldots (2.1.11)$$

The effect of this change on commodity k is known by solving (2.1.11) for any $\frac{\partial q_k}{\partial p_i}$

which, using Cramer's rule, yields the following two terms:

$$\frac{\partial q_k}{\partial p_i} = (-1)^{i+k} \lambda \frac{D_{ik}}{H} + \frac{D_{nk}}{H} \qquad (2.1.12)$$

where

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4. In obtaining this system of equation (2.1.11), the assumption that over the consumption period all price levels are independent was made.

'H' is the bordered Hessian determinant of the utility function 'U', D_{ik} is the co-factor of the element in the ith row and k th column of the co-efficient matrix in (2.1.11), while D_{nk} is the co-factor of the n,k element.

Similarly, the change in commodity k due to a change in income reduces (2.1.10) to[5]

$$\begin{bmatrix} U & -P \\ -P' & 0 \end{bmatrix} \begin{bmatrix} \frac{\partial q_1}{\partial y} \\ \frac{\partial q_2}{\partial y} \\ \vdots \\ \frac{\partial q_n}{\partial y} \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ \vdots \\ 0 \\ 0 \\ -1 \end{bmatrix} \quad \ldots (2.1.13)$$

When this system of equations is solved for any particular

$$\frac{\partial q_k}{\partial y},$$

the following equation is obtained;

$$\frac{\partial q_k}{\partial y} = \frac{D_{nk}}{H} \qquad (2.1.14)$$

where;

D_{nk} and H are as defined above. Substituting (2.1.14) into (2.1.12) yields two effects on q due to change in P, i.e.

$$\frac{\partial q_k}{\partial p_i} = (-1)^{i+k} \lambda \frac{D_{ik}}{H} + q_i \frac{\partial q_k}{\partial y} \quad \ldots (2.1.15)$$

Let V_{ki} be defined as substitution effect, that is,

$$V_{ki} = (-1)^{i+k} \lambda \frac{D_{ik}}{H}$$

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5. The assumption made in deriving this system of equation is that the current level of prices of the ith good and the individual consumer's level of income are also independent.

and thus (2.1.15) can be written as

$$\frac{\partial q_k}{\partial p_i} = V_{ki} + q_i \frac{\partial q_k}{\partial y} \quad . \qquad (2.1.16)$$

Equation (2.1.16) is the usual Slutsky equation. It shows that when all other prices and money income are held constant, the resultant change that occurs in a consumer's purchases of the k^{th} commodity in response to the i^{th} price movement is determined by the interaction of two effects. One of these is called the Income effect,

$$\left\{ q_i \frac{\partial q_k}{\partial y} \right\}$$

and is the change in the consumer's demand for the k^{th} good resulting from the variation in his real income induced by the price movement. The second and more dominant component is the Substitution effect,

$$V_{ki} = \left[(-1)^{i+k} \lambda \frac{D_{ik}}{H} \right] .$$

It is the allocation the consumer would make within his commodity bundle, as a consequence of the change in relative prices, when his real income is held constant. The important aspects of the restrictions are those imposed on V_{ki}, the substitution effect. The most important restrictions, the additivity, the homogeneity and the symmetry restrictions, can be derived from equations (2.1.4) and (2.1.16).[6] The additivity restriction, which states that,

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6. See, I.F. Pearce, A Contribution to Demand Analysis, (Oxford; Clarendon Press, 1964), pp. 44 - 57.

$$\sum_{i=1}^{n} P_i \frac{\partial q_i}{\partial y} = 1 \qquad (2.1.17)$$

is derived by differentiating (2.1.4) with respect to income y, and multiplying by the appropriate prices. The sum will be equal to unity.

If the V_{ki}'s are multiplied by appropriate prices, P_i, they will sum up to zero (a property of the determinant of the bordered Hessian matrix), i.e.

$$\sum_{i=1}^{n} V_{ki} P_i = 0 \qquad (2.1.18)$$

$$(k = 1, 2, \ldots, n).$$

This is the homogeneity property which implies the absence of money illusion. There are n of these as seen above.

The symmetry property is derived from (2.1.16) and provides that,[7]

$$V_{ki} = V_{ik}. \qquad (2.1.19)$$

These are non-trival for $i \neq k$ and there are $\frac{n(n-1)}{2}$ of them. There is the non-negativity property for the substitution part[8] of the own price derivative, i.e.

$$V_{kk} < 0 \qquad (2.1.20)$$

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7. S.O. Adamu, (1972), op. cit.,

8. R.G.D. Allen and E.J. Mishan, (1965), "Is the Substitution Term Ambiguous?", Economica, vol. 32, pp. 215-222. They have shown that if the concept of an increase in price is properly defined, this property remains invariant when one removes the linearity property of (2.1.2).

The implication of this property is that, in the case where the income derivative of (2.1.16) is positive or zero, i.e. when the commodity is not an inferior one, an increase in the price of such a commodity leads to a decrease in the quantity purchased. This argument forms the basis for the notion of negative relationship between quantity demanded and price.

Even with all these restrictions which try to define the utility function more precisely and realistically there are still problems of measurement in practice, hence statistical analysis begins directly with the demand functions as given in equation (2.1.7). The exact functional form is rarely deduced theoretically but is usually determined empirically.

2.2 PROBLEMS OF AGGREGATION IN STATISTICAL DEMAND ANALYSIS

The economic theory of consumer behaviour described in the preceding section yields a formulation of an individual's demand functions. However, the demand functions considered in this study are based on market data - national totals or averages. The results of aggregate market behaviour do not exactly depict the results of a single individual's behaviour. This suggests the following question: what is the relation between the estimated market demand parameters and the individual demand parameters? This is the so-called aggregation problem.

In this study, two types of aggregation problems arise. The first is the aggregation of individual consumer behaviour, and, the second is the aggregation of commodities. In order to simplify the presentation of these aggregation problems, a linear individual demand function is assumed. Suppose that the j^{th} individual's demand for the k^{th} commodity can be expressed as

$$q_k^{(j)} = \alpha_{ok}^{(j)} + \alpha_{1k}^{(j)} P_1^{(j)} + \alpha_{2k}^{(j)} P_2^{(j)} + \ldots + \alpha_{nk}^{(j)} P_n^{(j)} + \beta_k^{(j)} y^{(j)} + w_k^{(j)} \quad (2.2.1)$$

$(k = 1, 2, \ldots H)$,

in which all prices and incomes are deflated by an index of general prices. It should be noted that the time subscript is omitted for convenience. Quantities demanded, prices, incomes, and disturbances $(w_k^{(j)})$ are assumed to vary among individuals. Market demand is obtained by aggregating over individual demand; i.e.

$$\sum_{j=1}^{N} q_k^{(j)} = \sum_{j=1}^{N} \alpha_{ok}^{(j)} + \sum_{j=1}^{N} \alpha_{1k}^{(j)} P_1^{(j)} + \sum_{j=1}^{N} \alpha_{2k}^{(j)} P_2^{(j)} + \ldots + \sum_{j=1}^{N} \alpha_{nk}^{(j)} P_n^{(j)} + \sum_{j=1}^{N} \beta_1^{(j)} y^{(j)} + \sum_{j=1}^{N} w_k^{(j)} \quad (2.2.2)$$

Equation (2.2.2) could also be written on an average or per capita basis, i.e.

$$Q_k = A_{ok} + A_{1k} P_1 + A_{2k} P_2 + \dots + A_{nk} P_n + B_k Y + W_k, \qquad (2.2.3)$$

where Q_k denotes per capita consumption of the k^{th} good, P_1, P_2, ... , P_n denote average prices of q_1, q_2, ... , q_n, Y denotes per capita disposable income, and

$$A_{ok} = \frac{1}{N} \sum_{j=1}^{N} {}^{(j)}\alpha_{ok} \qquad (2.2.4)$$

$$A_{ik} = \sum_{j=1}^{N} {}^{(j)}\alpha_{ik} \, {}^{(j)}P_i \Big/ \sum_{j=1}^{N} {}^{(j)}P_i \qquad (2.2.5)$$

$$(i = 1,2, \dots , n)$$

$$B_k = \sum_{j=1}^{N} {}^{(j)}\beta_k \, {}^{(j)}y \Big/ \sum_{j=1}^{N} {}^{(j)}y, \qquad (2.2.6)$$

and

$$W_k = \frac{1}{N} \sum_{j=1}^{N} {}^{(j)}W_k. \qquad (2.2.7)$$

The coefficients of A_{ik} and B_k are weighted arithmetic means of the individual α_{ik} and β_k, the weights being the individual P_1, P_2, ... , P_n and y, respectively. The coefficients in (2.2.3) will be constant, independent of time, under the following conditions.[9]

(1) the distribution of prices and incomes does not change over the time period considered, or

(2) all prices change in fixed proportion, λ_p, and all incomes change in fixed proportion, λ_y, or

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9. Karl Fox, (1960); Econometric Analysis for Public Policy (Ames, Iowa; The Iowa State University Press), pp. 58-60.

(3) the correlations between $\alpha_{ik}^{(j)}$ and $P_i^{(j)}$ and $\beta_k^{(j)}$ and $y^{(j)}$, respectively, are zero at all time periods.

For case (3), the parameters A_{ik} and B_i are simple averages of the individual $\alpha_{ik}^{(j)}$ and $\beta_k^{(j)}$. Case (1), (2) or (3) is usually assumed when a linear aggregate demand function is fitted statistically to average prices, per capita consumption, and income data over a period of years.

The subject of commodities also presents problems of aggregation. For example, there are different brands of cigarettes[10] of various quality and prices, but in this study, cigarette is not treated on individual brand basis. The reason is that data on the various brands are not available. Cigarettes are thus regarded as homogeneous commodities and aggregated on that basis. Normally, aggregation over individual consumers and aggregation over individual commodities are equivalent processes.[11] In this study, the aggregate cigarette quantity (sticks of cigarettes) is defined as the total number of domestic

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10. Cigarettes are either filtered or unfiltered. There are high and low quality brands, some of which are, Benson & Hedges, Victory, Gold Leaf, Target, Link, Bicycle, Sweet Menthol, Richmond, Flight, Mark-Ten, Green Spots, Niger Green, High Society, Craven A, State Express, Varsity, Big Town, etc. In 1970 there were over twenty-five brands on sale in Nigeria.

11. R.G.D. Allen; Mathematical Economics (London: MacMillan & Co., 1956), pp. 694-724.

production, irrespective of brands, plus imports adjusted for stocks and re-exports. The use of production figure as a proxy for consumption figure is based on the following, (1) Data on cigarette consumption are not available - (2) cigarettes cannot be stored for long without losing their characteristics (flavour and humidity), so raw materials are stock piled instead with which the firms can easily meet abrupt changes in demand since the manufacturing process is rather short, (3) there is still unsatisfied demand for cigarettes in the country[12] due to the monopolist supply practices indulged in by the few firms in the Industry.

The price index of the aggregate cigarette quantity is a weighted average of individual brands of cigarette, the weight being the number of cigarettes in a packet. If it is assumed that all price changes within the aggregate are approximately proportional, then an aggregate can be treated as a single commodity in the demand analysis. In this study the above assumption is

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12. Despite the high quantity of cigarettes smuggled into Nigeria and sold, cigarette prices remain considerably stable instead of falling as smuggling increased supply, which means there is unsatisfied demand. Secondly, the rate of expansion in the Tobacco Industry shows the existence of unsatisfied demand. For example, in 1964, The Philip Morris Company started producing and in 1972, The N.T.C., commissioned its ₦5,000,000 extension factory at Zaria. The Ibadan N.T.C. factory has also been expanded. In 1971, the Victory Tobacco Company entered the Industry.

adopted. Available data indicate that this is a realistic assumption.[13]

2.2.1. Aggregation of Non-Linear Equations

The analysis above was based on the assumption that both the individual and the aggregate market demand functions postulated are linear. Although this choice can be justified to some extent,[14] it may not be correct to consider non-linear relationships as unimportant. It is of some interest therefore, to obtain suitable generalization for them.

