CONSUMPTION PATTERNS IN ISRAEL

NISSAN LIVIATAN

FALK PROJECT FOR ECONOMIC RESEARCH IN ISRAEL

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Family budget studies have been carried out in most modern countries and the need for a systematic analysis of this kind has long been felt in Israel.

This book — which is based on part of a Ph. D. thesis submitted to the Hebrew University — tries to answer this need by means of a comprehensive econometric analysis of consumption patterns in Israel. In addition to the traditional examination of the income effect and the influence of family size on consumption, the study devotes two full chapters (out of a total of five) to the analysis of differences in consumption patterns of immigrants from various parts of the world.

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N. L.

CONTENTS

LIST OF TEXT TABLES

LIST OF TEXT TABLES

LIST OF APPENDIX TABLES

DIAGRAM

CHAPTER 1

DESCRIPTION OF THE STUDY

1. *Introduction*

STATISTICAL DEMAND analyses are of two types: (a) those based on aggregative time series data on quantities and prices of commodities and on aggregate income, and (b) those based on incomes and expenditures of a cross section of individual families in a given period of time. Our study is of the second type, which is often called a 'family budget study'.

This type of study has a relatively long history[1] and has been carried out, in one way or another, in practically every country which collects modern economic statistics. The data is usually collected from a sample of families which record their expenditures on the various commodities for a given period of time (usually not more than a month). The main purpose of collecting the data is usually the determination of weights for the cost-of-living index of wage-earning families. The survey includes, however, information on various family characteristics and it is therefore possible to use its data for econometric analysis.

The statistical material on which our study is based is the *Family Expenditures Survey 1956/57* which included about 6,500 Jewish wage-earning families living in cities of over 10,000 inhabitants. This survey was carried out, as usual, for the purpose of determining weights of a new cost-of-living index.[2] The period covered is the year beginning May 1956, each month

1 Cf. G. J. Stigler, "The Early History of Empirical Studies of Consumer Behavior", *Journal of Political Economy*, Vol. 62, April 1954, pp. 95–113, and C. C. Zimmerman, *Consumption and Standards of Living*, New York, 1936, Chaps. 15–16 on the history of family budget studies. For a summary of findings of a considerable number of such studies see H. S. Houthakker, "An International Comparison of Household Expenditure Patterns, Commemorating the Centenary of Engel's Law", *Econometrica*, Vol. 25, October 1957, pp. 532–51, and L. M. Goreux, *Income Elasticity of the Demand for Food*, FAO, Rome, 1959.

2 The Survey was carried out by the CBS. A short description of methods and results is given in *Statistical Bulletin of Israel: English Summary*, April-July 1958, p. 187. See also Appendix A of this study.

being based on an independent sample of new families. The fact that this survey, like most others of its type, is confined to wage earners—and further, in our case, to urban families only—naturally limits the general applicability of the findings.

One of the purposes of an econometric family budget study is to determine the relationship between the consumption of various commodities and the level of income — a relationship which is often summarized in terms of 'income elasticities'. The technique of the analysis is to relate the differences in consumption of a certain commodity by different families to the differences in their incomes. Thus a family budget study is based on interfamily comparisons in the same period of time; and it therefore follows that the commodity prices are approximately constant for all families. As a result, we cannot study effectively from cross-section data the effect of *prices* on consumption. The latter relationship must be left to time series studies.

The natural purpose of income elasticities computed from budget studies is to predict the effect of specified changes over time in aggregate income on the consumption of individual commodities (e.g., for the purpose of agricultural planning). However, the transition from the cross-section elasticities to elasticities for the economy as a whole is by no means a simple matter. It may be noted, for example, that insofar as marginal propensities to spend vary with income (and they usually do) account must be taken of the change both in the level of aggregate income and in its distribution among families.[3] The same can of course be said with respect to the demographic variables which affect consumption; the interaction between the various variables should likewise be borne in mind.

Apart from the aggregation problem we have to remember that our income elasticities were computed within a given framework of relative prices. In principle, the income elasticities may change when the price structure is altered. This difficulty is not likely, however, to be serious when the relative price changes are moderate.

It is clear from the preceding remarks that elasticities computed for prediction purposes from a given budget study cannot be used unreservedly. Nevertheless, in dealing with practical problems there is often no choice but to use them without any adjustment. An important check on the usefulness of the cross-section elasticities is examination of their accuracy in predicting

3 For an analysis of aggregation procedures in some simple cases the reader is referred to S. J. Prais and H. S. Houthakker, *The Analysis of Family Budgets*, Cambridge, 1955. This book also contains an interesting discussion of the implications of interdependence in consumers' tastes on the aggregation problem.

changes in aggregate time series data. This check is, however, rather difficult to carry out since the effects of price changes have first to be eliminated and this requires knowledge of all relevant price elasticities.

As we have noted, the main interest in family budget analysis is in the 'income effect', rather than in the effect (on consumption) of other, mainly demographic, variables. This is probably due to the fact that income usually shows relatively large changes over time, while the demographic variables change very slowly. However, this is not always the case; in Israel, for example, important changes in demographic variables (say, in average family size) have been caused recently by mass immigration and similar changes may take place in the future. The effects of demographic variables on consumption are therefore of greater interest in the present study.[4]

While the variation in the demographic structure over time may often be small, the variation of demographic variables (in particular family size) between the families in the *cross section* is of course very large. In addition, these variables are usually correlated with income. It follows, therefore, that even if one is interested only in income elasticities one must somehow hold the effect of the main demographic variables 'constant'.

Among the explanatory variables to be analyzed in addition to income, the most important is family size (measured by number of persons in the family). In some cases we shall take into account not merely the size but also the *composition* of the family in terms of children and adults. As in some other studies, we shall also analyze the difference in consumption levels between manual and non-manual workers. Finally, account must be taken of the differences in consumption habits of immigrants from different parts of the world. In studying this factor we shall distinguish mainly between two groups of immigrants—those originating from Asia and Africa and those from Europe and America. We shall also examine whether the differences in consumption patterns between these two groups tend to diminish the longer they stay in the country.

After discussing the independent (or 'explanatory') variables we now describe briefly the dependent variables, i.e. the commodity groups analyzed in our study. These include both food and non-food items and are usually measured as expenditures in terms of IL. The food items in our analysis usually consist of seven to nine broadly-defined commodity groups such as meat, vegetables, and fruit. We have also tried to analyze the behavior of some 30 more narrowly-defined food commodities, such as tomatoes and

4 In Israel the study of the consumption patterns of various demographic groups—especially of different immigrant groups—is of sociological as well as of economic interest.

citrus, but here we did not have the classifications necessary to carry out a complete analysis in terms of all the relevant explanatory variables. As for non-food items these consist in some cases of five major groups—such as clothing and footwear (as a single commodity), while in other cases a more detailed classification resulting in ten non-food commodity groups was used.

2. *Summary of Findings*

Chapter 2 analyzes consumption patterns in Israel using an approach which has become fairly standard in recent budget studies—analysis in terms of two independent variables: income[5] and family size. Further, the estimating function fitted to the data is linear in the logarithms of the dependent and the two independent variables. Thus, according to this approach the elasticities of consumption with respect to income and family size are assumed to be approximately constant. The advantages of this approach lie in the simplicity of the computations and in the interpretation of the results as well as in the greater degree of comparability with studies carried out in other countries.

The results of computing the consumption functions for the main commodity groups show that, in very general terms, the consumption patterns in Israel are similar to those known from budget studies carried out abroad. Thus it is found that food items are inelastic with respect to income (i.e. the percentage change in the expenditures on these commodities is smaller than the percentage change in income) while non-food items are usually income-elastic. Among food items the relatively income-inelastic commodities are bread, cereals, and fats, with income elasticities of – 0.22, 0.29, and 0.22 respectively. The income elasticities for animal protein foods are higher, ranging from 0.44 for fish to 0.75 for meat. In between we have the elasticities for eggs (0.68) and milk (0.53). The income elasticity of fruit (0.71) is twice as large as that of vegetables (0.34). As for 'total food' the income elasticity is 0.53. Among the major non-food items we find relatively low income elasticities for household maintenance (fuel, light, gas, etc.) and clothing, the elasticities being 0.98 and 1.10 respectively, while the highest income elasticity is found to be in the case of durables (2.04).[6] This structure of

5 As in most budget studies we used 'total consumption expenditures' as the indicator of real income (or standard of living).

6 Expenditures on durables consist mainly of purchases of furniture, electrical equipment (refrigerators, washing machines, etc.), and gas appliances.

elasticities is very much in line with studies carried out in various European countries.[7]

The elasticities of consumption with respect to family size are to a large extent functions of the corresponding income elasticities (which are based on constant family size). In particular it is shown that high expenditure elasticities with respect to family size are associated with commodities which are relatively inelastic in regard to income. For example, while the elasticity of expenditures on bread with respect to family size is as high as 1.0 its elasticity in regard to income is -0.2. It can also be stated that for commodities with income elasticity of less than unity (such as food items) an increase in family size tends to raise expenditures (when income is constant), while the opposite is true for income-elastic commodities. All these relationships are in fact implied in the statement that it is income *per capita* which determines consumption behavior. We show, however, that the simple form of the 'per capita' approach cannot explain other features of the empirical consumption elasticities. In particular it is shown that consumption expenditures (per capita) tend to vary with changes in family size even when income per capita is kept constant. This can be attributed to the existence of 'economies of scale'[8] in consumption (a well-known phenomenon in other studies).

Having analyzed the expenditure patterns with respect to the broadly-defined standard expenditure groups we estimated the pattern of income elasticities for some 30 *narrowly*-defined food items. It was found here that the components of such commodity groups as vegetables and meat show a high degree of heterogeneity in terms of their income elasticities. In the case of vegetables, for example, the income elasticities of the components range from negative value (for beans, eggplants, and squash) to almost unitary elasticities for carrots and cauliflowers. For the most important vegetable items—potatoes, cucumbers, and tomatoes—the income elasticities are very low (0.09. 0.14, and 0.17 respectively). Analysis of the components of other broadly-defined commodity groups revealed, as one might expect, a tendency for the income elasticities of the components to increase with their expensiveness. Thus, for example, within the group of fats we find that the income elasticity of butter is 0.91 while that of margarine is only 0.13. Similarly, in the group 'milk and milk products' we find that expenditures on a cheap variety of sour cream and on unpasteurized milk decrease

7 All the foregoing results are based on Table 1 below.

8 This term refers to the greater economy achieved by larger families in utilizing the consumption goods. This is done mainly by overcoming various indivisibilities and wastage.

as income rises, while the income elasticities of ordinary sour cream and of pasteurized milk are close to unity. Finally, in the group of meats we find that the income elasticity of fresh beef is 1.43, while that of (the relatively cheaper) poultry meat is only 0.44.[9]

At the end of Chapter 2 we deviated from the usual procedure of defining the dependent variables in terms of expenditures. Instead, we broke down expenditures on the detailed food items into quantities (kilograms) and average prices (per kilogram). The variation of the average price of a narrowly-defined commodity among income groups may then be interpreted as a shift to more expensive varieties—or, in other words, as an improvement in quality. As in other studies, our results reveal a marked tendency among consumers to improve the quality of commodities as income rises. This tends to counteract the tendency towards saturation in terms of physical units of food consumption.

The analysis in Chapter 2 follows a fairly standard pattern in terms of the independent variables used and the form of the estimating equation adopted. In the following chapters we depart from this system by examining the form of the Engel curves in some detail, and mainly by introducing new explanatory variables specific to the demographic structure of Israel consumers.

In Chapter 3 we relax the assumption of constant income elasticities (upon which the foregoing analysis is based) and try to examine the actual form of the Engel curves for the main categories of food consumption. This is done by fitting different forms of Engel curves to the data and examining their performance in terms of the degree of correlation and of the pattern of residuals from the fitted curves. Our results show that the income elasticities are not strictly constant over the whole range of the income distribution. In fact there is a tendency for income elasticities to decrease in the higher income levels. The same tendency is also observed for the marginal propensities to consume out of income (i.e. the slope coefficients of the Engel curves). In the case of milk and eggs in particular we found that the Engel curves tend to become so flat in the high income groups that the corresponding consumption levels may be considered as being close to the saturation levels (i.e. at the given prices).

The foregoing properties of the Engel curves of food items are of course relevant for such problems as the effect of a change in the income distribution on demand, or for the prediction of demand at high income levels. However, insofar as one is interested in estimating income elasticities at (or about) the mean income level in the sample, which is very often the case, it was

9 The foregoing results are based on Table 4 below.

found that the usual simple forms (linear or logarithmic) serve as a good approximation.

Chapter 4 is mainly devoted to an analysis of the effect of three additional socio-demographic variables on the main categories of food consumption. These new factors are occupation, continent of origin of the immigrants, and their duration of residence in Israel. The new variables are analyzed simultaneously with income and family size (i.e. the effects of the new variables are measured for comparable levels of income and family size).

By occupation we mean simply the distinction between families having as head a manual worker and those having a non-manual worker. It appears that the effect of this factor on food consumption is not very important being in most cases statistically insignificant. In the case of bread and cereals and of meat we found, however, a clear tendency for manual workers to have higher expenditure levels than non-manual workers.

The analysis by continent of origin[10] shows that while there are no differences between the continent groups in their expenditures on 'total food', there are very significant differences with respect to expenditures on all the major food components (except fruit). We find that—other things being equal—European immigrants spend 30 per cent less on bread and cereals, 15 per cent less on vegetables and 10 per cent less on fats than the Asian immigrants. On the other hand, the European immigrants spend more on 'animal protein' foods. In particular, their expenditure on milk is 26 per cent higher, and on eggs and meat about 20 per cent higher than among Asian immigrants.

Since the above results refer only to a classification of immigrants into two very broad groups, it was interesting to examine the degree of homogeneity *within* each continent group. To this end we subdivided the European immigrants into three subgroups—those originating from Eastern Europe, the Balkans, and Others, and the Asian immigrants into four groups—those originating from Iraq and Persia, Yemen and Aden, North Africa, and Others. In general, we found a considerable degree of uniformity within each continent as compared with the differences between continents. This justifies the usual practice of considering the classification into European and Asian immigrants as the main dividing line in consumption habits. At the same time, there are certain differences within the continent groups (in particular the differences between Yemenite and other Asian immigrants) which merit analysis.

10 Which distinguishes between immigrants from Europe-America and Asia-Africa. For the sake of brevity we shall refer to the former as European and to the latter as Asian immigrants.

In view of the significant differences between the two continent groups, the question naturally arises as to whether these differences tend to diminish as the immigrants stay longer in Israel. To examine this possibility we classified each of the two types of immigrants into 'veterans' and 'newcomers' (according to whether they came to Israel before or after 1948). We then compared the differences between continents within the group of newcomers and within the group of veterans. This showed that the foregoing pattern of differences between continents continues to hold both for newcomers and veterans. The main question, however, is whether these differences tend to be smaller for veterans than newcomers, (i.e. whether the differences tend to diminish over time). The answer is generally positive, but there are various exceptions to the rule. We may say therefore that there is a slight tendency towards diminishing differences in food consumption patterns. In particular, with regard to those commodities where the differences between 'continents' are most marked, we found a reduction in these differences over time of bread and cereals, milk, and meat, while in the case of vegetables and eggs we found no tendency towards increasing uniformity in consumption levels.

In considering the three food items where the differences between continents do diminish considerably, we tried to see whether it is the Asian immigrants who are approaching European standards or vice-versa. No simple answer to this question can be given. In the case of milk, for example, the consumption levels of the European immigrants (who consume relatively more milk than the Asian immigrants) remains constant, while that of Asian immigrants increases by some 15 per cent as they change from newcomers to veterans. Thus it is the Asian immigrants who seem to adopt the standard of the Europeans. In the case of meat, however, we find a pattern of convergence, with each group of immigrants moving towards the other. Yet another pattern is found in the case of bread and cereals. In this case both groups tend to reduce expenditures as they stay longer in the country, but with the Asian immigrants (who are the greater consumers of bread and cereals) the decline is steeper, so that on balance the gap between European and Asian immigrants is narrowed by about one third. These findings indicate that the tendency towards convergence of food consumption patterns, insofar as it exists, is by no means a simple phenomenon, and that in order to study it a large number of commodities have to be analyzed.

We should note that all the above findings relate to the broadly-defined food items. It is possible, and indeed likely, that the differences between continents are more marked for the more *detailed* food items. It would therefore be important for future research in this field to carry out a similar analysis for detailed food items. The latter type of analysis might well reveal a clearer picture of the convergence of consumption patterns than that presented by using broadly-defined food categories.

Since the differences in consumption levels between continent groups were found to be important, this factor should be considered even if one is interested (as is often the case) only in *income* elasticities. The reason for this is obvious; since there is a correlation between distribution by income level and by continent of origin and since the latter affects food expenditures the estimation of income elasticities which ignore the classification by continent will result in biased income elasticities. The income elasticities presented in Chapter 4 (where the effect of continent was held constant) are therefore to be preferred to those presented in Chapter 2 (where the effect of continent was disregarded). However, in those cases where the two sets of estimates are comparable it will be seen that they are not fundamentally different.[11] The main reason for this is that the income differentials between continents are not large enough to create a considerable bias when the effect of continent is ignored.[12] It remains true, however, that when the continent effect is very strong (as may be the case with narrowly-defined food items) considerable biases in the income elasticities may still occur when the classification by continent of origin is ignored.

We turn now to summarize the main findings on the effect of continent of origin and duration of residence on *non*-food expenditure items. This analysis was carried out in Chapter 5 with respect to ten non-food items. As in Chapter 4, the effects of the new demographic variables are estimated simultaneously with the effects of income and family size.

Our results show that in the case of non-food items the differences between continents are even more marked than with food items. One of the main features of these differences is that expenditures on cultural needs are much higher (other things being held constant) in the European groups of immigrants. In particular, expenditure on books and newspapers is about 95 per cent higher and expenditure on education is about 140 per cent higher among European immigrants as compared with Asian immigrants. We also find that the European immigrants tend to spend more on private health services (70 per cent more than Asian immigrants). This pattern of differences is undoubtedly due to a large extent to the higher educational level of the European immigrants.

11 See, for example col. (1) in Table 1 and col. (1) in Table 18.

12 The main difference between the continents is in family size. It is therefore the elasticity of this variable which is likely to be considerably biased when continent is ignored.

In contrast to expenditures on cultural needs European immigrants spend less than Asian on clothing and footwear, the percentage difference for these two items being 28 and 16 per cent respectively. It is not unreasonable to interpret the high levels of spending on clothing by the Asian immigrants as a kind of 'conspicuous consumption' which is a psychological reaction to their lower status in Israel society. This, however, is a matter of personal speculation which cannot be verified from cold economic facts. As for other non-food items, we found that European immigrants tend to spend less on tobacco (26 per cent) and more on household maintenance (17 per cent) than the Asian immigrants.

An analysis of expenditure on non-food items *within* each continent showed that, in general, the differentials in consumption patterns between the two continent groups as a whole continue to exist when individual country comparison is made between the two continents. In other words, the breakdown of immigrants by continent is undoubtedly significant. Nevertheless, any broad classification of this kind conceals different features of the individual countries of origin. In particular it was found that immigrants from the Balkan countries (included in the European group) occupy an intermediate position between European and Asian non-food consumption patterns.

Having found significant differences between European and Asian immigrants we proceeded to examine whether these differences tend to diminish as the immigrants stay longer in Israel. This was again done by classifying the immigrants from each continent into newcomers and veterans. It turned out that in the case of non-food items there is no sign of a general tendency towards a reduction in consumption differences. In particular, while for clothing and footwear there is a small reduction in differences we find that for expenditure on education, books and newspapers, and tobacco the gap between the continents is even widening. In only one case, namely expenditure on private health services, did we find a drastic reduction in intercontinental differences as the length of stay in Israel increased. Additional analysis of this problem showed that the Asian immigrants tend in fact to change their expenditure patterns in the direction of European standards. Thus they tend to reduce their expenditure on clothing and footwear and to increase it on education and other cultural needs. However, for reasons we were not able to determine, the European immigrants tend to change their non-food consumption patterns in precisely the same direction as the Asian immigrants. The net result of this process is that quite often the gap between the continents does not diminish and may even increase (as in the case of expenditures on education). It seems therefore that the basic differences between immigrants in non-food consumption are here to stay for a long time.

In addition to, and simultaneously with, the effects of continent of origin and duration of residence in Israel we analyzed the differences in non-food consumption patterns between manual and non-manual workers. It has been found that there exist significant differences between these two groups which are strikingly similar to the differences between consumption patterns of Asian and European immigrants. In this comparison manual workers compared with the non-manual ones behave like Asian immigrants compared with the European ones. Since it is clear that the differences between the two occupational groups are due mainly to differences in educational levels we may infer that, in the same way, the differences in non-food consumption patterns between the Asian and European immigrants are due mainly to general factors such as education and not so much to the particular 'traditions' of the immigrants as such.

