AN ECONOMETRIC ANALYSIS OF THE DEMAND FOR BASIC LIVING MATERIALS IN JAPAN

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ABSTRACT

AN ECONOMETRIC ANALYSIS OF THE DEMAND FOR
BASIC LIVING MATERIALS IN JAPAN

by Feng-Yao Lee

In this study, information from both cross-section and time-series data was utilized to derive the statistical consumer demand functions for basic living materials in Japan during the period of 1951-1962. Basic living materials were classified into four groups: food, housing, fuel and light, and clothing. Food was further subdivided into fourteen items, housing into three, and clothing into two.

In the cross-section analysis, the elasticities of income and family size were estimated by both the method of instrumental variables and least-squares regressions. Dummy variables were employed to investigate the stability of demand over time as well as the differences in consumption patterns among occupations, regions, city sizes, number of earners, and types of dwelling house.

The expenditure elasticities obtained from cross-section data were combined with the time-series data to estimate the elasticities with respect to own-price, "all other prices," and related goods' prices. Also the income

elasticities and other demand elasticities were estimated by the original least-squares regressions.

The expenditure elasticities estimated by the instrumental variables method are very little different from those obtained by the least-squares regressions using total expenditure as an explanatory variable, but they are considerably larger than the corresponding income elasticities estimated by least-squares regressions. Since the expenditure elasticity obtained from the instrumental variables method has been shown to be the consistent estimate of the "true" parameter, and since it can be interpreted as the permanent income elasticity, the least-squares regression bias in estimating expenditure elasticity may be negligible with a sufficiently large sample size, and the income elasticity obtained by the least-squares regressions tends to be underestimated.

Income elasticities estimated from the pure time-series equations are, in the majority of cases, considerably different from their corresponding cross-section estimates. Despite the divergence between the income elasticities from cross section and time series, the order of magnitudes of the income and expenditure elasticities resulting from both analyses contains few surprises.

The own-price elasticities for a few items have implausible signs, but for most commodities the elasticities have the "right" signs. Many of the cross-elasticities with respect to the prices of related goods have the expected signs and their magnitudes seem reasonable, but surprising relationships were found in quite a few cases. The results obtained by using the conditional regression and the pure time-series equation differ considerably in many cases and the latter approach appears to be superior to the former in terms of goodness of fit and the standard error of estimates.

A cross-section test of the permanent income hypothesis indicates that Friedman's method of testing the permanent income hypothesis with respect to individual goods is inadequate although the hypothesis cannot be rejected on the basis of this test. In time-series analysis, permanent income is found to be a better variable than disposable income in determining expenditures on basic living materials for farm households, but the opposite is true for urban households. Whenever transitory income was introduced along with permanent income in the equation, the results always appear to be better than those estimated by using disposable income alone as an independent variable. It is also found that expenditures on non-durable goods are determined almost solely by permanent income, and that the transitory income seems more important than permanent income in explaining the consumption of consumer durable goods.

Although this study of the demand for basic living materials has been based on somewhat imperfect data and has utilized relatively simple methods, the analyses show that the pattern of consumer's behavior in quantitative terms can be sketched out. In the great majority of cases, the results obtained are those expected.

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by

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CHAPTER I

INTRODUCTION

Although the econometric study of demand relationships can be traced back to a little more than a century ago when Engel studied the pattern of consumer expenditure and proposed a law of consumption in 1857, there had not been much progress in this area before the 1930's. Compared with other fields of economics, the empirical study of demand is still in its infancy. The reason for this is not that this area was unimportant or neglected, but rather that its research involved many difficulties. As recently as three decades ago data were seldom available, and statistical techniques of estimation and testing hypotheses were not well developed.[1]

Over the past few decades, a considerable number of empirical demand analyses have been made. These studies, however, have almost exclusively been based on data of the United States and some European countries because of the lack of suitable observations in the rest of the world. To be sure, Japan is a noteworthy exception to this generalization. In fact, Japan seems to have the greatest wealth of data in the world. It is, perhaps, the only country that has had both urban

[1]The difficulties and problems of empirical demand analysis have been fully discussed by Richard Stone, The Measurement of Consumers' Expenditure and Behavior in the United Kingdom, 1920-1938, Vol I (Cambridge University Press, 1954), and Herman Wold and Lars Jureen, Demand Analysis, (New York: John Wiley and Sons, Inc., 1953).

family budget survey and farmer's budget survey every year over a long period of time. And Japan's national income and expenditure survey in 1959 covered as many as 42,000 households. This sample is probably the largest available anywhere. Yet, in spite of the rich data available, no one has attempted a rigorous and systematic study of demand conditions. It is hoped that the present study will add to the knowledge of consumer demand, which is now limited to the United States and Europe, by presenting a picture of the demand conditions in Japan.

The main line of approach in this study is to utilize information from both cross section and time series so as to obtain a clear demand structure in Japan. In cross-section analysis, the method of instrumental variables is used to estimate the demand elasticities and that of dummy variables is employed to investigate the differences of consumer behavior among different group samples. Both the original least-squares regression method and the combined techniques are to be used in the time-series analysis.

Although the family budget data from 1926 to 1941 in Japan are available, they should not be combined with postwar data since the prewar and postwar data have different coverages. As the differences in coverage preclude any meaningful comparison between the estimates obtained from the prewar and postwar periods, we shall exclude the prewar data from our present discussion. Furthermore, because

Japan's economy from 1946 to 1950 had not recovered from World War II and the data in these years were published in a way that severely limits their usefulness for our purposes, the period dealt with in this study is 1951-1962.

The study is divided into five chapters: The first chapter presents a statement of the purposes of the study and a brief description of the sources and nature of the data used. Empirical consumer demand studies are briefly surveyed in Chapter II; the bulk of our theoretical framework is developed in detail and our statistical models are also formulated. Our empirical results from cross-section data and time-series data are analyzed in Chapters III and IV respectively. Finally, our analyses are reviewed and some conclusions drawn in the last chapter.

PURPOSES OF THE STUDY

In this study we are to derive statistical demand functions for basic living materials in Japan. For the purposes of this study, basic living materials are classified into four groups: food, housing, fuel and light, and clothing. Food is further subdivided into 14 items; these are rice, barley, bread, fish, meat, milk and eggs, vegetables, processed food, condiments, cakes and candies, fruits, alcoholic beverages, non-alcoholic beverages, and food prepared outside the household. Housing includes rent, repairs and improvements, and furniture and utensils. Clothing is subdivided into clothes and personal effects. The primary purpose of this study is to obtain reliable estimates of the effect of income on demand for basic living materials. Another objective is to investigate how consumer demand for basic living materials is affected by family size, type of tenure of dwelling houses, number of earners in household, prices (own price and other prices), occupation of the head of the household, social class, and regional variations such as geographical location, city size, and urban-rural effects.

Information of this kind is not only extremely valuable in such areas as economic development and planning, interregional and international trade, and population and consumer economics, but is also very useful for a number of sociological purposes. The present study, though primarily empirical in nature, attempts to narrow the gap between the existing economic theory of consumer behavior and empirical investigations by stressing how they support each other.

In the process of our analysis, an attempt will be made to test the permanent income theory of consumption with respect to the individual category of consumption. This study, although primarily concerned with basic living materials only, has significant implications for the analysis of the savings and consumption pattern in general.

SOURCES AND NATURE OF THE DATA USED

The specific data used in the present study were taken from: (1) National Survey of Family Income and Expenditure of 1959, conducted by the statistics Bureau of the Prime Minister's Office, Japan; (2) Kakei Chōsa (Family

Budget Survey) from 1951 to 1962, conducted by the same bureau; and (3) Noka Keizai Chōsa (Farm Household Economy Survey) from 1951 to 1962, conducted by Nōrinsho (Department of Agriculture and Forestry).

These sources can be briefly described as follows:

(1) National Survey of Family Income and Expenditure of 1959.--This national survey covered 42,841 non-farmers' and non-fishers' households in 544 cities and 253 towns and villages, and was published in six volumes in 1961 by the Bureau of Statistics, Office of the Prime Minister, Japan. It was conducted continuously for three months from September to November of 1959 and surveyed detailed income and expenditures as well as quantities of durable goods possessed by these households.[2] Average monthly income and total expenditure were classified into sixteen groups. These data enable us to investigate the differences in consumption pattern due to household size, number of earners in household, regional variation, city size, age and occupation of household heads, social class, and type of tenure of dwelling houses. Since not all the information was classified in the same manner, this survey also enables us to analyze the classification bias.

(2) Kakei Chōsa (Family Budget Survey) 1951-1962.--This source covered about four thousand urban households every month in the 28 cities with population of more than

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[2]However, one person households (732) were surveyed in October and November only.

fifty thousand. The survey was published monthly in Monthly Report on Family Income and Expenditure Survey and yearly in Annual Report on Family Income and Expenditure Survey. The results were also published in General Report on Family Income and Expenditure Survey (1946-1962) for the convenience of researchers who wished to do time-series analysis. The method of selection was stratified, multistage random sampling. Average monthly income and total expenditure were classified into fifteen classes in 1951, eleven in 1952, sixteen in 1953 and in 1959-1962, and twenty-one in 1954-1958. Both receipts and disbursements were published in every detail. This study was based on the monthly average for the eleven months from January to November. This was done because the Statistics Bureau of the Prime Minister's Office excluded December from the yearly average on the ground that bonuses were mostly awarded in this month and hence both income and expenditures were very different from those of the rest of the year. Income and total expenditure in December were almost twice as much as the average of the rest of the year. Because of the large expenditures in December, the expenditures in January and February reduced considerably as compared with those of the other months. This survey can be utilized for both cross-section and time-series analyses. This kind of repeated survey produces the most valuable data for time-series analysis, in spite of the limitations on their scale and classifications.

(3) Noka Keizai Chōsa (Farm Household Economy Survey) 1951-1962.--This survey covered almost six thousand households each year. It has been conducted on the fiscal year basis, from April 1 to March 31. Although this survey provides data for time-series analysis for the period from 1951 to 1962, it enables us to do cross-section estimations only from 1959 to 1962, because the resultant tables of the survey before 1959 were either unpublished or without income information. Income in this survey was classified into only eight classes, but these classes had cross-classifications of family size and income groups, which enabled us to investigate the effects of family size. Owing to the differences in demand structure between farm and non-farm households, this survey could not be conducted and classified in the same way as the urban family income and expenditure survey.

CHAPTER II

THEORETICAL CONSIDERATIONS AND STATISTICAL FORMULATIONS

The purpose of econometrics, which is nothing but a combination of economic theory and facts by means of mathematical and statistical techniques, is to explain economic phonomena and to make predictions. The critical problem of econometric demand analysis is how to relate the data available to the theoretical formulation of demand relationships. Since theories provide guides for empirical studies, it is necessary to formulate a pure theory of demand relationship based on the theory of consumers' choice, and to develop the statistical models of estimation.

In this chapter, the earlier related empirical studies will be briefly surveyed before discussing the relevant variables in demand relation in Section 2. In the final section, the statistical model of estimation will be developed and formulated. The main topics in this final section are: (1) the combination of information from time series and cross section; (2) least-squares vs. simultaneous equations; (3) the method of instrumental variables; (4) the forms of demand equation; and (5) time-series equations.

A BRIEF SURVEY OF THE EMPIRICAL
STUDIES OF CONSUMER DEMAND

The empirical work in consumer demand goes back to a little more than a century ago when Ernest Engel (1857) studied the pattern of consumer expenditure based on the Belgian family budget data and formulated a famous law: "The poorer a family, the greater the proportion of its expenditure that must be devoted to the provision of food." He later extended his law by saying, "the wealthier a nation, the smaller the proportion of food to total expenditure."[1] About a decade later (1868) Hermann Schwabe studied Berlin budget data and proposed a law now referred to as the Schwabe Law: "The poorer anyone is, the greater the amount relative to his income that he must spend for housing."[2] Since then, Engel's law has been verified by a great number of other budget surveys and similar laws have also been formulated for other expenditure patterns.[3]

Although econometric study of demand started early, it is still, compared with other fields of economics, in its infancy owing to the fact that it was not undertaken

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[1]For an excellent survey of the empirical studies of consumer behavior up to World War I, see George J. Stigler, "The Early History of Empirical Studies of Consumer Behavior," Journal of Political Economy, XLIII, (August, 1935), 433-481.

[2]*Ibid*., p. 100.

[3]For the bibliography of recent studies, see James Morgan, "A Review of Recent Research on Consumer Behavior," in Lincoln H. Clark (ed.), Consumer Behavior: Research on Consumer Reactions (New York: Harper, 1958), pp. 93-219.

on a sound theoretical and statistical basis until the turn of this century. Fortunately, for the past two decades, a number of empirical researches on demand conditions have been done. Although Moore, in the 1910's,[4] became the first significant economist to do statistical demand analysis, the stage of "take-off" in this area began probably in 1935 when Allen and Bowley published their excellent econometric study of family budgets.[5] Since that time, the major contributions have been made by Schultz,[6] using the U. S. agricultural data; Wold and Jureen,[7] using Swedish budget and market data; and Stone,[8] and Prais and Houthakker,[9] working with British data. For a comparison of their works, the reader is referred to an excellent survey article by Hood.[10]

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[4]Henry Moore, The Laws of Wages (New York: The Macmillan Company, 1911); Economic Cycles: Their Law and Cause (New York: The Macmillan Company, 1914); and Forecasting the Yield and the Price of Cotton (New York: The Macmillan Company, 1917).