However, due to the linearization in logarithms and the assumption of constant elasticity applied to the non-linear function adopted in this study, the non-linear aggregation problem reduces to that of ordinary linear equation. If aggregate market demand variables, argued Theil, are defined such that their logarithms are linear combinations of the logarithms of corresponding individual demand variables and if it is postulated that these aggregate demand variables are connected by a constant-elasticity relation, the results obtained in aggregating are identical with those found in section 2.2

13. See, Department of Customs and Excise, Annual Reports, 1950-1959. Also see U.A.C., Annual Report and Accounts, various years.

14. See, Theil, H.(1965); Linear Aggregation of Economic Relations, (North-Holland Publishing Company, Amsterdam) pp. 34-38. Also see, Samuelson, P.A. (1948); Foundations of Economic Analysis, (Cambridge, U.S.A.) Chapters IV and V.

for linear equations.[15] It is however clear that in this case the aggregation itself, too, cannot be called linear; it is linear in the logarithms and hence non-linear in the original variables.

Of more importance, perhaps, is a polynominal aggregation though little difference appears in the basic procedure and results. The one striking difference between polynomial and linear equation is that the covariances cannot in general be reduced to zero by means of the simple fixed-weight approach used in the linear aggregation methods. For linear equations this can always be done because the number of available weight (= the number of exogenous individual demand variables) is always sufficient in order to transform the individual demand coefficients such that aggregation is identical with summation of individual demand relations - which is the procedure adopted in section 2.2. For polynomial equations, the number of weights is the same, but the individual demand parameters are usually much more numerous - which makes the difference.[16]

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15. Ibid., p. 126.

16. For a more detailed discussion and mathematical demonstration, see Theil, H. op. cit., pp. 126-132 and Chapter VII. Also see, Klein, L.R. (1950); Economic Fluctuations in the United States, 1921-1941, (New York-London), p. 45.

All in all, it appears that linear aggregation of polynomial individual equations to a polynomial market equation (the degree of which is not smaller than that of the individual demand equations) is quite similar to the problem of linear aggregation of linear individual to linear market demand equations [Theil, 1965].

CHAPTER THREE

METHODOLOGY AND DATA

3.1. METHODOLOGY

The present study utilizes a set of time-series data for the whole country during the period 1950-1971. This period was chosen because of data constraint. In economics, samples are almost of necessity small.[1] Series covering as long a period as twenty-two consecutive years, such as are used in the present study, will normally take years to assemble on any considerable scale. Endeavours to increase the size of the sample beyond 1950 were thwarted by the lack of some relevant data such as the income variate.

In analysing time-series the aim is usually to discover the structural relationship between certain series when all other important influences are taken into account. There are several methods that might be adopted to explain the variations in the demand for a commodity of all consumers taken together. The one selected will depend partly on the type of the information available and partly on the precise way in which the problem is formulated.[2]

The general formulation adopted in this study is to explain the demand for aggregate cigarette using the single-equation approach with a set of time-series. However, per capita consumption formulation is

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1. See, R. Stone, (1945), "The Analysis of Market Demand", Journal of the Royal Statistical Society, vol. 108, pp. 286-382.

2. Ibid., p. 288.

also tested. The parameters of the variables are derived by least squares.

Certain factors determined the choice of the single-equation model for this study. Besides the simplicity of formulation and the mathematical and computational convenience entailed in the single-equation approach, the type of data available for this study was another important determinant in the choice. National aggregate data, which are more suitable for single-equation analysis than any other method, are utilized here. In addition, market conditions favour the use of single-equation rather than a simultaneous-equation approach in this study, since all the variables except the dependent variable - quantity of cigarettes purchased - are "predetermined" in the sense that their current values are not affected by the current values of other variables in the regression equation. Furthermore, cigarette is one of the few industrial products where public regulations and excise returns provide accurate quantity data for single-equation regression analysis, (Cramer 1969). Other scholars, [Stone (1945); Maier (1955); Koutsoyannis, (1963); Wiseman (1968); Sumner (1971) and Hamilton (1972)] who worked on the demand function for cigarettes in other countries also used the single-equation model in their analysis.

The single-equation procedure is a useful one even though it has the problems of aggregation. Without going into details, it would be said that the advantage of the approach is that it makes feasible

an approximate explanation in the case of any commodity for which accurate data can be assembled, [Stone (1945); Wold and Jureen (1953); Cramer (1969)]. An interesting alternative method for analysing demand for branded consumer goods suggested by Pessemier[3] involves the grouping of cigarettes on price or brand basis for analysis. This approach cannot be applied in this study because the quantity data is not available on brand basis. This study, therefore, considers cigarettes as a homogeneous commodity and aggregates it for the analysis which follows hereafter.

The equation fitted in this study is of the general form;

$$Q_t = AY_t^{\beta} P_t^{\gamma} I_t^{\delta} e^{rT + fW} \quad \ldots\ldots\ldots\ldots\ldots \quad (3.2.1)$$

where

Q_t = aggregate quantity of cigarettes purchased in year t.

Y_t = aggregate income in year t: ideally personal disposable income should be used. G.D.P. at factor cost is used as a proxy since the required series on personal disposable income are not available.

P_t = average price of cigarettes in year t.

I_t = index of prices of all commodities in year t.

W = Civil war years dummy with values: W = (0 for non war years, (1 for war years

T = time in calendar years

e = base of natural logarithms

Equation (3.2.1) assumes that the relationship between the dependent and the explanatory variables is non-linear. By taking logarithms

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3. See, E.A. Pessemier, (1963); Experimental Methods for Analysing Demand for Branded Consumer Goods, Pullman; Washington State University Press.

equation (3.2.1) can be linearized in logarithms as:

$$\text{Log}_{10}Q_t = \text{Log}_{10}A + \beta\log_{10}Y_t + \gamma\log_{10}P_t + \delta\log_{10}I_t + T\log_{10}e + fW\log_{10}e \quad \ldots\ldots (3.2.2)$$

Equation (3.2.2) assumes that the elasticities, β, γ, δ, are constant over time and that the trend takes the form of a constant rate of change per unit of time.

Apart from the fact that the double logarithmic transformation adopted here is the form of demand function frequently tested [Wiseman 1968], it has the advantage of easiness of interpretation. Furthermore, it yields a better fit than the linear formulation as proved in this study. A comparison of linear and double logarithmic regressions shows a marked superiority of the latter over the former.

3.2. VARIABLES

It is hypothesized in this study that the demand for cigarettes is a function of such factors as disposable income, average price of cigarettes and a general index of prices of all other commodities. Although these explanatory variables are indisputable, it is customary in empirical demand analysis to work with real income and prices.[4] The theory of consumer demand rests on the assumption that money is a scale factor. Thus inflationary and deflationary pressures are regarded simply as changes in the monetary unit and are therefore assumed to have no influence on consumer behaviour. However, nominal income series are used in this study. The assumption made

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4. See H. Wold and L. Jureen; op. cit., pp. 115-116.

is that consumers react more to changes in their money incomes than to changes in the real purchasing power of those money incomes. Experience suggests that this is a reasonable assumption, at least in periods when there are no violent movements in price level, and therefore in real income. It is observed that in periods of depression consumers, especially wage and salary earners, are influenced in their consumption patterns by money income, and the same seems to be true in periods of slow price increases. It is only when price-increases take the form of rapid inflation that money income ceases to be the predominant guide in consumption pattern.[5] Therefore it is money income which is important for demand function, especially for the period under consideration, during which increases in prices in Nigeria were moderate and never took the form of uncontrolled inflation. Chart I (see next page) shows the movement of the all-cities consumer price index for the lower income group for 1950-1971 and a corresponding cigarette price index in Nigeria. In general, cigarette prices have been relatively stable over the years except in 1959 when excise duty was abruptly raised. Thereafter, prices maintained, to a large extent, a stable trend. In comparison, the all-cities price index shows a moderate and gradual increase over the period. The "outburst" between mid 1965 and mid 1967 was caused by the political upheaval that enrapped the country at that period while post-war factors were responsible for the rise after 1969. Furthermore it is believed that

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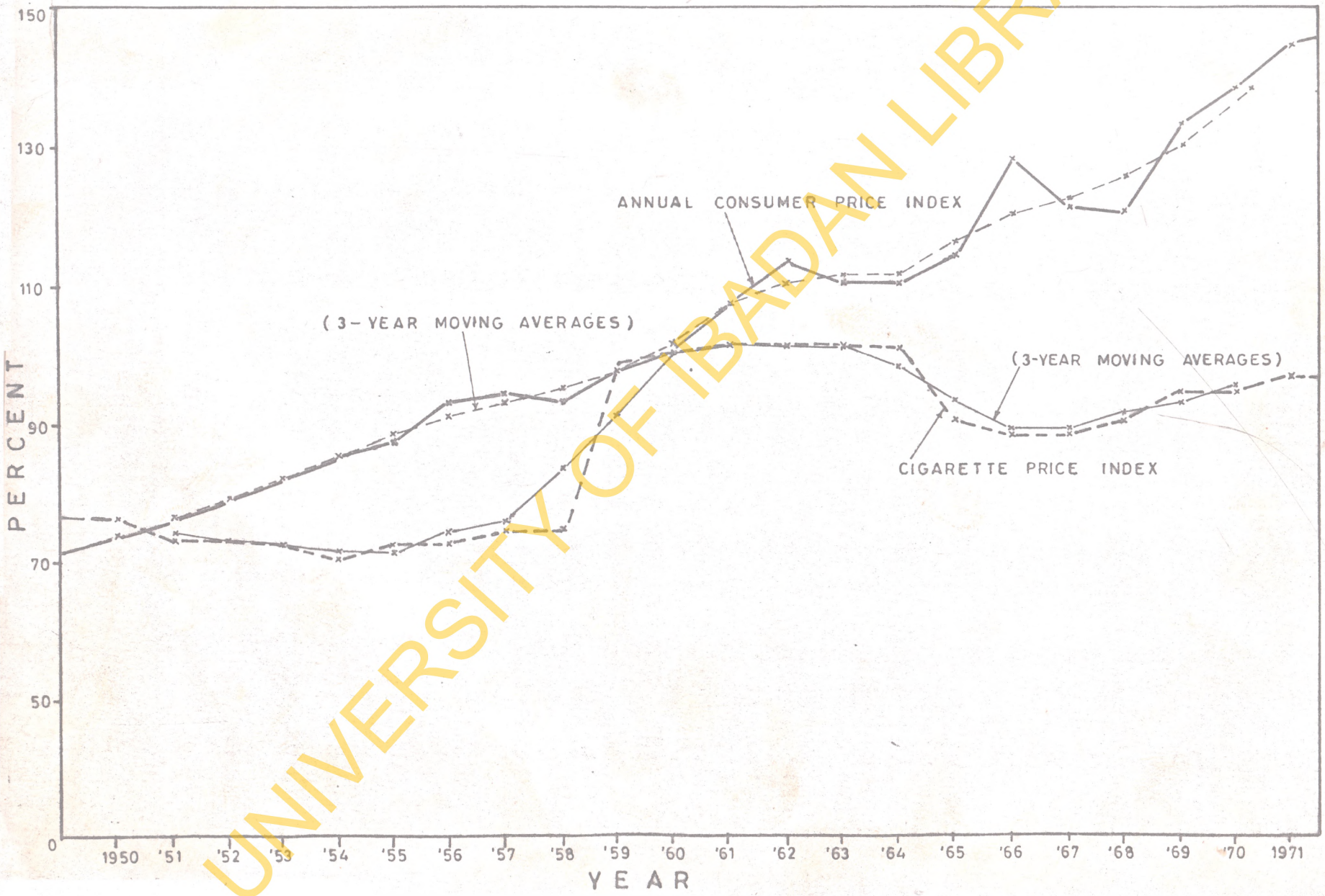
5. R.P. Congrad, Etude econometrique de la demande de tabac, Paris 1955.