CHAPTER 2

CONSUMPTION ELASTICITIES WITH RESPECT TO INCOME AND FAMILY SIZE

1. *Income and Family Size as Independent Variables*

INCOME AND THE age-sex structure of the family are widely recognized as the most important determinants of consumption (apart from relative prices which are approximately constant in the cross section). It is, however, difficult in practice to take these variables satisfactorily into account.

Ideally, we would like income to represent the economic position of the family in terms of the net worth (including anticipated receipts and liabilities). The actual data on income, however, include in most expenditure studies mainly income received during a short period (one month in our data), so that it may not be representative of the true economic position. Furthermore, since the construction of weights for the cost-of-living index does not require income data, the latter are usually measured inaccurately in expenditure surveys. In particular, income of subsidiary earners and income from property are often ignored. This may introduce various kinds of bias in the estimation of the elasticities.[1]

It is for this reason that in many studies 'total expenditure', i.e., the sum of expenditures on all commodities, is used as the independent variable instead of income. The latter procedure is, however, again not very satisfactory. While total expenditure is measured much more accurately than income it is still based on a very short time period (again one month in our data). Consequently there are many families whose total expenditure in a given month is far from being representative of their economic position (this point is clearly illustrated by a family which buys a refrigerator or a suit of clothes in the survey month).

As the statistical procedure we adopted to overcome this difficulty is explained in detail elsewhere,[2] a brief indication of the main points will

1 See M. Friedman, *A Theory of the Consumption Function*, Princeton University Press, 1957, for the effect of random errors in measured income on the estimated elasticities.

2 See N. Liviatan, "Errors in Variables and Engel Curve Analysis", *Econometrica* Vol. 29, No. 3, July 1961, pp. 336–62; reissued as FP Research Paper 11, December 1961. See also Appendix C.

suffice here. Since income (Y) is more or less independent of the random elements in expenditure we may use it as a classifying variable and compute within each income group mean values (per family) of total expenditure (C) and of expenditures on the various consumption categories (X). This procedure has the effect of 'averaging out' the random variation in expenditures in every income group (provided the groups are large). We then apply to the averages of X and C the usual least squares procedures. This involves some loss of statistical efficiency but seems justified in view of the considerable biases which may result from using the traditional procedures. An alternative procedure is to use Y as an instrumental variable.[3]

As for 'age-sex distribution' of the family, the main difficulty is that it can be described adequately only by the use of a whole complex of variables, which is rather impractical for our purposes. Moreover, as recent analysts show,[4] these variables enter the consumption function in a rather complicated (non-linear) manner, which makes the computation procedure very difficult. In practice many studies ignore the whole problem and simply estimate the Engel curves in per capita terms. In some other cases, the various types of persons are first weighted by some arbitrary scale of consumer units.[5]

Since the latter procedure is arbitrary we shall not discuss it further. As for the simple 'per capita' approach, it is now recognized that it is based on the unrealistic assumption that income per person alone explains all the variations in expenditure per person.

The compromise adopted was either to use the number of persons in the family (denoted by S) as a *free* independent variable, or, in some cases, to split it into two free independent variables—number of persons below and above the age of 17. The latter distinction is particularly relevant in the comparison of consumption patterns of European and Asian immigrants differing widely in family composition.

2. *Elasticities of Main Commodity Groups*

We shall present below the elasticities for fairly standard, broadly-defined expenditure groups. These computations are based on about 3,000 families interviewed in the six months November 1956–April 1957. These families

3 That is, forming the estimate $\frac{\Sigma xy}{\Sigma cy}$. See Appendix C.

4 S. J. Prais and H. S. Houthakker, *The Analysis of Family Budgets*, Cambridge 1955, Chap. 9.

5 See R. M. Woodbury, "Economic Consumption Scales and Their Uses", *Journal of the American Statistical Association*, Vol. 39, December 1944, pp. 455–68.

were first cross classified by nine income (Y) groups and seven family size groups, and averages of X and C (denoting expenditures on the particular commodities and on all consumption items respectively) were computed for each cell. These group means were then transformed to logarithms which were used to compute the (weighted) regression equation

$$\log X = b_0 + b_1 \log C + b_2 \log S. \tag{2.1}$$

The coefficients b_1 and b_2 are estimates of the (partial) elasticities of X with respect to C and S (these elasticities will also be denoted by η_{xc} and η_{xs}, where, for example, η_{xc} is the percentage change in X which is associated with a 1 per cent change in C). We may note that the use of the full logarithmic form is very common in recent budget studies, and it has therefore the advantage of being comparable with other studies. It is also very convenient both for computation and interpretation. As we shall see later, this form (which assumes constant elasticities) does not give the best fit to the data, but the results obtained by using it are very close to those obtained by the more accurate curves.

Column (1) of Table 1 shows that income elasticities of food items are always less than unity, which means that a given percentage increase in income[6] leads to a smaller percentage increase in food expenditure. Within this group the relatively high elasticities are those of 'animal proteins'—meat, milk, and eggs—while the lower elasticities are those of fats, vegetables, and bread (the latter behaves like an 'inferior good'). Unlike food items, most non-food items are 'elastic', the highest elasticity (around 2) being that of household durables.

Let us consider now the effect of an increase in family size on consumption. Clearly, when income (or total expenditure) is constant, increased expenditure on any one item resulting from an increase in family size must be offset by a reduction in expenditure on other items (i.e., the weighted sum of elasticities with respect to family size is equal to zero). If we consider an increase in family size (when family income is constant) as involving a reduction in the standard of living, we should expect it to be accompanied by a reduction in expenditure on 'luxuries' and an increase in expenditure on 'necessities' (i.e., the income-inelastic commodities). This seems to be

6 From now on we shall often refer to total expenditure (C) as 'income', since we use C as an indicator of the 'true' income. This is in accordance with the terminology used in other budget studies. Income earned from wages and property will always be denoted by the letter Y.

the explanation of the elasticities in column (2), which are generally positive for food items and negative for non-food commodities.

TABLE 1. *Income and Family Size Consumption Elasticities*

Commodity	*Elasticity with respect to*		
	Income (C) (b_1)	*Family size* (S) (b_2)	[(1)+(2)]—1
	(1)	(2)	(3)
Bread	—0.220 (± 0.068)[a]	1.009 (± 0.051)	—0.211
Cereals	0.285 (± 0.144)	0.582 (± 0.110)	—0.133
Fats (incl. butter and margarine)	0.215 (± 0.052)	0.584 (± 0.037)	—0.201
Vegetables	0.337 (± 0.068)	0.514 (± 0.049)	—0.149
Fish	0.437 (± 0.058)	0.225 (± 0.042)	—0.338
Total food	0.516 (± 0.022)	0.286 (± 0.016)	—0.198
Milk (incl. milk products)	0.528 (± 0.076)	0.255 (± 0.055)	—0.217
Eggs	0.675 (± 0.060)	0.293 (± 0.043)	—0.032
Fruit	0.713 (± 0.053)	0.239 (± 0.038)	—0.048
Meat	0.753 (± 0.046)	—0.072 (± 0.033)	—0.319
Maintenance (of household)	0.982 (± 0.091)	—0.087 (± 0.059)	—0.105
Clothing and footwear	1.103 (± 0.072)	0.065 (± 0.046)	0.168
Sundry (incl. tobacco)	1.522 (± 0.064)	—0.350 (± 0.042)	0.172
Health, education, and literary expenditures	1.842 (± 0.143)	—0.412 (± 0.093)	0.430
Durables	2.039 (± 0.156)	—0.393 (± 0.101)	0.646

[a] The numbers in parentheses are standard errors of estimates. For definition of items see Appendix A. In computing elasticities of *food* items we exclude one-person families since bachelors eat many of their meals in restaurants. These are not included in the ordinary food items.

We may note that there is also a tendency for η_{xs} (i.e., the elasticity with respect to family size) within the group of food items to decrease as η_{xc} increases. For example, the highest elasticity with respect to family size (η_{xs}) is found in the case of bread which is an 'inferior commodity', while the lowest η_{xs} is found with meat which is the most income-elastic food item.

All this is in fact implied by the 'per capita' approach.[7] In its simple form this states that expenditure per person (i.e. $\frac{X}{S}$) is a function of income per person ($\frac{C}{S}$). It then follows that $\eta_{xs} = 1 - \eta_{xc}$. Thus the per capita approach implies that η_{xs} is positive for necessities ($\eta_{xc} < 1$) and negative for luxuries ($\eta_{xc} > 1$), and that η_{xs} and η_{xc} are negatively correlated. These implications are confirmed by our data.

7 For a detailed account of all this see Prais and Houthakker, *op. cit.*, pp. 88–93 and Chaps. 9 and 10.

We should note, however, that we do not find that the *sum* of the partial elasticities, i.e. $\eta_{sx} + \eta_{xs}$, equals unity, contrary to what one would expect on the basis of the simple per capita approach. In fact we find (see column (3)) that the latter sum is less than unity for food commodities and more than unity for non-food commodities. This means that even when *income per person* is constant, the composition of expenditure per person changes with an increase in family size.[8] In particular there is a shift from 'necessities' to 'luxuries' (on per capita terms). This behavior, which was also found in other studies, indicates that larger families, with the same income per person, enjoy a higher standard of living than smaller families. In view of this pattern of behavior it is clear that the formulation of Engel curves in per capita terms is a serious oversimplification.

3. *Some International Comparisons*

The general picture which emerges from Table 1, in terms of the ranking of the different commodity elasticities, is not very different from what is known from budget studies carried out in various European countries. What we need, however, is a detailed study of the differences in consumption patterns between Israel and other countries—a very difficult task which cannot be carried out satisfactorily for two main reasons. First, there are differences in real per capita income and in the structure of prices which may affect the size and meaning of income elasticities. Second, and perhaps more important, are the differences in the estimating procedures of the Engel curves employed in the various studies, as well as differences in the definitions of the variables. The latter set of difficulties will probably resolve itself in the future since there is a tendency towards standardization in research methods.

In fact there has recently been an attempt by the FAO[9] to apply similar estimating techniques to budget data of various countries. While this constitutes an important step towards facilitating international comparisons, the FAO study is still far from being homogeneous with respect to the treatment of various bodies of data (mainly because of lack of necessary classifications). Before using this study for purposes of comparison we

8 Note that equation (2.1) can be written as:

$$\log\frac{X}{S} = b_0 + b_1 \log\frac{C}{S} + (b_1 + b_2 - 1)\log S.$$

Thus the figures in col. (3) can be interpreted as the elasticity of $\frac{X}{S}$ with respect to S when $\frac{C}{S}$ is constant.

9 L. M. Goreux, *Income Elasticity of the Demand for Food*, FAO, Rome, 1959.

may also note that it differs from our own in various respects, mainly in the method of classification by economic level. Thus while in our study families are classified first by current income (Y), the FAO study is based on a direct classification by total expenditure groups. Another difference is in the treatment of family size (S). In the FAO study the effect of S on X was eliminated directly only for part of the samples, while for other samples only a rough correction was made to account for this variable. In our study, on the other hand, we took account of S in computing the income elasticity of every commodity.

In addition to the income elasticities taken from the FAO we took some elasticities from two well known studies, namely those of Prais and Houthakker[10] and Wold and Jureen.[11] Here again there are certain differences in the estimating procedures.

We may point out again that because of the differences in methods the following comparisons should be regarded with great caution. The aspects common to the various studies are: (a) the estimating equation of the constant elasticity type (i.e. full logarithmic equations); (b) the independent variable is total expenditure; (c) in all cases at least some effort was made to hold the effect of family size constant; (d) almost all the samples were taken in recent years, i.e. in the 1950's.

For the purpose of our comparison we selected budget studies from European countries only (because of greater similarity with Israel in per capita income) and excluded samples based exclusively on farm population. When there was more than one sample for a given country we chose one of them (the largest). The differences in the definitions of the food expenditure groups limited our comparison to six groups only.

Table 2 shows that had we used European budget data to predict the behavior of Israel consumers we would have made good guesses only for two cases out of six—these two being the income elasticities of eggs and of total food. In the case of meat and milk the elasticities in Israel seem to be relatively high, while for fish and bread our elasticities are relatively low.

As noted earlier, comparison with the FAO study for the other food commodities which appear in Table 1 was not possible because of differences in item definition. For fruit and vegetables, however, we compared our results with the above-mentioned studies of Prais and Houthakker and Wold and Jureen. The results are given in Table 3.

10 *Op. cit.*

11 H. Wold and L. Jureen, *Demand Analysis*, New York, 1952.

TABLE 2. *A Comparison of Income Elasticities of Some Food Commodities in European Countries and in Israel*

Commodity group	*Number of European countries (samples) used in the comparison* (1)	*Number of countries with elasticity exceeding that of Israel* (2)	*Average*[a] *elasticity in European Countries* (3)	*Elasticity in Israel* (4)
Meat	12	3	0.60	0.75
Fish	10	8	0.64	0.44
Eggs	9	3[b]	0.66	0.68
Milk	11	1	0.33	0.53
Bread and cereals	11	11	0.26	—0.04
Total food	12	9	0.56	0.52

[a] These averages are based on the number of countries given in col. (1).

[b] In one case the elasticity of eggs happened to be the same in Israel and in one of the European countries. This case was not included in col. (2).

SOURCES: Practically all income elasticities were taken from Goreux, *op. cit.* Some elasticities were taken from Prais and Houthakker, *op. cit.* and Wold and Jureen, *op. cit.* See complete table of elasticities in Appendix E. The elasticities of col. (4) were taken from Table 1. The elasticity of bread and cereals is based on the same data.

TABLE 3. *Income Elasticities of Vegetables and Fruit in Three Budget Studies*

	UK (1)	*Sweden* (2)	*Israel* (3)
Vegetables	0.57	0.46	0.34
Fruit	0.88	0.84	0.71

SOURCES: Col. (1): Prais and Houthakker, *op. cit.*, p. 141, Table 30.
Col. (2): Wold and Jureen, *op. cit.*, p. 265, Table 16.5.2 relating to the sample of workers and low grade employees in 1933. The Swedish study uses income and not total expenditure as the independent variable.
Col. (3): Table 1.

Thus, as in the other countries, the elasticity of fruit in Israel is higher than that of vegetables, but both elasticities (particularly that of vegetables) seem to be lower than abroad. Some further indication of this is found in the FAO study where the dependent variable was defined as the *aggregate* expenditure on fruit and vegetables. If we form the elasticity of this aggregate from our data (by weighting the elasticities of the components according to the proportion of expenditures on each component) we find that the combined elasticity is systematically lower in Israel than in Europe.

It is rather difficult to make international comparisons for non-food items because the differences in definitions are much larger than in the case of food. For the category clothing and footwear, however, it was possible to make a comparison with the FAO study. On the average, the income elasticity of clothing tends to be higher in Europe, the average elasticity based on 11 countries (see Appendix D) being 1.38 while that of Israel is 1.10 (according to Table 1). As for durables, our elasticity of about 2 is not out of line with other studies.

4. *Consumption Elasticities of Detailed Food Items*[12]

We have dealt so far with broadly-defined commodity groups, each of which is composed of numerous subgroups. The above level of classification is in fact the most commonly used in those budget studies whose aim is to present a general picture of consumption patterns. For various policy purposes, however, our earlier classification is too broad. It is often the case that we are asked to predict changes in demand for more narrowly-defined commodities such as tomatoes, citrus, fresh beef etc. We may also note that using more homogeneous expenditure categories is desirable on theoretical grounds, since broadly-defined (composite) expenditure groups lose their economic meaning when the relative prices of their components change over time.

However, in a general study of consumption patterns one cannot carry the classification of commodities too far because of the burden of the computations. In spite of this difficulty we have in this section striven in the direction of greater disaggregation by using a more detailed classification of commodities than in the rest of this study. The following analysis is, however, confined to food items only.

12 The computations of the elasticities in this and the following section were planned and carried out in cooperation with the study of "Long-Term Projections of Supply and Demand for Agricultural Products in Israel" (see *Fifth Report*: *1959 and 1960*, FP, Jerusalem 1961).

The statistical source for the analysis were tables prepared by the CBS on expenditures and physical quantities of commodities. In these tables all the Jewish families of the 1956/57 survey (i.e. over 6,500 families) were cross-classified by groups of disposable income per person ($\frac{Y}{S}$) and by the number of persons (S). In each of the cells resulting from the cross classification, averages were computed of expenditure per person ($\frac{X}{S}$) on the various commodities. No data on total expenditure (C) were given in these tables, so that we had to use indirect methods [13] in order to compute the coefficients of equation (2.1).

The elasticities of the detailed commodity groups with respect to C and S (i.e. η_{xc} and η_{xs}) are given in columns (1) and (2) of Table 4. In no case do the commodities in the table comprise *all* the components of the more broadly-defined commodities which we considered earlier (such as vegetables, meat and so on). We did include, however, all the important components in terms of their proportion in expenditure (the importance of each of these components is indicated by the data in column (3)).

Table 4 shows that except for fruit there is considerable heterogeneity in the income elasticities (η_{xc}) of the components of each broadly-defined group. In the case of vegetables, for example, we find (column (1)) income elasticities ranging from -0.4 (beans) to 0.95 (cauliflowers). Thus in most cases the elasticity of the broadly-defined group as a whole cannot be representative of the individual components.

We turn now to consider another aspect of the structure of elasticities in Table 4, namely the relation between the income elasticities of the commodities and their expensiveness. It is often said that the more expensive the commodity the more income-elastic it will tend to be. The main difficulty in analyzing this statement is that we cannot define an unambiguous quantity measure in terms of which we may measure the relative expensiveness of different commodities. Anyway, insofar as there is any point in

13 On the basis of the above-mentioned tables we could compute the coefficients of

$$\log X = a_0 + a_1 \log Y + a_2 \log S$$

where Y is disposable income. We then computed from our own data (i.e. the data used in the earlier sections) the coefficients of

$$\log C = h_0 + h_1 \log Y + h_2 \log S.$$

We then combined the coefficient of the above two equations to compute

$$\log X = b_0 + b_1 \log C + b_2 \log S$$

which is the desired equation.

TABLE 4. *Consumption Elasticities of Detailed Food Items With Respect to Total Expenditure and Family Size*

Commodity	η_{xc} (1)	η_{xs} (2)	*Per capita expenditure in IL per month* (3)	*IL per kilogram* (4)
Vegetables				
Beans (fresh)	—0.395	1.157	0.09	0.54
Eggplants	—0.305	0.764	0.10	0.26
Squash	—0.158[a]	0.879	0.10	0.26
Dry onions	—0.029[b]	0.552	0.19	0.36
Potatoes	0.086[a]	0.668	0.64	0.20
Peppers (green and red)	0.110[a]	0.574	0.15	0.39
Cucumbers	0.136[a]	0.684	0.26	0.30
Tomatoes	0.173	0.627	0.82	0.30
Cabbages	0.489	0.441	0.05	0.27
Radishes and beets	0.560	0.433	0.06	0.26
Beetroots	0.613	0.258	0.05	0.27
Carrots	0.807	0.075	0.18	0.29
Cauliflowers	0.950	0.302	0.05	0.32
Fats				
Oil, etc.[c]	—0.055[b]	0.880	0.73	*d*
Margarine	0.134	0.884	0.43	1.02
Butter	0.910	—0.105	0.36	1.64
Milk and milk products				
Lebenia[e]	—0.447	1.053	0.06	*d*
Standard unpasteurized milk	—0.379	1.277	0.80	*d*
Milk of all kinds	0.346	0.567	1.74	*d*
Cheese of all kinds	0.765	—0.041	0.64	*d*
Sour cream	0.932	—0.104	0.45	*d*
Pasteurized milk	1.044	0.057	0.84	*d*
Meat				
Chicken	0.439	0.202	3.50	2.76
Beef (total)	0.925	0.006	2.39	4.36
Fresh beef	1.431	—0.268	1.49	5.93
Fruit				
Grapes	0.725	—0.123	0.53	0.46
Citrus	0.815	0.273	0.67	0.20
Guavas	0.871	0.226	0.05	0.53
Bananas	0.884	0.515	0.65	0.69
Plums	0.904	—0.073	0.15	0.73

[a] Standard error of a_1 exceeds half $|a_1|$ but is smaller than $|a_1|$ where a_1 is the coefficient of log Y in the first equation in footnote 13.

[b] Standard error of a_1 exceeds the value of this coefficient.

[c] Consists mainly of edible oils, but includes also tehina and mayonnaise.

[d] Indicates that these commodities were not calculated in terms of kilograms but in other units such as bottles, packages, etc, thus rendering impossible a comparison of prices of the different commodities.

[e] Lebenia is a cheap variety of sour cream.

looking for a relation between expensiveness and the size of η_{xc}, this must be confined to very similar commodities. This question was therefore raised in relation to the data in Table 4 with its narrowly-defined commodities, which may in some cases be considered as being rather 'similar' from the consumers' point of view.