[5]Ray G. D. Allen and Arthur L. Bowley, Family Expenditure (London: Staples, 1935).

[6]Henry Schultz, The Theory and Measurement of Demand (Chicago: The University of Chicago Press, 1938).

[7]H. Wold and L. Jureen, op. cit.

[8]R. Stone, op. cit.

[9]S. J. Prais and Hendrik S. Houthakker, The Analysis of Family Budget (England: Cambridge University Press, 1955).

[10]Wm. C. Hood, "Empirical Studies of Demand," Canadian Journal of Economic and Political Science, XXI (August, 1955), 309-327. For other good survey article, see Robert Ferber, "Research on Household Behavior," American Economic Review, LII (March, 1962), 19-63.

THEORETICAL CONSIDERATIONS OF
THE RELEVANT VARIABLES IN
DEMAND RELATION

It is well known that according to the theory of consumer demand, individual expenditure depends on income and the prevailing prices under a given set of preferences. However, a number of variables in addition to income and prices play a role in determining demand for basic living materials. These variables, regarded as preferences or tastes and habit in the economic theory, include type of family (family size and composition, age of head), region, rural-urban, city size, number of earners in the family, occupation of the head of the household, amount of wealth, debt, family liquid assets holdings, home tenure, consumer credit terms, education, stocks of durable goods, new products, income change and income expectations, past consumption patterns, supply conditions, etc. Assume X_1, X_2, X_3,....., X_n denote income, prices, family size, and other variables, respectively, then the household demand for commodity i can be expressed implicitly as:

$$C_i = f(X_i) \qquad i = 1, 2, 3, \ldots\ldots n \qquad (1)$$

Although there are many factors that determine the pattern of demand for a commodity, no one has attempted to include explicitly a large number of the variables into an empirical study of demand. The fact is that some of the factors are extremely difficult to handle statistically. Since most of the factors are closely associated with the level of income, in order to avoid the bias in the demand relationship, all the previous demand studies have made a considerable effort to keep "other variables constant" by using an "equivalent adults" or "consumer units" scale to deal with the variations in family size and composition, and by classifying family into relatively homogenous groups to overcome the factors affected by place of residence, occupation, and so forth.

Because of the nature of cross-section and time-series data, some factors are more suitable for analysis from corss-section data while others are better analyzed from time-series data.[11] Of course, not all of the variables listed above will enter the present study. Some of the relevant variables of demand for basic living materials are discussed below.

Income

Income is the most important factor in explaining consumer behavior. However, owing to the unavailability of information on income, many early budget studies used total expenditure as a proxy for income in investigating variations in food, clothing, housing, and other items of consumption.[12]

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[11]For discussion of this point and the listing of the relevant variables with reference to house furnishings and equipment in cross-section and time-series analyses, see: Vernon G. Lippitt, Determinants of Consumer Demand for House Furnishings and Equipment (Harvard University Press, 1959), pp. 6-8.

[12]For example, Richard Stone, op. cit.; R. G. D. Allen and A. L. Bowley, op. cit.; and S. J. Prais and H. S. Houthakker, op. cit., all used total expenditure as the determining variable in the Engel Curve. Stone derived income elasticities by discounting 10 percent of the estimated expenditure elasticities.

Even if income data were available, a number of demand analysts argued that total expenditure should be used as an explanatory variable because it was too difficult to obtain accurate and reliable income data. Thus Prais and Houthakker used total expenditure in examining the household consumption behavior on the grounds that it was too difficult to ascertain the information on income, and that savings could be ignored when total expenditure was used as an explanatory variable. Nevertheless, for the purposes of comparison with expenditure elasticity, they did estimate some income elasticities of the middle-class household.

A further argument in favor of using total expenditure as an explanatory variable is that it is a better measurement of a household's permanent economic status than measured income if Friedman's permanent income hypothesis[13] is accepted. Friedman argues that measured income consists of two parts: the systematic part called the permanent income and the non-systematic part called the transitory income,

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[13] Milton Friedman, A Theory of Consumption Function (Princeton: Princeton University Press, 1957). The permanent income theory has been vigorously discussed intensively and extensively by many economists, in particular see Franco Modigliani and Richard Brumberg, "Utility Analysis and the Consumption Function," in Post Keynesian Economics, Kenneth K. Kurihara (Editor), (Rutgers University Press, 1954), pp. 388-436; Margaret G. Reid and Marilyn Dunsing, "The Effect of Variability of Income on Level of Income-Expenditure Curves of Farm Families," Review of Economics and Statistics, XXXVIII (February, 1956), 90-95; Irwin Friend and Irving B. Kravis, "Consumption Patterns and Permanent Income," Proceedings of the American Economic Review, XLVII (May, 1957), 548-555; H. S. Houthakker, "The Permanent Income Hypothesis," American Economic Review, XLVIII (June, 1958), 396-404; and Robert Eisner, "Permanent Income Hypothesis: Comment," American Economic Review, XLVIII (December, 1958), 972-990.

and that mean transitory components of income and consumption tend to be zero. His hypothesis postulates that consumption is a function of the permanent component of income, wealth possessed, the interest rate, and tastes such as the size and composition of households, and other variables. The permanent component of income determines people's consumption, but the transitory income does not affect the consumption decision. However, permanent income cannot be observed directly because measured income consists partially of transitory income. It is argued that total consumption is closer to the permanent component of income than is recorded income.[14] Reid used measured income as an explanatory variable in investigating the housing-income relations for 1950 and 1960 in the United Stated and found the elasticity of housing was less than 1.0--about 0.35 for 1950. This result is consistent with Schwabe's law of rent--as income increases the proportion of income spent for housing decreases. But when Reid used permanent income instead of the measured income, she obtained the income elasticities of housing of between 1.5 and 2.0. From this she concluded that housing was a luxury item according to the American standard of living. She then used total consumption as the explanatory variable in the regressions and found that expenditure elasticity of housing was on the average 39 percent greater than the elasticity obtained by using measured income as an independent

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[14]One of the basic hypotheses of the permanent income theory is that total consumption tends to be a constant proportion of permanent income.

variable. Because of the fact that the expenditure elasticity is much closer than the measured income elasticity to the permanent income elasticity, she argued that total consumption was more suitable than measured income to stand as proxy for permanent component of income.[15]

However, family budget surveys usually show that total expenditure is approximately proportional to income in each income class and that the higher the income of these income classes, the relatively smaller proportion of income is spent. So, if we assume that total expenditure is a function of income, C = c(Y), it is readily shown that

$$\eta_{c_i Y} = \eta_{c_i C} \cdot \eta_{CY}$$

where $\eta_{c_i Y}$ is the elasticity of expenditure on item i with respect to income, $\eta_{c_i C}$ the elasticity of expenditure on item i with respect to total consumption, and η_{CY} elasticity of total expenditure with respect to income. The formula clearly shows that income elasticity has the tendency to be smaller than expenditure elasticity, although they are approximately equal.[16]

Since they are almost the same, do we have any reason for prefering one to the other as an explanatory variable? With regard to this question, Wold and Jureen state:

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[15] Margaret G. Reid, Housing and Income (The University of Chicago Press, 1962).

[16] If we are dealing with the economic concept of income and consumption, and accept the hypothesis that permanent consumption is a constant fraction of permanent income, then income elasticity is the same as expenditure elasticity. In the case of measured income and consumption, η_{CY} is usually slightly less than one, hence $\eta_{C_i C}$ is slightly greater than $\eta_{C_i Y}$.

> Since they are nearly equal, there is not a great deal to choose between two elasticity variants in practice. If nonetheless we wish to pursue the distinction between the two elasticities, they should not be regarded as competitive but rather as complementary. They answer different questions, and which variant should be employed depends upon whether we are concerned with the effect of changes in income or in total expenditure. Both elasticities have a place in demand analysis. It would seem, however, that from the viewpoint of the applications it is the income elasticity that is of primary relevance, problems referring to total expenditure entering secondarily via assumptions concerning the propensity to consume.[17]

Crockett and Friend give one of their reasons for using income rather than total expenditure as an explanatory variable as follows:

> A further decision to relate all expenditure categories directly to income, rather than relating only total consumption to income and individual consumption items to total consumption, was based in part on a belief that certain types of expenditure--for example, purchase of durables, educational expenses, and abnormal medical expenses--may be largely competitive with saving rather than with other areas of consumption only. The danger of least squares bias may be substantially increased when total consumption is used as an explanatory variable.[18]

Prices

As with such variables as interest rates and wage rates, prices are held constant in cross-section analysis. they are, however, the important variables in the time-series studies of the demand relationships.[19] However, the fact

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[17]H. Wold and L. Jureen, op. cit., p. 221.

[18]Jean Crockett and Irving Friend, "A Complete Set of Consumer Demand Relationships," in Irving Friend and Robert Jones (eds.), Consumption and Savings (University of Pennsylvania Press, 1960), Vol I, p. 7.

[19]Because of inter-regional price differentials, attempts have been made to estimate price elasticities in cross-section analysis; however, no satisfactory results have been obtained yet. Although 46 regional income and expenditures cross-section data of Japan are available, price elasticities cannot be estimated owing to the lack of an inter-regional price index. It is possible to construct such an index from the data available, but the work involved is too heavy to be included in this study.

that prices are not treated as variables in the cross-section data does not imply that the same prices are paid by every household. It is only assumed that over a given period of time all the households in the survey faced the same market possibilities. Indeed, differences in prices frequently occur under many circumstances--for example, imperfect market conditions, quality and product differentiations (which include the location, services, and environment of the shop), economies of scale of purchase in large quantity, and so on.

Family Size and Composition

The size and the age and sex composition of a family, which are the most important forms of variation in preferences, greatly affect the demand for basic living materials. In fact, since income and expenditures of a family are highly correlated to its size and composition, income elasticities estimated from cross-section data will be biased if income and expenditures are not adjusted to family size and composition. The reason for the strong correlation between family size and income in household surveys is that larger families tend to have more earners so that their family income is higher, and that in families with more children, the heads of the families are usually older so that their earning powers increase. The larger the family size, the more the expenditure on food, clothing, and housing would have to be. But the relationship between family size and expenditures is not proportional. The coefficient of family size estimated by Houthakker[20] is only 0.24, which suggests great economies of scale. The economies of scale result from many factors: the reduction of per unit price if purchases are in large quantity, the indivisibility of goods, the chances of giving outgrown clothes to other members of the family, and families of all sizes tend to use kitchens and bathrooms of the same size. The low family size coefficient can also be explained by the fact that the larger family usually consists of more children and living expenses of children are lower. Allen[21] and Nicholson[22] have studied the effect of children on household concumption pattern and noted that the net effect of an additional child will be smaller the more children there are already.

To appraise the effect of the age and sex composition in estimating the income effect on family budget study, differences in age and sex have been usually adjusted by means of an equivalent adult male or "unit consumer" scale. Unfortunately, the budget data available would not permit the application of such a scale in this study. However, this

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[20] Hendrik S. Houthakker, "An International Comparison of Household Expenditure Patterns Commemorating the Centenary of Engel's Law," Econometrica, XXV (October, 1957), 532-551.

[21] R. G. D. Allen, "Expenditure Patterns of Families of Different Types," in Oscar Lange, Francis McIntyre, and Theodore O. Yntema (eds.), Studies in Mathematical Economics and Econometrics (The University of Chicago Press, 1942), pp. 190-207.

[22] J. L. Nicholson, "Variations in Working-class Family Expenditure," Journal of Royal Statistical Society, Series A, CXII (1949).

would probably not cause bias in the parameters, since the surveys covered a large number of households where composition and size do not vary widely; also, the average family size in each income group is approximately equal. We expect that the age and sex composition in each income group is nearly the same. Even if the data are available, the use of the equivalent adult male scale is not without problems--the economic significance of the application of this scale was seriously questioned by Allen.[23] With respect to the use of this scale, Houthakker warns:

> . . . a more correct treatment of family size is quite complicated, whereas blind application of an equivalent-adult scale intended for nutritional purposes to all commodities is probably worse than useless not to speak of the difficulty of choosing between the many scales that have been proposed from Engel's days to our own.[24]

Occupations of and Number of Earners in the Household

Occupation of the household head certainly does affect the demand for basic living materials. Laborers purchase larger quantities of food but spend less on clothing than office workers with the same level of income. Strictly speaking, the differences in consumption pattern among different occupations arise from the necessity of the work involved, not from variations in preferences.

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[23] R. G. D. Allen, op. cit.

[24] "An International Comparison of Household Expenditure Patterns," op. cit., p. 543.

It can be seen from family budget data that income and the number of earners in the household are usually intercorrelated; the larger the number of earners in the household, the larger the family income. Hence, the demand for basic living materials may be affected by the number of earners. Even though income and expenditure data are adjusted by using an equal number of earners in each income or total expenditure class, some difficulties still appear. For example, when many members of the family are at work, they may have lunch at restaurants and hence cause the expenditure on food to increase. Also they are likely to spend more on clothing, and probably need babysitters or other domestic help. In spite of these considerations, the biases in the demand elasticities estimated are probably small, if any, if the number of earners is disregarded since the principal effect of the number of earners on the expenditure on basic living materials is very likely due to the fact that the number of earners in the household and the family size are highly positively correlated.