Chart I

MOVEMENT OF ALL CITIES CONSUMER PRICE INDEX FOR LOWER INCOME GROUP AND CIGARETTE PRICE INDEX (1950-71) ANNUAL AVERAGES



during the period under consideration there was money illusion at work. Using nominal income and prices, the condition for the absence of money illusion would be indicated by

$$\beta + \gamma + \delta = 0 \quad .. \quad .. \quad .. \quad .. \quad (3.2.3).$$

If nominal prices and real income are used as R. Stone did in his studies in 1945, then the absence of money illusion would be indicated by the sum of the two price elasticities being equal to zero. However, the results obtained here do not prove these to be true.

Another reason for using money income in this study, besides its better results compared with the real income formulation,[6] is that it is easier for economic interpretation. It is also more convenient for practical computations to have the whole price effect, (substitution plus income effect) measured by a single coefficient for each P (price of cigarette) and I (price of other commodities). The interest in demand analysis is in measuring the percentage change in the quantity demanded of a commodity as a result of a percentage change in its own price (P) or in prices of other commodities (I), not bothering to split this change into an "income effect" and a "substitution effect".[7] Furthermore, the general price index (I) is suspected to be biased because of the inadequate coverage of the consumer surveys from which the index was computed. It is possible

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6. See Appendix B1 - B3 for the Real Income and Relative price formulation results which are "poorer".

7. See A. Koutsoyannis, op. cit., pp. 4-5.

that this bias has contributed partly to the bad results of the real income and relative price formulation.

In the chosen equation, absolute prices, (P) and (I), are included explicitly. Such a formulation indicates, by implication, that the coefficients (γ) and (δ) - which represent total price elasticities - are left to "float-free" instead of being restricted as in real price formulation which is of the form:

$$Q = a \left(Y/I\right)^{b} \left(P/I\right)^{c} e^{rT + fW}$$

In the latter formulation the restriction is imposed upon the coefficients of P and I that, $-\gamma = \delta = C$. In fact, a-priori, it is expected that $-\gamma > \delta$; i.e. that demand for cigarettes is more sensitive to changes in the price of cigarettes than to changes in other prices. By leaving γ and δ unrestricted, such a hypothesis can be tested directly in terms of the estimated values of $\hat{\gamma}$ and $\hat{\delta}$.

The variable P is an average price for all brands of cigarettes, computed by dividing total expenditure on cigarettes during each year by the quantity consumed. The average price computed in this way will be a weighted average of the retail prices of all brands during the year in question. Thus the regression coefficient of log P will be an average price elasticity for one time period of a year. It is not possible to measure point elasticity because of the lack of data for short periods. Even if it were possible to measure the short-run elasticity, it would be of limited practical value since it is the

long-run elasticity that is important in empirical analysis, [Wold and Jureen 1953]. The reaction of consumers to any change in price in the short-run is usually capricious especially for tobacco products. Experience shows that the immediate effect of a change in retail price tends to be a turning to lower quality types of cigarettes,[8] so that the total quantity will be practically unaffected. After a short period, (perhaps one to four months) consumers resume the old pattern of their demand.[9] Thus it is the long-run elasticity which is most significant from an economic point of view. Similar consideration holds for the coefficient of income.

Since cigarettes have no exact direct substitute (except substitution among the different brands of cigarettes) the influence on cigarette consumption of a change in price of any other particular product is not considered.

Instead of the price of any particular commodity, the influence of changes in the prices of all other commodities as reflected by a general price index which should, of course, exclude the price of cigarette, is examined. Unfortunately the index is not net of cigarette index. It is expected that errors introduced from this source will be small. On the other hand, even if the price of cigarette could be extracted from the index, it would make no perceptible difference to the price-index of the remainder.[10]

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8. See, Budget Speech 1960, Federal Ministry of Finance, Lagos.
9. See, Tobacco, published by Barclays Bank D.C. (London, 1961), p. 62. Also see, N.T.C., Annual Reports 1959 and 1960.
10. See also, R. Stone, op. cit., (1945).

It has been suggested by economic theory that the distribution of income is an important factor for demand analysis. For the period covered in this study, it was reported that there has been a trend towards greater equality in the distribution of income in Nigeria.[11] However, it is believed that the influence of this factor on consumption may not be important in the short-run. If there has been any variation in Q due to changes in the distribution of income, it is assumed that the coefficients of income and the trend variate will absorb it.

In addition to price and income factors, changes in population size could also influence the demand and consumption levels for cigarettes as well as the distribution by age and sex. A demand analysis should take such influences into consideration. Two ways of doing this are either to work with per capita data or by introducing population (to be denoted by N) as a separate variable in the equation. By the latter method, the direct influence of population change upon quantity demanded (Q) is measured while the former method (per capita data of consumption and income) assumes that the coefficients of income and population, in the formulation involving population, N, explicitly, sum to unity,[12] i.e.

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11. See, E. Vielrose, Distribution of Income in Nigeria, N.I.S.E.R., University of Ibadan, 1973.

12. The ideal 'population variable' to use is changes in the proportion of smokers to non-smokers which may not correspond exactly to changes in population, N, as applied in this function. In the analysis in chapter four two population variables are applied: i.e.
N = total population used to deflate G.D.P.
N' = Adult population over 21 years used as a proxy for proportion of smokers which data are not available (See Appendix D for more explanation).

$$Q/N = a\,(Y/N)^{\beta}\,P^{\gamma}\,I^{\delta}\,e^{rT} + fW \qquad \ldots\ldots\ldots\ldots (3.2.3)$$

$$= aY^{\beta}\,P^{\gamma}\,I^{\partial}N^{-\beta}\,e^{rT} + fW$$

$$Q = aY^{\beta}\,P^{\gamma}\,I^{\partial}N^{1-\beta}\,e^{rT} + fW$$

Because of the high intercorrelation of population N and the trend variable T, as do the N and Y (money income) series in this study, the per capita formulation is tested. In some cases, however, population was introduced explicitly in the equation and tested, if not for anything, to see what difference it could make in the results. But in general, where the function was expressed in aggregate as distinct from per capita terms, 'population' was dropped and its influence assumed absorbed by the trend factor, T.

Time, T, as an explanatory variable is introduced into the equation to take care of continuous variations of variables which have not been introduced explicitly into the relationship. In this study, the trend factor is expected to absorb the influences of such factors as changes in taste, in the distribution of income etc. It is also expected to account for such factors as advertisement[13] and

13. Advertisement in Nigeria is a very young enterprise and has yet to make its impact. For example, total advertisement outlay in Nigeria in 1970 was only 0.26% of the GDP for that year which was estimated at ₦3,720 million while the comparable figures for other countries are; Switzerland, 2.18; United States, 2.11; Australia, 1.40; Ireland, 2.25; United Kingdom, 1.13; Canada, 1.25; U.A.R., 0.52; Zambia, 0.44; and Ghana, 0.14 (see Daily Times, Sept., Saturday, 16th 1972, p.13). The N.T.C., the monopolist firm in the Tobacco Industry in Nigeria, started "noticeable" advertisement in the 1960's. Though its advertisement is making some impact (see, Chairman's Report in N.T.C. Annual Reports, 1964 and 1967), there is no data on the outlay. However, advertisement in the Nigerian Tobacco Industry has not assumed an "aggressive"

other social variables for which data are not available.

For the Civil War years, 1967-1970, a dummy variable, W, was introduced to account for variations in Q not due to changes in Y, P, I and not absorbed in T. The dummy will therefore take care of erratic influences on Q during the civil war period. For a greater part of this period, about 25% of Nigerian population was cut-off from the rest of the country which meant a loss of market for cigarettes. Such a loss was expected to reduce the total quantity of cigarettes consumed in the country, all things equal. However, this was not the overall result! It is suggested therefore, that some "erratic factors" at work in the larger population under the Federal Military Government might have caused the positive increase in consumption to off-set the negative effects caused by the temporarily lost smaller market. The dummy is introduced to measure this "net" effect.

3.3 PROBLEMS OF DATA COLLECTION IN NIGERIA

It must be admitted that one of the major problems in statistical analysis in the developing countries is the unavailability of relatively accurate data. Many students have been frustrated by this problem. The main cause of the problem is the suspicion and poor understanding existing between the producers and the users of statistical data. This is also the reason why producers of relevant data often refuse users the access to such data even when the data are

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(Footnote 13 continued)

nature because there is no doubt about the market for cigarettes in Nigeria nor is there any serious competition. (See, P. Kilby, op. cit., pp. 81-96).

available. In the present study, for example, it took a considerable time to convince the producers of the relevant data to make them available. The effect of this problem is that researchers resort to using available proxies which often affect the statistical results.

Another data problem in Nigeria, as correctly stated by Adamu (1972), is the difficulty in making national estimates for some relevant variables in some particular studies. At its present level of manpower and economic development, Nigeria cannot effectively undertake a nation wide consumer survey to cover all parts of the country simultaneously. As a result, the surveys[14] conducted so far in Nigeria took place at different periods and concentrated on some selected urban centres such as Lagos, Ibadan, Enugu, Kaduna, Ondo and a few others. In the first place, such "partial" surveys conducted at different times in the same country will introduce some bias into the resultant computations. Secondly, there is the problem of unrepresentativeness of the derived data since the surveys were biased towards the urban centres. For example, the general

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14. Urban Consumer Surveys were conducted in several towns at different times, viz.

Lagos,	1953/54, 1959/60
Enugu,	1954/55, 1961/62
Kaduna,	1955/56, 1962/63
Zaria,	1955/56
Ibadan,	1961/62
Onitsha	1963/64
Oshogbo/Ife/Ilesha,	1963/64
Akure/Ondo/Owo,	1964/65
Sokoto/Gusau,	1964/65

The Federal Office of Statistics, Lagos, compiles some of its data from the results of these surveys.

consumer price index used in this study was derived from the published data of the Federal Office of Statistics, Lagos, which got its information from the "partial" surveys. Nigerian society is not composed of only salary and wage earners, artisans and self-employed who live in the urban areas, on whose expenditure the index was computed. Over 70% of Nigerian population live in the rural areas where the surveys were not extended to. Furthermore, it is wrong to assume that the urban area dweller and the rural-area man in Nigeria buy all their consumer demand from the same market. Thus the general consumer price index as computed by the Federal Office of Statistics and used in this study will not go without suspicion.

These problems indicate that to pool data for any particular study, some assumptions have to be made. In addition to the above peculiar data problems are the usual difficulties common with data collection by sample surveys irrespective of the level of development though the problems assume greater dimensions in the developing countries.

Most of the data used in this study are considerably accurate because of the sources and methods of derivation, some of which are stated here below and others in appendix. Cigarette is one of the industrial products for which existing public regulations and Excise returns provide accurate quantity data for regression analysis. Excise tax returns and other public regulations such as "The Tariff Acts" were fully utilized to derive some of the appropriate data.