In Table 4 the measure of expensiveness is the price in IL per kilogram. In the case of vegetables we do not find any systematic relation between the expensiveness (column (4)) and the income elasticity (η_{xc} in column (1)). This may be due to the lack of considerable variation in prices (in column (4)) or perhaps to the lack of sufficient similarity between the components of vegetables (at least in terms of units of weight). The groups where we do find a clear relationship between expensiveness and η_{xc} are fats, meat, and milk. In each of these groups the income elasticities of the components rise with their expensiveness. This cannot be seen directly in column (4) for the case of milk (since the quantity units in this category vary) but it is clear that for any reasonable quantity unit we will find that sour cream and pasteurized milk are more expensive than lebenia and standard (unpasteurized) milk respectively.

5. *'Quality' Equations*

It is perhaps more reasonable to look for an empirical relation between η_{xc} and expensiveness for still more narrowly-defined commodities than those appearing in Table 4, as, for example, when considering different 'varieties' of the same commodity (e.g. Tamar and Moneymaker tomatoes).

The relation between the prices of varieties and their income elasticities is economically significant. Should the more expensive varieties be more income-elastic, this means that the proportion spent on them increases with the level of income. This in turn signifies that an improvement in the 'quality' of consumption has taken place. Our purpose now is to see what can be said about this improvement in quantitative terms.

We cannot look into this matter directly by considering the income elasticities of the different varieties because we do not have a more detailed classification than that presented in Table 4. We can, however, analyze this problem by using indirect methods devised by recent writers.[14] Suppose that the expenditure (X) on a certain commodity is composed of expenditures on a certain number of varieties (n) of this commodity. Consider now the

14 See Prais and Houthakker, *op. cit.*, Chap. 8, and H. Theil, "Qualities, Prices and Budget Enquiries", *Review of Economic Studies*, Vol. 19, 1952, pp. 129–47.

total physical quantity consumed (Q) and the weighted average (P) of the prices paid for the individual varieties (i.e. $P = \sum_{i=1}^{n} \frac{Q_i}{Q} P_i$ where Q_i and P_i are the physical quantities and prices respectively of the individual varieties). Using these concepts we have $X = PQ$, whence it follows that $\eta_{xc} = \eta_{pc} + \eta_{qc}$. In other words, the income elasticity of expenditures (η_{xc}) on the commodity can be divided into two components—the income elasticity of the physical quantity (η_{qc}) and the income elasticity of the average price of the varieties. Let us now consider the meaning of the latter elasticity.

We should first note that in cross-section studies the price of any homogeneous commodity is assumed to be constant (or at least not to vary systematically with income). It follows therefore that when we are dealing with a perfectly homogeneous commodity (i.e. consisting of one variety only) then η_{pc} would equal zero (and therefore $\eta_{xc} = \eta_{qc}$). However, when the commodity consists of different varieties, the average price P may change as a result of the change in the weights ($\frac{Q_i}{Q}$). It is intuitively clear that if P rises with income (i.e. $\eta_{pc} > 0$), this means that there is an increase in the weights of the more expensive varieties. Alternatively, this means that the more expensive varieties must have higher income elasticities than the cheaper ones.[15] It is for this reason that the magnitude of η_{pc} can serve as an indicator of the intensity of the shift from cheaper to more expensive varieties, or of the degree of improvement in *quality* of consumption following a rise in income.

In computing the quality elasticities we did not have to compute P directly. Instead we computed for each commodity the following equations:

$$\log X = b_0 + b_1 \log C + b_2 \log S \text{ and} \tag{2.2}$$

$$\log Q = d_0 + d_1 \log C + d_2 \log S, \tag{2.3}$$

where Q is the number of kilograms consumed. The value of η_{pc} is then given by $b_1 - d_1$; similarly the elasticity of P with respect to S is given by

15 It can be shown that a necessary condition for η_{pc} to be positive is

$$\sum_{i=1}^{n} \frac{Q_i}{Q} (P_i - P)(\eta_{q_i c} - \eta_{qc}) > 0$$

when $\eta_{q_i c}$ relates to the i'th variety. In other words, if $\eta_{pc} > 0$ then there must be 'on the average' a positive relationship between the prices of the varieties and their income elasticity (note that for *varieties* $\eta_{q_i c} = \eta_{x_i c}$, since their prices are assumed to be constant).

$b_2 - d_2$. (For purposes of comparison we shall also present the coefficient of equation (2.3).)

The quality elasticities in Table 5, column (1), confirm the anticipations of a positive relation between quality of consumption and level of income. Moreover, the size of the elasticities is quite considerable, often being around 0.2. These findings suggested that the tendency towards improving the quality of consumption as the level of income rises is an important counterforce to the tendency of the physical quantities of food consumption to reach satiety levels.

TABLE 5. *Elasticities of Quality (P) and Quantity (Q) With Respect to Total Expenditure and Family Size*

Commodity	η_{pc} (1)	η_{ps} (2)	η_{qc} (3)	η_{qs} (4)
Vegetables				
Beans	0.360	—0.092	—0.755	1.249
Eggplants	0.184	—0.192	—0.489	0.956
Squash	0.437	—0.310	—0.595	1.189
Dry onions	0.205	—0.211	—0.234	0.763
Potatoes	0.044	—0.025	0.042[a]	0.693
Peppers (green and red)	0.228	—0.170	—0.118[b]	0.744
Cucumbers	0.467	—0.337	—0.331	1.021
Tomatoes	0.263	—0.218	—0.090[b]	0.845
Cabbages	0.275	—0.175	0.214	0.616
Radishes and beets	0.143	—0.212	0.417	0.645
Beetroots	0.173	—0.121	0.440	0.379
Carrots	—0.077	—0.069	0.884	0.144
Cauliflowers	0.227	—0.133	0.723	0.435
Fats				
Margarine	0.043	—0.043	0.091[b]	0.927
Butter	0.499	—0.489	0.411	0.384
Meat				
Chicken	0.141	—0.128	0.298	0.330
Beef (total)	0.326	—0.264	0.599	0.270
Fresh beef	0.148	—0.095	1.283	—0.173
Fish	0.093	—0.077	0.328	0.409
Fruit				
Grapes	0.172	—0.259	0.553	0.136
Citrus	0.083	—0.118	0.732	0.391
Guavas	0.166	—0.122	0.705	0.348
Bananas	0.064	—0.038	0.820	0.553
Plums	0.099	—0.066	0.805	—0.007

[a] Standard error of a_1 exceeds the value of this coefficient, where a_1 is the coefficient of log Y in the first equation in footnote [13].

[b] Standard error of a_1 exceeds half a_1 but is smaller than a_1.

If the quality of consumption rises with the standard of living we may expect it to decline with an increase in family size (when family income is constant). Indeed, this is what we find in column (2) for all commodities. Moreover, according to the simple per capita approach we should expetc the sum of the elasticities in columns (1) and (2) to be zero. In most cases, however, this sum is positive which implies that even when income *per person* is held constant there is still some rise in quality of food as family size increase. This can be interpreted as resulting from 'economies of scale enjoyed by large families.

6. *Comparison of the 1956/57 and 1959/60 Surveys*[16]

In concluding this chapter we present a comparison of income elasticities computed from the 1956/57 survey with corresponding elasticities computed from a survey carried out about three years later. The latter survey was relatively small,[17] including about 1,200 families interviewed during the year beginning October 1959 (new families being selected each month). The income elasticities computed from the 1959/60 survey were based only on half the number of families—some 600 of which were interviewed during the first six months. These families were cross-classified by disposable income and family size, the resulting group means in each cell being then transformed to logarithms. The elasticities were then determined from the estimating equation (2.1).[18]

A comparison of columns (1) and (2) in Table 6 shows that in the majority of cases there is considerable similarity between the elasticities computed in the two different years. Even in the cases where the differences appear relatively large it is doubtful whether they are significant in view of the sampling errors. On the basis of these data it is fair to conclude that no significant change occurred in the general structure of income elasticities between the two years. This is in fact what one would expect to find when comparing surveys only three years apart.

16 The computations of the elasticities from the 1959/60 survey were carried out on the initiative and with the cooperation of Dr. Yair Mundlak, who was interested in these elasticities for his study on supply and demand for agricultural products (see *Fifth Report: 1959 and 1960*, FP, Jerusalem, 1961).

17 See Appendix A for a short description of this survey.

18 These equations were estimated by using log Y and log S as instrumental variables. See Appendix *C*.

TABLE 6. *Comparison of Income Elasticities (η_{xc}) Computed from the 1956/57 and 1959/60 Surveys*

Commodity	*1956/57* (1)	*1959/60* (2)
Bread and cereals		
Bread	—0.220 (± 0.068)	—0.255 (± 0.081)
Cereals	0.285 (± 0.144)	0.307 (± 0.098)
Fats		
Oil[a]	—0.055	—0.357 (± 0.162)
Margarine	0.134	—0.119 (± 0.164)
All vegetable fats[b]	0.015	—0.109 (± 0.064)
Imported butter	0.910	0.758 (± 0.263)
Local butter		1.039 (± 0.230)
Vegetables		
Tomatoes	0.173	0.126 (± 0.090)
Carrots	0.807	0.502 (± 0.160)
Potatoes	0.086	0.176 (± 0.103)
All vegetables[c]	0.337 (± 0.068)	0.270
Milk and eggs		
Liquid milk	0.346	0.397 (± 0.086)
Sour cream and lebenia[d]	0.770	0.863 (± 0.206)
Cheese	0.765	1.067 (± 0.140)
Milk and milk products	0.528 (± 0.076)	0.588 (± 0.085)
Eggs	0.675 (± 0.060)	0.425 (± 0.075)
Meat and fish		
Chicken	0.439	0.375 (± 0.086)
Fresh beef[e]	1.431	1.301 (± 0.238)
Fresh and frozen beef	0.925	1.276 (± 0.233)
Fish	0.437 (± 0.058)	0.324 (± 0.095)
All meat and fish[f]	0.703	0.663 (± 0.099)
Fruit		
Citrus	0.815	0.543 (± 0.106)
Bananas	0.884	0.592 (± 0.167)
All fruits	0.713 (± 0.053)	0.790

[a] In 1956/57 this included mayonnaise and certain (relatively unimportant) vegetable fats.

[b] Includes margarine. For 1956/57 the elasticity was computed as a weighted average of the elasticities of oil and margarine in Table 4 (the weights being the average expenditures on these commodities).

[c] The elasticity for 1959/60 was computed as a weighed average of elasticities of fresh vegetables, potatoes, and canned vegetables (with weights proportional to expenditures). This item does not include (in 1959/60) expenditures on legumes which had a rather small weight.

[d] The figure for 1956/57 was computed as a weighted average of the elasticities of sour cream and lebenia in Table 4. In 1959/60 this item included a new kind of sour cream 'eshel' which did not exist in 1956/57.

[e] In 1959/60 this included expenditures on veal, which are however, quantitatively negligible.

[f] The figure for 1956/57 was computed as a weighted average of elasticities of meat and fish in Table 1.

SOURCES: The elasticities in col. (1) which have the sampling errors on their right are taken from Table 1. All the other elasticities of col. (1) (except that of 'all meat and fish') are taken from Table 4. No sampling errors are available for the latter elasticities.

CHAPTER 3

THE FORM OF ENGEL CURVES FOR FOOD ITEMS

1. *Introduction*

In the preceding computations we used the full logarithmic estimating equation which is quite common in budget studies. As already noted, this form assumes that the elasticities of consumption with respect to income and family size are constant over the entire range of variation of the above independent variables. In this chapter we shall examine in some detail the assumption of constant elasticities as well as other characteristics concerning the form of Engel curves.

We should, however, note at the outset that even if the true elasticities are not constant but rather change (say) with the level of income, the fitting of a *constant* elasticity curve can still be regarded as a reasonable approximation for many purposes. It should be remembered that in most cases we are interested in knowing the income elasticity of a commodity at the average income level, and it is very likely that the desired income elasticity can be fairly well approximated by the constant elasticity curve even though the elasticity does in fact change with the level of income. The main purpose of studying the form of the Engel curves in greater detail is the occasional need to analyze or predict the behavior of consumers at income levels (or family sizes) which differ considerably from those of the observed sample averages.

In the following analysis we shall examine the forms of the Engel curve of some food items. This group comprises total food and six of the nine food components in Table 1. The basis for this choice was the regularity of the relation between X and C[1] in a preliminary graphical analysis. The most irregular relationship happened to be in the case of bread and cereals and there seemed to be no point in carrying out a detailed statistical analysis of the precise form of the Engel curves of these (and similar) categories.

1 The difficulty of the random variation in C is taken care of by using averages of C within classes of Y.

Since the main interest in family budget studies is in the income effect, we confined the analysis to the form of relationship of X with income only, and not with family size. We cannot of course carry out this analysis by simply ignoring the differences in family size, since the latter is correlated with income. We must therefore somehow eliminate the effect of family size on our analysis. A simple way out of this difficulty is to follow the procedure of Prais and Houthakker,[2] and analyze the form of Engel curves[3] with income *per person* as the explanatory variable. This procedure does not, however, take full account of the effect of family size. We preferred therefore to carry out our analysis, whenever possible, *within* each of the various size groups and this procedure calls for somewhat different techniques than those used by Prais and Houthakker, as will be explained below.

In analyzing the form of Engel curves we tested on the data the following three simple forms, which are the most commonly used in budget studies:

(3.1) $$X = a + b\,C \quad \text{(linear curve)}$$

(3.2) $$\log X = a + b \log C \quad \text{(logarithmic curve)}$$

(3.3) $$X = a + b \log C \quad \text{(semi-logarithmic curve)}$$

where a and b are constants. The first curve assumes that the marginal propensity to consume (MPC) out of C is constant, while the second curve assumes that it is the elasticity which is constant. The third curve assumes that both the MPC and the elasticity decline (for 'normal' commodities, i.e. for $b > 0$) with the rise of C.[4] We may note that these three functions were selected from a larger group of simple functions which were fitted to food items by Prais and Houthakker. The conclusion from the latter analysis was that the semi-logarithmic curve (3.3) was the most appropriate form for food items.

2. *The Criterion of Highest Correlation*

In our analysis we shall try to determine which of the three alternative forms describes most appropriately the actual behavior of families. One

2 S. J. Prais and H. S. Houthakker, *The Analysis of Family Budgets*, Cambridge, 1955.

3 Named after Ernst Engel (who formulated Engel's Law), and is the technical term for the relation between X and C.

4 Differentiating (3.3) with respect to C we have MPC $= \frac{dX}{dC} = b\frac{1}{C}$. The elasticity η_{xc} is defined as $\frac{dX}{dC}\frac{C}{X}$ i.e. $\eta_{xc} = b\frac{1}{X} = b\frac{1}{a + b\log C}$. Thus for $b > 0$ both MPC and η_{xc} decline as C rises.

simple criterion for choosing between alternative forms is the square of the correlation coefficient (r^2) associated with each form. In other words, we choose that form which 'explains' the relatively largest proportion of the variation of X.

In order to isolate the effect of family size we made use of the cross-classification by family size and income described in Chapter 2, Section 2.[5] Taking, for example, the linear form we computed for each family size the regression equation

$$\bar{X}_{ij} = a_i + b_i\bar{C}_{ij} + d_{ij},$$

where i and j are indices of family size and income class respectively, $\bar{X}_{ij}$ and $\bar{C}_{ij}$ denote the group means in the (ij)th cell (which contains N_{ij} families) and d_{ij} is the deviation from the regression line. We then computed the 'unexplained' proportion as follows:

$$1 - r^2 = \frac{\sum\limits_{i,j} N_{ij}d_{ij}^2}{\sum\limits_{i,j} N_{ij}(\bar{X}_{ij} - \bar{X}_i)^2}.$$

These computations were repeated for each of the remaining forms.

TABLE 7. *Unexplained Proportion of Variability* ($1-r^2$) *in the Three Alternative Functions*

Commodity	*Form of function*		
	Linear	*Logarithmic*	*Semi-logarithmic*
	(1)	(2)	(3)
Fruit	0.233	0.173	0.163
Vegetables	0.494	0.488	0.455
Meat	0.125	0.090	0.114
Fish	0.287	0.290	0.231
Eggs	0.212	0.206	0.165
Milk	0.261	0.264	0.211
Total food	0.072	0.058	0.058

The result of the above computations with respect to a selected number of food items is given in Table 7. The results are presented in terms of the unexplained (residual) variation in X (i.e. $1-r^2$) and it is clear that we should

5 Excluding single-person families, for reasons stated in notes to Table 1.

prefer the form with the smallest residual variation.[6] A comparison of the three columns in Table 7 shows that the semi-logarithmic curve fits the data better than the two alternative forms. The decline in $(1-r^2)$ when passing from columns (1) and (2) to column (3) is not large, but it is repeated in a systematic manner. It seems, therefore, that for food items the assumption of declining MPC's and elasticities is the more reasonable one.

3. *The Criterion of Randomness of Residuals*

Another (and related) criterion for the goodness of fit of the Engel curves is the randomness of the residuals (d_{ij}). Consider, for example, the deviations of expenditures on total food from six linear regressions. (i.e. corresponding to form (1)) as shown in Table 8. It can be seen that the residuals are not random with respect to C; in particular, they tend to be negative for high and low values of C and positive for the central values of C. This means that the actual values of X tend to be below the linear regression lines at the extremes and above these lines in the center.

TABLE 8. *Residuals (in IL) from Six Linear Regression Equations of Total Food on Total Expenditures*[a]

Family size	Total expenditure class								
	1	2	3	4	5	6	7	8	9
2	—10.9	— 5.2	4.2	3.6	2.9	0.8	— 1.7	— 7.5	— 6.3
3	—10.0	— 6.5	1.4	1.6	1.0	7.2	— 7.7	2.1	—15.1
4	—10.4	— 7.8	2.3	4.1	0.8	— 4.1	2.4	— 3.9	— 8.7
5	— 5.6	— 6.9	0.8	4.8	— 3.2	8.9	— 0.6	— 6.5	— 2.5
6	—11.8	5.7	4.0	— 2.2	3.4	4.9	— 2.9	— 3.6	—63.6
7+	2.3	— 1.4	4.6	— 6.6	7.3	25.1	—26.7	2.4	0.3

[a] The values of X and C used in each regression are mean values of these variables within each of nine fixed income groups. The residuals are ordered from left to right according to the ascending array of the values of C. The values of C corresponding to any column are of course not equal, but tend to increase with the number of persons in the family.

6 It should be pointed out that the use of $(1-r^2)$ as a criterion is legitimate (if we want to be exact) only in regard to the comparison between forms (1) and (3). On the other hand, in form (2) $(1-r^2)$ was calculated after we applied the logarithmic transformation to the *dependent* variable, so that we measured the unexplained proportion in the variation of *logarithms* of the dependent variable. In fact we should have calculated this proportion in regard to the *original* numbers. When Prais and Houthakker were confronted with this difficulty, they concluded that in the instances with which we are concerned it is to be expected that the differences between $(1-r^2)$ computed on a logarithmic basis, or on the basis of original numbers, would be small.

We turn now to the problem of finding a statistic by which we may test more precisely the randomness of the residuals in Table 8. In their study Prais and Houthakker test the randomness of residuals by applying a 'run test' to their signs.[7] In our case this procedure was not practical since the number of residuals in each size group is too small for the proposed test. An appropriate non-parametric test for the randomness of the residuals in Table 8 as a whole is Friedman's two-way analysis of variance for variables expressed in terms of ranks.[8] For this purpose we shall first assign ranks (R) to the nine residuals in each row (i) of Table 8, from 1 (the smallest residual) to 9 (the largest residual). The results of this transformation are given in Table 9. Note that the sum of ranks in each row is $\sum_j R_{ij} = 45$ and altogether $\sum_{ij} R_{ij} = 270$. On the other hand, the sum of ranks in each column, i.e. $R_j = \sum_i R_{ij}$, may of course vary.

TABLE 9. R_{ij} *Corresponding to Table 8*

Family size (i)	*Total expenditure group* (j)								
	1	2	3	4	5	6	7	8	9
2	1	4	9	8	7	6	5	2	3
3	2	4	6	7	5	9	3	8	1
4	1	3	7	9	6	4	8	5	2
5	3	1	7	8	4	9	6	2	5
6	2	9	7	5	6	8	4	3	1
7+	5	3	7	2	8	9	1	6	4
Total R_j	14	24	43	39	36	45	27	26	16
R'_j	—0.53	—0.20	0.43	0.30	0.20	0.50	—0.10	—0.13	—0.47

7 See Prais and Houthakker, *op. cit.*, pp. 53–54. This test is based on the order in which the + and — signs appear in the sequence of the residuals. This order can be tested for randomness by the so-called run test.

8. See M. Friedman, "The Use of Ranks to Avoid the Assumption of Normality Implicit in the Analysis of Variance", *Journal of the American Statistical Association*, Vol. 32, 1937, pp. 675–701.