Home Tenure

The type of tenure of dwelling--owned house, rented, and issued house--plays a part in determining the consumption of basic living materials chiefly through an income effect and specific effect.[25] The difference in consumption pattern of different types of dwelling arises because the owned house and issued house rents are seldom estimated, hence income and expenditure on rent are incorrectly measured.[26]

Regional Variations

Regional differences such as rural-urban, size of city, and geographical location undoubtedly make differences in the demand for basic living materials. As a general rule, living expenses are higher in urban areas than in rural areas and in big cities than in small ones.

Supply

Price and income elasticities from time-series data may also be influenced by supply conditions. A priori, the more elastic the supply is, the lower the income elasticity tends to be. Failure to include supply of basic living materials might bias the estimates of parameters in the demand equation. However, because of lack of data, the influences of prices on supply will not be included in the

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[25] Specific effect and income effect are equivalent to the Slutsky-Hicks' substitution effect and income effect. For the discussion of the effects, see H. S. Houthakker, "The Econometrics of Family Budgets," Journal of the Royal Statistical Society, Series A, CXV (Part I, 1952), 1-28. The effect has been interpreted in terms of changes in preference by S. Ichimura, "A Critical Note on the Definition of Related Goods," Review of Economic Studies, XVIII (1950-51), 179-183; and J. R. Hicks, "A Comment on Mr. Ichimura's Definition," Review of Economic Studies, XVIII (1950-1951), 184-187.

[26] Although people were asked to estimate their owned and issued house rents in the Japanese surveys, it is apparent from the data that they did not do it well.

present study, and it is believed that this will not bias the estimates of the demand parameters, as shown by Tobin.[27]

Other factors, such as the initial stocks of consumer goods, especially durable goods, are sometimes taken into account in a few demand studies. Nevertheless, the inventory of consumer goods is not included in this study, since the stocks data are not available. But it is believed that our study of the demand for nondurable living materials such as most food, fuel, and light would be little affected.

STATISTICAL FORMULATIONS

On the Combination of Time-Series and Cross-Section Analysis

In demand analysis, three types of data are generally used:[28] (1) cross-section surveys for a single period; (2) continuous cross-section surveys through time; and (3) aggregate or macroeconomic time series. While the first and second surveys have the same coverage, cross section and aggregate time series are usually different in their coverage and in population involved, and macro time-series data have the statistical problem of aggregation. Although we have

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[27] James Tobin, "Statistical Demand Function for Food in the U.S.A.," Royal Statistical Society Journal, Series A, CXIII (Part II, 1950), 113-140. He investigates the possibility of bias due to a relationship between supply and prices and concludes that the relationship between supply and prices with respect to food is not significant.

[28] For the nature and problems of the three types of data, see Marguerite C. Burk, "Some Analyses of Income-Food Relationships," Journal of American Statistical Association, LIII (December, 1958), 905-927.

abundant data of all the three types, the aggregate time-series data will not be utilized in this study.[29] The repeated surveys data can be used not only for investigating the stability of cross-section function over time but also to obtain a closer combination of cross-section with time-series data.

Cross-section data reflect a particular period of time and hence provide a static picture, i.e., variables such as prices, tastes, technological changes, and changes in market structures of the economy are assumed constant. Time-series data generally cover a much longer period of time and relfect dynamic changes in the sense that the variables held constant in the cross-section analysis are no longer assumed to be unchanged.

Income elasticities estimated from time-series data are usually lower than that from cross section in various studies of the demand for food. For example, using U. S. data, Tobin[30] obtains .56 for the year 1941 from cross-section data, and .27 from time-series data for the period 1913-1941.

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[29]Expenditures on broad categories of commodities such as food, housing, fuel and light, and clothing for the whole country were estimated for a long period of time by the Bureau of Economic Planning, Japan, and were published in its National Income White Paper. But these data differ considerably from the expenditures estimated by Miyohei Shinohara, "An Estimate of Food Expenditure in Japan, 1909-1940," Keizai Kenkyu, XII (January, 1961), 31-41, and Kazushi Okawa, Miyohei Shinohara, and Tsutomu Noda, "An Estimate of Investment and Consumption in the Postwar Period," Keizai Kenkyu, X (January, 1959), 29-47. The main reason for not doing aggregate time-series analysis is that no reliable price index covering the country as a whole is available.

[30]J. Tobin, op. cit.

Wold and Jureen[31] get .51 for Sweden for 1938 from cross-section data and .28 from time-series data for the period 1921-1939. But working with U. S. cross-section data, Burk[32] obtains .30 and .25 for 1942 and 1955, respectively, and using time-series data she obtains .68 for 1929-1941 and .38 for 1948-1957.

Although others have attempted to explain the reasons the estimates differ in the two different approaches, Kuh and Meyer have probably done the most comprehensive work in this area.[33] Their main arguments are summarized as follows:

(1) The basic reasons that cross-section estimates of income elasticity are generally larger than those estimated by time series are: (a) cross-section data tend to measure long-run adjustments but time-series data typically tend to reflect shorter-run reaction;[34] (b) owing to the

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[31]H. Wold and L. Jureen, op. cit.

[32]M. C. Burk, op. cit., p. 919.

[33]Edwin Kuh and John R. Meyer, "How Extraneous Are Extraneous Estimates?" Review of Economics and Statistics, XXXIX (November, 1957), 380-393. Also see Edwin Kuh, "The Validity of Cross-Sectionally Estimated Behavior Equations in Time Series Applications," Econometrica, XXVII (April, 1959), 197-214; Richard Stone, "The Demand for Food in the U. K. Before the War," Metroeconomica, III (1951-1952), 8-28; and Trygve Haavelmo, "Family Expenditures and the Marginal Propensity to Consume," Econometrica, XI (January, 1947), 335-341.

[34]This is only a tendency. It is not always true that cross-section data cannot show short-run changes and that time-series data cannot measure long-run adjustments. In fact, both cross-section and time-series data can be designed to estimate both short- and long-run parameters. For this, see Lawrence R. Klein, An Introduction to Econometrics (Englewood Cliffs, N.J.: Prentice-Hall, 1962), p. 73.

availability of data, cross-section data usually measure outlay elasticity whereas time-series data tend to estimate quantity elasticity, and outlay elasticity is greater than quantity elasticity because of quality differences.[35]

(2) The estimates of parameters are different because of using different estimating equations.

(3) The length of time to which the cross section pertains also plays a role in the quality differential and hence causes the discrepancy between the two approaches.

(4) The differences in estimate between the two data are partly due to the differences in coverage in the two types of data. The time-series, but not the cross-section, relationships are affected by the changes in the distribution of families by income group.

The results obtained by cross-section or time-series data alone are always unsatisfactory. Although estimation of parameters from cross section encounter much less statistical pitfalls than from time series,[36] it is difficult to use cross section as a basis for prediction because it is static in nature. In order to overcome some of the statistical difficulties in time series and to get consistent

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[35] For the comparison of quantity and outlay elasticities from cross-section data, see H. Wold and L. Jureen, op. cit., and S. J. Prais and H. S. Houthakker, op. cit.

[36] For the statistical pitfalls in time series, see R. Stone, "The Analysis of Market Demand: An Outline of Methods and Results," Review of the International Statistics Institute, III (1948), 23-35.

parameters from both cross-section and time-series data, the method of combining the two types of data has been widely employed by research workers since Marschak[37] suggested it in 1939. Briefly speaking, the method is to insert the income elasticity estimated from cross-section analysis into the equation used in analyzing the time series.[38] The problem of multicollinearity[39] encountered in time series is believed to be overcome by this conditional regression analysis. With regard to this method, Hood notes that "we do not yet have an adequate theoretical economic framework to guide us in attempts to combine these two kinds of information."[40]

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[37]J. Marschak, "On Combining Market and Budget in Demand Studies: A Suggestion," Econometrica, VII (October, 1939), 332-335. This method has been developed and commented upon by many writers, in particular, Hans Staehle, "Relative Prices and Post-War Markets for Animal Food Products," Quarterly Journal of Economics, LIX (February, 1945), 237-279; J. Tobin, op. cit.; J. Durbin, "A Note on Regression When There Is Extraneous Information About One of the Coefficients," Journal of American Statistical Association, XLIX (1953), 23-32; H. Wold and L. Jureen, op. cit.; R. Stone, The Measurement of..., op. cit.; and Irving Hoch, "Estimation of Production Function Parameters Combining Time Series and Cross Section Data," Econometrica, XXX (January, 1962), 34-53.

[38]It is to note that this combining technique is inconsistent with Friedman's permanent income hypothesis. For this, see M. Friedman, op. cit., pp. 136-137. The method of instrumental variables to be discussed later in this chapter is in fact a way suggested by Friedman to combine cross-section and time-series data.

[39]This term refers to the situation where independent variables in the equation(s) are related to each other. For example, income elasticities estimated from time series are subject to bias due to intercorrelation of income and the price series. Multicollinearity is first discussed by Ragnar Frisch, Statistical Confluence Analysis By Means of Complete Regression Systems (Publication No. 5, 1934, University Institute of Economics, Oslo).

[40]WM.C. Hood, op. cit., p. 323.

Because the cross-section and time-series data are influenced by the many different factors mentioned above, Kuh and Meyer question the validity of the combined technique.[41] The income elasticity estimated from cross-section data is usually larger than the equivalent time-series estimate, and this usually tends to overestimate the price elasticities when the conditional regression technique is used. For example, using time series alone, Tobin obtains a price elasticity of .27, but he gets an estimate of .53 when he uses the combined cross-section, time-series technique.[42] Why are the price elasticities from the combined technique usually larger than the price elasticities from "pure" time series? Let us assume the simplest conditional regression model:

$$\log q = \log a + \eta \log Y + b \log P \qquad (2)$$

where q denotes the original time-series values of the dependent variable such as quantity of consumption, P the "own" price level, Y income, b the price elasticity and η the income elasticity estimated from cross section. As "own" price elasticity is expected to be negative and it is conventionally reported as a positive number, the above equation is multiplied by minus one, then the relationship between price elasticity and income elasticity is

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[41]E. Kuh and J. R. Meyer, *op. cit.*

[42]*Op. cit.*

$$b = \frac{-d \log q + \eta \, d \log Y}{d \log P} = - \frac{P \, d \, q}{q \, d \, P} + \frac{PdY}{YdP} \eta \qquad (3)$$

Because of the various reasons mentioned earlier, income elasticities estimated from cross-section data are usually larger than those from time-series estimations. Since a majority of the empirical evidence shows that price and income elasticities are positively correlated, the relationship of equation (3) indicates that the larger estimate of the income elasticity tends to overestimate the price elasticity by conditional regression.[43]

Despite the fact that we cannot accept this combined method without reservation, we use this technique because so far no better technique of dealing with both cross-section and time-series data is available. In concluding the discussion of this combination of cross section and time series, let us borrow Kuh and Meyer's words:

> In sum, great care should be exercised in utilizing cross section parameters estimates jointly with time series. In particular, careful thought must be given to the possibility that a cross-section estimate is likely to measure very different influence from those represented by time series movements. Clearly, there is such a thing as being too extraneous.[44]

Since this method is not without problems, the original least-squares (without this restriction) will also be applied in time-series analysis.

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[43]For the similar argument, see E. Kuh and J. R. Meyer, op. cit., p. 391.

[44]Ibid., p. 393.

Some Considerations Concerning Least-Squares vs. Simultaneous Equations

Since the appearance of Haavelmo's article[45] in 1943, the problem of estimating economic parameters by single equation or equation system method has caused vigorous discussion. The main argument against the classical least-squares is that it could lead to biased estimates even for large samples. But no definite conclusion has been reached in favor of the alternative method. In discussing the choice of the two methods, Christ concludes:

> Thus the question of which method to use for any finite sample size is still open, for we do not know how to tell whether the bias of the limited-information method at a given sample size is smaller than that of the least-square method by enough to compensate for its bigger variance.[46]

In order to determine the relative merits of equations fitted by least-squares and limited information for use in forecasting, the Agriculture Marketing Service of the Department of Agriculture designed a Monte Carlo experiment and found that coefficients estimated by both methods are almost the same, unless a high degree of correlation exists among the unexplained residuals in the simultaneous equations. Thus they recommend that, if the above correlations are not anticipated to be high, the structural coefficients could be estimated by least-squares method because of its computational

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[45] "The Statistical Implications of A System of Simultaneous Equations," Econometrica, XI (January, 1943), 1-12.

[46] Carl F. Christ, "Aggregate Economic Models: A Review Article," American Economic Review, XLVI (June, 1956), 398.

simplicity.[47] It should also be noted that the parameters obtained in a few empirical researches are not much different whether fitted by least-squares or by limited information (Table 1). The reason that the results of the two approaches are in certain instances so close has been explained by Wold and Faxey.[48] Wold and Jureen state in the section, "Least-squares regression under debate": "The final conclusion must be, no doubt, that the regression analysis as traditionally applied is essentially sound. In demand analysis, at least, it can still be safely recommended."[49]

"A Symposium of Simultaneous Equation Estimation" presented by four econometricians in October, 1960 issue of Econometrica is probably the most complete discussion of the controversy on single equation versus equation system method.[50] Christ concludes his arguments there as follows:

> In summary, it is not yet clear that the least squares method for structural estimation is dead and should be discarded....The important task ahead is to

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[47] Richard J. Foote, Analytical Tools for Studying Demand and Price Structures (Agriculture Handbook, No. 146, USDA, Washington, D. C.), p. 69.

[48] Herman Wold and P. Faxey, "On the Specification Error in Regression Analysis," Annals of Mathematical Statistics, XXVIII (1957), 265-267.

[49] H. Wold and L. Jureen, op. cit., p. 59.