Limitations in the Study

Although most of the data used in the present study are considerably reliable, there are still some peculiar problems and limitations in this study which could be possible sources of error.

First, there are the problems of the single equation technique adopted in this study to analyse the time series. Some of such problems are:

(a) that the "disturbance term" could be autocorrelated in which case statistical tests on the estimated coefficients would be unreliable. Though this is an obvious problem, the computed Durbin-Watson 'd' statistic used in testing autocorrelation of disturbance term does not seem to suggest the existence of autocorrelation.

(b) that some of the variables in the formulations are considerably correlated as shown by the matrix of Zero-Order Correlation coefficient in chapter four. It is expected that multicolinearity problems would arise thus distorting the parameter estimates. As problematic as it is, this source of error was cross-checked with the computed standard errors which do not seem to confirm any serious multicolinearity problems. In addition, in this case the non-linear relation adopted in the analysis helped to reduce the above problem. However, it is expected that whatever multicolinearity problem that remains will have less distortive effect on the estimates.

(c) that other problems such as heteroscedasticity could arise. These ones were aptly asumed away in the log-linear relation adopted. Furthermore, the number of observations is deemed not too small as to aggravate these problems. Other problems like identification and specification errors are discussed in appendix C.

Secondly, there are the problems raised by the aggregation of cigarettes discussed in the preceeding section. This problem follows logically from the first one above. Aggregation over individual consumers tends to hide individual differences in terms of consumption behaviour, response to changes in price and income etc. In the same way, aggregation over products (i.e. brands of cigarettes as done in this study) conceals the intra-product differences in terms of the individual characteristics of the various brands. Aggregation in this study has led logically to some assumptions, one of which is the assumption that cigarettes are homogenous, which, in reality may not be very correct since different brands of cigarettes of different qualities and prices are available. Logically, this suggests that individual peculiarities are expected to exist among the brands. For example, the price elasticity of demand for cigarettes may not be same for all the brands as is indicated by the possibility of consumers shifting from an expensive high quality cigarette to a cheaper brand if the price of the former is raised. This type of

intra-product analysis is not provided here because of abject lack of relevant data. The alternative left, which this study applies, was to aggregate and assume that cigarettes are homogeneous products. It is expected that this problem will not introduce much bias in the analysis since the basic characteristics of cigarette consumption seem to be the same.

Finally, there is the data problem which is an obvious one in developing countries. Some of the required time-series are rarely available, thus proxies are utilized. For example, the required series of disposable personal income were not available so G.D.P. at factor cost was used instead. To reduce errors introduced through this source, the per capita consumption and income formulation was tested to compare with the nominal value formulations. Another problem stems from the lack of data on such other tobacco products as snuff, pipe tobacco, home-made cigarettes etc. which could have been tested as possible substitutes for manufactured cigarettes. These tests are not, therefore, tried though it seems doubtful if these products are exact direct substitutes of cigarettes. In addition, cigarettes are the major products of the Tobacco Manufacturing Industry in Nigeria; cigarettes occupy about 95% of the manufactures of the firms in the Industry. It seems therefore that the substitution mentioned above may not be a serious one, hence errors from this source may be negligible.

However, the deficiencies introduced by all these sources are taken into consideration in the interpretation of the results of the analysis as well as the application of the results to policy matters in chapters four and five.

CHAPTER FOUR

ANALYSIS OF TIME SERIES OF CIGARETTE

The single-equation model adopted in this study to analyse the time series data is applied in two ways. First, there is the static analysis, and, second, the dynamic analysis.

4.1. STATIC ANALYSIS

Equation (3.2.2) states that demand for aggregate cigarette is a function of personal disposable income, average prices of all goods in a consumer's budget and other explanatory factors, such as, a war-year dummy and a trend variable which is expected to absorb the influences of all other "autonomous" factors, (e.g. population, taste, habit, etc.) which affect the dependent variable. However, there are several reasons that, in practice, a regression is not specified in this study to include all factors which may have causal influence on the dependent variable under analysis.[1] First, it is legitimate to make the demand theory as simple as possible, taking into explicit account only the main causal factors. Second, statistical data are lacking for certain variables. Finally, the causal factors may be highly inter-correlated. The large number of explanatory variables may increase the sampling errors of the regression coefficients and tend to obscure the importance of the explanatory variables in the equation. Thus equation (3.2.2) is fitted in the present analysis.

1. See H. Wold and L. Jureen (1953); Demand Analysis (New York: John Wiley and Sons, Inc.), pp. 35-48.

In section (2.2), the discussion came to a conclusion that there are two major alternative assumptions relating the results obtained from market data to the parameters of the individual demand functions. The first is that a market is assumed to be homogeneous in the sense that all consumers have the same preferences and face the same prices. For this assumption, the coefficients of prices and income variables in a market demand function are simple averages of the individual coefficients of prices and incomes. The alternative assumption is that all the incomes of consumers change in the same proportion and that all prices change in the same proportion over the entire market. Thus, the coefficients of price and income variables in the market demand function will be weighted arithmetic means of the individual coefficients of prices and income variables, the weights being the individual prices and incomes respectively. In this study, the first assumption is adopted. This procedure makes it easier to interpret the results of market data in terms of individual demand behaviour.

Summarising therefore, the demand for aggregate cigarette in the static analysis, can be stated as a function of disposable income, average price of cigarettes, and the prices of all other commodities together with two other variables, a trend factor and a war-years dummy. However, adult population was introduced explicitly in some of the equations to assess its impact.

This study attempts to test the following hypotheses:

(1) Consumer demand for aggregate cigarette is inelastic with respect to an average of cigarette prices; the demand response is negative. The price elasticity of demand is expected to be low because; (a) smoking has become a very strong social habit, so that cigarette is considered among the "necessity" products; (b) cigarettes have no direct substitutes.

(2) Disposable income (nominal) will affect aggregate cigarette consumption positively with a low income elasticity of demand. This results from the fact that cigarette is not an inferior good. A second reason is that as a "necessity" cigarette accounts for a small proportion of consumers' budgets which is used to purchase quantities adequate to satisfy the needs of smoking. An additional reason for the low elasticity is that, unlike most other "necessity" commodities, cigarette is offered at a wide variety of prices according to quality which makes it possible for the consumer to turn to cheaper brands when income falls and to higher quality type when income increases without affecting the total quantity demanded.

(3) The average level of all other prices (I) will affect cigarette consumption positively with a low elasticity. The low elasticity expectation is as a result of the lack of direct substitutes for cigarettes. However, the results obtained here do not support this expectation.

(4) The influence of variation in adult population will affect the demand for cigarette positively and significantly.

(5) Other factors such as taste, advertisement, social factors etc. which are not included explicitly in the functions but assumed absorbed in the 'catch all' variable, T, will have a positive effect on cigarette consumption.

(6) The civil-war-years dummy will have a "Net" positive effect on cigarette consumption.

Using the classical least-squres estimation technique on (3.2.2), the estimated results for 1950-1971 are:

$$Q_t = -1.2867 + 0.6393Y_t - 0.3228P_t + 1.7492I_t + 0.0072T + 0.0360W \quad (4.1.1)$$

$$(2.3658) \quad (-2.4913) \quad (6.0696) \quad (2.1642) \quad (1.7395)$$

$R^2 = 0.9948$ S.E. = 0.0186 D-W = 2.0214

where R^2 denotes the coefficient of determination, S.E. denotes the standard error of estimate, and D-W denotes the Durbin-Watson 'd' statistic for testing serial correlation of random disturbance. Note that all the variables in equation, (4.1.1) and others to follow are in logarithms except T and W. The value in the parentheses under each regression coefficient is the calculated t-value of the coefficient.

The statistical results indicate that 99.48% of the variation in aggregate consumption of cigarette during the period 1950-1971 can be explained by the variation of the five explanatory variables. According

to the two-tail "t" test,[2] each explanatory variable is statistically significant at the 5% level except the dummy variable.

Since the logarithm function is adopted in this analysis, the elasticities can be read off from the regression results. However, the computed income elasticity is 0.6393, the price elasticity is

(0.1666)

- 0.3228

(0.1112)

and the cross elasticity with respect to prices of all other commodities is 1.7492

(0.1537)

The values in the brackets are the standard errors of the estimated elasticities.

From these results, it can be inferred that the demand for cigarettes during the period 1950-1971 is inelastic with respect to its price and the current income factor though both are statistically significant. Anna Koutsoyannis in her 'aggregate' study of the demand functions of tobacco products in fourteen countries[3] came out with the same result of inelastic demand for price and the current income factor. The results of this study is compared with her findings as shown in the table 2 below (using, U.S.A., France, U.K., Canada, Ireland, Australia, Finland, Sweden, Belgium, Greece from her study and Nigeria

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2. Throughout this study, whenever "t"-test is mentioned it implies a two-tail 't'- test.

3. See A. Koutsoyannis, op. cit.

Table 2

Comparison of Price and Income Elasticities

Country	β_Y	γ_P	No. of Independent Variables	R^2
U.K.	0.0663 (1.07)	- 0.0365 (0.17)	4	0.997
France	0.8281 (12.87)	- 0.5439 (14.90	3	0.937
U.S.A.	0.3370 (1.18)	- 0.9373 (5.63)	3	0.722
Canada	0.0898 (0.17)	- 0.2094 (0.30)	3	0.902
Ireland	0.5556 (1.07)	- 0.1471 (1.04)	3	0.722
Australia	0.4258 (0.81)	- 0.3619 (3.43)	3	0.977
Finland	0.1322 (2.65)	- 0.4150 (30.03)	3	0.918
Sweden	0.2632 (0.77)	- 0.4137 (1.83)	3	0.789
Belgium	-	- 0.6780 (7.04)	2	0.574
Greece	0.0655 (0.36)	-	3	0.965
Nigeria	0.6393 (5.62)	- 0.3228 (6.18)	5	0.995

as reported here). It should be noted however, that the basis of comparison is not very tenable because of the following:

(a) Nigeria is not as developed as anyone of the 14 countries she studied.

(b) She used only 10 observations (i.e. 1950-59) while this study used 22 i.e. 1950-71. Sampling errors in a ten-year period may be expected to be greater than in twenty-two-year period.

(c) Her independent variables are not as many as are used here.

(d) The market conditions for cigarette in all the countries are not the same.

Although these are strong basis for non-comparability, the comparison was done just to see how the two sets of results look and because there is no known comparable earlier study in Nigeria. The values in the brackets are the values of the "F" tests on the estimated parameters. The above table shows the plausibility of the results of this study which support the hypothesis that the demand for cigarettes is inelastic with respect to its price and current income. None of the coefficients in the table for any of the countries including Nigeria is up to unity. It will later be seen that these results are also supported by the per capita data formulation.

The effect of prices of all other commodities on the demand for cigarette is positive, strong and statistically significant. The coefficient is well above unity and greater than the coefficient of

price of cigarette. The latter situation (i.e. $\partial > \gamma$) indicates that consumers are more sensitive to the prices of other commodities than to the prices of cigarettes. Stone discovered the same pattern of reaction in the U.S.A. Stone had a cross elasticity of about 1.146 for prices of other commodities (Π), when he excluded income in his equation, and 0.590 (where the cigarette price elasticity was - 0.236) when income was included.[4] If consumers in such a high per capita income country like the U.S.A. are more sensitive to the prices of other commodities, then a stronger sensitivity may be expected in Nigeria which has a very low per capita income.