If the residuals in Table 8 were random one would expect the column sums R_j to be approximately equal. To be more precise, the hypothesis that the residuals are randomly distributed among columns (the null hypothesis) implies $ER_j = \frac{1}{g} \sum_{ij} R_{ij}$, when E denotes the expected value and g is the number of columns. In Table 9 for example, ER_j under the null hypothesis is $30 (= 270/9)$. In the bottom row of Table 9 we express R_j in terms of relative deviations from ER_j, i.e. $R'_j = \frac{R_j - ER_j}{ER_j}$, and it is clearly seen that R_j varies systematically among the columns.

In order to test whether the column-sums of the ranks are randomly distributed Friedman computes the statistic

$$\chi_r^2 = \frac{12}{tg(g+1)} \sum_{j=1}^{g} R_j^2 - 3t(g+1),$$

which is distributed (under the null hypothesis) approximately according to chi-square with $g-1$ degrees of freedom (t and g being the number of rows and columns respectively). We should note the difficulty arising from the fact that Friedman's test is formulated for conditions where the original variables (i.e. the residuals in Table 8) are free variables, while in our situation they are constrained as a result of their being deviations from calculated regression lines. In this case, the number of effective degrees of freedom of χ_r^2 is not clear, but apparently $g-2$ would be a conservative estimate. In the standard tables we find that the 5 per cent significance level of chi-square[9] is 14.07 while the value of χ_r^2 computed from Table 9 is 22.3, so that we may reject the null hypothesis at the above-mentioned level, and conclude that the Engel curves for total food are non-linear.

So far we have studied the randomness of residuals for one commodity and one form only. The same technique has been applied to all seven commodities and to each of the three alternative forms. The resulting 21 values of χ_r^2 are given in Table 10. The lower values of χ_r^2 in column (3) indicate that R_j is most evenly distributed in the semi-logarithmic form. In other words, the latter form is the most satisfactory from the point of view of randomness of residuals.

While none of the values of χ_r^2 in column (3) is significant, we found by further analysis some indication that the residuals in the semilogarithmic

9 With seven degrees of freedom.

TABLE 10. *Value of χ_r^2 Obtained for Food Items in the Three Alternative Estimating Equations*

Commodity	*Form of function* Linear (1)	Logarithmic (2)	Semi-logarithmic (3)
Fruit	19.96	23.11	7.95
Vegetables	15.55	14.44	10.80
Meat	17.60	18.40	4.80
Fish	18.31	15.02	9.64
Eggs	19.60	6.62	11.78
Milk	10.62	7.16	6.53
Total Food	22.27	14.27	5.73

form are not completely random. This can be seen if we combine the values of R_j $(j = 1 \ldots 9)$ for the six food components. Denoting the food component by q we form the aggregate column sums $\bar{R}_j = \sum_{q=1}^{6} (R_j)_q$. On the assumption that the deviations are random we know that $E\bar{R}_j = 30 \times 6 = 180$, and accordingly we define $\bar{R}'_j = \frac{\bar{R}_j - 180}{180}$.

TABLE 11. *Combined Deviations ($\bar{R}'_j$) for Six Food Items Obtained From Three Alternative Estimating Equations*

Expenditure group	*Form of function* Linear (1)	Logarithmic (2)	Semi-logarithmic (3)
1	−0.38	−0.30	−0.14
2	−0.23	−0.10	−0.17
3	0.23	0.28	0.15
4	0.28	0.31	0.18
5	0.28	0.23	0.11
6	0.34	0.16	0.21
7	−0.11	−0.13	−0.17
8	−0.08	−0.11	−0.03
9	−0.33	−0.33	−0.14

The behavior of these relative deviations in different expenditure groups is given in Table 11. This table shows that in all three forms the residuals tend to vary systematically with C. The shape of this relationship suggests that the MPC declines (as C rises) more rapidly than is assumed by any of these functions. At the same time it is clear that there is a very considerable reduction in the amplitude of the deviations as we pass to the semi-logarithmic form.

4. *The Log-Normal (LN) Curve*

In general, we cannot expect a simple curve of the types analyzed to give an adequate description of the behavior of families at the extremes of income distribution. This is even more true when we try to extrapolate our curves beyond the observed income range. In a recent contribution Brown and Aitchison fitted to budget data a curve which is more flexible than ordinary ones and probably more useful for studying behavior at high income levels.[10] This curve is the cumulative Log-Normal distribution function, or in short the LN curve. It starts from the origin (of X and C) with a rate of change (MPC) at first increasing and then decreasing. The curve has an upper asymptote which is interpreted as the saturation level of consumption. The saturation level is reached only at infinite income levels but it can be estimated on the basis of the sample observations.

We should note that it is not very important whether the saturation level actually exists. The main purpose of the estimated (hypothetical) saturation level is as an indicator of the degree at which the Engel curve tapers off at high income levels.[11] It is very difficult to learn about this aspect of the behavior of the Engel curve from the ordinary curves, since the parameters of the latter curves effectively describe the behavior of families in the vicinity of the sample means.

The mathematical form of the LN curve can be written

$$\frac{X}{T} = \int_{-\infty}^{z} \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}t^2} dt, \tag{3.4}$$

10 J. A. C. Brown and J. Aitchison, "A Synthesis of Engel Curve Theory", *The Review of Economic Studies*, Vol. 22, 1954, pp. 35–46.

11 It should be noted that this curve does not take into account the possibility that a commodity can be 'inferior' at a certain income range (i.e. that the expenditures on the commodity may decline as C rises). It is therefore more appropriate for broadly-defined commodity groups.

where T is the saturation level and $z = \alpha + \beta \log C$. This curve can be fitted to the data by using an iterative regression scheme, the first step of which requires guessing the saturation level.[12] In our analysis we followed a less accurate procedure and determined the parameters T, α, and β by graphical methods.[13] We should also note that in this case we carried out our analysis in per capita terms, since the fitting of the LN curve for each family size group separately was impractical owing to the high degree of variability within each individual group. The data used in this analysis is the same as that used in the previous sections with $\bar{X}_{ij}$ and $\bar{C}_{ij}$ divided by the appropriate number of persons (S_i). This resulted in 54 group means which were then combined into 12 groups for the purpose of the graphical analysis,

TABLE 12. *Average Per Capita Expenditure on Various Food Items Compared with the Estimated Saturation Level*

Commodity	*Average per capita expenditure (IL per month)* (1)	*Estimated saturation level* (2)	(1) ÷ (2) (3)
Eggs	3.2	4.4	0.73
Milk	3.2	4.5	0.71
Meat	8.5	20.0	0.43
Fruit	3.4	7.5	0.45
Vegetables	3.5	6.0	0.59
Total Food	35.1	80.0	0.44

The diagrams for total food and five food components are given in Figure 1. These diagrams show the relationship between per capita expenditures on a commodity ($\frac{X}{S}$) as a fraction of the saturation level T (on the vertical axis) and total expenditure per capita ($\frac{C}{S}$) (on the horizontal axis). It can be seen that in most cases the LN curve gives quite a close fit to the data. The commodities which seem to be very close to the saturation level, in the highest income groups, are eggs and milk. For fruit and meat, on the other hand, the expenditures in the highest income groups do not

12 See Brown and Aitchison, *op. cit.*, pp. 45–46.

13 On the other hand, our method is less restrictive, since we let β be freely determined and did not follow Brown and Aitchison in fixing $\beta = 1$.

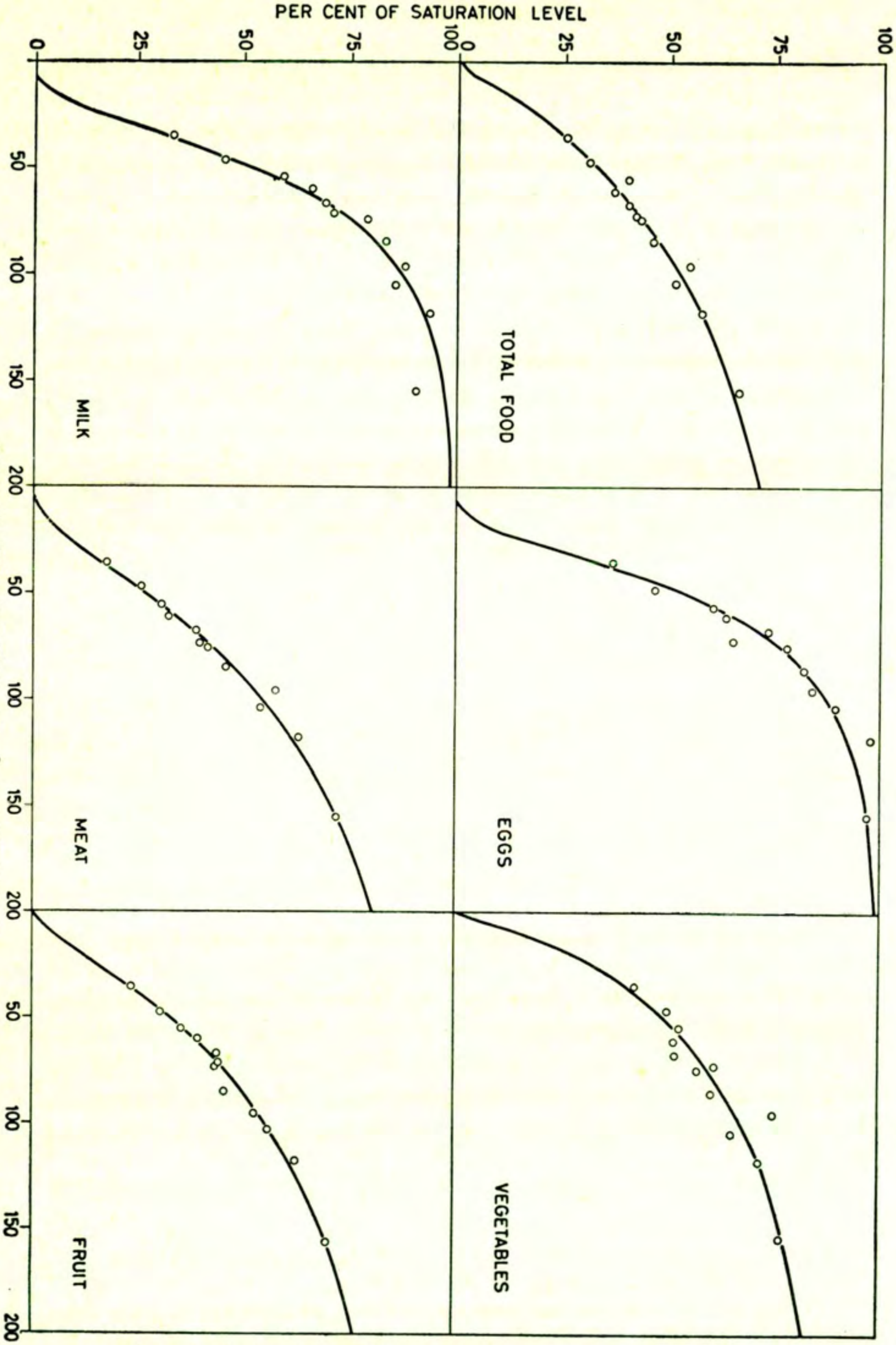

Figure 1. The Log-Normal Curve Fitted to Six Food Commodities

exceed 70 per cent of the saturation level. The relation between the average per capita expenditure in our sample and the estimated saturation level is given in Table 12. Again we see that expenditures on eggs and milk are relatively close (about 70 per cent) to the saturation level. It is interesting to recall that the latter commodities are quite income elastic 'on the average', and it is only at the highest income levels that the curve flattens out.

5. *Income Elasticities Derived from Alternative Functions*

In the beginning of this chapter we pointed out that insofar as we are interested in measuring the income elasticities at the point of sample means the constant elasticity curve may be a reasonable approximation. We should not be surprised to find the same thing for the simple linear curve. It is only when we move away from the sample means that the error involved in using the incorrect form becomes serious. It should be understood that these remarks need not apply to every hypothetical situation; nevertheless they seem to be in line with our data, as well as with the experience in some other studies.[14]

To examine this point, which is of some practical importance for future budget studies in Israel, we computed the income elasticities from alternative forms, where both income and family size are used as independent variables. The equations are:

$$X = b_0 + b_1 \log C + b_2 \log S \tag{3.5}$$

$$\frac{X}{S} = b_0 + b_1 \log \frac{C}{S} + b_2 \log S \tag{3.6}$$

$$\log X = b_0 + b_1 \log C + b_2 \log S. \tag{3.7}$$

In the first two equations income (C) enters in a semi-logarithmic form while in the third it appears in a full logarithmic form. In view of the preceding discussion the former equations are the more realistic from the point of view of the income effect.

As for family size, we experimented with two alternative formulations in (3.5) and (3.6). The latter is a formulation used by Prais and Houthakker as an extension[15] of the simple semi-logarithmic curve of the per capita type $\frac{X}{S} = b_0 + b_1 \log \frac{C}{S}$. The function (3.5) is simpler to handle but

14 See L. M. Goreux, *Income Elasticity of the Demand for Food*, FAO, Rome, 1959, p. 27.

15 Note that (3.6) implies that the MPC out of C varies across family size in direct proportion to the change in S. This is probably an exaggeration of the influence of S.

it has the disadvantage of ignoring the possible interaction between the effects of C and S. Finally, we may note that all the three formulations assume that the marginal effect of S on consumption varies with the level of S. This assumption is reasonable in view of the economies of scale in consumption and in view of the fact that the proportion of small children (whose effect on X is small) increases with S.

The income elasticities (η_{xc}) derived from the above equation, at the point of sample means, are given in Table 13. It can be seen that the choice of the form has a surprisingly small effect on the value of the income elasticities. Similar conclusions were reached in most cases for the elasticities with respect to family size.

These conclusions refer of course to the elasticities computed at the sample means. In order to obtain some idea of the change in income elasticity as we move across income levels we may consider the figures in Table 14. The income elasticities were calculated here for five different income levels by using the semi-logarithmic curve (3.5), which we assume to be more appropriate for food items in general.

All these calculations refer to a family of four persons. It can be seen that the variation of the elasticities across income groups is larger for the

TABLE 13. *Elasticities (η_{xc}) of Food Items Obtained from Three Alternative Estimating Equations*[a]

Commodity	*Estimating equations*		
	(3.5) (1)	(3.6) (2)	(3.7) (3)
Bread and cereals	—0.047	—0.026	—0.043
Fats	0.212	0.229	0.215
Vegetables	0.170	0.334	0.337
Fruit	0.616	0.715	0.713
Fish	0.418	0.404	0.437
Meat	0.705	0.796	0.753
Eggs	0.615	0.667	0.675
Milk	0.501	0.506	0.528
Total Food	0.488	0.562	0.516

[a] The computations relate to the same families as in the rest of this chapter. The commodities include all food commodities which appeared in Table 1, with bread and cereals combined into one group.

TABLE 14. *Income Elasticities of Food Items at Five Income Levels*[a]

Commodity	*Level of income (C) in IL*				
	200 (1)	250 (2)	300 (3)	350 (4)	400 (5)
Bread and cereals	—0.046	—0.047	—0.047	—0.047	—0.048
Fats	0.230	0.219	0.210	0.203	0.198
Vegetables	0.181	0.174	0.169	0.166	0.161
Fruit	0.792	0.673	0.600	0.549	0.513
Fish	0.492	0.444	0.411	0.386	0.367
Meat	0.946	0.782	0.684	0.618	0.571
Eggs	0.792	0.672	0.599	0.549	0.511
Milk	0.611	0.539	0.490	0.456	0.430
Total Food	0.592	0.523	0.478	0.445	0.420

[a] The mean values of C and S for the families on which this analysis is based are $C =$ IL 287, $S = 3.98$.

more income-elastic commodities.[16] Thus, as income doubles (from IL 200 to 400) the elasticity of meat declines by 40 per cent while that of vegetables declines by 11 per cent only.

We may conclude our findings in this chapter as follows:

a. For broadly-defined food items such as meat, fruit, etc., there is a tendency for both the MPC's and the income elasticities to decline as income rises. The form of Engel curve (i.e. the relation between X and C) can be reasonably well represented by the semi-logarithmic form $X = b_0 + b \log C$.

b. Milk and eggs exhibit a strong tendency towards reaching a saturation level at the high income levels in the sample.

c. The elasticities computed at the sample means are insensitive to the choice of form of the relationship.

16 On this point see Prais and Houthakker, *op. cit.*, p. 123.

CHAPTER 4

FOOD CONSUMPTION IN VARIOUS DEMOGRAPHIC GROUPS[1]

1. *Additional Demographic Variables*

Income and family size are the most important determinants of consumption in a cross section but clearly not the *only* ones. The purpose of the analysis in this and the following chapter is to investigate the effect of some additional factors on consumption. We shall now briefly review these new variables.

First we should note that analysis of consumption patterns can be improved by considering not merely the effects of family size, as measured by the number of persons, but also the effects of family *structure*, i.e. the age-sex distribution of family members. A complete analysis of the effect of family structure on consumption is a complicated matter and requires a separate study.[2] However, in order to obtain at least some idea of the quantitative effect of family structure on consumption we simply divided the members of the family into two groups—adults and children—the dividing line being the age of 17 years. This analysis was confined to food items only.

Another demographic variable which is sometimes considered in budget studies is the *occupation* of the consumer, particularly in estimating Engel curves for food items. This is done on the assumption that people doing manual work (skilled and unskilled laborers) have a different diet from clerks, managers, and professionals. In our study we have also made a distinction between these two types, to which we shall refer, for the sake of brevity, as laborers and clerks.

It should be pointed out that, in fact, this distinction is not easy to make

1 The computations in this chapter include 1,359 families from Asia and 2,827 from Europe. These figures represent all Jewish families in the 1956/57 Survey (see Table A-1), apart from the Israel-born and families without children.

2 For conceptual problems and statistical technique of analysis see S. J. Prais and H. S. Houthakker, *The Analysis of Family Budgets*, Cambridge, 1955; J. A. C. Brown, "The Consumption of Food in Relation to Household Composition and Income", *Econometrica*, Vol. 22, 1954, p. 444.

since occupation refers only to that of the head of the family. The larger the number of children in the family, the smaller the occupational influence of the family head on the consumption pattern of the entire family. It is also possible that in any particular family there may be additional wage earners (wife, adult sons, etc.) whose occupations differ from that of the head of the family. On the other hand, it is more likely that the sons of a laborer will be laborers than that the sons of a clerk will be laborers.

In the preceding discussion we only pointed out the differences in *diet* between the two occupational groups, but it is known that there are also important differences in educational level between these groups. Clerks have a higher educational level, on the whole, than have laborers. This may create considerable differences in expenditures on non-food commodities. We will, in fact, be particularly interested in this aspect of occupational differences. Of course, the most desirable thing would be to use a variable that expresses the educational level of the family, but unfortunately this information is lacking in the statistical material at our disposal.

Another demographic, or social, factor of particular importance in Israel is the consumer's country of origin.[3] Since there are probably different consumption patterns in different countries, and particularly in different continents, we would be likely to find in Israel that the consumers still maintained to some extent the consumption patterns of their countries of origin. If we want to divide the countries of origin for the purposes of our study into two categories, the basic distinction would probably be made between the countries of Europe and America on the one hand, and the countries of Asia and Africa on the other. This distinction is more or less equivalent to the division on a communal basis, i.e. the division between Ashkenazim and Others (a *direct* distinction between the communities cannot be made on the basis of the material at our disposal). Most of our analysis will be carried out for these two groups only, but we shall also supplement our findings with some analysis using a finer classification—by country of origin. Our analysis will not cover Israel-born families, since this group constitutes a mixture from a communal point of view and it was not possible to obtain a proper classification of the heads of these families by continent of origin of their parents.

The question then arises as to whether there is a tendency for the differences in consumption patterns according to continents of origin, insofar as they exist, to decline. A partial answer to this can be obtained by dividing

3 We may note that, as in the case of 'occupation', the classification by continent of origin refers solely to the *head* of the family, but we know that the continents of origin of husband and wife are very strongly correlated.

the families within each continent-of-origin group according to their duration of residence in Israel. We therefore divided the families into two categories: veterans (those who immigrated before the establishment of the State) and newcomers. Our problem is then to examine whether the differences in consumption patterns of Asian and European immigrants are smaller among veterans than among newcomers. For the sake of brevity we shall refer to Asia-Africa as Asia, and to Europe-America as Europe.

TABLE 15. *Background Information on Classification by Continent of Origin and Duration of Residence in the 1956/57 Survey*

Continent of origin	*Duration of residence*	*Distribution of families in sample (per cent)* (1)	*Average total expenditure (C) (IL per month)* (2)	*Average number of persons (S)* (3)	*Total expenditures per capita (IL per month)* (4)	*Per cent of children* (5)	*Per cent of laborers* (6)
Asia	Newcomers	18	256	5.3	48	53	83
	Veterans	7	278	5.1	54	51	78
Europe	Newcomers	29	246	3.3	74	33	67
	Veterans	37	296	3.4	87	37	43
Born in Israel		9	290	4.1	71	42	55

In Table 15 we give some background information on the classification according to continent of origin and duration of residence. Column (1) shows that European veterans are the largest group (37 per cent) and Asian veterans are the smallest (7 per cent) in the sample. There are outstanding differences in family size between the two continents—the European families average 3.5 members while the Asian ones average over 5. The Asian families also have a greater percentage of children. Column (6) shows that there are differences in the occupational structure of the 'continent-of-origin-duration-of-residence' groups. While the percentage of laborers among veteran European immigrants (family heads) is only 43 per cent, among new Asian immigrants it is 83 per cent.