[50] "A Symposium on Simultaneous Equation Estimation," Econometrica, XXVIII (October, 1960), 835-871: Carl Christ, "Simultaneous Equation Estimation: Any Verdict Yet?" pp. 835-845; Clifford Hildreth, "Simultaneous Equations: Any Verdict Yet?" pp. 846-854; Ta-chung Liu, "Underidentification, Structural Estimation and Forecasting," pp. 855-865; Lawrence R. Klein, "Single Equation vs. Equation System Methods of Estimation in Econometrics," pp. 866-871.

TABLE 1.--A comparison of the parameters estimated by least-squares and limited information methods*

Authors		Commodity	Price Elasticities	Current Income Elasticities	Lagged Income Elasticities
Girshick & Haavelmo	a)	food			
(LS)			-.37	.28	.06
(LI)			-.25	.24	.05
Judge	b)	eggs			
(LS)			-.53	.31	.22
(LI)			-.58	.44	.29
Nordin, Judge & Wahby	c)	pork			
(LS)			-.78	.43	.22
(LI)			-.79	.76	.29
French	d)	eggs			
(LS)			-.81	.18	---
(LI)			-.43	.17	---

*(LS) denotes least-squares estimated (by linear logarithmic form, and consumption per capita was used as the dependent variable); (LI), limited information maximum likelihood estimates. The estimates were from time-series data.

a) M. Girshick and T. Haavelmo, "Statistical Analysis of the Demand for Food: Examples of Simultaneous Equations of Structural Equation," Econometrica, XV (April, 1947), 79-110.

b) G. Judge, "Econometric Analysis of the Demand and Supply Relationships for Eggs," Storrs Agricultural Experiment Station (Storrs, Connecticut, Bulletin 456, 1954).

c) J. Nordin, G. Judge and O. Wahby, "Application of Econometric Procedures to the Demands for Agricultural Products," Iowa Agricultural Experiment Station (Research Bulletin 410, 1954).

d) Burton L. French, "The Statistical Determination of the Demand for Meat," Econometrica, XX (January, 1952),96.

> learn more about how to decide which estimation method is likely to be best for any given actual econometric problem. For this present, the situation appears to be as follows: For structural parameters, least squares sometimes is preferable to simultaneous equations method and sometimes is not.[51]

Klein stated there:

> A strong case can be made for the use of least squares methods in the estimation of Engel curves and other cross-sectional relationships. The fields of application of single equation methods is indeed broad, but each situation must be separately analyzed in terms of the most appropriate statistical technique.[52]

Since the simultaneous equation method has not yet been proved to be superior to the least-squares approach, and the latter is believed to be suitable for estimating the parameters in the demand analysis, no attempts are made to use the system equations in this study.

Method of Instrumental Variables

Least-squares, perhaps, is still the most common method used in estimating the demand parameters, despite the availability of other alternative methods. However, the bias obtained from direct application of the least-squares method in family budget study should be pointed out here. In spite of an effort to adjust the size and composition of family by a consumer unit scale and of sub-grouping family into social class, geographical location and so on, the estimated bias in the traditional analysis of household behavior still could not be eliminated. The reason has been

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[51] *Ibid.*, p. 845.

[52] *Op. cit.*, p. 871.

clearly pointed out by Summers.[53] His main argument is that the various expenditures and income are interdependent, and hence the biases will result from estimating regression coefficients by least-squares regression of individual items expenditures on total expenditure or income, which are not actually independent. In other words, his main objection to the least-squares method in household expenditure analysis is that total expenditure or income and expenditures on individual items are endogenous to the household and are determined simultaneously. On the basis of Summers' analysis, Liviatan[54] has shown that the bias from the relation between the systematic parts of total expenditure C, and its components can be eliminated in a large sample by using measured income, Y, as an instrumental variable.[55] The main purpose of using an instrumental variable is to eliminate or to minimize the random error of the independent variable. Let us

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[53]Robert Summers, "A Note on Least-Squares Bias in Household Expenditure Analysis," Econometrica, XXVII (January, 1959), 121-126.

[54]Nissan Liviatan, "Errors in Variables and Engel Curve Analysis," Econometrica, XXIX (June, 1961), 336-362.

[55]Let $Y = aX' + b$ and $X = X' + X''$, then Z is called instrumental variable if it is a variable correlated with X' but not with X'' or b, which is the disturbance term. Valavanis describes an instrumental variable as "exogeneous to the economy, ... not entering the particular equation, or equations, we want to estimate, nevertheless used by us in estimating these equation." See Stefan Valavanis, Econometrics (New York: McGraw-Hill Book Co., 1959), p. 107. For further discussion of instrumental variables, see Albert Madansky, "The Fitting Straight Lines When Both Variables Are Subject to Errors," Journal of American Statistical Association, LIV (March, 1959), 173-205. A number of writers have shown that instrumental variables can be used to obtain consistent estimators in certain cases, in particular, see H. Wold, op. cit; Olav Reiersol,

state briefly Liviatan's method. Suppose the estimate equations in cross section (Engel curve) are:

$$C_i = a_{oi} + a_{li}Y_p + V_i \qquad (_i = 1,2,\ldots n)$$

$$C = \sum_{i=1}^{n} = a_o + a_1 Y_p + U \qquad (4)$$

where C_i denotes expenditure on the ith commodity, Y_p the permanent income, uncorrelated with the error term V's. The purpose of the analysis is to estimate the regression of C_{ip} (the systematic part of C_i) on C_p (the systematic part of C),

$$C_{ip} = B_{oi} + B_i C_p \qquad (5)$$

where $B_{oi} = a_{oi} - a_{li}\, a_o\, /a_1$ and $B_i = a_{li}/a_1$. Since no data provide with C_{ip} and C_p, they are substituted by C_i and C, and the demand relationship can be derived from (4)

$$C_i = B_{oi} + B_i C + W_i \qquad (6)$$

where $W_i = V_i - B_i U$. Bias in B_1 is expected if it is estimated by the least-squares method since C and W_i have common elements B_i, hence they are not mutually independent. The bias will be eliminated by using Y as an instrumental variable, since

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"Confluence Analysis by Means of Lag Moments and Other Methods of Confluence Analysis," Econometrica, IX (January, 1941), 1-24; R. C. Greary, "Determination of Linear Relations Between Systematic Parts of Variables with Errors of Observation, the Variances of Which Are Unknown," Econometrica, XVII (January, 1949), 30-58; J. Durbin, "Errors in Variables," Review of the International Statistical Institute, XXII (1954), 23-32; and D. J. Sargan, "Estimation of Economic Relationships Using Instrumental Variables," Econometrica, XXVI (July, 1958), 393-415.

$$\bar{B}_i = \frac{\text{cov }(C_i, Y)}{\text{cov }(C, Y)} = \frac{\bar{a}_{1i}}{a_1} = \frac{a_{1i} \cdot d}{a_1 \cdot d} = \frac{a_{1i}}{a_1} = B_i$$

where $\bar{B}_i$ is the estimate of the parameter B_i, and

$$\bar{a}_{1i} = \frac{\text{cov }(C_i, Y)}{\text{cov }(C, Y)}; \quad \bar{a}_1 = \frac{\text{cov}(C, Y)}{\text{var}(Y)}; \quad d = \frac{\text{cov}(Y_p, Y)}{\text{var}(Y)} \neq 1$$

It should be noted that Friedman[56] in fact suggests that the income elasticities for individual commodities should be estimated by using the ratio a_{1i}/a_1. His permanent income hypothesis consists of three equations:

$$C_p = KY_p \qquad (7)$$

$$Y = Y_p + Y_t \qquad (8)$$

$$C = C_p + C_t \qquad (9)$$

where C_p stands for permanent consumption, Y_p permanent income, K constant, Y_t transitory income, and C_t transitory consumption. Each of the variables in the above equations is in the same period of time. In addition, Friedman makes the assumption that

$$\text{Cov }(Y_p, Y_t) = \text{Cov }(C_t, Y_p) = \text{Cov }(C_t, Y_t) = 0 \qquad (10)$$

and $EY_t = EC_t = 0$ (11)

Although Liviatan's analysis makes use of equations (8) and (9) and assumption (11), it does not make use of assumptions (7) and (10).

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[56] M. Friedman, op. cit., pp. 206-207.

Although the method of instrumental variables is capable of eliminating the bias, it should be realized that it involves a loss of efficiency in the sense that the variance of B is usually greater than that of the regression coefficient, b, of original least-squares procedure.[57] Thus an instrumental variable is not desirable unless the bias found in the ordinary least-squares estimators, but eliminated by this method, is found to outweigh the concomitant loss in efficiency. Liviatan has developed a testing criteria for determining which method is preferable, which involves a fairly simple computation.[58] The test statistic

$$\sum_{i=1}^{n} \frac{(b_i - B_i)^2}{\mathrm{Var}\ (b_i - B_i)} \quad \text{is chi-square distribution}$$

with (n - 1) degree of freedom, where $\mathrm{Var}(b_i - B_i) =$

$$\frac{\mathrm{Var}\ (W)}{N \cdot \mathrm{Var}\ (C)} \left(\frac{1}{r^2_{cY}} - 1\right) = \mathrm{Var}\ (b) \left(\frac{1}{r^2_{cY}} - 1\right).$$ If the

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[57]If Var (W) is constant, J. D. Sargan, op. cit., has shown the asymptotic variances of B and b are:

$$\mathrm{Var}\ (b) = \frac{\mathrm{Var}\ (W)}{N \cdot \mathrm{Var}\ (C)}, \text{ and } \mathrm{Var}\ (B) = \frac{\mathrm{Var}\ (W)}{N \cdot \mathrm{Var}\ (C)} \cdot \frac{1}{r^2_{cY}}$$

where N denotes the sample size, and r_{cY} the correlation coefficient between C and Y. Hence

$$\frac{\mathrm{Var}\ (b)}{\mathrm{Bar}\ (B)} = r^2_{cY} \leq 1$$

For a slightly different proof, see J. Durbin, op. cit., pp. 26-27.

[58]N. Liviatan, op. cit., pp. 346-348. For the computation of the variance of the difference between b and B, and the similar test, see J. Durbin, op. cit., pp. 27-28.

null hypothesis that the bias is due to errors of observation only be accepted, then the least-squares method is to be used, and if the hypothesis be rejected, the method of instrumental variable will be applied. As the coefficients of determination between C and Y are almost one in our cross-section estimation, we can directly employ the method of instrumental variables in this study.

If the above linear equations are expressed in double-logarithmic form,[59] the B_i are expenditure elasticities. However, they can be interpreted as the income elasticities if we are willing to accept Friedman's basic hypothesis that the elasticity of the systematic part of total expenditure with respect to the economic concept of income is unitary.[60] Though B_i are expenditure elasticities, they are derived by the regressions of measured total consumption and individual item expenditures on measured income, so they can be computed from cross-section data available, which are classified by income groups and give average values of income, total expenditure, and expenditures on individual items for such groups.

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[59]The above basic statistical analysis does not change if the equations are in logarithmic form.

[60]See M. Friedman, op. cit., pp. 206-207. Let

$${}^{\eta}C_{ip} \cdot Y_p \quad \text{be elasticity of}$$

expenditure on commodity i with respect to permanent income Y_p, then

$${}^{\eta}C_{ip} \cdot Y_p = {}^{\eta}C_{ip} \cdot C_p \cdot {}^{\eta}C_p \cdot Y_p. \text{ Hence } {}^{\eta}C_{ip} \cdot Y_p = {}^{\eta}C_{ip} \cdot C_p = B_i$$

$$\text{if } {}^{\eta}C_p \cdot Y_p = 1$$

It should be noted that the statistical model of instrumental variables discussed above eliminates the biases only under the assumption that family size is constant. Bias may arise if family size is not introduced into the equations since it is usually a variable in cross-section data. However, when the family size N is used as independent variable, in addition to C or Y, in a least-squares analysis, the coeffecient of N will usually be biased for N is correlated with C or Y. These biases can be eliminated by using the method of instrumental variables since the above simple instrumental variable equations are readily extended to multiple regression with the same statistical analysis.[61] Thus we can obtain the consistent estimates of the "true" parameters by using both Y and N as instrumental variables. Unfortunately, the estimation of family size elasticity from the multiple instrumental variable equations is still not clear. We cannot but estimate family size elasticity by the original multiple regression equation.

It should be realized that not all the data under this study have been available for families of different size. To those data that are not classified according to family size but provide average size of families in a given income group, the average total expenditure and individual expenditure in a given income class are sometimes adjusted by family size elasticities by a number of researchers in order to eliminate the family size effect. However, those methods of

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[61]A simple proof using matrix has been done by J. Durbin, op. cit., p. 29.

adjustment are only approximate, and in view of the fact that there is little difference in the average family size in each income group in our data, we decline to do the adjustment. Although the cross-section data of income and expenditure, based on per household, are readily transformed to a per capita basis, it is believed that the conversion into per capita basis is worse than the approximate adjustment by family size elasticities, for the relationship between family size and expenditure is far from proportional. Bias in the parameters estimated probably exists if family size variable is not included in the estimating equation. The bias, however, is believed to be very small, if any.

Each observation is weighted by the number of households on which it is based.[62] The parameters estimated would be biased if the estimate equation is not thus weighted, since the middle income classes contain a larger number of households than both the low and high income groups and the elasticities of demand are generally higher for the poor and lower for the rich. It is probably better to divide the income level into three or five classes and to estimate the parameters from each income class separately. However, we do not assume it necessary to do so because omitting the open-ended upper and lower classes and weighting by the household number is believed to remove the bias.