It is conceivable however, that $\partial > \gamma$ for one of the following possible three reasons.[5] First, it is possible that people pay more attention to the price movement of durable as opposed to non-durable goods, and try, if they can, to purchase durable goods when they are relatively cheap. Second, people may be relatively insensitive to the prices of articles which involve only small individual outlays. Thus they may be impressed by the relative lowness of rents in the suburb as opposed to the urban centre because rent is usually thought of as an annual sum, but may give an unreasonably small weight to the cost of travel between home and office because this is normally thought of as a rather trivial daily outlay. Finally, consumers may be less sensitive to the price movements of commodities that are

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4. See R. Stone (1945), op. cit., p. 327.

5. Ibid., p. 295.

habitually purchased than they are to those of goods which are bought only at rare intervals.

The high coefficient of I shows indirectly the utility of cigarettes to the consumers. Per capita income in Nigeria is very low compared to other advanced countries thus it should be expected that the demand for cigarette would be very sensitive to changes in the price level of other commodities. It would further be expected that Q would change in the opposite direction to changes in I because of the low per capita income. The latter expectation tends to underestimate the peculiar utility of cigarettes to the consumers compared with the utility of some other commodities. A smoker could risk walking a long distance home instead of hiring the service of a taxi-cab if the money he had was not sufficient for buying cigarette and paying the taxi-cab. The results obtained here support the above claim. The high coefficient implies that prices of other commodities have considerable influence on the demand for cigarette. To support this, the Chairman of N.T.C., in his annual report in 1971, stated that N.T.C.'s sales volume increased by 8½% in 1971 over that of 1970 despite the fall in producer incomes partly because the price of cigarettes was not raised when prices of other commodities rose in the country in 1971.[6] Thus this result seems realistic, at least in Nigeria, because of the "firm ground" smoking habit has gained among smokers and also, because of the peculiar and almost

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6. See N.T.C., Annual Reports and Accounts 1971, p. 11.

indescribable needs cigarette fulfils[7] which cause smokers to become addicts.

The statistical significance of the trend variable implies that the variation in cigarette consumption can be explained, in part, by the variations of other factors not included explicitly in the equation. The positive coefficient indicates that an increase of one per cent in the variation of the variable which represents the joint effect of the excluded factors (taste, habit, advertisement, population, etc.) will increase aggregate cigarette consumption by 0.007 of one per cent, holding the effects of other variables in the equation constant.

The positive coefficient of the 'war-dummy' indicates that some 'erratic factors' not accounted for by the other variables included in the function, affected the aggregate consumption of cigarette during the Nigerian Civil War period, 1967-1970. This result tends to support the finding in Zaire Republic (formerly Congo Kinshasha) after their civil war that the aggregate consumption of commodities such as cigarette and beer increases during major political upheavals.[8]

The error term in economic time-series analysis is likely to be positively correlated.[9] The variables in the function such as Y and I may be highly correlated. Table 3 shows the correlation matrix for the

7. The smoking habit is so strong among smokers that despite all the warning against the disastrous effects of smoking, more people still indulge in smoking. See, A.J. Isong, "Cigarette Smoking", in the Daily Times of 30/12/72, p. 7.

8. See P. Kilby (1966), op. cit., p. 94 (footnotes)

9. Arthur S. Goldberger, (1964); Econometric Theory, (New York: John Wiley & Son, Inc.), p. 242.

time series data for equation (4.1.1) and explains the problem above.

Table 3

Matrix of Zero-Order Correlation Coefficients for Equation (4.1.1)

	Q_t	Y_t	I_t	P_t	T	W
Q_t	1,000	0.918	0.922	0.610	0.808	0.521
Y_t		1.000	0.801	0.606	0.881	0.402
I_t			1.000	0.687	0.897	0.491
P_t				1.000	0.729	0.247
T					1.000	0.392
W						1.000

The correlation between income, Y, and the price index, I, is 0.801; between income and the price of cigarette, 0.606; and between income and the trend variable, 0.881. These relatively high intercorrelations of explanatory variables tend to increase the sampling errors in the individual coefficients of the demand function. However, the Durbin-Watson 'd' statistic is used to test autocorrelation of the disturbance term. The D-W statistic table shows that when n = 22 and k = 5 at a 5% level of significance, du = 1.92.[10] With the computed D-W statistic at

10. J. Durbin and G.S. Watson, (1950 & 1951); "Testing for serial correlation in Least-Squares Regression", Biometrika, Part I and II, vol. 37 and 38, pp. 407-428 and pp. 159-178.

2.0214, the hypothesis that no positive autocorrelation of disturbances is present can be accepted.

As stated earlier, the present study attempts to assess the influence of changes in the proportion of smokers to non-smokers[11] on cigarette consumption. Three formulations were tested. First, adult population, N', was introduced explicitly in equation (4.1.1) while the trend variable was excluded. The results obtained are:

$$Q_t = -1.3315 + 0.6423Y_t - 0.3224P_t + 1.7592I_t + 0.0160N'_t$$
$$\qquad\qquad (2.4662) \quad (-2.5221) \quad (9.9014) \quad (2.1346)$$
$$+ 0.0342W \qquad .. \qquad .. \qquad .. \qquad .. \qquad .. \qquad (4.1.2)$$
$$(1.2295)$$

$R^2 = 0.9934$ S.E. = 0.0212 D-W = 1.9912

where N'_t is adult population over 21 years in year t. The statistical significance and the positive coefficient of N'_t indicates that changes in adult population could explain, partly, the variation in aggregate cigarette consumption within the period 1950-71.

The above result is supported by the second formulation tested which includes explicitly both population, N', and trend, T, variables. The results obtained are:

$$Q_t = -1.9790 + 0.6231Y_t - 0.3223P_t + 1.7382I_t + 0.0105N'_t$$
$$\qquad\qquad (2.2005) \quad (-2.3515) \quad (6.2171) \quad (2.2210)$$
$$+ 0.0039T + 0.0360W \qquad .. \qquad .. \qquad .. \qquad (4.1.3)$$
$$(0.0293) \quad (1.4960)$$

$R^2 = 0.9945$ S.E. = 0.0117 D-W = 2.30

11. Adult population (i.e. population aged 21 and above) was used as a proxy for proportion of smokers in the total population using 1952/53 census figures. The age limit, 21 years, is the "Franchise age" which the Nigerian Government recognises as the age of adulthood. See Federal Government of Nigeria, The Republican Constitution 1963, Government Printer, Lagos, 1964.

The coefficient of N' is positive and considerably significant as in equation (4.1.2). Comparing equations (4.1.1) and (4.1.3), it is observed that the influence of N' is quite considerable. It reduced the coefficient of T in (4.1.1) and left it (equation 4.1.3), statistically non-significant as measured by the computed t-value.

Generally, it is known that the two variables, N' and T are highly intercorrelated. This is confirmed by Table 4 below which shows the zero-order correlation coefficient matrix for equation (4.1.3).

Table 4

Matrix of Zero-Order Correlation Coefficients for Equation (4.1.3)

	Q	Y	I	P	T	N'	W
Q	1.000	0.918	0.922	0.610	0.808	0.807	0.521
Y		1.000	0.801	0.606	0.881	0.820	0.402
I			1.000	0.687	0.897	0.810	0.491
P				1.000	0.729	0.620	0.247
T					1.000	0.900	0.392
N						1.000	0.352
W							1.000

The correlation between, N' and T is 0.900 which is quite high. However, the computed D-W statistic (D-W = 2.30), does not indicate that there is positive serial correlation of residuals.

The third formulation tested was the per capita data function. In this formulation, the aggregate cigarette quantity, Q, was deflated with adult population, N', while nominal disposable income, Y, was deflated with the total population figure for the country.[12] Because of the high correlation of N' and T (i.e. 0.900), and the statistical non-significance of the trend variable in (4.1.3), T is omitted in the per capita data function tested below. The results obtained are:

$$C_t = -1.1624 + 0.4012M_t - 0.3459P_t + 1.7614I_t + 0.0312W \quad .. \quad .. \quad (4.1.4)$$

$$(2.1781) \quad (-2.4709) \quad (10.5868) \quad (1.9251)$$

$R^2 = 0.9860$ S.E. = 0.0226 D-W = 1.995

where C_t is per capita cigarette consumption and M_t is per capita income, all in year t. All explanatory variables are statistically significant at the 5% level except the dummy which is significant at 10%. The variables also have right signs and the explanatory power of the function as indicated by the R^2 is quite high. These results are consistent with those of aggregate consumption - [i.e. equations (4.1.1) to (4.1.3).]

For a better comparison, a second per capita data function including T explicitly was tested.[13] In general the results obtained did not improve the fit any much better. In fact the per capita income, M, is significant only at the 10% level. The trend variable remains statistically non-significant though with the right sign for its

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12. See Appendix D for explanation on the Census (1952/53) figure used.

13. See the results in Appendix A4.

coefficient. Judging from all these results it seems reasonable to state that variations in adult population within the period under consideration had greater influence upon cigarette consumption in Nigeria than other "autonomous" factors assumed absorbed in the trend factor. One of the most important factors in population accounting for this influence is the increase in the proportion of smokers to non-smokers, mainly because of the extension of smoking among women and members of the lower age groups.

The statistical significance of the per capita income variable looks reasonable on both theoretical and empirical grounds. Even though cigarette as a "necessity" accounts for a small proportion of a consumer's budget used in purchasing quantities adequate to satisfy more or less the need of smoking, it seems reasonable to expect budget on cigarette to increase as income increases though less than proportionally. The significance of income is further explained in the speech of the Chairman of the N.T.C. to the Shareholders' Annual Conference in 1971; "Our own sales volume was up by 8½% over 1970 compared with an increase of 37% in 1970 over 1969. To some extent this was caused by the fall in produce crop [i.e. producer income] in the North".[14]

The results obtained in all the equations interpreted above are consistent with respect to signs, magnitude and statistical significance of the variables.

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14. See, N.T.C., Annual Report and Accounts, 1971, p. 11.

4.2. DYNAMIC ANALYSIS

The demand functions so far considered are static, in the sense that the quantity demanded in any time period depends on the incomes and the prices of that period alone. It is generally recognized that the past behaviour patterns of consumers may affect current consumption. For cigarettes, the social attitude attached to its consumption and the extraordinary nature of the need which it fulfils makes the consumption of it relatively stable in a consumer's budget. In fact, cigarette as a "necessity" product assumes the same position as food items in a consumer's budget.

Levels of cigarette consumption, therefore, are subject to habit formation, which suggests that these levels do not adjust immediately to changes in income and that current consumption is positively influenced by past consumption level. Metaphorically, it could be said that the consumer has built up a "psychological stock" of consumption habit.[15] This argument may be more correct in the case of cigarette which has become not only a "necessity" product to consumers, but a "peculiar" product that satisfies a "peculiar" need of smokers.

One of the commonly used approcches to test the habit-persistence hypothesis is to adopt the geometric distributed-lag model as formulated by Koyck.[16] He suggests the following model:

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15. H.S. Houthakker and L.D. Taylor, (1966); Consumer Demand in the United States 1929-1970, (Cambridge: Harvard University Press), pp. 8-11.

16. L.M. Koyck, (1954); Distributed Lags and Investment Analysis, (Amsterdam; North-Holland Publishing Co.).

$$Y_t = \beta \sum_{i=0}^{\infty} \lambda^i X_{t-i} + U_t \qquad \ldots\ldots\ldots\ldots\ldots \quad (4.2.1)$$

$$(0 < \lambda < 1)$$

where the coefficients decrease geometrically.