Finally, it is interesting to see the differences in the level of total expenditures between the continent-of-origin groups. As can be seen in column (2), European veterans head the list and are followed by the native-born. At the same time, it should be pointed out that the differences between the groups are not large. In order to get some idea of how these differences affect standard of living, the average size of the families in the various groups must be taken into consideration, since the average expenditure per family among Asian immigrants must be divided over a larger number of people. The figures in column (4), which present the average per capita expenditure, clearly show the considerable differences in standard of living between people coming from the various continents. If we look at the extreme groups—Asian newcomers and European veterans—we find that the per capita expenditures of the latter are almost twice as large as those of the former. It should be pointed out, however, that this ratio exaggerates the differences in standard of living to a certain extent because it does not take into account 'economies of scale' in consumption.

2. *Estimating Procedure*

In order to estimate the consumption functions of European and Asian immigrants we used the following estimating equation:

$$(4.1) \qquad X = b_0 + b_1 \log C + b_2 \log S_1 + b_3 \log S_2 + b_4 D,$$

where the income effect is assumed to be of the semi-logarithmic form, in accordance with the discussion in Chapter 3.

This equation is of the same type as equation (3.5). The main difference is that instead of using a single variable to represent the effect of family size, namely the number of persons in the family (S), we separated S into two types—number of adults in the family (S_1) and number of children (S_2). This distinction is particularly useful for the analysis of consumption patterns by continent of origin since, as we have seen, the two groups differ considerably in family composition.[4] The purpose of the variable D is to discover possible differences in consumption levels of laborers and clerks. This is accomplished by using D as a dummy variable which takes two values only—unity for laborers and zero for clerks.

Equation (4.1) was fitted separately for European and Asian immigrants so that it will be possible to compare both the slopes and levels of the behavior functions of these two groups. The analysis of the effect of 'duration of residence' will be restricted only to differences in levels. We shall assume that the coefficients $b_1 \ldots b_4$ in (4.1) are identical for veterans and newcomers in a given 'continent', and that the only possible differences between the

4 Since S_2 is transformed into logarithms in (4.1), we could not of course include in this analysis the families without children (i.e. with $S_2 = 0$).

latter take the form of differences in b_0. Under this assumption we may use a single estimating equation for both veterans and newcomers provided the various sample moments are computed about the means of the variable *within* each of the above groups (and not about the overall mean). We should point out that the main justification for making the above assumption was the simplification of the computations and not our confidence in its actual truth (see, however, footnote [7] of this Chapter).

Another refinement introduced in this chapter is the distinction between two 'periods of enquiry', i.e. the classification of families into two groups: those who were interviewed in the 'summer months' (May–October 1956) and those interviewed in the 'winter months' (November 1956–April 1957). The reason for making this distinction is that between the two enquiry periods the average value of C rose by about 7 per cent.[5] Suppose now that there are commodities the level of demand for which varies seasonally (assuming that otherwise the consumption functions in the two seasons are identical). It is then clear that if we ignore the seasonal variations in demand we will obtain biased elasticities although in our case the bias cannot be large since the change in C between the periods is relatively small). The effect of seasonality can, however, be 'kept constant' (under our assumption) by using the same methods as those described above in relation to 'duration of residence'. In other words, all our variables can be expressed as deviations from their group means within a cross classification both by 'duration of residence' and 'period of enquiry'.

The computational procedure was as follows. At first we cross-classified all the families in the 1956 survey (excluding those without children—see footnote [4]) by the following variables: disposable income (Y), number of adults (S_1), number of children (S_2), occupation (D), continent of origin, duration of residence, and period of enquiry. The mean values of the relevant variables (including C) computed within these cells formed the basis for estimating (4.1) for each continent, after allowing for the effects of duration of residence and period of enquiry.

The effects of the latter variables were kept constant by computing for each continent sample moments of the following form:

$$(4.2) \qquad \sum_{tdi} N_{tdi}(\bar{P}_{tdi} - \bar{P}_{td})(\bar{Q}_{tdi} - \bar{Q}_{td}),$$

where N denotes the number of families in the $(tdi)th$ cell, $\bar{P}$ and $\bar{Q}$ are mean values of any two variables within the $(tdi)th$ or $(td)th$ cells, t and d are the

5 In nominal terms; this corresponds to a rise of about 5 per cent in real terms.

indices of period of enquiry and duration of residence ($t, d = 1, 2$) and i runs over all cells resulting from the cross classification by Y, S_1, S_2 and D. This procedure is conceptually equivalent to using, instead of (4.1), an estimating equation with two additional independent variables:

$$(4.1') \quad X = b_0 + b_1 \log C + b_2 \log S_1 + b_3 \log S_2 + b_4 D + b_5 D' + b_6 D'',$$

D' being a dummy variable assuming two values only—1 for veterans and 0 for newcomers; similarly D'' equals 1 or 0 according to whether the family belongs to the first or second enquiry period. (4.1′) has of course the advantage of giving us the coefficients of D' and D'' directly, while in (4.1), in conjunction with (4.2), we merely keep these variables constant. Nevertheless we followed the latter procedure since it turned out to be computationally simpler.

The statistical method used to estimate (4.1) was that of instrumental variables (see Appendix C) with Y serving as the 'external' variable.

In the following analysis we shall use eight broadly-defined food expenditure groups. While it is perhaps more important to know whether the immigrants' consumption patterns differ with respect to these *aggregative* commodity groups (such as meat, vegetables) it is unlikely that the largest differences are found in the consumption of the *narrowly*-defined expenditure groups. This latter possibility requires, however, a separate analysis.

The results of our computations will be presented in a more detailed form than in Chapter 2. Instead of considering only the income elasticities (η_{xc}) we shall also consider the marginal and average propensities to consume.

3. *Marginal Propensities to Consume and Consumption Elasticities by Continent of Origin*

We will begin with a description of the marginal propensities to consume (MPC's). The meaning of 'MPC with respect to C', or in short MPC(C), is the change in expenditures on a certain commodity when income (C) rises by one IL, other things remaining constant. Clearly the MPC(C) itself may vary as we pass from low to high income groups. In fact equation (4.1) assumes, in accordance with the discussion in Chapter 3, that MPC(C) declines as C rises. The derivation of MPC(C) for any level of C is obtained by partial differentiation of (4.1) with respect to C, which yields MPC(C) $= \dfrac{b_1}{C^*}$ where C^* is an arbitrarily fixed value of C. In general we computed the MPC's (as well as other measures such as elasticities) at the mean values of

TABLE 16. *Marginal Propensities to Consume (MPC) Food Items, by Continent of Origin*[a]

Commodity	Continent (*A* = *Asia*; *E* = *Europe*)	MPC with respect to: Income (C) (1)	Number of adults (S_1) (IL per month) (2)	Number of children (S_2) (IL per month) (3)	Occupation (D) (IL per month) (4)
Total food	A	0.2911 (± 0.0204)	10.88 (± 1.96)	9.69 (± 0.90)	—0.51 (± 3.28)
	E	0.2530 (± 0.0125)	15.39 (± 1.51)	9.67 (± 0.71)	4.28 (± 1.52)
Bread and cereals	A	0.0208 (± 0.0057)	5.28 (± 0.54)	5.14 (± 0.25)	2.42 (± 0.91)
	E	0.0040 (± 0.0027)	3.67 (± 0.33)	2.49 (± 0.15)	1.04 (± 0.33)
Fats	A	0.0103 (± 0.0029)	1.33 (± 0.28)	1.01 (± 0.13)	0.45 (± 0.46)
	E	0.0069 (± 0.0015)	1.28 (± 0.18)	0.78 (± 0.09)	0.10 (± 0.18)
Vegetables	A	0.0256 (± 0.0044)	2.58 (± 0.42)	2.13 (± 0.20)	—0.43 (± 0.71)
	E	0.0153 (± 0.0030)	2.81 (± 0.36)	1.34 (± 0.17)	0.80 (± 0.36)
Milk	A	0.0238 (± 0.0028)	—0.38 (± 0.27)	0.15 (± 0.12)	—1.72 (± 0.44)
	E	0.0228 (± 0.0021)	1.53 (± 0.26)	1.82 (± 0.12)	—0.38 (± 0.26)
Eggs	A	0.0246 (± 0.0031)	0.25 (± 0.30)	0.41 (± 0.14)	—2.10 (± 0.50)
	E	0.0264 (± 0.0024)	0.66 (± 0.29)	1.40 (± 0.14)	0.17 (± 0.29)
Meat	A	0.0679 (± 0.0069)	0.83 (± 0.67)	—0.37 (± 0.31)	1.11 (± 1.12)
	E	0.0789 (± 0.0056)	2.87 (± 0.68)	—0.11 (± 0.32)	2.56 (± 0.68)
Fruit	A	0.0427 (± 0.0044)	—0.61 (± 0.42)	0.04 (± 0.19)	—1.08 (± 0.70)
	E	0.0393 (± 0.0039)	0.66 (± 0.46)	1.12 (± 0.22)	—0.10 (± 0.47)

[a] The common values of C, S_1, S_2 and D, on which these calculations are based, are as follows:

$$C = \text{IL } 268,\ S_1 = 2.22,\ S_2 = 1.91,\ D = 0.64.$$

These correspond approximately to the overall geometric means of these variables in the sample (excluding *families without children*). More precisely, they are the antilogs of log C, log S_1, and log S_2, where the latter are the averages of the logarithms of the group means corresponding to the cross-classification described on page 44.

Since the values of the independent variables are determined here arbitrarily we have e.g. $var(\frac{b_1}{C^*}) = \frac{1}{C^{*2}} var(b_1)$.

We used this formula to compute the various sampling errors in this table.

For the original coefficient of equation (4.1) see Appendix D.

the independent variables in the sample. Thus in Table 16, column (1), we find that a family of European immigrants, whose income corresponds to the overall average,[6] spends one quarter of every additional pound of C on food.

In a similar way we may speak of MPC with respect to (say) S_2, to be denoted by MPC(S_2). This is to be understood as the change in the family's consumption expenditures on a certain commodity as a result of an addition of one child (other things being equal). It should be clear that MPC(S_2) is not a measure of the consumption of the additional child itself, but rather of its effect on the consumption of the entire family (so that MPC(S_2) may even be negative). The value of MPC(S_2) computed for a given value of S_2 is given by $\frac{b_3}{S_2^*}$. This expression for MPC(S_2) reflects the reasonable assumption that the larger the family the smaller the influence of an additional child on its consumption. The figures of MPC(S_2) are given in Table 16, column (3); for example, in the first two rows we find that an addition of one child increases expenditures on food by about IL 10 per month (in relative terms this means an increase of about 7–8 per cent in the family food consumption).

A comparison of columns (2) and (3) shows that MPC(S_1), i.e. the effect of an additional adult, is not always larger than MPC(S_2), i.e. the effect of an additional child. However, the fact that in our data MPC(S_2) is larger than MPC(S_1) in the case of milk is not surprising since the need of children for milk is greater than that of adults. It is also not unreasonable to find the same behavior in the case of eggs. It is surprising, however, that in most other cases the differences between the effects of adults and children on food consumption are quite small.

In fact our experiment of separating the standard variable 'number of persons in the family' (S) into adults and children did not turn out very successful since, taking account of the sampling errors, we can say very little about the true differential effects of children and adults on food consumption. A possible explanation for the relative lack of sensitivity of our data to the distinction between children and adults is in our definition of these two categories. One could probably improve the analysis by placing the dividing line between these categories not at the age of 17 (as we did) but rather at the age of 14 or 10.

The data in column (4) correspond to the coefficient b_4 of (4.1). These figures show the excess, other things being equal, of the food expenditures

6 Since in (4.1) the independent variable appears in logarithmic form we carried out our computations at the point of the *geometric* means of the variables (see footnote [a] to Table 16).

of laborers over those of clerks. Thus we find, for example, that in the group of European immigrants laborers spend about IL 4.5 (per month) more on food than clerks. It can be seen that in about half the cases the effect of occupation is insignificant (thus, e.g. occupation does not seem to affect expenditures on total food of Asian immigrants). The most significant result in column (4) is that laborers tend to spend more than clerks on bread and cereals. This is to be expected on the ground that the demand for commodities which are important calorie suppliers is likely to be greater among those doing physical work. We may also conclude from column (4) that laborers spend more on meat than clerks and less on milk.

We turn now to consider the differences in the consumption function of Asian and European immigrants. It mayseen natural to do this by comparing the differences in the individual coefficients one by one. Strictly speaking, this procedure is not legitimate since all the coefficients in a given estimating equation are not independent. It is therefore important first to carry out an overall test of the significance of the differences between the *sets* of coefficients $b_1 \dots b_4$ in the two continents.

A formulation of a large sample chi-square test of this kind is derived in Appendix C. This test was carried out at an early stage of our study when all our computations were carried out for each period of enquiry separately. We did not repeat the tests for the combined (annual) data because of the heavy computations involved. We may note, however, that the differences between continents were of the same nature in each of the two periods of enquiry. The result of the chi-square test (which is based in each case on four degrees of freedom) for the semi-annual functions are given in Table 17. According to this table one half of the tests show highly significant differences between the behavior functions of the two continents. The commodities where these differences are greatest and where they appear systematically in each period are bread and cereals, milk, and eggs. In the case of these three commodities we are therefore fairly certain that the slopes of the consumption functions of Asian and European immigrants are different.[7]

Let us return now to Table 16 and examine the nature of the above differences in terms of the *individual* coefficient in the behavior function corresponding to the three commodities. In the case of bread and cereals we find that all the four coefficients are larger for Asian than for European immigrants. In the case of milk and eggs, however, we find that the income

7 Since the 'continent of origin' is a more basic factor than 'duration of residence' it is reasonable to think that the latter factor will affect the slopes of the consumption functions for an even smaller number of commodities.

TABLE 17. *Significance Tests for the Differences Between the Consumption Functions of Asian and European Immigrants*[a]

Commodity	Values of chi-square	
	First period (1)	Second period (2)
Total food	4.7	5.2
Bread and cereals	56.9[b]	48.7[b]
Fats	2.6	7.4
Vegetables	2.8	16.2[b]
Milk	70.1[b]	50.0[b]
Eggs	30.5[b]	20.1[b]
Meat	6.9	5.0
Fruit	9.3	14.9[b]

[a] For the derivation of this test see Appendix C. Every value of chi-square is based on four degrees of freedom. The 5 per cent and 1 per cent significance levels are 9.5 and 13.3 respectively.

[b] Means significant at the 1 per cent level.

effect, MPC(C), is practically the same for both continents and that the differences between the consumption functions are concentrated in the *other* coefficients. In particular, it seems that the consumption levels of milk and eggs by Asian immigrants are rather insensitive to changes in the number of adults or children. This is quite different from the behavior pattern of European immigrants whose consumption of milk and eggs increases considerably as the number of adults or children increases.

In Table 18 we present the previous results in terms of *elasticities*. The latter are computed as the ratios between the MPC's and the corresponding average propensities.[8] It can be seen that there is considerable similarity between the income elasticities of two continents, except for the case of

8 For example, the elasticity with respect to S_2 is given by

$$\eta_{xs_2} = \frac{\partial X}{\partial S_2} \div \frac{X}{S_2}.$$

TABLE 18. *Consumption Elasticities of Food Items, by Continent of Origin*[a]

Commodity	*Continent* ($A = Asia$; $E = Europe$)	*Elasticity with respect to* Income (C) (1)	Number of adults (S_1) (2)	Number of children (S_2) (3)
Total food	A	0.582	0.181	0.138
	E	0.516	0.261	0.141
Bread and cereals	A	0.250	0.527	0.441
	E	0.067	0.513	0.300
Fats	A	0.388	0.416	0.272
	E	0.289	0.443	0.232
Vegetables	A	0.412	0.345	0.244
	E	0.290	0.442	0.181
Milk	A	0.552	—0.074	0.026
	E	0.420	0.234	0.241
Eggs	A	0.626	0.052	0.075
	E	0.562	0.117	0.213
Meat	A	0.710	0.072	—0.027
	E	0.695	0.210	—0.007
Fruit	A	0.744	—0.088	0.005
	E	0.707	0.098	0.143

[a] The figures in this table were computed by dividing the MPC's by the corresponding average propensities. See also note [a] to Table 16.

bread and cereals. It seems, however, that there is a certain tendency for the income elasticities of food items of Asian immigrants to be somewhat higher than those of the European immigrants.

4. *Analysis of Consumption Levels by Continent and Country of Origin*

Until now we have spoken about marginal changes in the consumption of food resulting from changes in the explanatory variables. We will now consider the differences in the consumption *levels* of Asian and European immigrants. In order to do this it is first necessary to eliminate all the differences in consumption stemming from differences in income, family size, and structure and occupation. This is done by an analysis of adjusted means. In other words, we first of all determine common values for the independent variables of both continent groups. Afterwards we compute, using the estimating function of each continent group, the consumption level for the common values of the independent variables. In fact, we determined these common values at the overall average values of the independent variables (without distinction between the continent groups). The calculated consumption values, or the 'adjusted means', are therefore:

$$X_j^* = \bar{X}_j + b_{1j}(\overline{\log C} - \overline{\log C_j}) + b_{2j}(\overline{\log S_1} - \overline{\log S_{1j}}) + b_{3j}(\overline{\log S_2} - \overline{\log S_{2j}}) + b_{4j}(\bar{D} - \bar{D}_j), \tag{4.2}$$

where j is an index of the continent and $\bar{X}_j{}^*$ denotes the calculated consumption level of a particular commodity in continent group j. X_j represents the average (per family) consumption in continent group j, and the other members on the right side express the correction in $\bar{X}_j$ that has to be made in order to obtain X_j^*. (A bar over a variable indicates a mean value.)

It should be noted that the comparison of the consumption levels of the two continents is unambiguous only when the slope-coefficients $b_1....b_4$ are the same for both continents.[9] If, however, it is known that the latter coefficients are significantly different, then the differences in consumption levels (in the population) will be influenced by our choice of the point at which the comparison takes place (i.e., by the set of values assigned to the independent variables). In our analysis this difficulty is particularly relevant for bread and cereals, milk, and eggs.

In order to examine whether this ambiguity is in fact important in our data we computed the X_j^*'s at two additional points—at the mean values of the independent variables corresponding alternately to Asian and European immigrants. The differences between X_j^*'s of the two continents turned out to be rather insensitive to the above-mentioned changes at the point of comparison. We shall therefore present our results only for the comparison at the point of the overall sample means of the independent variables.

The values of X^* are given in Table 19. (The corresponding figures in terms of 'average propensities to consume' out of C are given in **Table 20**).

9 If the slope coefficients do not differ significantly between the continents then consideration of statistical efficiency suggests that one should combine the two estimating equations into a single one. In the following computations we ignored this possibility since it makes very little difference to the final results.

TABLE 19. *Calculated Food Consumption Levels, by Continent of Origin*[a] *(IL per month)*

Commodity	Continent of origin: Asia (1)	Continent of origin: Europe (2)	Difference between continents: Absolute (2)—(1) (3)	Difference between continents: Relative (3) ÷ (1) (4)
Total food	133.97 (± 1.59)	131.26 (± 0.75)	—2.71 (± 1.76)	—0.020
Bread and cereals	22.28 (± 0.44)	15.90 (± 0.16)	—6.38 (± 0.47)	—0.286
Fats	7.11 (± 0.22)	6.41 (± 0.09)	—0.70 (± 0.24)	—0.098
Vegetables	16.66 (± 0.35)	14.15 (± 0.18)	—2.51 (± 0.39)	—0.151
Milk	11.56 (± 0.22)	14.53 (± 0.13)	2.97 (± 0.25)	0.257
Eggs	10.52 (± 0.24)	12.60 (± 0.14)	2.08 (± 0.28)	0.198
Meat	25.61 (+ 0.54)	30.42 (±0.34)	4.81 (± 0.64)	0.188
Fruit	15.37 (± 0.34)	14.87 (± 0.23)	—0.50 (± 0.41)	—0.033

[a] The values of X^* were calculated according to formula (4.2). The common values of the independent variables are the same as in Table 16.
The variances of X^* were calculated according to the usual formula

$$\mathrm{var}(X_j^*) = \frac{\mathrm{var}(w_j)}{N_j} + \sum_{ik} Q_{ij} Q_{kj} \mathrm{cov}(b_{ij}, b_{kj}) \ (i, k = 1 \dots 4).$$

where Q_{ij} denotes the bracketed expressions in (4.2), i and k are the indexes of the independent variables, var(w_j) is the variance of residuals, and N is the number of cases. (See also Appendix C.)