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[62] Because the grouped data were used, the number of observations in the computations was the number of income or total expenditure classes which entered the estimating equations but not the number of households covered in the surveys.

Form of the Equation

Guidance by economic theory as to the form of equation to be fitted to the available data is limited. As noted in the last section, the values of the parameters estimated depend partly on the from of equation that has been used, and the choice of the mathematical form of demand equation has been regarded as very important by econometricians. The functional form, however, is limited to three main types, viz., the linear, semi-logarithmic, and double-logarithmic.

Linear forms were used by Allen and Bowley,[63] but have seldom been used since, because of the essential non-negativity of consumption though these forms satisfy the additivity criterion and are very convenient for computation.

After a careful examination of the possible forms of equations that could be used for family survey data, Prais and Houthakker conclude that semi-logarithmic form is better than double-logarithmic form, since the latter yields constant elasticities, which is not consistent with the generally accepted view that the income elasticity of total expenditure tends to decline as income increases.[64] They also conclude that the semi-logarithmic function is most suited for necessities and the double-logarithmic function for luxuries.[65]

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[63] R. G. D. Allen and A. L. Bowley, op. cit.

[64] S. J. Prais and H. S. Houthakker, op. cit., p. 97-98.

[65] Differences for the two classes of commodities (necessities and luxuries) also are suggested by other demand analysts. In particular, H. Wold and L. Jureen, op. cit. P. G. Champernowne, "Discussion on H. S. Houthakker, the Econometrics of Family Budget," Journal of Royal Statistical

Nevertheless, Houthakker later uses double-logarithmic form in his study of the international household expenditure patterns, regardless of necessities and luxuries, on the grounds that, in addition to its absence of the defect of the linear function, it allows more freedom in dealing with multiple currencies and an easier introduction of the effects of family size.[66]

Double-logarithmic form also has the advantage of somewhat greater flexibility than other forms. It should, however, be pointed out that the former method has the

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Society, Series A, CXV (Part I, 1952), has suggested that the two functions:

$$f(Z) = 1 - e^{-Z} \quad \text{for necessities, and}$$

$$f(Z) = Z^{\frac{1}{Z} + 1} \quad \text{for luxuries.}$$

But the concept of necessities and luxuries is not clear. Some goods are necessity for rich people but they may be luxury for the poor. This is also applied to the rich and poor countries; while many consumer goods are regarded as necessity in the United States, they are probably luxury for the underdeveloped countries. A number of goods appear as luxuries and then become semi-luxuries or even necessities as incomes rise and prices fall. Because of this phenomenon and because of the consideration that a saturation level of consumption exists at very high level of incomes, Aitchison and Brown have developed a so-called sigmoid Engel curve, which implies that a consumer good acts as a luxury at low income and as a necessity at high income. For this, see J. Aitchison and J. A. C. Brown, "A Synthesis of Engel Curve Theory," The Review of Economic Studies, XXII (1954-1955), 34-46; also their Lognormal Distribution (Cambridge, England: Cambridge University Press, 1957).

[66] H. S. Houthakker, op. cit.

difficulty of satisfying the additivity criterion. But this does not matter, because its discrepancy is in fact likely to be very small.[67]

In discussing the logarithmic form in economic analysis, Foote notes:

> From a statistical viewpoint, logarithmic equation should be used when (1) the relationships between the variables are believed to be multiplicative rather than additive, (2) the relations are believed to be more stable in percentage than in absolute terms, and (3) the unexplained residuals are believed to be more uniform over the range of the independent variables when expressed in percentage rather than absolute terms. To some extent, these items are different aspects of the same thing. The last two conditions are more likely to hold for analyses based on undeflated data than for those based on deflated data, although they might hold in either instance.[68]

Though the most appropriate form of demand equation has not been agreed upon by econometricians, the majority of demand analysts prefer the logarithmic form. In virtue of the above discussion and of nature of data under this study, we have not hesitated in choosing the double-logarithmic form in estimating demand parameters in this study.

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[67] As shown by H. S. Houthakker, "The Econometrics of . . . ," op. cit., p. 6, if

$$C_i = a_i \cdot C^{bi}, \text{ where } \sum_i^n C_i = C, \text{ then } C - \Sigma a_i \cdot C^{bi} =$$

$$e(1 - \Sigma_i a_i C^{bi}) \text{ tend to be zero for}$$

a considerable range of values of C, since the regression functions are fitted to observations which themselves satisfy the adding-up condition.

[68] Richard J. Foote, op. cit., p. 37.

Time-Series Equations

As to the equations used to estimate the parameter from time-series data, the statistical techniques for the demand analysis show little change. Following the traditional approach, parameters from time series are estimated by the equation[69]:

$$q_{ti} = A_i Y_t^{B_{i1}} \; Y_{t-1}^{B_{i2}} \; P_t^{C_{i1}} \; Q_t^{C_{i2}} \; R_t^{C_{i3}} \qquad (12)$$

where q_i denotes per household amount demand for commodity i, Y_t per household current real income, Y_{t-1} per household preceding year's real income (Y_t and Y_{t-1} also stand for the permanent income estimated by Friedman's method of weighted moving average of disposable income), P_t own price, and Q_t other price level, and R_t competitive or complementary good's price level. In the logarithmic form and treating P as a dependent variable, equation (12) becomes

$$\log P_t = \left(\frac{1}{C_{i1}}\right) \log A_i + \left(\frac{1}{C_{i1}}\right) \log q_{ti} - \left(\frac{B_{i1}}{C_{i1}}\right) \log Y_t$$

$$- \left(\frac{B_{i2}}{C_{i1}}\right) \log Y_{t-1} - \left(\frac{C_{i2}}{C_{i1}}\right) \log Q_t - \left(\frac{C_{i3}}{C_{i1}}\right) \log R_t \qquad (13)$$

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[69]This is the same as the equation used by J. Tobin, op. cit. Richard Stone, op. cit. uses an equation similar to this. He ignores preceding years income effect but introduces time to denote the changes in tastes and habit in his regression equation. We decline to use a time variable; the reasons have been given fully in H. Wold and L. Jureen, op. cit., pp. 240-242. Among other things, a time variable in time-series equation does not eliminate serial correlation.

In combining time-series and cross-section analysis, $B_i = B_{i1}+B_{i2}$ are taken from cross-section estimates, then equation (13) can be written:

$$\log P_t = h_o + h_1 (\log q_{ti} - B_i \log Y_t) + h_2 (\log Y_t - \log Y_{t-1})$$

$$+ h_3 \log Q_t + h_4 \log R_t \qquad (14)$$

The parameters in equations (12) and (13) can be derived from the coefficients in equation (14) as follows:

$$B_{i1} = B_i - \frac{h_2}{h_1},\ B_{i2} = \frac{h_2}{h_1},\ C_{i1} = \frac{1}{h_1},\ C_{i2} = -\frac{h_3}{h_1},\ C_{i3} = -\frac{h_4}{h_1}.$$

Another way of combining information from time series and cross section is stated as follows:[70] In terms of the logarithms of the variables, substitute $B_{i1} = B_i - B_{i2}$, so the equation (14) can be written:

$$\log q_{ti} - B_i \log Y_t = \log A_i - B_{i2}(\log Y_t - \log Y_{t-1})$$

$$+ C_{i1} \log P_t + C_{i2} \log Q_t + C_{i3} \log R_t \qquad (15)$$

What then are the differences between the estimates by equations (14) and (15)? Which one represents the better demand relationship? While we will estimate the parameters by both equations, it is argued that suitability of equation depends on a country's economic condition.

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[70] This method was used by Richard Stone in his <u>The Measurement of . . .</u>, <u>op. cit.</u>, while the preceding method using own price as regressand was used by J. Tobin, <u>op. cit</u>.

In the case of Japan, a regression of quantity on price seems more suitable for the demand for food, since Japan is not self-sufficient in food supply.[71] However, evidence shows that the absolute magnitudes of the elasticities are usually larger when price is used as a dependent variable in a "pure" time-series equation (Table 2).

There are many reasons why the absolute values of the estimated regression coefficients depend upon whether price or quantity is treated as dependent, as shown by Orcutt, [72] and Harberger.[73] They show, in particular, that either the errors of measurement in the independent variables or the shifts in the functions being estimated can cause bias in least-squares estimate, and Harberger concludes that the estimates by using price as a dependent variable can be regarded as "upper limits" and the estimates by treating quantity as a dependent variable as "lower limits" to the "ture" parameter. If this conclusion is true, equation (15) should be preferred to equation (14), since, as shown at the beginning of this section, price elasticities are usually larger by conditional regression than by

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[71]For this argument see L. R. Klein, op. cit., p. 73.

[72]Guy H. Orcutt, "Measurement of Price Elasticities in International Trade," Review of Economics and Statistics, XXXII (May, 1950), 117-132.

[73]Arnold C. Harberger, "Review of Stone's The Measurement of Consumers' Expenditure and Behavior in the United Kingdom, 1920-1938, Vol. I," Econometrica, XXIII (April, 1955), 217-218, and "Introduction" in A. C. Harberger (ed.), The Demand for Durable Goods (The University of Chicago Press, 1960), pp. 3-26.

TABLE 2.--A comparison of elasticities estimated using price and quantity as the dependent variable in the least-squares equation*

Commodity and Study	Period	Price Elasticities	Income Elasticities
Food:			
Girshick-Haavelmo[a]	1922-1941		
(1)		-.37	.28
(2)		-.56	.34
Burk[b]	1922-1941		
(1)		-.20	.24
(2)		-.29	.30
Food (Livestock Products):			
Fox[c]	1922-1941		
(1)		-.56	.47
(2)		-.61	.51
French[d]	1919-1941		
(1)		-.45	.53
(2)		-.71	.58

* (1) denotes least-squares equation using quantity of demand as the dependent variable, and (2) indicates the retail price of the commodity treated as dependent.

[a]M. A. Girshick and Trygve Haavelmo, "Statistical Analysis of the Demand for Food: Examples of Simultaneous Estimation of Structural Equation," Econometrica, XV (April, 1947), 79-110.

[b]M. C. Burk, "Changes in the Demand for Food from 1941-1950," Journal of Farm Economics, XXXIII (August, 1951), 281-298.

[c]K. A. Fox, "Factors Affecting Farm Income, Farm Prices, and Food Consumption," Agricultural Economic Research (July, 1951).

[d]B. L. French, "The Statistical Determination of the Demand for Meat," Econometrica, XX (January, 1952), 96.

"pure" time-series least-squares equation. In other words, price elasticities would be beyond the "upper limits" to the "true" parameters by combining cross-section and time-series technique.

CHAPTER III

ANALYSIS OF CROSS-SECTION DATA

In this chapter, the empirical results of the cross-section data, obtained by applying the techniques given in the preceding chapter, will be analyzed. Section 1 analyzes the empirical results from the National Survey of Family Income and Expenditure (hereafter referred to NSFIE), Attempts are made to utilize these data to investigate the classification bias and the influence of the following variables on expenditures for basic living materials: income, family size, type of dwelling house, number of earners per household, occupation, region, city size, and urban-rural differences. In Section 2, the income elasticities of basic living materials estimated from the Annual Report on Family Income and Expenditure Survey (hereafter referred to as ARFIES) are analyzed and the stability of the elasticities over time is tested. The Farm Households Economy Survey (hereafter referred to as FHES) is analyzed in Section 3. Furthermore, by comparing the income elasticities among four occupations in Section 1 and those between farm households and urban worker households in the third section, we will be able to test the permanent income hypothesis. Finally, the analyses of this chapter are summarized in the last section.

In all the cross-section equations, each observation was weighted by the number of households on which it was based, and the open-ended upper and lower classes were omitted.[1]

Income here is defined as the gross income plus income in kind minus non-living expenditures such as all taxes, social security, and others. Total expenditure is the original living expenditure plus income in kind when available. In NSFIE, in kind information on income, total expenditure, and food is provided. ARFIES did not survey income in kind for 1951 and 1952. However, since 1953, it gave income in kind on broad categories such as food, housing, fuel and light, and clothing, in addition to total income in kind. Income in kind on every item was recorded in FHES. Since incomes in kind are usually an extremely small proportion of total expenditure, and since more than half of them are food, it is believed that biases in the parameters estimated are negligible, even if the in kind data on individual expenditure items other than total food were not available. With regard to other categories of consumption, fish includes fresh fish and dried and salted fish, and vegetables include fresh, dried, and seaweed. Subsidiary food is the aggregate of fish, meat, milk, eggs, vegetables, processed food, and condiments.

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[1]Nevertheless, both of the open-ended classes in FHES were included in the computations. This was done on the grounds that income was classified into eight classes only in the surveys, and that the number of families in both extreme ends were as many as those in other income classes.

Differences in demand for basic living materials among ten occupations, eight regions, four city sizes, four numbers of earners, and five types of dwelling house, as well as the stability of the demand over time, are extensively investigated by employing dummy variables.[2] In applying the dummy variables to test the regression coefficients, two alternative assumptions could be made: (1) consumption levels (Y-axis intercepts or the coefficients of the constant terms) are different among the sample groups, but they have the same income elasticity; (2) the sample groups differ only in their income elasticity, and have the same level of consumption. Since the results of the *t*-test of the coefficients obtained by the two alternative assumptions were identical in every case, only the *t*-test of the estimates by the second assumption appears in the tables. However, the results are applicable to those estimated by the first assumption.