By deriving the difference between the two equations

$$Y_t = \beta X_t + \beta\lambda X_{t-1} + \beta\lambda^2 X_{t-2} + \ldots + U_t$$

$$\lambda Y_{t-1} = \beta\lambda X_{t-1} + \beta\lambda^2 X_{t-2} + \ldots + \lambda U_{t-1}$$

we have

$$Y_t = \beta X_t + \lambda Y_{t-1} + V_t \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4.2.2)$$

where $V_t = U_t - \lambda U_{t-1}$. Nerlove derives (4.2.2) directly by assuming that

$$Y_t^* = \alpha X_t \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.2.3)$$

where Y_t^* denotes the desired value of Y_t.[17] The adjustment to the desired value in one period is

$$Y_t - Y_{t-1} = \partial (Y_t^* - Y_{t-1}) \qquad \ldots\ldots\ldots\ldots \quad (4.2.4)$$

where $0 < \partial < 1$ is the "coefficient of adjustment". Substituting (4.2.3) into (4.2.4) and rewriting gives the form of (4.2.2):

$$Y_t = \alpha\delta X_t + (1 - \delta) Y_{t-1} \qquad \ldots\ldots\ldots\ldots \quad (4.2.5)$$

There are statistical problems in estimating β and λ in equation (4.2.2). The variable Y_{t-1} is determined in part by U_{t-1} and is not independent of $V_t = U_t - \lambda U_{t-1}$. Besides, V_t has serial correlation if the U_t are serially independent. Therefore, the classical least-squares estimators of β and λ might not be consistent. Klein has

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17. M. Nerlove, (1958); Distributed Lags and Demand Analysis, U.S. Department of Agriculture, Agriculture Handbook 141, (Washington; Govt. Printing Office), pp. 18-20.

suggested a method of obtaining consistent estimates of β and λ. He suggests that equation (4.2.2) be written directly with the assumption that V_t is a random disturbance with zero expectation and constant variance.[18] From Klein's suggestion, the dynamic formulation of demand function can be written as

$$Q_t = \beta_o + \beta_1 Y_t + \beta_2 P_t + \beta_3 I_t + \beta_4 T + \beta_5 W + \beta_6 Q_{t-1} + U_{2t} \quad \ldots\ldots(4.2.6)$$

where

Q_{t-1} is aggregate cigarette consumption in year t-1. U_{2t} is the random disturbance in year t. Note that equation (4.2.6) and others to follow are in logarithm formulation as in section (4.1), except the variables, T and W.

It is expected that β_6 should be positive, that is, the more a consumer has consumed cigarettes in the past, the more he will consume currently (taste, prices and income given). The expression $(1-\beta_6)$ is defined as the "coefficient of adjustment". Normally, the coefficient of adjustment is greater than zero and less than one.

The estimated results for 1950-71 are:

$$Q_t = \underset{}{-1.827} + \underset{(2.3150)}{0.5402Y_t} - \underset{(-2.1084)}{0.2636P_t} + \underset{(4.3895)}{1.4629I_t} + \underset{(0.6784)}{0.0102T} + \underset{(1.6863)}{0.0474W}$$
$$+ \underset{(1.7690)}{0.1448Q_{t-1}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.2.7)$$

$R^2 = 0.9942$ S.E. = 0.0199 D-W = 2.203

From the above results, the short-run income elasticity is 0.5402, the price elasticity is - 0.2636 and the cross elasticity with respect

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18. L.R. Klein, (1958), "The Estimation of Distributed Lags", Econometrica, vol. 26, pp. 553-565.

to all other prices is 1.4629. In the long-run, given sufficient time to adjust, for every set of prices and incomes, one and only one equilibrium quantity will be demanded. This implies that in the long-run $Q_t = Q_{t-1}$.

Thus equation (4.2.7) can be rearranged so that all the coefficients on the right side are divided by (1 - 0.1448) to obtain the long-run elasticities. In other words, the long-run income elasticity of demand, 0.6316, is given by

$$\frac{\beta 1}{1 - \beta_6} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4.2.8),$$

the long-run price elasticity of demand, - 0.3082, is given by

$$\frac{\beta 2}{1 - \beta_6} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4.2.9),$$

and the long-run cross elasticity of demand with respect to other prices, 1.7105, is given by

$$\frac{\beta 3}{(1 - \beta_6)} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4.2.10).$$

Given a longer time for consumers to adjust their consumption pattern in response to the changes in income and prices, long-run elasticities should be higher than short-run elasticities. The results obtained here are consistent with economic theory. The coefficient, β_6 is 0.1448 and has a positive sign which implies that the more a consumer has consumed cigarettes in the past, the more he will consume currently.

The computed "coefficient of adjustment", $(1 - \beta_6)$ is 0.8552, which implies that the consumption adjustment is quite fast.

This result seems reasonable especially for cigarette which gives the consumer some social, psychological and other "peculiar" satisfaction which, in turn, makes adjustment to changes in prices and income fast. The results are also supported by results obtained from per capita data formulation tested.

The results obtained are:

$$C_t = -0.9979 + \underset{(1.5266)}{0.3399M_t} - \underset{(-2.3581)}{0.2973P_t} + \underset{(4.7260)}{1.5203I_t} + \underset{(0.6583)}{0.1334Q_{t-1}}$$

$$+ \underset{(1.8814)}{0.0336W} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.2.11)$$

$R^2 = 0.9860$ S.E. = 0.0230 D-W = 1.9750

As in equation (4.2.7), rearranging equation (4.2.11) gives the long-run income elasticity as 0.3922; the long-run price elasticity as - 0.3430 and the long-run cross elasticity with respect to other prices as 1.7543. The computed "coefficient of adjustment" is 1 - 0.1334 = 0.8666 which is very high and, again, indicates a really fast consumption adjustment. The coefficient β_6 also has a positive sign as in (4.2.7).

As for the error term, in most cases, the addition of the lagged endogenous variable to the regression will reduce the serial correlation of the residuals and hence increase the Durbin-Watson statistics. However, in the above result, the statistic is biased towards 2,

(the value it should be if no serial correlation is present). This bias is due to the addition of the lagged endogenous variable to the regression equation. In such a situation it becomes doubtful if the statistic should be used to test for serial correlation in residuals.[19]

All the same, the results tend to confirm the hypothesis that habitual consumption patterns affect current consumption.

19. M. Nerlove and K. Wallis, (1966); "Use of the Durbin-Watson Statistic in Appropriate Situations", Econometrica, vol. 34, pp. 235-238.

4.3. SUMMARY OF RESULTS

TABLE 5

Summary of Results obtained in the Static and Dynamic Analysis of the Time Series Data of Cigarettes

VARIABLES	COEFFICIENTS OF STATIC ANALYSIS				COEFFICIENTS OF DYNAMIC ANALYSIS			
	EQUATION 4.1.1	EQUATION 4.1.2	EQUATION 4.1.3	EQUATION 4.1.4	EQUATION (4.2.7)		EQUATION (4.2.11)	
					SHORT-RUN	LONG-RUN	SHORT-RUN	LONG-RUN
Nominal Income	0.6393 (2.3658)	0.6423 (2.4662)	0.6231 (2.2005)	-	0.5402 (2.3150)	0.6316 (2.3115)	-	-
Per Capita Income				0.4012 (2.1781)			0.3399 (1.5266)	0.3922 (2.1025)
Price	-0.3228 (-2.4913)	-0.3224 (-2.5221)	-0.3223 (-2.3515)	-0.3459 (-2.4709)	-0.2636 (-2.1084)	-0.3082 (-2.5012)	-0.2973 (-2.3581)	-0.3430 (-2.2051)
Price Index	1.7492 (6.0696)	1.7592 (9.9014)	1.7382 (6.2171)	1.7614 (10.5868)	1.4629 (4.3895)	1.7105 (9.0260)	1.5203 (4.7260)	1.7543 (6.6723)
Trend	0.0072 (2.1642)	-	0.0039 (0.0293)	-	0.0102 (0.6784)	-	-	-
Adult Population	-	0.0160 (2.1346)	0.0105 (2.2210)	-	-	-	-	-
War-Dummy	0.0360 (1.7395)	0.0342 (1.2295)	0.0360 (1.4960)	0.0312 (1.9251)	0.0474 (1.6863)	-	0.0336 (1.8814)	-
Lagged Quantity Variable	-	-	-	-	0.1448 (1.7690)	-	0.1334 (0.6583)	-

Note: The figures in brackets are the computed 't' values.

CHAPTER FIVE

CONCLUSION AND SUMMARY

Having obtained the estimates of the parameters of all the functions tested in this study, it is now possible to compare directly the coefficients and comment on the test of some hypotheses. The comments and the policy implications of the results to be discussed later, from which some conclusions would be attempted are subject to the inevitable limitations in this study mentioned in chapter three.

5.1. Test of the Hypotheses:— $\gamma \neq \delta$ and $-\gamma > \delta$

The formulations including absolute prices, P and I permit a direct comparison of the coefficients of P and I. This comparison shows that

$$-\gamma \neq \delta \qquad \ldots\ldots\ldots\ldots\ldots\ldots (5.1.1)$$

in both aggregate and per capita data formulations. Another indirect test of the same hypothesis was done by computing models which included relative prices, $\frac{P}{I}$. Such formulations assume that

$$-\gamma = \delta \qquad \ldots\ldots\ldots\ldots\ldots\ldots (5.1.2)$$

If these relative price models yielded "worse" results than the models including absolute prices, it suggests that the two price elasticities are different. Indeed, all the functions (aggregate and per capita consumption) with relative prices give "worse" fit, which supports the evidence that $-\gamma \neq \delta$, (see appendix B1 - B3 for the results).

These results tend to suggest that consumers of cigarette, at least in Nigeria and within the period under analysis, do not act strictly according to the usual suggestions of economic theory. This result is in line with similar results obtained in France, Italy, the Netherlands, Sweden, Finland, Austraa, Canada and Australia.[1]

The second hypothesis, $-\gamma > \delta$, is settled unambiguously in the results. In all the computed equations, it is observed that

$$-\gamma < \delta \quad \ldots\ldots\ldots\ldots (5.1.3).$$

In other words, consumers appear to be more sensitive to changes in I than in P. Such comparable relation between P and I was found in Norway, Ireland and a few other countries[2] as well as in the U.S.A.[3]

These results further tend to support the argument that there was money illusion at work during the period under consideration. In the formulations adopted in the present study, the absence of "money veil" would be indicated by

$$\beta + \gamma + \delta = 0 \quad \ldots\ldots\ldots\ldots (5.1.4).$$

Even by mere observation it is seen that the sum of the three elasticities in all the equations is considerably different from zero. In addition, significance tests based on the estimated variance-covariance matrix of parameters in each of the relations including absolute prices, showed $\beta + \gamma + \delta$ to be significantly different from zero at the 5% level. Further tests conducted by

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1. A. Koutsoyannis (1963), op. cit., p. 16.
2. Ibid.
3. See R. Stone, (1945), op. cit., p. 315.

running regression for the periods 1950-66 and comparing with that of 1950-71 did not show a different picture.

Though these results are not completely free from such problems as serial correlation in the residuals, problems of aggregation and sampling errors which could make conclusions tentative, they seem plausible. For one thing, there were no violent movements in price levels, and therefore in real incomes within a greater part of the period under analysis to "rob money of its function" as a scale factor. Thus the assumption of the existence of money illusion seems plausible.

5.2. Economic and Policy Implications

With the necessary estimates of the coefficients available, it is easy to evaluate the demand situation for cigarettes and attempt at deriving some policy implications. The implications are considered on two levels.