TABLE 20. *Average Propensities to Consume* (APC) *Food Items, by Continent of Origin*

Commodity	Continent of origin: Asia (1)	Continent of origin: Europe (2)
Total food	0.5003 (± 0.0059)	0.4902 (± 0.0028)
Bread and cereals	0.0832 (± 0.0016)	0.0594 (± 0.0006)
Fats	0.0266 (± 0.0008)	0.0240 (± 0.0003)
Vegetables	0.0622 (± 0.0013)	0.0529 (± 0.0007)
Milk	0.0432 (± 0.0008)	0.0543 (± 0.0005)
Eggs	0.0393 (± 0.0009)	0.0471 (± 0.0005)
Meat	0.0957 (± 0.0020)	0.1136 (± 0.0013)
Fruit	0.0574 (± 0.0013)	0.0555 (± 0.0009)

The results show that while there are no significant differences between the continents in their expenditure on *total* food, there are considerable (and highly significant) differences in the composition of this aggregate. These differences take the form of relatively low expenditures by Asian immigrants on the various animal protein foods (about 17 per cent lower than the European level) and their relatively high expenditure on bread and cereals (about 40 per cent higher than the European level), and on vegetables (about 18 per cent higher than the European level). It should be remembered that these differences between continents are found after taking into account the level of income, family size and composition, and occupational structure. We may therefore ascribe the remaining differences largely to differences in taste.

We turn to a comparison of consumption levels corresponding to a more detailed classification of immigrants, in order to examine the degree of homogeneity *within* each continent. In Table 21 the immigrants of each

TABLE 21. *Calculated Relative Food Consumption Levels*[a], *by Country of Origin (Eastern Europe = 100)*

	Country of origin						
	Asia-Africa				*Europe-America*		
Commodity	*Iraq, Persia* (1)	*Yemen, Aden* (2)	*Morocco, Tunisia, Algeria* (3)	*Other Asia-Africa* (4)	*Eastern Europe* (5)	*Balkan countries*[b] (6)	*Other Europe-America* (7)
Total food	98	95	101	99	100	99	96
Bread and cereals	163	109	135	128	100	103	93
Fats	96	78	136	132	100	111	107
Vegetables	109	83	137	121	100	104	93
Milk	77	72	67	78	100	100	103
Eggs	85	61	70	73	100	88	92
Meat	79	99	76	78	100	96	89
Fruit	102	106	82	95	100	95	95
Number of families	402	231	263	463	1,528	699	600

[a] Consumption levels were calculated using the estimating equations of Asian immigrants for cols. (1)–(4) and those of European immigrants for cols. (5)–(7). The estimating equations are of the semi-log type given by (4.1) with the omission of the variable D. The common values of C, S_1, and S_2 are their arithmetic means in the entire 1956/57 sample (excluding families without children). These are:

$$C = \text{IL } 284, \quad S_1 = 2.31, \quad S_2 = 2.25.$$

[b] Balkan countries include Rumania, Bulgaria, Greece, and Yugoslavia.

continent are accordingly classified by 'country of origin' (which are actually groups of countries). For each country of origin we computed the values of X^* according to (4.2), using the coefficients $b_1 \dots b_4$ of the appropriate continent.[10]

The general conclusion which emerges from Table 21 is that our earlier classification by continent of origin is not unreasonable, though the behavior within each continent is not quite uniform. Thus in the case of bread and cereals, we find that every subgroup of Asian immigrants spends more than any subgroup of European. Similarly, looking at the expenditures on animal proteins we find that European immigrants generally spend more than the Asians. There are, however, certain cases where we find considerable differences within a given continent. Thus the immigrants from Yemen and Aden often tend to have an entirely different pattern of expenditures from the rest of the Asians. In particular, they spend relatively little on bread and cereals, fats (even less than the Europeans) and eggs, while their expenditures on meat are on the same level as the Europeans. In view of the results in this table it seems desirable to carry out a more detailed analysis of consumption patterns by country of origin, particularly in the group of Asian immigrants.

5. *The Influence of Duration of Residence*

The natural explanation for the existence of differences in the consumption levels of Asian and European immigrants (after allowing for the effect of other variables) is that these immigrants continue to maintain consumption patterns in Israel that are characteristic of their countries of origin. Can it be expected that after a number of years in Israel the 'diets' of these two types of immigrants will be more similar? This seems likely, but there is reason to believe that food consumption patterns do not change quickly (as everyone knows from his own experience).

In order to get some idea of the situation, we calculated the expenditures on the various categories of food, for the common values of the four independent variables, within groups cross-classified by continent of origin

10 We should point out that if there are, in fact, significant differences in the X^*'s within a given continent, then the original values of b's for each continent will generally be biased (since the heterogeneity in consumption level within each continent has not been taken into account when we estimated the b's). This 'specification error' is, however, unlikely to have any important effect on our results.

and duration of residence.[11] The resulting calculated values (X^*) in IL per month and in the form of indexes are given in Tables 22 and 23.

TABLE 22. *Calculated Food Consumption Levels, by Continent of Origin and Duration of Residence[a] (IL per month)*

Commodity	Asian immigrants: Newcomers (1)	Asian immigrants: Veterans (2)	European immigrants: Newcomers (3)	European immigrants: Veterans (4)
Total food	133.80 (± 1.79)	134.43 (± 2.45)	133.41 (± 1.14)	129.64 (± 1.01)
Bread and cereals	23.46 (± 0.50)	18.98 (± 0.68)	16.59 (± 0.25)	15.38 (± 0.22)
Fats	7.16 (± 0.25)	6.99 (± 0.35)	6.60 (± 0.13)	6.27 (± 0.12)
Vegetables	17.08 (± 0.39)	15.46 (± 0.53)	14.90 (± 0.27)	13.65 (± 0.24)
Milk	11.14 (± 0.24)	12.72 (± 0.33)	14.35 (± 0.19)	14.66 (± 0.17)
Eggs	10.42 (± 0.28)	10.76 (± 0.38)	12.17 (± 0.21)	12.93 (± 0.19)
Meat	24.74 (± 0.61)	28.13 (± 0.83)	31.91 (± 0.51)	29.29 (± 0.46)
Fruit	14.88 (± 0.38)	16.73 (± 0.52)	15.28 (± 0.35)	14.57 (± 0.31)

[a] See notes to Tables 16 and 19.

TABLE 23. *The Data of Table 22 with Asian Newcomers = 100*

Commodity	Asian immigrants: Newcomers (1)	Asian immigrants: Veterans (2)	European immigrants: Newcomers (3)	European immigrants: Veterans (4)
Total food	100	100	100	97
Bread and cereals	100	81	71	66
Fats	100	98	92	88
Vegetables	100	91	87	80
Milk	100	114	129	132
Eggs	100	103	117	124
Meat	100	114	129	118
Fruit	100	112	103	98

11 We should note that the veterans and newcomers have different distributions by country of origin. It is therefore not impossible that part of the effect which we attribute to duration of residence should in fact be attributed to country of origin. This remark is more relevant to the group of Asian immigrants.

It is more convenient for our purposes to present the above results in the forms of Tables 24 and 25. In Table 24 we see that the effect of the continent is generally in the same direction both for veterans and for newcomers. The interesting question, however, is whether the 'continent effect' is smaller for veterans. Let us try to answer this question by examining the commodities with respect to which differences between the continents are largest, namely bread and cereals, vegetables, milk, eggs, and meat. In columns (3) and (4) we find a reduction in the differences between the continents in the cases of bread and cereals, milk, and especially meat. On the other hand, there does not seem to be any appreciable change in the relative differences between continents in expenditures on vegetables and eggs. We may therefore conclude that there exists a tendency towards reducing the differences in consumption levels, but that this tendency is not characteristic of all commodities under consideration.

TABLE 24. *Differences in Calculated Food Consumption Levels Between European and Asian Immigrants Within Groups of Duration of Residence*

Commodity	*Absolute differences in IL per month*		*Relative differences*	
	$EN - AN$[a]	$EV - AV$	$\frac{EN - AN}{AN}$	$\frac{EV - AV}{AV}$
	(1)	(2)	(3)	(4)
Total food	—0.39 (± 2.12)	—4.79 (± 2.65)	—0.003	—0.036
Bread and cereals	—6.87 (± 0.56)	—3.60 (± 0.71)	—0.293	—0.190
Fats	—0.56 (± 0.29)	—0.72 (± 0.37)	—0.078	—0.103
Vegetables	—2.18 (± 0.47)	—1.81 (± 0.58)	—0.128	—0.117
Milk	3.21 (± 0.31)	1.94 (± 0.37)	0.288	0.154
Eggs	1.75 (± 0.35)	2.17 (± 0.42)	0.168	0.202
Meat	7.17 (± 0.80)	1.16 (± 0.95)	0.290	0.041
Fruit	0.40 (± 0.52)	—2.16 (± 0.61)	0.027	—0.129

[a] We use the following abbreviations: *EN* for Europe-Newcomers, *AN* for Asia-Newcomers, *EV* for Europe-Veterans, and *AV* for Asia-Veterans.

Let us now consider the three commodities where differences between continents are lessening, and try to see who is drawing closer to whom—the Asian immigrants to the European or vice-versa. Table 25 (columns (3) and (4)) shows that no simple answer can be given to this question. In fact each of these commodities represents a different possibility of closing the gap between the consumption levels. In the case of milk we see that consumption of European immigrants changes very little as they stay

TABLE 25. *Differences in Calculated Food Consumption Levels Between Veterans and Newcomers, by Continent of Origin*

Commodity	*Absolute differences (IL per month)*		*Relative differences*	
	$AV-AN$	$EV-EN$	$\frac{AV-AN}{AN}$	$\frac{EV-EN}{EN}$
	(1)	(2)	(3)	(4)
Total food	0.63	—3.77	0.005	—0.028
Bread and cereals	—4.48	—1.21	—0.191	—0.073
Fats	—0.17	—0.33	—0.024	—0.050
Vegetables	—1.62	—1.25	—0.095	—0.084
Milk	1.58	0.31	0.142	0.022
Eggs	0.34	0.76	0.033	0.062
Meat	3.39	—2.62	0.137	—0.082
Fruit	1.85	—0.71	0.124	—0.046

longer in the country while that of Asian immigrants increases by about 15 per cent. Therefore, in this category, the Asian immigrants are drawing closer to the pattern of European ones rather than the other way around. As far as meat is concerned, we find that the gap is being reduced in both directions at once—European immigrants consume less meat as they stay longer in the country while Asian immigrants increase their consumption of that commodity. The closing of the gap as far as bread and cereals are concerned assumes a different form again—*both* groups spend less on them after they have been in the country for a time, but with the Asian immigrants (who are the greater consumers) the decline is steeper.

CHAPTER 5

NON-FOOD CONSUMPTION IN VARIOUS DEMOGRAPHIC GROUPS[1]

1. *Introduction*

In this chapter we shall carry out a more detailed analysis—from the points of view of both the dependent and the explanatory variables—of the non-food items dealt with in Chapter 2.

The list of explanatory variables in this chapter is the same as that in the preceding chapter, the difference being that here no distinction is made between children and adults. Instead, we use a single variable—the number of persons in the family (S)—as in Chapters 2 and 3.

In Chapter 2 the estimating equation of non-food items (with C and S as explanatory variables) was of the full-logarithmic type. This is the most commonly used form for estimating Engel curves of non-food items. In the present chapter, however, the use of the above form involves certain technical difficulties, arising from the fact that in the case of non-food items it often happens that during the survey month the individual family spends nothing on the item in question (say durables or clothing), and it is therefore impossible to apply the logarithmic transformation to the dependent variable.[2] This difficulty does not arise when the calculations are based on group means which are in turn based on a sufficient number of families. This was in fact the case in Chapter 2. In the present chapter, however, we had to use a more detailed cross classification (because of the additional demographic variables) resulting in many small cells where we often find zero expenditures on particular items.

For this reason we used a different estimating equation of the form

$$X = b_0 + b_1 C + b_2 \log S. \qquad (5.1)$$

1 The computations in this chapter include 1,581 families from Asia and 4,211 from Europe. These figures represent all Jewish families in the 1956/57 Survey (see Table A-1), apart from the Israel-born.

2 Since the logarithm of zero is minus infinity; see the discussion of various practical solutions to this difficulty in S. J. Prais and H. S. Houthakker, *The Analysis of Family Budgets*, Cambridge, 1955.

This equation assumes that MPC(C) is constant (which is probably not very realistic) and that MPS(S) is decreasing as S increases. The latter assumption is not unreasonable because of the 'economies of scale' enjoyed by larger families and in view of the fact that the increase in S usually takes the form of an increase in the number of children (whose weight in consumption is generally relatively small). While the properties of (5.1) are of course different from the more usual full logarithmic equation, it turned out (by experimenting with the data of Chapter 2) that the elasticities estimated by the two alternative forms, *at the sample means*, were practically the same. (For similar conclusions with respect to food items see Chapter 3, section 5.)

Equation (5.1) was estimated for the various non-food commodities within each of the two continents of origin. As for duration of residence and occupation, it was assumed for the sake of simplicity (as in Chapter 4) that these variables affect only the *level* and not the slopes of the consumption functions. We could therefore keep these variables constant, when estimating (5.1), by expressing X, C, and log S in each continent in terms of deviations from their means *within* cells resulting from a cross classification by duration of residence and by occupation.[3] The effect of the latter variables on the level of consumption can then be analyzed by using adjusted means (X^*) as in the preceding chapter.[4]

The statistical technique employed for estimating (5.1) was again that of instrumental variables (see Appendix C) with log S and Y serving as the instrumental variables.

Among the commodities which will be analyzed in this chapter, durables and 'maintenance' have already appeared in the analysis presented in Chapter 2. Clothing and footwear which appeared in Chapter 2 as a single (composite) commodity will be split in this chapter into its two components. Similarly, with the composite expenditure item 'education, literary, and health' each of the three components will be analyzed separately.

Some conceptual problems relating to these items should be noted. The item 'education' represents expenditures incurred by the *family* on education of children and adults. Since education in primary schools is practically free and because of the system of grants used in secondary schools, there is no simple relationship between the family's recorded expenditure on education and the true value of educational services. Analysis of this item can be considerably improved by distinguishing between types of education and types of persons in the family. It is hoped, however, that the *differences*

3 The same technique was used with respect to duration of residence in Chapter 4.

4 The two periods of enquiry were treated as in the preceding chapter.

between European and Asian immigrants are fairly well represented even by the present data.

The meaning of expenditures on 'health' and 'fees' also needs some explanation. Expenditures on health include expenditures on services of private doctors and on the purchase of medicines and medical instruments outside the organized health services. It includes also the payments for various private medical insurance schemes. The most important source of medical services for workers—the Sick Fund of the Histadrut (The General Federation of Labor)—is, however, not reflected in the item 'health'. The payment for medical services of the Sick Fund is included in the general membership fees paid to the Histadrut. These payments will be analyzed under the heading of 'fees'.

Two things about the latter item should be noted. Firstly, not all the 'fees' are intended to be payments for health services (it is estimated, on a *global* basis, that about 60 per cent of the fees to the Histadrut are attributable to health services)[5]. Secondly, the payment of fees is to a large extent of an obligatory nature since membership in the Histadrut is practically compulsory for the ordinary worker and the *size* of the payment is geared to the individual member's income according to a given payments scale. It can therefore be argued that fees are to a large extent unrelated to the consumers' decisions. At the same time we should mention that there exist certain possibilities for the family to vary its payment for the health services received from the Sick Fund; these mainly take the form of varying the health insurance coverage and rights for non-working family members. It is because of this fact that there seems to be some point in analyzing consumers' expenditures on fees as a supplement to the analysis of expenditure on health.

Finally, we did not think that it was worthwhile to analyze in detail such a heterogeneous item as 'sundry'. Instead, we selected two of its components which may be of interest—tobacco (including cigarettes) and entertainment (including expenditures on cinemas, theaters, vacations, parties, etc.).

2. *Mpc*'s *and Elasticities by Continent of Origin*

Before considering the individual values of the MPC's of Asian and European immigrants we may consider the overall significance of the differences in the sets of coefficients (b_1, b_2) of equation (5.1) of the above-mentioned groups. The results in Table 26 show that the commodities for

5 The item 'fees' includes, in addition to fees paid to the Histadrut, some payments to other organizations (such as political parties). These are, however, negligible.

which we find highly significant differences between the continents are clothing and footwear, education, and literary expenditures.

TABLE 26. *Significance Tests[a] for the Differences Between Non-Food Consumption Functions of Asian and European Immigrants*

Commodity	*Value of chi-square*
Clothing	17.8[b]
Footwear	31.6[b]
Durables	4.6
Maintenance	5.7
Tobacco	1.2
Education	31.6[b]
Literary	15.9[b]
Health	6.2
Fees	0.9
Entertainment	1.7

[a] For the derivation of these tests see Appendix C.
The tests in this table are based on two degrees of freedom. The 5 per cent and 1 per cent significance levels are 6.0 and 9.2 respectively.

[b] Significant at 1 per cent level.

The nature of the differences in individual MPC's of these commodities can be seen in Table 27. In the case of clothing and footwear the main differences are with respect to MPC(C); it seems that Asian immigrants tend to spend a larger proportion of each additional pound both on clothing and on footwear. In the case of education and literary expenditures we find the opposite phenomenon—the Asian immigrants spend a smaller proportion out of each additional pound on these items. It should be noted that in the case of education the main difference between the two continents is with respect to the effect of an increase in *family size* (which means essentially an increase in the number of children) on expenditures. In particular, the addition of a member to a European family raises expenditures on education sixfold as compared to an Asian family.

In Table 28 we present the consumption *elasticities* corresponding to Table 27. These were derived by dividing the MPC's (in Table 27) by the corresponding average propensities (all these quantities were computed at the overall sample means). It can be seen from Table 28 that in most cases the income elasticities (column (1)) exceed unity, i.e. we are dealing with 'luxuries'. In view of the discussion in Chapter 2 (p. 15), this explains the general tendency for the increase in family size to exercise a negative effect

TABLE 27. *Marginal Propensities to Consume Non-Food Items, by Continent of Origin*

Commodity	*Continent (A = Asia; E = Europe)*	MPC *with respect to*	
		Income (C) (1)	*Family size (S)*[a] *(IL per month)* (2)
Clothing	A	0.1889 (± 0.0152)	—1.64 (± 0.58)
	E	0.1274 (± 0.0074)	—1.87 (± 0.32)
Footwear	A	0.0513 (± 0.0058)	0.70 (± 0.22)
	E	0.0167 (± 0.0028)	0.94 (± 0.13)
Durables	A	0.0860 (± 0.0205)	—0.49 (± 0.79)
	E	0.1183 (± 0.0104)	—2.35 (± 0.46)
Maintenance	A	0.0613 (± 0.0099)	—0.52 (± 0.38)
	E	0.0733 (± 0.0057)	0.16 (± 0.25)
Tobacco	A	0.0122 (± 0.0028)	—0.24 (± 0.11)
	E	0.0146 (± 0.0016)	—0.19 (± 0.07)
Education	A	0.0269 (± 0.0048)	0.23 (± 0.18)
	E	0.0387 (± 0.0044)	1.32 (± 0.20)
Literary	A	0.0156 (± 0.0027)	—0.47 (± 0.10)
	E	0.0278 (± 0.0019)	—0.49 (± 0.08)
Health	A	0.0174 (± 0.0046)	—0.58 (± 0.17)
	E	0.0289 (± 0.0048)	—0.34 (± 0.21)
Fees	A	0.0527 (± 0.0037)	—0.44 (± 0.14)
	E	0.0565 (± 0.0025)	—0.43 (± 0.11)
Entertainment	A	0.0637 (± 0.0122)	—1.01 (± 0.46)
	E	0.0718 (± 0.0054)	—1.70 (± 0.24)

[a] The common value of S used for calculating MPC(S) in col. (2) is the overall sample average $S = 3.93$.
For the original coefficients of log S in equation (5.1) see Appendix D.

on expenditures.[6] We may note, however, certain exceptions to this rule. Education expenditures by Asian immigrants are highly elastic and yet the effect of an increase in family size on these expenditures is positive. Similarly,

6 The increase in S when C is constant can be regarded as a reduction in the standard of living of the family. Therefore, according to the various 'per capita' theories of expenditure, the family will cut down on expenditures which are elastic with respect to C and increase expenditures on items which are inelastic with respect to C. On all this see Prais and Houthakker, *op. cit.*

the expenditures on tobacco are (income) inelastic (like food expenditures) and yet these expenditures decrease as family size increases. The explanation for the latter phenomena is presumably that an increase in the number of children tends only to reduce the standard of living (and therefore expenditures on tobacco) without increasing the need for this item.