The B_i in the tables denote the expenditure elasticities estimated by the method of instrumental variable, i.e., the elasticity of a particular consumption category with respect to measured income divided by the elasticity of total expenditure with respect to measured income. All the other results shown in the tables are obtained by regression equations. As was noted before, the variance of B is simply that of the coefficient estimated by original least-squares method

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[2]For a note on the method of dummy variables in practical application, see Appendix A.

divided by the R^2 (coefficient of determination) of the total expenditure on measured income. Since the coefficient of determination is nearly one in every case, the standard errors of B_i do not appear in the tables. All the tests in the tables are two-tailed t-tests.

NATIONAL SURVEY OF FAMILY INCOME AND EXPENDITURE

The simple instrumental variable regressions of cross-section analysis are

$$\log C_i = \log a_{0i} + a_{1i} \log Y \qquad (i = 1,2, \ldots,n)$$

$$\log C = \log a_0 + a_1 \log Y \qquad (16)$$

where C_i stands for expenditure on the ith commodity, Y the recorded income, and $C = \sum_{i=1}^{n} C_i$. Liviatan has shown that $B_i = a_{1i}/a_1$ are the consistent estimates of the expenditure elasticities, as stated in the preceding chapter. Because the grouped data are used, a problem arises of whether the table classified by income or by total expenditure should be used in fitting the above equations. Although a_{1i}/a_1 are the estimates of expenditure elasticities and it seems as though it would be more reliable to use the table classified by total expenditure, it should be realized that income is treated as an explanatory variable in each regression equation above. According to Friedman,[3] the table classified by income classes should be used while fitting the regression

[3] M. Friedman, op. cit., pp. 200-201.

of measured C on measured Y. On the other hand, in fitting the regression of measured Y on measured C, we are supposed to use the table classified by total expenditure classes. Thus it is more appropriate to use the table classified by income groups in fitting the above equations.

Next, let us compare the estimates by the method of instrumental variables with those by the least-squares regressions. In the previous studies, only Prais and Houthakker[4] employed both income and expenditure as independent variables. They computed elasticities with respect to both Y and C in a double-logarithmic form of the least-squares regression based on the British surveys of 1937-1939. To make the comparison of the parameters estimated by using alternatively the methods of instrumental variables and least-squares, Liviatan computes B_i and claims that the least-squares bias is not negligible, as given in Table 3. Among other things, the considerable differences between B_i and b_i in the table can be traced to two factors: (1) the sample size was quite small--the total number of families was only 1,361; and (2) the income data used by Prais and Houthakker were poor--they had only the "income of the head of household" of the "middle class sample."

Our estimates of All Households (All Japan, urban and rural) from the tables classified by income classes and by total expenditure groups are shown in Table 4, while the

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[4]S. J. Prais and H. S. Houthakker, op. cit., p. 102.

TABLE 3.--Estimates of Engel curves using least-squares and instrumental variables methods by Prais and Houthakker, and by Liviatan*

Expenditure Group (i)	a_{1i} (1)	b_i (2)	$B_i = \frac{a_{1i}}{a_1} = \frac{a_{1i}}{1.17}$
Farinaceous	.47	.33	.40
Dairy	.36	.26	.31
Vegetables	.55	.40	.47
Fruit	.75	.55	.64
Fish	.79	.57	.68
Meat	.60	.44	.51
Rent	.83	.49	.71
Fuel	.95	.73	.81
Clothing	1.35	1.24	1.15
Durables	1.94	1.77	1.66
Literary	1.36	1.05	1.16
Vice	1.78	.61	.67

*This table was adopted from Nissan Liviatan, op. cit., Table 1 (p. 342.) a_{1i} and b_i are elasticities with respect to income and total expenditure respectively, by using the least-squares method, estimated by Prais and Houthakker.

estimates of Worker and General Households[5] are given in Appendix B. Table 4 shows that income elasticities (Column 1) are smaller than the corresponding expenditures elasticities (Column 3) when they are estimated from the tables classified by income classes, and the opposite is ture when they are estimated from the tables classified by total expenditure groups. The reason for this can be easily explained by the relationship ${}^{n}C_iY = {}^{n}C_iC \cdot {}^{n}CY$, where ${}^{n}C_iY$ is the

[5] All households are the summation of Worker and General Households. For the definition of these households, see Appendix C. Urban is equivalent to all shi which roughly corresponds to the English terminology of city, and rural includes all machi and mura which are about the size of town and village.

TABLE 4.--A comparison of the elasticities estimated from the tables classified by income group and by total expenditure classes, all households*

	Estimated from the Tables Classified by Income Classes			Estimated from the Tables Classified by Total Expenditure Classes		
	η_y	col(1)/a_i	η_E	η_y	col(4)/a_i	η_E
	(1)	(2)	(3)	(4)	(5)	(6)
			All Japan			
Total Expenditures	.7804			1.1382		
Food	.5861	.7510	.7508	.8085	.7103	.7105
Cereals	.3467	.4443	.4443	.5088	.4470	.4476
Subsidiary Food	.6697	.8581	.8580	.8758	.7695	.7697
Cakes, Candies, Fruits and Beverages	.8063	1.0332	1.0310	1.0779	.9470	.9471
Food Prepared Outside Household	1.1412	1.4623	1.4577	1.4974	1.3156	1.3168
Housing	.8589	1.1006	1.0996	1.5268	1.3414	1.3410
Rent	.2358	.3022	.2956	.5910	.5192	.5165
Repairs & Improvements	1.1498	1.4733	1.4773	2.0196	1.7744	1.7754
Furniture & Utensils	1.1542	1.4790	1.4788	2.0405	1.7927	1.7933
Fuel and Light	.6824	.8744	.8751	.9291	.8163	.8172
Clothing	1.0295	1.3192	1.3177	1.5578	1.3687	1.3687
			Urban			
Total Expenditures	.7781			1.1364		
Food	.5896	.7577	.7569	.8050	.7084	.7086
Cereals	.3677	.4726	.4717	.5309	.4672	.4676
Subsidiary Food	.6458	.8300	.8296	.8448	.7434	.7435
Cakes, Candies, Fruits and Beverages	.8005	1.0288	1.0264	1.0747	.9457	.9464
Food Prepared Outside Household	1.0456	1.3438	1.3367	1.3773	1.2120	1.2138
Housing	.7857	1.0098	1.0087	1.4200	1.2496	1.2482
Rent	.0701	.0901	.0806	.4072	.3583	.3545
Repairs & Improvements	1.3006	1.6715	1.6802	2.0250	1.7819	1.7837
Furniture & Utensils	1.1416	1.4672	1.4681	2.1037	1.8512	1.8514
Fuel and Light	.6654	.8552	.8553	.9096	.8004	.8016
Clothing	1.0592	1.3613	1.3622	1.6136	1.4199	1.4209
			Rural			
Total Expenditures	.7697			1.1935		
Food	.5494	.7138	.7147	.8171	.6846	.6839
Cereals	.3259	.4234	.4255	.5273	.4418	.4428
Subsidiary Food	.6529	.8483	.8484	.9212	.7718	.7700
Cakes, Candies, Fruits & Beverages	.8064	1.0477	1.0467	1.1399	.9551	.9524
Food Prepared Outside Household	1.0497	1.3638	1.3618	1.4847	1.2440	1.2425
Housing	.9546	1.2402	1.2349	1.8344	1.5370	1.5397
Rent	.1840	.2391	.2354	.5431	.4550	.4369
Repairs & Improvements	1.0553	1.3711	1.3603	2.3530	1.9715	1.9807
Furniture & Utensils	1.1911	1.5475	1.5439	2.0948	1.7552	1.7563
Fuel and Light	.6681	.8680	.8715	.9909	.8302	.8258
Clothing	.9872	1.2826	1.2787	1.5814	1.3250	1.3230

The left side was estimated from NSFIE Vol. (1), Table 1-1, and the right hand side from the same source, Table 2-1.

η_y denotes the income elasticity and η_E, the expenditure elasticity.

elasticity of expenditure on commodity i with respect to income, ${}^{\eta}C_iC$ the elasticity of expenditure on commodity i with respect to total expenditure, ${}^{\eta}CY$ the elasticity of total expenditure on income. Whether ${}^{\eta}C_iY$ is greater or smaller than ${}^{\eta}C_iC$ depends upon the magnitude of ${}^{\eta}CY$. If we assume that $C = c\ (Y)$ as in the resultant table, which is classified by income classes, the ${}^{\eta}CY$ is usually less than unity, for the data showed that during the short period of the survey the increase in the rate of total expenditure is smaller than that of income. Hence ${}^{\eta}C_iY$ is smaller than ${}^{\eta}C_iC$. On the contrary, if the assumption that income is the function of total expenditure be made, the table classified by total expenditure is the proper one to be used and ${}^{\eta}CY$ is supposed to be greater than one so that ${}^{\eta}C_iY$ is larger than its corresponding ${}^{\eta}C_iC$.

The B_i from both classifications show little difference from their corresponding b_i. Since the B_i have been shown to be the consistent estimate of the "true" parameters, this indicates that the least-squares regression may be a suitable method in demand analysis if the sample size is sufficiently large. While the B_i of food (except cereals) and fuel and light from the tables classified by income classes are slightly larger than the corresponding B_i from the tables classified by total expenditure groups, the B_i of housing, clothing, and their components tend to be smaller. A slight difference between the estimates from these two tables of different classifications is expected, for among other things, the number of households in each table is not exactly the same. For instance, although there are 42,841 households in "All Japan" in the tables classifying consumer units by both income and total expenditure groups, by excluding both open-ended classes from computation, 41,786 households in the former and 42,554 households in the latter actually entered the estimating equations. For the reason given earlier, and because all other resultant tables classified by total expenditure classes do not provide income information, the rest of our results are based exclusively on the tables classifying consumer units by income groups.

To carry the analysis of classification bias further, the tables classified by income, by family size, and those cross-classified by income and family size are utilized. In Table 5, η_y denotes income elasticity and η_N family size elasticity. Columns (1) - (4) are estimated from the table classified by income, columns (5) - (8) by family size, and columns (9) - (12) by both income and family size. While η_y and B_i estimated from the table classified by income group [columns (1) and (2)] are close to the corresponding figures estimated from the table cross-classified by income and family size [columns (9) and (10)] except for rent, they differ considerably from the income elasticities estimated by the table classifying consumer units by family size [columns (5) and (6)]--except for food. But for reasons to be discussed below the estimate for rent is doubtful.

Although the family size elasticities are quite different in the three classifications, the elasticities estimated

TABLE 5.--A Comparison of the elasticities computed the resultant tables of different classifications, all Japan, worker households.

Commodity	Estimated from the Table Classified by Income Group				Estimated from the Table Classified by Family Size				Estimated from the Table Cross-Classified by Income & Family Size			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	η_Y	$B_i=(1)/a_i$	η_N	$\bar{R}^2$	η_Y	$B_i=(5)/a_i$	η_N	$\bar{R}^2$	η_Y	$B_i=(9)/a_i$	η_N	$\bar{R}^2$
Total Expenditure	.72	--	.64	1.00	.89	--	.07	1.00	.85	--	.09	.99
Food	.42	.59	.71	1.00	.53	.60	.38	1.00	.51	.60	.37	.99
Cereals	.02	.03	1.12	.98	.74	.84	.64	1.00	.05	.05	.89	.98
Subsidiary Food	.57	.79	.51	1.00	-.05	-.06	.49	1.00	.63	.74	.22	.98
Cakes, Candies, Fruits & Beverages	.90	1.26	-.22	.99	-.41	-.46	.50	.85	.85	1.00	.01	.96
Food Prepared Outside Household	1.53	2.14	-1.11	.98	2.96	3.34	-.94	.77	1.35	1.60	-.30	.94
Housing	1.14	1.59	-.64	.98	.31	.35	-.30	.59	1.12	1.32	-.57	.90
Rent	.93	1.30	-2.90	.55	-2.95	-3.32	.22	.99	.48	.57	-1.08	.66
Repairs & Improvements	1.27	1.77	.89	.98	2.62	2.95	-.73	.08	1.48	1.74	-.07	.74
Furniture & Utensils	1.41	1.97	-.42	.96	.88	.99	-.35	-.05	1.42	1.68	-.47	.85
Fuel & Light	.59	.82	.80	1.00	-.26	-.29	.51	1.00	.74	.88	.12	.96
Clothing	1.15	1.61	-.17	.99	.71	.81	.07	.92	1.14	1.35	-.14	.97

by tables classified by family size and cross-classified by income and family size are relatively close. The relative discrepancy in family size elasticities is probably due to the bias in the least-squares regression since income and family size are positively correlated. Table 5 seems to support the general belief that it is more reliable to estimate income and family size elasticities from the resultant table cross-classified by both income and family size.