5.2.1. Demand-Price Relationship

The computed elasticity of demand with respect to an average price of cigarettes is very low. In other words, the response of demand to changes in the price of cigarette is low. On the other hand, the computed cross-elasticity with respect to the prices of other commodities, I, is positive and greater than unity. Since these results indicate that there is a sort of "substitution" of cigarette for some other commodities when their prices are very high relative to cigarette price and since income has a positive coeffi-

cient, a fairly stable cigarette price will make cigarette relatively cheaper and thus bring about a greater net increase in sales, ceteris paribus. For instance, in 1970, the effects of some increases in income and the general price level coupled with stable cigarette prices accounted, partly, for the 37% increase in sales recorded by the N.T.C. But in 1971, the high rate of increase in sales fell considerably mainly, because of the fall in producer incomes in some parts of the country, especially in the North. The net increase of 8½% recorded that year was due partly to the unchanged prices of cigarettes when prices of other commodities went up which made cigarettes relatively cheaper. Perhaps if prices of cigarettes had increased along with the increase in prices of other commodities in addition to the fall in producer incomes, the net effect might have been a very low or negative increase in sales in 1971, all things being equal. It seems reasonable therefore to suggest to firms engaged in the Tobacco Industry to pursue a policy of retail price stabilization. Perhaps this accounts partly for the relative stability of cigarette prices over the years.[4]

5.2.2. Tax Revenue Policy

The practical implications of the computed price and income elasticities with respect to excise tax policies are quite significant. With a highly inelastic demand with respect to price of

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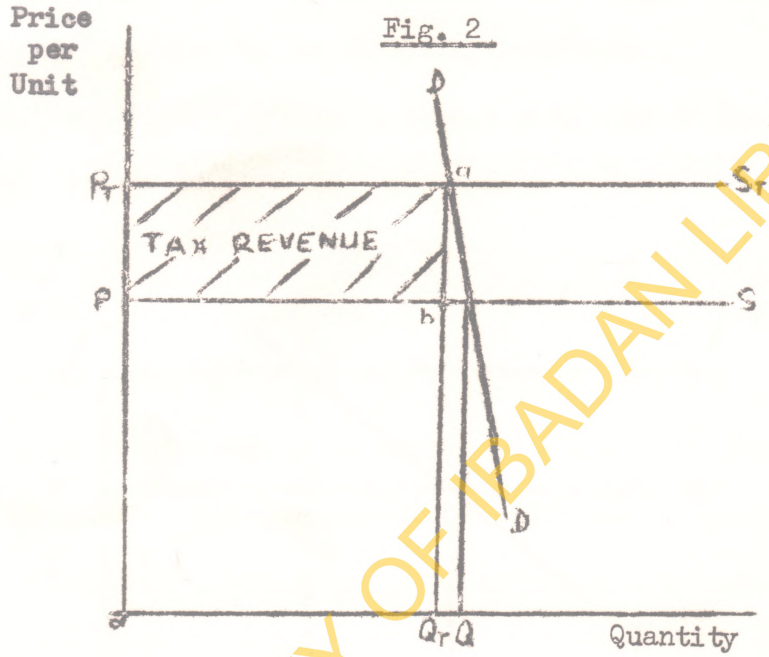
4. Most of the cigarette brands especially the low grade types have maintained the same price over the years. For instance, Bicycle, Sweet Menthol and a few other brands have remained at 1 kobo (1d) per stick since the 1950's.

cigarette and a perfectly elastic supply,[5] an imposition of per unit excise tax on cigarettes will raise price by the whole amoung of the tax; in other words, the tax will be paid entirely by the consumer. Figure 2 below depicts the situation:

Fig. 2



OP and OQ are the price and quantity of cigarette bought before the tax was imposed. OP_T and OQ_T are price and quantity bought after the imposition of the tax while PP_T is the unit tax. S is the supply curve before tax and S_T is the curve after tax. Since manufacturers of cigarettes in Nigeria are willing to supply any amount at a fixed price, apart from tax, the supply is infinitely elastic at that price. The diagram shows that the inelastic demand (D-curve) for cigarettes has caused price to rise by the whole tax, PP_T, to a new price, P_T.

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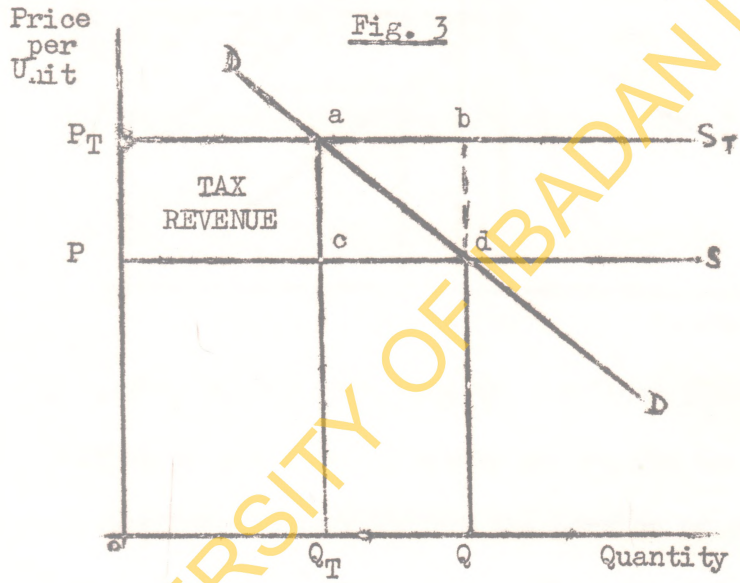
5. It is assumed, perhaps realistically, that since manufacturers are willing to supply any quantity at a fixed price, apart from tax, the supply is infinitely elastic.

The decrease in quantity demanded as a result of the rise in price is negligible (i.e. $0Q-0Q_T$). Consumers thus bear the incidence of the tax while Government achieves her objective - increased tax Revenue, P_TabP. Besides the larger revenue going to Government, the size of the industry is virtually unaffected.

Compare the above case with a situation of elastic demand as shown in fig. 3:

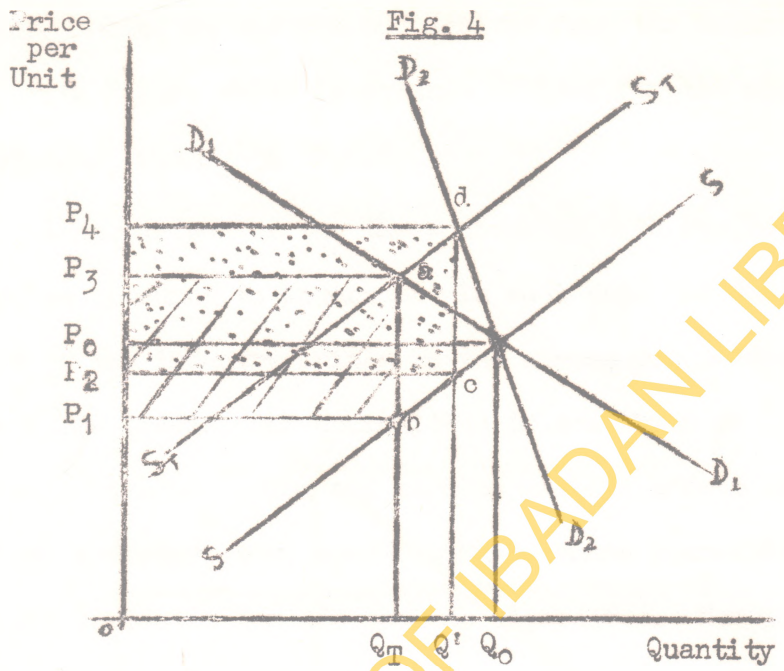
Fig. 3



OP, OQ, OP_T, OQ_T and the supply curves are as defined previously. The perfectly elastic supply assumption still holds. The producer increases price by the whole tax, $P - P_T$; quantity demanded at P_T falls considerably from OQ to OQ_T; the size of the industry is heavily affected and Tax Revenue is less by about the size of the area abcd, (compare with fig. 2).

But suppose supply is as elastic as demand but not perfectly elastic as in the two cases above. This is shown in figure 4:

Fig. 4



As usual, the S_T indicates the new cost level after tax. The new equilibrium price and quantity are P_3 and Q_T respectively on D_1. The unit tax imposed is P_1P_3 but the portion of the tax consumers pay in the form of higher price is less than the total unit-tax, i.e. $P_0P_3 < P_1P_3$. While the consumer pays P_0P_3 of the tax, the producer pays P_1P_0 of it thus receiving OP_1 as the new price for his commodity, which, of course is less than his previous price, OP_0. The industry size is affected as quantity supplied fell from OQ_0 to OQ_T. Government's objective of raising more revenue from tax will not be achieved because of the large decrease in quantity demanded in response to a small rise in price caused by the tax. Government's tax revenue is

$P_1P_3 \times OQ_T$ which is obviously less than a possible tax revenue if demand had been inelastic (D_2 curve) - in fig. 4 compare the area P_2cdP_4 which is tax revenue derived from the inelastic demand curve, D_2, with P_1baP_3 which is revenue derived for the elastic D_1. Obviously, $P_2cdP_4 > P_1baP_3$.

A comparison of the three diagrams with respect to the tax revenue accruing to Government in each case and the effect on the size of the industry brings up the strong suggestion that if governments are looking for commodities to tax which will yield a large revenue without having any serious adverse effect on the structure of the industry, they should turn to those commodities which have highly inelastic demands such as cigarettes. However, much caution should be taken in imposing tax on cigarettes. Cigarettes are in grades based upon the quality of tobacco-leaf and other materials used in manufacturing them. There are high, intermediate and low grade cigarettes which probably have individual characteristics in terms of elasticities. Unfortunately there are no sufficient data to measure these! However, one might think that a tax imposed on the high grade cigarettes which might have relatively more elastic demand with respect to their prices, could cause consumers to shift to cheaper brands; aggregate quantity consumed would be unaffected but the targetted tax revenue would not be realised because of the shift. This is precisely what happened to the Nigerian Federal Government in 1959 when it raised excise tax-rate on intermediate

grade cigarettes from 40 to 48% of the ex-factory price and failed to realise the additional £2 million (₦4 million) excise tax revenue expected. Indeed, because of the resultant lower tax revenue per £ of cigarette sales (i.e. consumers shifted to cheaper cigarettes) the then Federal Minister of Finance admitted that the move was a mistake.[6] It seems therefore, that the probably most price-inelastic grade of the three, (i.e. the low-grade) is the best bet for raising larger tax revenue. Unfortunately, on welfare grounds, the low-grade cigarettes need not be taxed since they are bought mainly by the poor whose standard of living is already too low.

5.3. SUMMARY

This study has aimed at quantifying economic and demographic factors that have affected consumer demand for cigarettes during the period, 1950-71. Perhaps everybody knows that the demand for cigarette is inelastic with respect to its price, but the question is, just how inelastic is it? This is the question this study has attempted at answering. Economic factors in this study include variations in incomes and prices while the demographic factor is changes in adult population.

The study has tried to depict the structure of demand for cigarette in Nigeria by analysing aggregate cigarette consumption in two ways: (1) as nominal aggregate product and (2) as per capita consumption. The time-series data used in the study has been analysed

6. See, Chief The Hon. F.S. Okotie-Eboh, Federal Minister of Finance, Budget Speech 1960, Federal Ministry of Finance, Lagos.

in static and dynamic formulations. While the static analysis regressed the dependent variable, Q, upon the current values of the independent variables, the dynamic approach introduced a lagged variable for cigarette consumption as an explanatory variable. The dynamic approach has been adopted to test the habit-persistence hypothesis of the consumption of cigarettes.