TABLE 28. *Consumption Elasticities of Non-Food Items, by Continent of Origin*

Commodity	*Continent* (A = *Asia*; E = *Europe*)	*Elasticity*[a] *with respect to* *Income* (C) (1)	*Family size* (S) (2)
Clothing	A	1.527	−0.191
	E	1.420	−0.301
Footwear	A	1.204	0.237
	E	0.465	0.377
Durables	A	1.505	−0.123
	E	2.313	−0.663
Maintenance	A	0.765	−0.093
	E	0.784	0.025
Tobacco	A	0.482	−0.140
	E	0.776	−0.143
Education	A	2.001	0.247
	E	1.216	0.600
Literary	A	1.858	−0.808
	E	1.710	−0.439
Health	A	1.303	−0.630
	E	1.276	−0.215
Fees	A	1.403	−0.168
	E	1.240	−0.137
Entertainment	A	1.814	−0.417
	E	2.145	−0.735

[a] The common values of C and S used to calculate the elasticities are the overall sample averages: C = IL 272, S = 3.93.

A careful comparison of the data in Tables 27 and 28 will reveal that there is often a tendency for the differences between continents to be smaller when the comparison is in terms of *elasticities*. For example, the income elasticities of clothing, literary, and health are very similar in both continents, while there are considerable differences in the corresponding MPC's.

3. *Differences in Consumption Levels by Continent and Country of Origin*

We turn now to consider the differences in non-food consumption *levels* of Asian and European immigrants. We shall consider these differences after allowing for differences in income and family size. This is done simply by computing means X^* (or 'calculated consumption levels') for each continent with the aid of its estimated behavior equation (5.1), for *common* values of C and S.[7] The point of comparison was chosen, as usual, at the overall sample means of the independent variables. These comparisons do not take into account the differences between the continents in occupational structure and distribution by duration of residence (insofar as these two factors affect non-food consumption). Our comparison therefore shows the differences between families of Asian and European immigrants who have the same incomes and family size but retain the occupational structure and distribution by duration of residence of their continent group as a whole.

The data in Table 29 show (column (3)) that except for two commodities (durables and entertainment) there exist significant differences between the continents in the (calculated) consumption level of all other items. The largest relative differences are found in education, literary, and health where the European level exceeds the Asian one by about 140, 95, and 70 per cent respectively. A large part of these differences are probably attributed to the relatively lower cultural level of Asian immigrants. In contrast to the above-mentioned items we find that Asian immigrants spend more than the Europeans on clothing, footwear, and tobacco.

It is interesting to speculate on the above-mentioned tendency of Asian immigrants to spend heavily on clothing. Clearly if the Asian immigrants spend less than the Europeans on education and other cultural needs, they must spend the extra funds on other items. We feel, however, that there might be a special explanation for the fact that the extra funds are absorbed mainly by clothing. From a sociological point of view, one could argue that the high expenditure levels on clothing by Asian immigrants is a reaction to their position compared with European immigrants as far as 'success' and social standing are concerned. The tendency to react in this kind of situation by spending on items which have a superficial connection with status and wealth is not a new phenomenon.[8]

7 See discussion in Chapter 4, page 51.

8 We may also note that a study of more detailed material shows that the large expenditure by Asian immigrants on clothing is particularly pronounced in the category of outer clothing—which strengthens our hypothesis. We also find that the expenditure of Asian immigrants (particularly the newcomers) on jewelry is much higher than that of European immigrants. On this, see CBS, *Statistical Abstract No. 9*, pp. 118–19, Table 3.

TABLE 29. *Calculated Non-Food Consumption Levels, by Continent of Origin*[a] *(IL per month)*

Commodity	Continent of origin		Difference between continents	
	Asia (1)	*Europe* (2)	*Absolute* (2)—(1) (3)	*Relative* (3) ÷ (1) (4)
Clothing	33.68 (± 1.22)	24.42 (± 0.52)	—9.26 (± 1.32)	—0.275
Footwear	11.61 (± 0.46)	9.78 (± 0.20)	—1.83 (± 0.50)	—0.158
Durables	15.55 (± 1.64)	13.93 (± 0.73)	—1.62 (± 1.79)	—0.104
Maintenance	21.81 (± 0.80)	25.45 (± 0.40)	3.64 (± 0.89)	0.167
Tobacco	6.88 (± 0.23)	5.11 (± 0.12)	—1.77 (± 0.26)	—0.257
Education	3.66 (± 0.39)	8.67 (± 0.31)	5.01 (± 0.50)	1.369
Literary	2.29 (± 0.22)	4.43 (± 0.13)	2.14 (± 0.25)	0.934
Health	3.63 (± 0.36)	6.17 (± 0.34)	2.54 (± 0.50)	0.700
Fees	10.22 (± 0.30)	12.40 (± 0.18)	2.18 (± 0.35)	0.213
Entertainment	9.56 (± 0.65)	9.11 (± 0.38)	—0.45 (± 0.76)	—0.047

[a] The figures in cols. (1) and (2) were calculated, on the basis of equation (5.1) for each continent, at the point of overall sample means of C and S. See note to Table 28.

TABLE 30. *Average Propensities to Consume (APC)*[a] *Non-Food Items, by Continent of Origin*

Commodity	*Continent of origin*	
	Asia (1)	*Europe* (2)
Clothing	0.1237 (± 0.0045)	0.0897 (± 0.0019)
Footwear	0.0426 (± 0.0017)	0.0359 (± 0.0007)
Durables	0.0571 (± 0.0060)	0.0512 (± 0.0027)
Maintenance	0.0801 (± 0.0029)	0.0935 (± 0.0015)
Tobacco	0.0253 (± 0.0008)	0.0188 (± 0.0004)
Education	0.0134 (± 0.0014)	0.0319 (± 0.0011)
Literary	0.0084 (± 0.0008)	0.0163 (± 0.0005)
Health	0.0133 (± 0.0013)	0.0227 (± 0.0012)
Fees	0.0375 (± 0.0011)	0.0455 (± 0.0006)
Entertainment	0.0351 (± 0.0024)	0.0335 (± 0.0014)

[a] The APC's were calculated as X^*/C^*, where X^* is given by cols. (1) and (2) of Table 29 and C^* is the value of C at which X^* is calculated (i.e. C^* is the value of C which equals the overall sample mean of C).

Let us turn now to examine the differences in consumption levels by a more detailed classification, i.e., by *country* of origin. The results in Table 31 show that, in general, the relations found earlier between X^*'s of the two continents as a whole continue to hold between individual countries belonging to the two continents. Thus, for example, immigrants from every Asian country spend more on clothing and less on education than the immigrants from every European country. At the same time we should point out the clear tendency of the immigrants from Balkan countries to differ from the other European immigrants in the direction of Asian consumption patterns. In particular, the immigrants originating from Balkan countries tend to spend more than the other European immigrants on clothing and tobacco and to spend less on education, literary, and health.

TABLE 31. *Calculated Relative Non-Food Consumption Levels*[a], *by Country of Origin* (*Eastern Europe = 100*).

	Country of origin						
	Asia-Africa				*Europe-America*		
Commodity	*Iraq, Persia* (1)	*Yemen, Aden* (2)	*Morocco, Tunisia, Algeria* (3)	*Other Asia-Africa* (4)	*Eastern Europe* (5)	*Balkan countries* (6)	*Other Europe-America* (7)
Clothing	140	145	136	133	100	107	87
Footwear	121	110	119	118	100	101	91
Durables	133	107	99	96	100	100	99
Maintenance	69	106	79	82	100	90	98
Tobacco	166	120	143	163	100	141	112
Education	37	49	27	42	100	75	99
Literary	45	57	47	51	100	82	105
Health	60	72	44	69	100	93	123
Fees	75	79	85	84	100	102	85
Entertainment	105	101	127	126	100	114	89
Number of families	468	266	293	564	2,194	1,133	878

[a] The calculated consumption values which form the basis for the data in this table were computed at the point of overall sample means of C and S.

4. *Differences in Non-Food Consumption Levels of Veterans and Newcomers*

We turn now to examine whether there exists a tendency for differences in consumption levels of Asian and European immigrants to be reduced as they stay longer in Israel. As in Chapter 4, this will be done by comparing the consumption levels (adjusted for differences in income and family size), of newcomers and veterans. The values of the adjusted levels corresponding to a cross classification by continent of origin and duration of residence are given in Table 32 (the same figures, transformed to index numbers, are given in Table 33). It is, however, more convenient for our purposes to rearrange the data in the form of Tables 34 and 35.

TABLE 32. *Calculated Non-Food Consumption Levels, by Continent of Origin and Duration of Residence*[a] *(IL per month)*

Commodity	*Asian immigrants*		*European immigrants*	
	Newcomers (1)	*Veterans* (2)	*Newcomers* (3)	*Veterans* (4)
Clothing	34.80 (± 1.40)	30.64 (± 1.92)	24.78 (± 0.52)	24.13 (± 0.75)
Footwear	12.08 (± 0.53)	10.33 (± 0.72)	10.39 (± 0.29)	9.30 (± 0.27)
Durables	15.03 (± 1.88)	16.95 (± 2.58)	13.87 (± 1.06)	13.97 (± 0.99)
Maintenance	21.23 (± 0.91)	23.38 (± 1.25)	23.87 (± 0.59)	26.72 (± 0.55)
Tobacco	6.93 (± 0.26)	6.68 (± 0.36)	5.81 (± 0.17)	4.54 (± 0.16)
Education	3.52 (± 0.45)	4.55 (± 0.61)	6.77 (± 0.45)	10.21 (± 0.42)
Literary	2.23 (± 0.25)	2.43 (± 0.34)	3.90 (± 0.20)	4.85 (± 0.18)
Health	3.19 (± 0.42)	4.81 (± 0.57)	5.45 (± 0.49)	6.32 (± 0.46)
Fees	10.34 (± 0.39)	9.87 (± 0.47)	12.99 (± 0.26)	11.92 (± 0.24)
Entertainment	8.86 (± 0.73)	11.44 (± 1.53)	9.30 (± 0.56)	8.97 (± 0.52)

[a] See note to Table 29.
It should be noted that the figures in cols. (1) and (2) are not independent statistically, since they were computed from the same estimating equation. It is for this reason that we cannot compute from this table the standard error of the difference between these columns. The same thing holds for cols. (3) and (4).

Table 34 shows that the 'continent effect' works in the same direction both for newcomers and veterans. The more important conclusion, however, is that there is no general tendency for the differences between continents to be reduced (i.e., to be smaller for veterans). This is particularly so when we consider the *relative* differences in columns (3) and (4). While for clothing and footwear the relative differences show a certain tendency to diminish, we find in the cases of tobacco, education, and literary that the differences are even growing. It is only in the case of health that we find a drastic reduction of relative differences in expenditures.

Table 35 sheds additional light on the adjustment process of the immigrants' consumption patterns. This table shows a clear tendency for Asian consumption levels to change in the direction of the European standards. Thus, the former tend to reduce their expenditures on clothing and footwear and increase their expenditures on education, literary, and health. It turns out, however, that precisely the same pattern is exhibited by the *European* immigrants, so that the net result is in some cases a widening of the gap between the consumption patterns. The fact that expenditures on education fall in the above category may have serious social consequences.

While the effect of duration of residence on Asian immigrants lends itself to a simple interpretation—mainly, as a desire to imitate the European standards—it is difficult to rationalize the effect of duration of residence on *European* immigrants. This question requires a more detailed analysis.

TABLE 33. *Calculated Non-Food Consumption Levels, by Continent of Origin and Duration of Residence (IL per month) (Asian newcomers = 100)*

Commodity	*Asian immigrants*		*European immigrants*	
	Newcomers (1)	*Veterans* (2)	*Newcomers* (3)	*Veterans* (4)
Clothing	100	88	71	69
Footwear	100	86	86	77
Durables	100	113	92	93
Maintenance	100	110	112	126
Tobacco	100	96	84	66
Education	100	129	192	290
Literary	100	109	175	217
Health	100	151	171	198
Fees	100	95	126	115
Entertainment	100	129	105	101

TABLE 34. *Differences in Calculated Non-Food Consumption Levels Between Asian and European Immigrants, by Duration of Residence*

Commodity	*Absolute differences (IL per month)*		*Relative differences*	
	$EN - AN$[a] (1)	$EV - AV$ (2)	$\frac{EN-AN}{AN}$ (3)	$\frac{EV-AV}{AV}$ (4)
Clothing	−10.02 (± 1.59)	−6.51 (± 2.04)	−0.288	−0.212
Footwear	− 1.69 (± 0.60)	−1.03 (± 0.77)	−0.140	−0.100
Durables	− 1.16 (± 2.16)	−2.98 (± 2.77)	−0.077	−0.176
Maintenance	2.64 (± 1.09)	3.34 (± 1.37)	0.124	0.143
Tobacco	− 1.12 (± 0.31)	−2.14 (± 0.39)	−0.162	−0.320
Education	3.25 (± 0.64)	5.66 (± 0.74)	0.923	1.244
Literary	1.67 (± 0.32)	2.42 (± 0.39)	0.749	0.996
Health	2.26 (± 0.64)	1.51 (± 0.74)	0.708	0.314
Fees	2.65 (± 0.43)	2.05 (± 0.53)	0.256	0.208
Entertainment	0.44 (± 0.92)	−2.47 (± 1.62)	0.050	−0.216

[a] Abbreviations as in Table 24.

TABLE 35. *Differences in Calculated Non-Food Consumption Levels Between Veterans and Newcomers, by Continent of Origin*

Commodity	Absolute differences[a] (IL per month)		Relative differences	
	$AV-AN$ (1)	$EV-EN$ (2)	$\frac{AV-AN}{AN}$ (3)	$\frac{EV-EN}{EN}$ (4)
Clothing	—4.16	—0.65	—0.120	—0.026
Footwear	—1.75	—1.09	—0.145	—0.105
Durables	1.92	0.10	0.128	0.007
Maintenance	2.15	2.85	0.101	0.119
Tobacco	—0.25	—1.27	—0.036	—0.219
Education	1.03	3.44	0.293	0.508
Literary	0.20	0.95	0.090	0.244
Health	1.62	0.87	0.508	0.160
Fees	0.47	—1.07	0.045	—0.082
Entertainment	2.58	—0.33	0.291	—0.035

[a] The standard errors of the differences in cols. (1) and (2) were not computed since their derivation is rather complicated as a result of lack of independence of the original figure. See note to Table 32.

For abbreviations see Table 24.

TABLE 36. *The Net Effects of Continent of Origin and Occupation (IL per month)*

Commodity	Net effect of continent (Europe minus Asia) among		Net effect of occupation (Clerks minus Laborers) among	
	Newcomers (1)	Veterans (2)	Asian immigrants (3)	European immigrants (4)
Clothing	—9.20 (± 1.50)	—5.67 (± 1.86)	—6.26 (± 2.35)	—0.39 (± 1.07)
Footwear	—1.95 (± 0.62)	—1.11 (± 0.78)	—1.09 (± 0.99)	—0.35 (± 0.41)
Durables	—0.98 (± 1.93)	0.44 (± 2.32)	0.57 (± 2.86)	—4.84 (± 1.49)
Maintenance	2.01 (± 1.11)	2.09 (± 1.39)	2.29 (± 1.73)	1.87 (± 0.87)
Tobacco	—0.95 (± 0.32)	—1.50 (± 0.48)	—1.29 (± 0.49)	—1.66 (± 0.26)
Education	2.96 (± 0.66)	5.57 (± 0.73)	2.89 (± 0.76)	2.49 (± 0.66)
Literary	1.59 (± 0.26)	2.18 (± 0.28)	1.25 (± 0.29)	1.52 (± 0.26)
Health	2.40 (± 0.70)	1.48 (± 0.78)	1.11 (± 0.80)	0.13 (± 0.73)
Fees	2.67 (± 0.41)	2.53 (± 0.49)	0.69 (± 0.52)	—0.74 (± 0.42)
Entertainment	—1.32 (± 1.26)	—2.46 (± 1.61)	—1.36 (± 2.06)	—0.10 (± 0.77)

5. *The Influence of Occupation*

Unlike the estimating equations for food items, the present estimating equations (5.1) do not include a special variable to represent the effect of occupation. The latter variable has however been introduced implicitly by the fact that all our observations used in computing (5.1) were expressed (among other things) as deviations from occupational group means (see p. 59.) It remains to use the technique of adjusted means in order to analyze the effect of this variable on the level of non-food consumption.

The analysis which we will now describe was in fact carried out at an earlier stage of our study when we worked with semi-annual estimating equations. For every non-food commodity we had accordingly four estimating equations such as (5.1) (for each half year and for each continent). Each of these equations, in turn, has been used to compute four adjusted means X^* —for newcomers and veterans within each occupational group. Thus, for each commodity we had altogether 16 adjusted means, so that for each classifying criterion (such as continent, occupation) we had eight comparisons. These have usually been divided into two subgroups of four comparisons which were used to derive estimates of the relevant coefficients.[9]

In this section we shall present only some of the results of this analysis, in particular the influence of occupation. It should, however, be noted that when we introduce occupation into our analysis we are likely to affect the coefficients of the other variables analyzed in the preceding section. In actual practice, however, the general pattern of the results presented in the preceding section is not affected by introducing occupation. This can be seen when we compare columns (1) and (2) of Table 36, which describe the continent effect *within* occupational groups, with columns (1) and (2) of Table 34, where no allowance was made for differences in occupation. The data in Table 36, however, should be considered as the more accurate estimate of the continent effect since in this case we 'keep constant' not only income, family size, and duration of residence, but also occupation.

In the analysis of *food* items, we may think of the effect of occupation as being associated with differences in the diets required by manual and non-manual workers ('clerks'). Now why should we expect that occupation should affect *non-food* consumption items? First, it could be argued that if occupation affects food expenditure it must affect (because of the budget restraint) some non-food items. However, we have seen in Chapter

9 A full account of the statistical technique is given in N. Liviatan, "The Estimation of Income Elasticities from Family Budgets and the Analysis of Consumption Functions in Israel", unpublished Ph.D. thesis, Hebrew University, Jerusalem, 1961.

4 that the effect of occupation on total food expenditures is relatively small. In our opinion we should expect to find that occupation influences non-food consumption not in its own right but because it is correlated with other factors, in particular with the cultural level of the family (on which we have no direct data). In our case it is known that the educational level of 'clerks' is considerably higher that that of 'laborers'. The cultural and educational level in turn is very likely to affect the spending pattern on non-food items.

Turning to columns (3) and (4) we find that occupation has a significantly positive effect on education and literary expenditures; this is in line with what one would expect in view of the previous comments. The most striking feature, however, of the results in columns (3) and (4) is that they are generally of the same sign as the figures in columns (1) and (2). In other words, we find that the effect of occupation on non-food expenditures tends to be in the same direction as the effect of continent. In particular, the pattern of differences between European and Asian immigrants is of the same type as the differences between clerks and laborers within each immigrant group. This suggests that the differences in non-food consumption patterns between continents is primarily the result, not of the particular 'traditions' of the two continents as such, but of more general factors such as formal education.

APPENDIX A

DESCRIPTION OF SURVEYS

1. *The 1956/57 Family Expenditure Survey*

This survey was carried out in Israel by the Central Bureau of Statistics in order to determine the weights in the new consumers' price index. The sample was drawn from lists of the labor force surveys and of voters to the Knesset, and included families of wage earners residing in urban communities with over 10,000 inhabitants. The 'population' includes three-quarters of all wage earners' families in Israel. The sampling method is that of a self-weighting stratified sample, with each family having an equal chance of being included in the sample.

The study was carried out over a period of a year (from May 1956 to May 1957) with over 6,500 Jewish families and some 200 non-Jewish families being included. Different families were studied each month, so that each month constitutes an independent sample of 500–600 families. In most months there was an additional division of the families into three panels: those who listed all their expenditures over the entire month, those who listed all their expenditure on food during the first two weeks of the month and their other expenditures over the entire month, and those who listed their expenditure on food during the second two weeks of the month and their other expenditures over the entire month. Each of the three panels within each month also constitutes an independent sample. In our study no distinction was made between the various panels.

From the total 6,614 Jewish families of the survey we excluded about 3 per cent whose incomes were not ascertained, in addition to a small number of families whose expenditures on certain items were extremely large. The number of families included in our study and their distribution by continent of origin, duration of residence, and enquiry period are presented in Table A–1.

TABLE A–1. *Number of Families in Survey, by Continent of Origin, Duration of Residence, and Enquiry Period*

	Enquiry period 1	*Enquiry period 2*	*Total*
	(1)	(2)	(3)
Asian veterans	237	191	*428*
Asian newcomers	581	572	*1,153*
European veterans	1,170	1,165	*2,335*
European newcomers	936	940	*1,876*
Native-born	270	313	*583*
TOTAL FAMILIES	**3,194**	**3,181**	**6,375**

2. *The 1959/60 Survey*[1]

This survey was carried out by the CBS during the year October 1959 to September 1960, and included 1,112 urban wage-earning families. Each month *new* families were selected. The framework of the sample was a list of all flats (for the first half of the survey) and the list of Knesset voters (for the second half). All the families recorded their food and non-food expenditures for the entire month.

The data from this survey have been used only in Chapter 2, section 6.