To confirm our belief, we estimated the demand relationships from the information of typical worker households in the cities with a population of 50,000 or more. Because these typical worker households consist of husband, wife and children with one earner only, they are a relatively homogeneous group and are free from the effect of the number of earners per household. The results reported in Table 6-A are estimated from data cross-classified by family size and income group, while those in Table 6-B are estimated from data classified by income group only; each income group also provides data on average family size in that group. In order to make comparison more meaningful between the two different classifications, both simple and multiple regressions were employed to estimate the demand parameters. The coefficients of constant terms and expenditure elasticities in Table 6-A are very similar to those corresponding figures in Table 6-B. However, the family size elasticities are quite different in the two tables. The coefficients of determination adjusted by degree of freedom ($\bar{R}^2$) usually tended to improve when a multiple

TABLE 6.--Demand elasticities estimated for typical worker households.*

	A. Computed from the table classified by income									B. Computed from the table cross-classified by income & family size								
	Simple Regression				Multiple Regression					Simple Regression				Multiple Regression				
	Constant Term	η_y	B_i	$\bar{R}^2$	Constant Term	η_y	B_i	η_N	$\bar{R}^2$	Constant Term	η_y	B_i	$\bar{R}^2$	Constant Term	η_y	B_i	η_N	$\bar{R}^2$
Total Expenditure	.45	.89	--	.990	.50	.84	--	.29	.990	.47	.88		.974	.50	.87		.08	.980
Food	1.38	.60	.67	.987	1.50	.49	.58	.62	.996	1.37	.60	.68	.775	1.50	.52	.60	.38	.978
Cereals	2.57	.20	.23	.791	2.77	.025	.03	1.03	.977	2.57	.20	.23	.057	2.88	.02	.02	.88	.947
Rice	2.71	.16	.17	.683	2.88	-.003	-.003	.91	.898	2.74	.14	.16	.023	3.05	-.04	-.04	.88	.918
Subsidiary Foods	.67	.68	.77	.989	.77	.60	.71	.49	.994	.68	.68	.77	.903	.76	.64	.73	.21	.961
Fish	.34	.59	.67	.986	.41	.52	.62	.40	.989	.36	.59	.67	.848	.43	.54	.63	.22	.926
Meat	-2.18	1.13	1.26	.981	-2.16	1.11	1.32	.11	.979	-2.17	1.12	1.27	.886	-2.22	1.15	1.33	-.15	.896
Milk & Eggs	-1.50	1.00	1.12	.972	-1.50	1.00	1.19	-.01	.969	-1.55	1.01	1.14	.793	-1.60	1.03	1.19	-.13	.799
Vegetables	.40	.58	.65	.982	.53	.46	.55	.69	.994	.41	.58	.66	.830	.49	.53	.61	.25	.930
Processed Food	.99	.44	.50	.933	1.13	.31	.37	.73	.953	1.04	.43	.49	.510	1.20	.34	.39	.45	.883
Condiments	.65	.50	.56	.937	.86	.30	.36	1.13	.980	.67	.49	.56	.551	.84	.39	.45	.48	.904
Cakes, Candies Fruits & Beverages	-.64	.88	.98	.983	-.51	.76	.90	.68	.987	-.63	.87	.99	.923	-.60	.85	.98	.10	.930
Cakes & Candies	-1.03	.86	.97	.975	-.88	.71	.85	.84	.982	-1.06	.86	.98	.709	-.88	.76	.88	.50	.863
Fruits	-1.33	.91	1.03	.987	-1.25	.83	.99	.45	.988	-1.30	.90	1.02	.909	-1.27	.89	1.03	.07	.911
Alcoholic Beverages	-.99	.81	.91	.877	-.81	.65	.78	.93	.878	-.99	.81	.92	.604	-1.09	.87	1.00	-.29	.650
Non-Alcoholic Beverages	-1.86	.94	1.06	.978	-1.79	.88	1.04	.37	.977	-1.86	.94	1.06	.823	-1.86	.94	1.08	.005	.821
Food Prepared Outside Household	-2.42	1.19	1.34	.958	-2.45	1.22	1.45	-.18	.954	-2.41	1.19	1.34	.848	-2.42	1.20	1.38	-.05	.947
Housing	-.59	.90	1.01	.965	-.52	.84	1.00	.37	.964	-.52	.88	1.00	.596	-.75	1.01	1.17	-.63	.797
Rent	2.77	.04	.05	-.069	2.35	.44	.52	-2.25	.205	2.76	.04	.05	-.012	2.43	.23	.27	-.94	.537
Repairs & Improvements	-5.24	1.76	1.98	.868	-4.75	1.31	1.56	2.60	.875	-5.15	1.74	1.97	.618	-5.33	1.84	2.12	-.50	.647
Furniture & Utensils	-3.06	1.36	1.53	.916	-2.66	1.00	1.19	2.07	.930	-2.95	1.33	1.51	.699	-3.08	1.41	1.63	-.39	.734
Fuel & Light	-.78	.86	.97	.983	-.69	.77	.92	.52	.985	-.75	.85	.96	.915	-.74	.85	.98	.03	.914
Clothing	-1.66	1.15	1.29	.978	-1.54	1.04	1.24	.59	.978	-1.69	1.15	1.30	.910	-1.70	1.16	1.34	-.05	.910
Clothes	-1.51	1.08	1.21	.971	-1.42	1.00	1.19	.45	.971	-1.56	1.09	1.23	.855	-1.59	1.10	1.27	-.06	.855
Personal Effects	-2.87	1.30	1.47	.983	-2.70	1.15	1.37	.90	.986	-2.88	1.30	1.47	.948	-2.88	1.30	1.51	-.004	.948

* Number of households is 8,053.

regression method was used because demand for some commodities, especially basic food such as cereals and its components, are affected to a great extent by family size. Whether B_i, estimated by a simple instrumental variable method (or a least-squares regression), are greater or smaller than the corresponding elasticities obtained by the equations including family size, depends on the sign of the family size elasticities.

So much for the classification bias. In order to know the demand conditions of the households other than farmers and fishers, the resultant table of All Households[6] (All Japan) has been used to estimate the elasticity of demand with respect to income. The results of this estimation are set out in Table 7. All of the coefficients of income are significantly different from zero at better than 1 percent level by two-tailed *t*-test. Of the twenty-seven items (including group totals and sub-totals), only one shows a negative elasticity, while eleven show elasticities between 0 and 1 and fifteen show elasticities greater than one. The orders of magnitude of the elasticities are generally what we expected them to be. It is natural to find that the elasticity of demand for barley shows a negative sign because it is regarded as a less desired item among cereals. It is also natural that the elasticity is lowest in cereals, and high in those goods such as meat, milk and eggs, and food

[6] Single household was excluded from the estimation.

TABLE 7.--Results of the estimation of coefficients, all Japan, all households.*

	Constant	η_y	$B_i = \frac{\eta_y}{.7804}$	$\bar{R}^2$
Food	1.442(.045)	.586(.010)	.751	.996(.008)
Cereals	2.020(.048)	.347(.011)	.443	.987(.009)
Rice	1.928(.045)	.351(.011)	.450	.989(.008)
Barley	3.825(.233)	-.392(.053)	-.502	.807(.042)
Bread	-1.273(.176)	.815(.040)	1.045	.970(.031)
Other Food	.614(.054)	.731(.012)	.936	.996(.010)
Subsidiary Food	.731(.049)	.670(.011)	.858	.996(.009)
Fish	.248(.058)	.624(.013)	.799	.994(.010)
Meat	-1.760(.098)	1.016(.022)	1.302	.994(.017)
Milk & Eggs	-1.215(.121)	.915(.027)	1.172	.989(.022)
Vegetables	.074(.059)	.659(.013)	.844	.995(.010)
Processed Food	.596(.050)	.535(.011)	.686	.994(.009)
Condiments	.800(.052)	.474(.012)	.607	.992(.009)
Cakes, Candies Fruits & Beverages	-.370(.084)	.806(.019)	1.033	.993(.015)
Cakes & Candies	-.764(.123)	.784(.028)	1.005	.984(.022)
Fruits	-.882(.073)	.802(.017)	1.027	.995(.014)
Alcoholic Beverages	-.976(.172)	.814(.039)	1.042	.971(.031)
Non-Alcoholic Beverages	-1.519(.091)	.856(.021)	1.097	.993(.016)
Food Prepared Outside Household	-2.347(.202)	1.141(.046)	1.462	.980(.036)
Housing	-.509(.157)	.859(.035)	1.101	.978(.028)
Rent	1.719(.338)	.236(.076)	.302	.396(.060)
Repairs & Improvements	-2.439(.212)	1.150(.048)	1.473	.978(.038)
Furniture & Utensils	-2.214(.282)	1.154(.064)	1.479	.962(.050)
Fuel & Light	.029(.084)	.682(.019)	.874	.990(.015)
Clothing	-1.153(.082)	1.030(.019)	1.319	.996(.015)
Clothes	-1.258(.101)	1.021(.023)	1.308	.994(.018)
Personal Effects	-1.798(.074)	1.050(.017)	1.346	.997(.013)

prepared outside the household. The very high elasticities in housing and clothing are in accord with the estimates in most previous studies.

With the exception of rent, the $\bar{R}^2$ of all other items are very high. In addition to its three items in the table, housing also includes water whose elasticity of demand was not estimated because it represents a very small fraction in housing expenditure. The $\bar{R}^2$ of rent in the table as well as that in the estimates from other information are relatively low as compared with the $\bar{R}^2$ of the other commodities demanded. The standard errors of the coefficients of rent also appear to be larger than those of other items. The estimate of the demand for rent is not reliable because the rent of owned and issued houses was seldom estimated, as can be seen clearly from Table 8. The expenditure on rent of a rented house or room probably included expenditure on fuel and light for the furnished house or room sometimes provided utilities, which were not always distinguishable from the expenditure on rent.

Because of the poor data on rent, income and total expenditure were incorrectly measured. However, the estimates of the demand elasticities of items other than housing are believed to be little affected, since rent is a very small proportion of income and total expenditure. In order to see the consumer behavior among the five types of dwelling houses, the method of dummy variables has been used,

TABLE 8.--Monthly expenditure on rent by type of tenure of dwelling houses (worker households, all Japan).

Income Classes	Type of Dwelling House: Owned House	Rented House (Privately Owned)	Rented House (Public Owned)	Rented Room	Issued House
Average	132	1,515	1,100	1,694	374
1	0	342	---	248	0
2	18	798	275	831	113
3	42	861	577	1,149	56
4	62	1,206	844	1,532	149
5	75	1,630	988	1,701	162
6	88	1,593	954	1,943	262
7	161	1,759	1,155	2,348	378
8	173	1,675	1,217	2,078	465
9	139	1,792	1,357	1,824	580
10	177	1,686	1,681	2,039	572
11	162	1,597	2,534	2,154	731
12	150	1,775	2,477	1,390	596
13	579	2,299	270	5,423	927
14	350	2,528	1,307	3,000	985
15	37	1,500	---	---	1,740
16	1,715	4,309	---	660	1,971

and the results are given in Table 9. These results are obtained by taking the owned house as the base (i.e., the dummy variable of the owned house was omitted in the least-squares regressions). In addition to the two-tailed *t*-test in testing whether their consumption patterns are significantly different at a given level of significance, the values of regression coefficients are included in the table to enable us to know the differences of the magnitudes of the demand elasticities for various commodities among the different types of dwelling houses. As the regression equations had been expressed in double logarithmic form, the antilog of the regression coefficient shows that the expenditure on a particular item of a given type of dwelling house in terms of percentage is greater or smaller than that of a certain type of dwelling house whose dummy variable was omitted. For example, the antilog of -.0029 of rented house (privately owned) elasticity for food is about .993, which indicates that rented house demand elasticity for food is .7 percent less than the owned house.

Table 9 shows that owned house demand for housing, rent, repairs and improvements, and fuel and light are considerably different from those of the other types of dwelling houses. This is in accord with our expectation. Because of the failure in estimating owned house rent value, the people in the rented house category seem to spend more on housing and rent. The expenditure of other types of dwelling houses on repairs and improvements, and fuel and light were reduced

TABLE 9.--Income elasticities estimated for five types of tenure of dwelling houses using dummy variables, all Japan.

		Type 1	Type 2	Type 3	Type 4	Type 5	
	Constant	Owned House	Rented House (privately owned)	Rented House (public owned)	Rented Room	Issued House	$\bar{R}^2$ (S)
Total Expenditure	.5425	.8686	-.0003#	-.0004#	-.0037a	-.0012#	.9922(.0146)
Food	1.4076	.5923	-.0029*	-.0061*	-.0130*	-.0011#	.9836(.0148)
Cereals	2.3673	.2687	-.0068*	-.0166*	-.0268*	-.0045a	.8606(.0256)
Subsidiary Food	.6708	.6825	-.0013c	-.0038a	-.0109*	-.0019b	.9884(.0141)
Cakes, Candies, Fruits & Beverages	-.5185	.8372	-.0022#	-.0052#	-.0001#	.0117*	.9744(.0261)
Food Prepared Outside Household	-2.9867	1.2923	.0131*	.0088c	.0206*	-.0045#	.9570(.0507)
Housing	1.8045	1.1441	.0444*	.0351*	.0607*	-.0261*	.9231(.0653)
Rent	-1.8752	.8765	.2714*	.2349*	.3014*	.0986*	.9495(.1288)
Repairs&Improvements	-3.5567	1.4471	-.0964*	-.0910*	-.1858*	-.1801*	.8996(.1414)
Furniture & Utensils	-2.8520	1.3085	-.0078#	.0160c	.0028#	.0030#	.8858(.0886)
Fuel & Light	-.4346	.7909	-.0127*	-.0070c	-.0223*	-.0376*	.9201(.0461)
Clothing	-1.4517	1.1033	-.0072a	.0019#	-.0043#	.0010#	.9773(.0319)

Note: The figures in the parentheses to the right of $\bar{R}^2$ are standard errors of estimates.