From all the results obtained in this study the following conclusions are derived;

First, the assumption of constant elasticity adopted here has yielded plausible results. In both nominal and per capita data formulations, the explanatory power of the independent variables has been very high, (i.e. R^2 is very high).

Second, the results indicate that price and income elasticities are very low. In other words, the demand for cigarette in the period under analysis was inelastic to changes in price of cigarette and in income. In all the formulations, both price and income elasticities are far below unity.

Third, cross elasticity with respect to other commodities is greater than one and other commodity prices seen to have significant influence upon the consumption of cigarettes. In all the formulations, it appears true that - $\gamma \neq \delta$ which implies that consumers might not have reacted, within the period under analysis, to relative prices as would have been expected. Furthermore the results indicate that

$$- \gamma < \delta ,$$

in other words, consumers might have been more conscious of changes in the prices of other commodities than in the prices of cigarettes. This result is supported indirectly by the "poorer" results of the relative price models.

Fourth, cigarette consumption seems to be influenced considerably by changes in the number of smokers either as a result of increase in adult population or increase in the proportion of smokers to non-smokers, especially through the extension of the smoking habit to the women and members of lower age-group.

Fifth, the results tend to indicate the existence of money illusion during the period under analysis. In the models adopted here, the absence of money illusion would be indicated by

$$\beta + \gamma + \delta = 0. \qquad \ldots\ldots\ldots (5.3.2).$$

Significance tests based on the estimated variance-covariance matrix of parameters in all cases showed $\beta + \gamma + \delta$ to be significantly different from zero at the 5% level.

Sixth, the dynamic analysis adopted confirms the habit-persistence hypothesis which states that the more cigarettes one has consumed in the past, the more one will consume currently. The adjustment period of consumption is quite fast as shown by the value of the coefficient of adjustment.

Seventh, consumption of cigarettes seems to increase during major National political upheavals as indicated by the war-dummy.

The above conclusions about the signs, magnitudes and significance of the regression coefficients are confirmed by computations with per capita data of consumption and income. Thus the results are considerably plausible.

However, in future when data basis and structure improves the analysis should be able to shift to Brand basis applying the simultaneous equation approach to measure and assess the intra-product differences.

Appendix A

Some Brands of Cigarettes on Nigerian Markets

1. Benson and Hedges
2. Bicycle
3. Big Town
4. Capstain
5. Craven 'A'
6. Dunhill
7. Flight
8. Galleon
9. Green Spot
10. Guinea Gold
11. Gold Leaf
12. Gold Flake
13. Happy Day
14. High Society
15. Holly Wood
16. Link
17. Mark Ten
18. Mars Filter
19. Niger Green
20. Richmond
21. State Express
22. Sweet Menthol
23. Sweet Menthol Filter
24. Sweet Menthol Cork tipped filter
25. Target
26. Three Rings
27. Three Plan.

Appendix - B1

Real Income and Relative Price Regression Results

	Coefficient	t-value	S.E.
Real Income	- 0.5623	- 2.5236	0.2228
Relative Price	- 0.0211	- 2.0946	0.0120
Trend	0.0353	23.6114	0.0015
Dummy	- 0.0253	- 1.0496	0.0241

R^2 = 0.8995 S.E. = 0.0308 D-W = 2.025

The results show wrong sign for Income. Only the dummy variable is not significant at the 5% level of significance while the coefficient of determination (R^2) is relatively low. The D-W statistic is 2.025 which implies that there is no positive serial correlation of residuals.

Appendix - B2

Real Income and Relative price Regression Results

including "N" explicitly

	Coefficient	t-value	S.E.
Real Income	- 1.311	- 3.0742	0.4265
Relative Price	- 0.0190	- 1.0708	0.01784
Adult Population	4.3613	13.1365	0.3395
Dummy	0.0126	0.3078	0.0411

R^2 = 0.9315 S.E. = 0.0540 D-W = 2.222

Note: Income has wrong sign but is significant at 5% level. Price has right sign but not significant. Population has right sign and is significant while the dummy has a right sign but not significant. The D-W shows no positive serial correlation of residuals. The real income and relative price formulation was rejected because of its "poorer" results.

Appendix - B3

Per Capita Real Income and Relative Price Regression Results

	Co-efficient	t-value	S.E.
Per Capita Real Income	- 0.6903	- 2.2265	0.2290
Relative Price	- 0.0166	- 1.4738	0.0150
Trend	0.0446	6.7107	0.0026
Dummy	0.0257	0.6664	0.0386

R^2 = 0.929 S.E. = 0.0507 D-W = 1.9705

Note: Here per capita real income is applied and still the sign is wrong though significant. The R^2 is relatively low though the D-W indicates no existence of autocorrelation of disturbances.

Appendix B1-B3 suggested that the real income formulation is not suitable in this study.

Appendix - B4

Per Capita Consumption Regression Results

including "T" explicitly

Variable	Co-efficient	Standard Error	t-value
Per Capita Income	0.5684	0.2606	1.9891
Price	- 0.3420	0.1380	- 2.4086
Price-Index	1.7635	0.3089	6.1274
Trend	0.0061	0.0054	1.1261
Dummy	0.0444	0.0207	2.1470

R^2 = 0.9685 S.E. = 0.0224 D-W = 1.9502

Appendix - B5

Matrix of Zero-Order Correlation Coefficient for Equation 4.1.4)

	Q/N'	Y/N	I	P	T	W
Q/N'	1.00	0.585	0.828	0.677	0.903	0.530
Y/N		1.000	0.771	0.702	0.888	0.279
I			1.000	0.729	0.905	0.491
P				1.000	0.729	0.247
T					1.000	0.392
W						1.000

Note: N' is adult population.

N is total population of Nigeria 1952/53 census.

Appendix C

Methodological Notes

The analysis employed in this study uses annual time-series covering the whole country for the period 1950-71. In Demand analysis some of the problems often encountered are those of specification Error and Identification.

Specification Error

It will be recalled that in the basic regression equation a dummy was included for the Civil-War period, 1967-70. In effect the dummy took account of all the other factors (those not included in the regression equation either as explicit variable or absorbed in the trend factor) that caused consumption levels to differ within the civil-war years.

In addition, a linear time trend variable was included to find the net effect of changes over time in omitted variables. Consider one such omitted variable, the percentage of the population in low age groups or taste. If there is a change over time in the age-distribution of the population of Nigeria or the taste of the people for cigarette that affects the level of cigarette consumption, whether aggregate or per capita, it will be captured by the trend variable.

The trend variable also absorbs the influence of shifts in demand over the years. As long as the omitted variables are uncorrelated with the included variables, there will be no problem

of biased coefficients. If they are correlated with any of them, however, the coefficients of the included variables may be biased. The computed D-W statistic in each of the equations answers this question!

Identification

It is argued here that this study deals satisfactorily with the problem of identification and that a single equation approach is adequate. The identification problem in the present context will first be discussed briefly. To simplify the discussion, "price" is assumed to be the only independent variable. It should be noted, however, that the same considerations apply to the other bona fide variables actually included in the study (Income, Index, and Adult population).

Suppose that in a demand analysis the basic data are a set of price-quantity observations. In a diagram having price and quantity as the coordinate axes, the observations appear as points scattered within the first quadrant. If the same demand schedule applies to each observations, but the supply schedule shifts, the points theoretically trace out the demand curve. If only demand curve shifts, the points trace out a supply curve. If both curves shift, a line fitted through their intersections may look like a demand or supply curve, but may have the wrong slope.

If the first of these cases in fact applies - that the same demand schedule applies to all observations - the demand curve may

be estimated by simply fitting a line through the points. For time-series observations this implies that the demand schedule is identical for every consumer. In the present study neither condition can be assumed to hold. Cigarette industry advertisements, changes in age-distribution and taste are among the factors that cause shifts over time in the demand curve.

The problem can be overcome if a hypothesis can be formulated that describes the relationship, if any, between shifts in demand and supply. This is possible using a simultaneous equation model. The problem can also be solved by including in a multiple regression equation the variables that cause the demand to shift. In effect, this has been done in the present study by the use of a war-year dummy and a trend variable in the regression equation as explained in chapter III. This procedure allows the demand schedule to shift over time to reflect the other factors that affect demand.

Appendix D

Variables and Sources of Derivation

Mainly six variables are used in this study. These are Quantity of Cigarette, Disposable Income (G.D.P. at factor cost), Average price of Cigarettes, Consumer Price Index with 1960 = 100, Adult population N', and Total population N.

Description of Variables used in the Analysis

Q_t = Aggregate Quantity of Cigarettes in year t.

Y_t = Nominal Disposable Income, (G.D.P. at factor cost was used in the absence of personal disposable income), in year t.

P_t = Average weighted retail price of Cigarettes in year t.

I_t = General Consumer price Index at 1960 purchasing power in year t.

N'_t = Adult population above 21 years in year t. (Ideally proportion of smokers in the total population should be used but data on it is not available). (1952/53 Census is used).

N_t = Total population of Nigeria in year t using 1952/53 National Census figures.

C_t = Per capita cigarette consumption in year t. This variable was derived by dividing the aggregate quantity of cigarettes, Q_t, by the adult population figures, N'_t, i.e. Q_t/N'_t.

M_t = Per Capita Income, i.e. Y_t/N_t, in year t.

Y_t' = Real Income in year t, i.e. Y_t/I_t.

P_t' = Relative price in year t, i.e. P_t/I_t.

Y_t'' = Per Capita Real Income in year t, i.e. $\frac{Y_t}{N_t\ I_t}$

T = Linear time-trend variable

W = Civil-War dummy variable.

Sources of Data

(1) Quantity of Cigarette: This includes domestic production and imports adjusted for re-exports and stocks. The figures were got from:

(a) N.T.C. records (1960-1971).

(b) Federal Office of Statistics Records and Publications.

(c) U.N.O. Statistical Year book, various years.

(d) Customs and Excise Department Records.

(2) Income:- This refers to Money Income. The figures were obtained from:

(a) Federal Office of Statistics Publications.

(b) P.N. Okigbo; Nigerian Public Finance, Evanston, North-western University Press, 1965.

(c) Central Bank of Nigeria Publications, various years.

(d) The Second National Development Plan, 1970-74, Federal Ministry of Information, Lagos, 1970.

(3) Price:- Figures were obtained from:

(a) N.T.C. Records.

(b) U.A.C. Records got from the National Archives at Ibadan.

(c) Federal Office of Statistics Records from which computations were made to derive weighted average retail price index.

(d) Federal Government, Tariff Acts, Federal Ministry of Finance, Lagos, various years.

(e) Board of Customs and Excise Records.

(4) Consumer Price Index:- The figures were derived from:

(a) Federal Office of Statistics Publications, various years.

(b) Central Bank of Nigeria publications, various years.

(c) F.O.S., Urban Consumer Surveys, for 1953, 1955/56 and 1962/63.

(5) Population Figures:- This includes both N_t and N'_t. Figures were obtained from the 1952/53 National Census Results. Note that there was a more current National population census conducted in 1963. The decision to use the 1952/53 census figures was due to the controversies over the reliability of the 1963 census. In addition estimates made from sample surveys tend to support figures given by the 1952/53 census - see U.N.O. Demographic Yearbook, (various years), 1953-1971.

The population series (1950-71) used were derived as follows:

$$N_t = No\,[1 + g]^t$$

where g = population rate of growth (annual). Since two National Censuses (1952/53 and 1963) were conducted during the period 1950-71 with the estimated rate of population growth as 1.9% and 2.5% respectively, we decided to use the mean rate of growth which is 2.2%. Thus, g = 2.2%.

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