1 For a more detailed account of survey and enquiry methods see CBS, *Survey of Urban Families Expenditures: 1959/60*, Special Series No. 123, Jerusalem, March 1962 (Hebrew).

APPENDIX B

DEFINITION OF COMMODITY GROUPS

Expenditure on every commodity was registered at its full value, whether or not paid for in cash. Expenditures on services like electricity, water, and tuition were recorded on a cash (not accrual) basis.

The following are the definitions of the expenditure categories in the 1956/57 survey:

1. *Total food*	Includes alcoholic beverages and meat.
2. *Bread*	All kinds of bread including halot and rolls.
3. *Cereals*	Cakes, biscuits, flour, noodles, macaroni, corn flour, rice, and some other small items.
3a. *Bread and cereals*	2 plus 3.
4. *Meat*	All kinds of meat including canned meat, salami, and sausages.
5. *Fish*	Fresh fish, canned fish, sardines, smoked fish.
6. *Fats*	Margarine, butter, oil, and other fats.
7. *Milk*	Liquid milk of all kinds, leben, lebenia, sour cream, cheese of all kinds.
8. *Vegetables*	All fresh vegetables, lentils, potatoes, and canned vegetables.
9. *Fruit*	All fresh fruit, canned and dried fruit, fruit juices, peanuts, and other nuts.
10. *Household maintenance* (*or in short* '*maintenance*')	Including expenditure on gas, kerosene, electricity, water, painting and whitewashing, household expenses (such as ice, soap, and insecticides), municipal taxes.
11. *Durables*	Expenditure on furniture, heavy electrical equipment (such as electric refrigerators, electric washing machines, stoves), light electrical equipment (such as irons, electric percolators), gas appliances, eating utensils, bedclothes, and decorations.

12. *Clothing*	Expenditure on clothing of adults and children; includes expenditure on laundries, jewelry, materials, and sewing necessities.
13. *Footwear*	Including shoe repairs.
13a. *Clothing and footwear*	12 plus 13.
14. *Health*	Expenditure on private health services, hospitals, medicines, medical accessories (such as glasses), and health insurance outside the framework of the Histadrut.
15. *Education*	Tuition fees for kindergartens, elementary schools, secondary schools, universities, vocational schools, adult education classes, private lessons and lectures; expenditure on text books and educational materials.
16. *Literary*	Expenditure on newspapers, books, and writing materials.
17. *Sundry*	Cigarettes, tobacco, and smoking accessories, traveling expenses, mail, maintenance of private vehicles, personal services, beauty treatment, household help, entertainment.
18. *Tobacco*	Including cigarettes, tobacco, and smoking accessories (pipe, cigarette lighter, etc.).
19. *Entertainment*	Cinema, theater and concerts, vacations, celebrations and parties.
20. *Health, education and literary*	Total of the three appropriate categories.
21. *Fees*	Dues to Histadrut and other labor organizations.
22. *Total expenditure*	Does not include imputed rent or imputed 'key money', but includes rent paid in cash (which is negligible). Does not include direct taxes and saving items.

The items 1–9, 10, 11, 13a, 17, and 20, appear in Table 1, Chapter 2. The analysis in Chapter 3 is based on the items 1, 4, 5, 7, 8, 9, and eggs. In Chapter 4 we analyzed items 1, 3a, 4, and 6–9. The commodities analyzed in Chapter 5 are 10, 16, 18, 19, and 21.

In Table B–1 we present the weight of each of the categories within total expenditure on consumption for all the Jewish families of the 1956/57 survey which were included in our study. Column (1) shows the average monthly expenditure per family and column (2) shows this expenditure as a proportion of total consumption expenditure.

TABLE B-1. *Weight of Each Category Within Total Expenditure on Consumption*

Expenditure category[a]	*Average expenditure per family (IL per month)* (1)	*Proportion of total expenditure* (2)
Total food	123.4	0.453
Bread and cereals	16.4	0.059
Fats	6.1	0.022
Fish	5.2	0.019
Meat	27.4	0.101
Milk	11.9	0.044
Eggs	10.5	0.038
Vegetables	13.9	0.051
Fruit	13.9	0.051
Maintenance	24.4	0.090
Durables	15.3	0.056
Clothing	27.6	0.101
Footwear	10.0	0.037
Health	5.2	0.020
Education	6.8	0.025
Literary	3.9	0.014
Tobacco	5.6	0.020
Entertainment	9.6	0.035
Fees	11.7	0.043

[a] The categories in this table do not include *all* expenditure categories but only those we used in most parts of the study.

APPENDIX C

STATISTICAL METHODS

In this appendix we present a brief description of our estimating procedures. These are analyzed in detail elsewhere.[1]

1. *The Use of Instrumental Variables in Family Budget Analysis*

We shall first consider the problem which leads us to reject the use of the ordinary estimating procedures in family budgets. Suppose that both X (the expenditure on a particular good) and C (total expenditures) are linear functions of some 'true' concept of income (say 'normal' income) Y', i.e.

$$X = \alpha_{01} + \alpha_1 Y' + U_1 \tag{C.1}$$

$$C = \alpha_0 + \alpha Y' + U, \tag{C.2}$$

where U_1 and U are random disturbances.

In practice we do not have data on Y'. At most we have data on disposable income earned in the survey period Y. This variable, is however, unsatisfactory as a substitute for Y' for two reasons. Firstly, the survey period is usually very short (say a month) so that measured income may be a poor indicator of the 'normal' income of the family. Secondly, the main purpose of expenditure surveys is to determine the weights for the cost-of-living index and this does not require the data of income (except perhaps as a check); therefore even the income data for the survey period are often deficient and various income components are neglected (in particular, income of subsidiary earners and income from property). It is for these reasons that in most cases C is substituted for Y as the explanatory variable in budget analysis.

The meaning of the relation between X and C can be seen by using (C.1) and (C.2) to obtain

$$X = \beta_0 + \beta C + W \tag{C.3}$$

$$\beta_0 = \alpha_{01} - \frac{\alpha_1 \alpha_0}{\alpha}; \ \beta = \frac{\alpha_1}{\alpha} \text{ and } W = U_1 - \beta U.$$

1 N. Liviatan, "Errors in Variables and Engel Curve Analysis", *Econometrica*, Vol. 29, No. 3, 1961, reissued as FP Research Paper 11; and "The Estimation of Income Elasticities from Family Budgets and the Analysis of Consumption Functions in Israel", unpublished Ph. D. thesis, The Hebrew University, Jerusalem, 1961.

First we note that by using C as the explanatory variable we give up the idea of estimating α_1 (the MPC out of Y') and we are content with β. (We know of course that β is usually larger than α_1 since $\alpha < 1$). In terms of elasticities (η) we have (ignoring the random elements) $\eta_{xc} = \dfrac{\eta_{xy'}}{\eta_{cy'}}$. It follows that if $\eta_{cy'}$ is very close to unity (as some economists think[2]) then the difference between $\eta_{xy'}$ and η_{xc} can be neglected.

This is, however, a minor difficulty. The main problem arises from the fact that C and W are generally correlated (note that they have common components) and therefore the use of C as an independent variable in ordinary least squares regression leads to inconsistent estimates of β.

We may now note that measured income (Y), though inappropriate as an independent variable, can be assumed to retain two important properties: (a) a strong correlation with Y', and (b) lack of correlation with the random elements in consumption — U_1 and U. We may therefore apply the theory of instrumental variables[3] to obtain consistent estimates of β. We form the estimate (the lower case letters express the variables as deviations from the sample means)

$$b = \frac{\Sigma xy}{\Sigma cy} = \frac{\Sigma(\beta c + w)y}{\Sigma cy} = \beta + \frac{\Sigma wy}{\Sigma cy}, \tag{C.4}$$

which is a consistent estimate of β provided $\text{cov}(W, Y) = 0$ and $\text{cov}(C, Y) \neq 0$ which correspond to assumptions (a) and (b) stated above. (Y serves here as the instrumental variable).

An alternative (but less efficient) method is to eliminate in the first stage the errors U_1 and U by grouping the observations according to classes of Y. Suppose we classify the families by two classes of Y (the dividing line being, say, the median income), and compute averages (per family) of X and C within each of the two classes. Denoting mean values by a bar over the variables and letting 1 and 2 denote the income classes, we have (using C.3)

$$\frac{\bar{X}_1 - \bar{X}_2}{\bar{C}_1 - \bar{C}_2} = \beta + \frac{\bar{W}_1 - \bar{W}_2}{\bar{C}_1 - \bar{C}_2}. \tag{C.5}$$

It can be seen that under assumption (a) above $\bar{W}_1 - \bar{W}_2$ tends to zero in the limit, while under assumption (b) $\bar{C}_1 - C_2$ tends to a limit which is different from zero. Hence (C.5) is a consistent estimate of β.

2 See M. Friedman, *A Theory of the Consumption Function*, Princeton University Press, 1957: and H. Wold and L. Jureen, *Demand Analysis*, New York, 1952, p. 221.

3 J. Durbin, "Errors in Variables", *Review of the International Statistical Institute*, Vol. 22, 1954, p. 23.

The computations which were used to obtain the data in Table 1 are based essentially on the above 'method of grouping', the difference being that instead of using only two groups we used more. The relation between the group means was then determined by ordinary least-squares. The same data was used in Chapter 3. In Chapters 4 and 5 our data were classified by Y (and other exogenous variables) but the groups were too small for the purpose of error elimination. We therefore applied to these data estimates of the type given by (C.4).

2. *Multivariate Methods*

In Chapters 4 and 5 we had in fact to estimate a *multivariate* relationship by the method of instrumental variables. This does not raise any new conceptual problem. In Chapter 4, for example, the additional explanatory variables were S_1, S_2, and D. Since these variables can be assumed to be independent of the random elements in consumption in the period of enquiry, we may use them both as independent *and* instrumental variables. To be quite general let $C_1 \dots C_m$ denote the explanatory variables in the behavior equation and $Z_1 \dots Z_m$ the instrumental variables, where some (or all) of the C's may be identical with the Z's. Our expenditure function is then

$$x = \sum_{j=1}^{m} \beta_j c_j + w. \tag{C.6}$$

In order to estimate the β's by instrumental variables we multiply (C.6) alternatively by $z_1, z_2 \dots z_m$ and sum on all observations[4], ignoring products of w and z. This leads to m normal equations which can be solved for the m unknown parameters (b's). This was the method employed in estimating (4.1) and (5.1) in the text.

3. *Sampling Errors of Coefficients*

The method of computing asymptotic sampling errors of instrumental variables estimates are given by Sargan[5]. Let M_{ZC} denote the asymptotic covariance matrix of the instrumental variables (Z) with the explanatory variables (C) and let M_{ZZ} denote similarly the asymptotic covariance matrix of the Z's. Let σ^2 denote the asymptotic variance of W and let N denote the

4 For example, in estimating equations (4.1) we multiply both sides alternatively by log Y, log S_1, log S_2 and D.

5 J. D. Sargan, "The Estimation of Economic Relationships Using Instrumental Variables', *Econometrica*, Vol. 26, July 1958, pp. 393–415. Since the instrumental variables method, in the 'just identified' case, is identical with 'two stage least-squares', the reader may also be referred to H. Theil, *Economic Forecasts and Policy*, North-Holland Publishing Company, Amsterdam, 1958, where this method and the associated sampling errors are formulated.

number of cases.[6] The asymptotic variance matrix of the estimators $b_1 ... b_m$ is then given by

$$\text{(C.7)} \qquad V = \frac{\sigma^2}{N}\left[M_{zc}^{-1} M_{zz} M_{cz}^{-1} \right],$$

where M_{zc}^{-1} is inverse and M_{cz} is the transposed matrix of M_{zc}. In the actual computations we replace of course all the asymptotic moments by the ordinary sample moments. All the sampling errors of the coefficients of equations (4.1) and (5.1) in Chapters 4 and 5 were computed according to these principles.

4. *Covariance Analysis*

Suppose we estimate the column vector of coefficients

$$B = \begin{bmatrix} b_1 \\ \cdot \\ \cdot \\ b_m \end{bmatrix}$$

by instrumental variables for each of h demographic groups (say Asian and European immigrants). Let us denote the estimated vectors by $B_1 ... B_h$. Suppose further that the asymptotic covariance matrices of each B_i (i.e. $V_1 ... V_h$) are known. We now wish to test the significance of the differences between the B_i's. Now the classical covariance analysis[7] cannot be applied to this case since the vectors B_i have been estimated by instrumental variables and not by ordinary least-squares. We shall therefore formulate a covariance analysis, based on large sample methods, which will be appropriate for our case.

Our null hypothesis (H_o) is

$$\text{(C.8)} \qquad H_0 : \text{plim}\, B_i = \beta \qquad i = 1 \ldots h.$$

6 A typical element (moment) in the M_{ZC} matrix is

$$\underset{N\to\infty}{\text{plim}} \frac{1}{N} \Sigma\, (Z_q - \bar{Z}_q)\,(C_p - \bar{C}_p).$$

7 For an application of the classical covariance method of family budget analysis see G. Stuvel and S. F. James, "Household Expenditure on Food in Holland", *The Journal of the Royal Statistical Society*, Series A, Vol. 113, 1950, p. 59.

Consider now the quadratic form

$$F_i = (B_i - \beta)' V_i^{-1} (B_i - \beta). \tag{C.9}$$

Since the B_i's are asymptotically normal, it follows that under H_o (C.9) is the exponent of the joint normal distribution of the elements of B_i. This in turn implies that (C.9) is distributed like 'chi-square' with m degrees of freedom. If we had a hypothesis about β we could test (C.8) by the sum $\sum_{i=1}^{h} F_i$ which is distributed (asymptotically) under H_0 like chi-square with $m \times h$ degrees of freedom.[8]

In the practical cases, however, we do not have any hypothesis about β; all we want is to test the equality of the B_i's. We therefore use a substitute for β in the form of the vector B

$$B = \left[\sum_g V_g^{-1}\right]^{-1} \sum_i V_i^{-1} B_i; \qquad g, i = 1 \cdots h. \tag{C.10}$$

which is a combination of the B_i's with each B_i weighted by the inverse of its covariance matrix. It can be shown that the following relation holds identically

$$\begin{aligned} &\sum_i (B_i - \beta)' V_i^{-1} (B_i - \beta) \\ &= \sum_i (B_i - B)' V_i^{-1} (B_i - B) + (B - \beta)' \left(\sum_g V_g^{-1}\right)(B - \beta), \end{aligned} \tag{C.11}$$

or in short $Q = Q_1 + Q_2$. We have noted already that Q is distributed (asymptotically) like chi-square with $m \times h$ degrees of freedom. Similarly, Q_1 and Q_2 are distributed like chi-square with $m(h-1)$ and m degrees of freedom respectively. Since Q_1 does not involve the unknown vector β we may use it as a test of the equality of the B_i's in the population. This was in fact the test which we used in Tables 17 and 26.

5. *Variances of Adjusted Means*

Finally, let us consider the sampling errors of calculated consumption *levels* and of the differences in these levels in various demographic groups. The adjusted mean (or the 'calculated consumption level') can be written as

$$X^* = \bar{X} + \sum_{j=1}^{m} b_j (C_j^* - C_j). \tag{C.12}$$

8 The F_i's are mutually independent since they are based on independently drawn samples.

where the C^*'s are arbitrary values of the independent variables and are considered as fixed in repeated samples.

The asymptotic variance of X^* is given by the well-known formula

$$\text{(C.13)} \quad \operatorname{var}(X^*) = \frac{\operatorname{var}(W)}{N} + \sum_j \sum_k (C_j^* - \bar{C}_j)(C_k^* - \bar{C}_k)\operatorname{cov}(b_j, b_k),$$

where $j, k = 1 \ldots m$ and N is the number of cases. All the sampling errors of consumption levels (e.g. in Table 19) were computed according to this formula. The variance of the difference between the X^*'s computed for two different demographic groups (and using different estimating equations) is simply the sum of the individual variances. This is the principle according to which we computed, for example, the sampling errors in Table 24.

APPENDIX D

COEFFICIENTS OF LOGARITHMIC VARIABLES IN EQUATIONS (4.1) AND (5.1)

In Table D–1 we present the coefficients of log C, log S_1, and log S_2 in the equation

$$X = b_0 + b_1 \log C + b_2 \log S_1 + b_3 \log S_2 + b_4 D,$$

which was used in Chapter 4 for the derivation of MPC's and elasticities of food items.

TABLE D–1. *Coefficients of Equation (4.1)*

Commodity	*Continent (A = Asia; E = Europe)*	*Coefficient of* $\log_{10} C$ (1)	$\log_{10} S_1$ (2)	$\log_{10} S_2$ (3)
Total food	A	179.51	55.72	42.65
	E	155.99	78.78	42.56
Bread and cereals	A	12.81	27.06	22.61
	E	2.47	18.78	10.98
Fats	A	6.36	6.81	4.45
	E	4.27	6.54	3.42
Vegetables	A	15.81	13.23	9.36
	E	9.46	14.41	5.90
Milk	A	14.69	−1.96	0.70
	E	14.07	7.82	8.05
Eggs	A	15.17	1.27	1.82
	E	16.30	3.39	6.17
Meat	A	41.86	4.24	−1.61
	E	48.66	14.70	−0.48
Fruit	A	26.32	−3.12	0.18
	E	24.22	3.37	4.91

In Table D–2 we present the coefficients of log S in the equation

$$X = b_0 + b_1 C + b_2 \log S,$$

which was used in Chapter 5 for non-food items.

TABLE D–2. *Coefficients of Equation (5.1)*

Commodity	*Continent (A = Asia; E = Enrope)*	*Coefficient of* $\log_{10}S$
Clothing	A	−14.84
	E	−16.90
Footwear	A	6.34
	E	8.49
Durables	A	−4.39
	E	−21.27
Maintenance	A	−4.68
	E	1.45
Tobacco	A	−2.21
	E	−1.68
Education	A	2.08
	E	11.99
Literary	A	−4.25
	E	−4.48
Health	A	−5.26
	E	−3.06
Fees	A	−3.96
	E	−3.90
Entertainment	A	−9.18
	E	−15.41

APPENDIX E

INCOME ELASTICITIES OF FOOD ITEMS IN EUROPEAN COUNTRIES

In Table E–1 we present the detailed list of income elasticities on which Table 2 is based. Practically all the elasticities were taken from the interesting work of Goreux. The reader is referred to this work for a detailed description of the data and the estimation procedures employed[1].

TABLE E–1. *Income Elasticities Computed from Budget Data in Various European Countries*

		Income elasticity (η_{xc}) *of*						
Code no.	*Country*	*Meat* (1)	*Fish* (2)	*Eggs* (3)	*Milk* (4)	*Bread and cereals* (5)	*Total food* (6)	*Clothing* (7)
1	Austria	0.52[a]	0.77[a]	0.34[a]	0.22[a]	0.21[a]	0.55	1.97
10	Denmark	0.35[a]	[b]	[b]	0.13[a]	0.11[a]	0.37	[b]
12	Finland	0.73	0.54	0.67	0.34	0.45	0.58	1.58
16	France	0.72[a]	0.74[a]	0.68[a]	0.36[a]	0.37	0.62	1.35
18	Germany	0.54	0.51	0.96	0.36	0.23	0.61	1.71
26	Greece	1.00	0.80	[b]	0.85	0.20	0.70	1.40
32	Ireland	0.70[a]	0.94[a]	0.72[a]	0.40[a]	0.35[a]	0.62	1.39
35	Italy	0.80[a]	0.75[a]	[b]	[b]	0.21[a]	0.63	1.23
47	Netherlands	0.43	0.37	0.84	0.22	0.24	0.46	1.25
	Sweden	0.49	0.57	0.51	0.27	[b]	0.53	1.15
60	Switzerland	0.51[a]	[b]	0.65[a]	0.06	0.18[a]	0.48	1.17
	UK	0.40	0.38	0.56	0.43	0.29	0.53	1.01

[a] The effect of family size has not been taken into account directly. The income elasticities in these cases were, however, corrected on the basis of other data. See Goreux, *op. cit.*, pp. 36–37.

[b] No data available.

SOURCES: Goreux, *op. cit.*, except for Sweden and the UK. The numbers in the first column on the left are the code numbers used by Goreux, so that the reader interested in more details on the various budget data used here may consult the description given by him.

The data for Sweden (cols. (1)-(4)) were taken from H. Wold and L. Jureen, *Demand Analysis*, Wiley, New York, 1952, p. 265, Table 16.5.2, and relate to the survey of workers and low-grade employees in 1933. Cols. (6) and (7) are based on Goreux, *op. cit.*, Survey No. 58.

The elasticities for U.K. (cols. (1)–(6)) were taken from S. J. Prais and H. S. Houthakker, *The Analysis of Family Budgets*, Cambridge, p. 141, Table 30; and col. (7) from the same source, p. 151, Table 31.

[1] L. M. Goreux, *Income Elasticity of the Demand for Food*, FAO, Rome, 1959.

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INDEX

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