* Significantly different from owned house at better than the 1 percent level.
a Significantly different from owned house at better than the 5 percent level.
b Significantly different from owned house at better than the 10 percent level.
c Significantly different from owned house at better than the 20 percent level.
\# Difference from owned house is not significantly different from zero.

as compared with that of the owned house, since the expenditures of the former on these items were either unnecessary or partly included in rent. Although demand for other commodities are also significantly different at the 1 percent level in several cases, the differences are much less as compared with those items just mentioned. We may conclude from this analysis that the demand parameters estimated for rent, and for such items as housing, repairs and improvements, as well as fuel and light are not as reliable as those of other commodities.

Next, the effect of number of earners will be analyzed. In all of the above estimations of demand relationships, the effect of the number of earners per household was ignored. Is the number of earners a significant factor in determining the demand for basic living materials? In order to answer this question, the one earner household is taken as a base in the dummy variable procedure, and the results of the *t*-test are given in Table 10.

Inspection of Table 10 reveals that the estimated elasticities of total expenditure with respect to income are not different among the households with varying number of earners. But the elasticities for food, housing and its components (except repairs and improvements) are generally significantly different. However, the differences in the pattern of the demand for food and housing are probably not attributable to the number of earners, but rather to the fact that the number of earners and family size are positively

TABLE 10.--Income elasticities estimated for the number of earners using dummy variables, worker households, all Japan.

	Income Elasticities			
	Earner 1	Earner 2	Earner 3	Earner 4
Total Expenditure	.8761	-.0011#	.0008#	.0004#
Food	.5909	-.0004#	.0087*	.0135*
Cereals	.2197	.0123*	.0312*	.0450*
Subsidiary Food	.6876	-.0044*	.0047a	.0095*
Cakes, Candies, Fruits, & Beverages	.9039	-.0156*	-.0222*	-.0321*
Food Prepared Outisde Household	1.3320	-.0067c	-.0272*	-.0470*
Housing	1.0383	-.0082a	-.0264*	-.0269*
Rent	.2892	-.0124a	-.0438*	-.0479*
Repairs & Improvements	1.4618	.0138c	.0000#	-.0151#
Furniture & Utensils	1.3980	-.0182*	-.0434*	-.0521*
Fuel & Light	.7862	-.0044b	.0000#	-.0050#
Clothing	1.1155	.0042c	.0089a	-.0150a

* Significantly different from earner 1 at better than the 1 percent level.
a Significantly different from earner 1 at better than the 5 percent level.
b Significantly different from earner 1 at better than the 10 percent level.
c Significantly different from earner 1 at better than the 20 percent level.
\# Difference from earner 1 is not significantly different from zero.

correlated, as is shown in Table 11. The more earners a household has, the higher its income is. However, the per capita income of the household with more earners is not necessarily greater than that of the household with less earners because the number of earners per household is usually associated with family size. As a matter of fact, Table 11 (line 5) shows that, although the per capita income of two earner households is slightly larger than that of one earner families, the per capita income of the households with three and four earners is lower than those of the households with one and two earners.

As an increase in family size outweighs the higher income of the household with more earners and hence the family becomes relatively poorer, the family is forced to purchase lower quality goods. The family, after an increase in expenditures on relatively necessary goods such as food, cannot but spend less on other commodities. This explains why the level of consumption and expenditure elasticities of cereals and subsidiary food of the households with more earners are usually higher, and those of other commodities lower than that of the households with less earners. Since the effect of the number of earners on the demand for basic living materials is essentially due to the fact that family size and number of earners are closely related, and the number of earners itself has little to do with the consumption of basic living materials, the number of earners per household can be ignored in estimating the parameters of the demand relationships.

TABLE 11.--Average monthly receipts and disbursement per household by number of earner (worker household).

Earners per Household	1	2	3	4
No. of Households	16,643	6,244	1,634	557
Persons per Household	4.06	4.45	5.62	6.48
Net income	27,144	30,230	36,694	42,132
Per Capita Income	6,686	6,793	6,529	6,502
Total Expenditure	24,543	26,448	32,041	36,367
Food	10,249	10,785	13,327	15,331
Cereals	3,141	3,639	4,663	5,605
Subsidiary Food	4,820	4,925	6,177	7,222
Cakes, Fruits & Beverages	1,666	1,558	1,759	1,799
Food Prepared Outside Household	622	663	728	705
Housing	2,315	2,396	2,439	2,843
Rent	693	666	495	520
Repairs & Improvements	520	616	781	993
Furniture & Utensils	989	1,006	1,032	1,158
Fuel & Light	1,075	1,106	1,331	1,429
Clothing	2,717	3,172	4,301	4,525

Source: Table 6, Volume 1 of <u>1959 National Survey of Family Income & Expenditure</u>, Bureau of Statistics, Office of the Prime Minister, Japan.

The rest of this section is devoted to investigating the differences in demand for basic living materials caused by such variables as occupation, region, urban-rural differences, and city size.

In regard to occupations, there were ten for which data were available: regular laborers, temporary and day laborers, non-governmental employees, governmental employees, merchants and craftsmen, managerial staffs of unincorporated enterprises, managerial staffs of incorporated enterprises, professionals, other occupations, and without occupation. For the definition of and examples of these occupations, see Appendix C. In the computation each occupational group was first treated separately in order to know the level of consumption and expenditure elasticities of various items in each occupation. A crude cross-section test of the adequacy of the permanent income hypothesis (hereafter referred to as PIH) as applied to individual category of consumption was made. Then the data were pooled to obtain the regression coefficients by using dummy variables.

Of the many implications of Friedman's permanent income theory for the analysis of the expenditures on individual items, only the income elasticities estimated from the different types of group samples will be discussed. In testing the PIH by use of cross-section data, the interpretation of income elasticities derived from different characteristic groups of family are of crucial importance; on the basis of the hypothesis we expect the elasticities of expenditure on any particular category of consumption with respect to measured income to be lower for a group of families that have highly fluctuating incomes than for a group whose incomes are stable.

Among the ten occupational groups, two groups--regular laborers and governmental employees--have the most stable incomes and another two groups--temporary and day laborers, and merchants and craftsmen--probably have the most variable incomes. The income elasticities for basic living materials in the four occupational groups are presented in Table 12. Barley and rent were excluded from the table because of their extremely low $\bar{R}^2$. It is, of course, η_y's, not B_i, that are the relevant elasticities in testing the PIH, for the η_y's were estimated by the regressions of expenditure on a particular category with respect to measured income and hence they contain a transitory component of income. This can be seen clearly from the relationship,[7] expressed in the following equation:

$$\eta_{C_i Y} = \eta_{C_i Y_p} \cdot \eta_{Y_p Y} = \eta_{C_i Y_p} \cdot \eta_{C_p Y} \qquad (17)$$

It shows that the elasticity of ith commodity with respect to measured income is the product of two elasticities: the elasticity of the expenditure on the ith commodity with respect to permanent income and the elasticity of permanent consumption on measured income. The more variable the income

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[7]The relationship is shown in M. Friedman, op. cit., pp. 206-207. Our notation is slightly altered.

TABLE 12.--A comparison of the estimates of income elasticities among four occupational groups.

	Regular Laborers	Governmental Employees	Temporary & Daily laborers	Merchants & Craftsmen
Total Expenditures	.830	.878	.796	.657
Food	.627	.639	.571	.546
Cereals	.415	.489	.356	.382
Rice	.438	.484	.375	.392
Bread	.896	.831	.918	.739
Other food	.767	.719	.749	.659
Subsidiary food	.693	.689	.678	.612
Fish	.685	.672	.632	.581
Meat	1.033	.963	1.103	.851
Milk & eggs	.898	.794	1.117	.798
Vegetables	.658	.691	.655	.622
Processed food	.593	.595	.587	.541
Condiments	.521	.501	.508	.439
Cakes, candies, fruits, & beverages	.859	.725	.898	.725
Cakes & candies	.757	.730	.785	.723
Fruits	.817	.724	.813	.719
Alcoholic beverages	1.033	.684	.986	.711
Non-alcoholic beverages	.849	.843	1.058	.762
Food prepared outside household	1.231	1.062	1.350	.993
Housing	1.014	.804	1.227	.692
Repairs & improvements	1.310	1.741	1.959	.727
Furniture & utensils	1.532	.959	1.486	.978
Food & light	.647	.699	.681	.581
Clothing	1.046	.987	1.278	.894
Clothes	1.043	.947	1.310	.910
Personal effects	1.051	1.105	1.187	.849

is, the lower $^{\eta}Y_pY$ or $^{\eta}C_pY$ would be expected to be. As was shown in the preceding chapter, B_i are consistent estimates of the elasticities of expenditure on ith commodity with respect to permanent consumption, and it is, of course, permanent income elasticity if the hypothesis that permanent consumption tends to be a constant proportion of permanent income is accepted. Our method of deriving B_i is also suggested by Friedman to combine cross-section and time-series data. On the basis of equation (17), we would expect that the more stable a group's income is, the closer η_y will be to B_i.

As can be seen in Table 12, the elasticities of total expenditure on measured income of regular laborers and governmental employees are larger than that of the other two occupational groups. This seems to support the permanent income hypothesis that the closer the elasticity of total expenditure with respect to measured income is to unitary, the nearer η_y will be to B_i. Therefore, we cannot test the hypothesis with respect to an individual category of consumption by simply comparing the divergences of η_y and B_i between occupational groups. In the table, only the η_y's of milk and eggs, alcoholic beverage, and furniture and utensils of merchants and craftsmen are slightly greater, all the η_y's of other expenditure items are smaller than the corresponding figures of governmental employees and regular laborers. However, eighteen out of the twenty-six η_y's for the temporary and day laborers are greater than the corresponding elasticities for governmental employees or regular laborers. In

spite of this, we certainly cannot conclude that, based on this simple test, the PIH is invalid even if our assumption that incomes of temporary and day laborers are more variable than those of the regular laborers and governmental employees were correct, since the η_y's are also influenced by tastes and preferences. Furthermore, the income elasticity of particular categories of consumption also reflects the differences in prices and the level of income.

The effect of the income level on the differences in income elasticity among the occupational groups deserves our special attention. Wold and Jureen[8] investigate this problem extensively and conclude that income elasticities decrease with increasing income as far as aggregate food and animal foodstuffs are concerned.

Food is the main item in the family budget, but there are considerable differences between the occupational groups with regard to food. Table 13, which gives the average monthly income and basic living materials consumption per household of the four occupations (the same occupational groups as appear in Table 12), and is arranged in descending order of income, shows that as income decreases, aggregate food expenditures decrease and the percentage of income for food increases from about one-third in the highest income occupation to more than one-half in the lowest one. Since the higher income families tend to have owned houses and the owned house rent values are seldom estimated, the higher

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[8] H. Wold and L. Jureen, op. cit., Chapter 14.

TABLE 13.--Monthly average income and the comsumption of basic living materials per household in different occupations.

	Merchants & Craftsmen		Governmental Employees		Regular Laborers		Temporary & Day Laborers	
	Average Income & Expenditure	Percent of Income	Average Income & Expenditure	Percent of Income	Average Income & Expenditure	Percent of Income	Average Income & Expenditure	Percent of Income
Income	37,385		32,102		27,154		16,281	
Food	12,885	34.5	11,588	36.1	10,836	39.9	8,324	51.1
Cereals	4,162	11.1	3,278	10.2	3,694	13.6	3,660	22.5
Fish	1,263	3.4	1,072	3.3	956	3.5	745	4.6
Meat	723	1.9	711	2.2	515	1.9	281	1.7
Milk & Eggs	813	2.2	931	2.9	671	2.5	323	2.0
Vegetables	1,263	3.4	1,071	3.3	989	3.6	724	4.4
Processed Food	1,154	3.1	957	3.0	979	3.6	839	5.2
Condiments	879	2.4	803	2.5	753	2.8	569	3.5
Cakes & Candies	581	1.6	627	2.0	508	1.9	260	1.6
Fruits	543	1.5	570	1.8	450	1.7	241	1.5
Alcoholic Beverages	559	1.5	342	1.1	417	1.5	241	1.5
Non-Alcoholic Beverages	224	.6	221	.7	178	.7	89	.5
Food Prepared Outside Household	649	1.7	867	2.7	624	2.3	257	1.6
Housing	2,048	5.5	2,832	8.8	2,148	7.9	1,236	7.6
Repairs & Improvements	396	1.1	596	1.9	377	1.4	196	1.2
Furniture & Utensils	859	2.3	1,226	3.8	891	3.3	393	2.4
Fuel & Light	1,346	3.6	1,303	4.1	945	3.5	694	4.3
Clothing	2,820	7.5	3,422	10.7	2,550	9.4	1,298	8.0
Clothes	2,047	5.5	2,377	7.4	1,855	6.8	939	5.8
Personal Effects	773	2.1	1,045	3.3	696	2.6	359	2.2

income group does not always have a larger housing expenditure than the lower income group. The fact that the clothing expenditure of merchants and craftsmen (the highest income occupation) is smaller than that of the governmental employees is likely due to the nature of the work involved and the tendency in the latter group to purchase higher qualtiy clothing.

If we turn to Table 12 again and compare the income elasticities from the viewpoint of the level of income, we find that although the income elasticity for total food is not smaller for the higher income occupation, the income elasticities for such luxury commodities as meat, milk and eggs, housing, and clothing are highly correlated with the level of income, i.e., the higher the income, the lower the income elasticities tend to be. Their negative correlation is due to the relatively low satiation of consumption of the luxury or superior goods at low income levels and its rapid increase at higher levels. It is not surprising to find that the income elasticities for the necessities, especially cereals, are not always lower for the higher income groups, because the consumption of these goods is relatively well satisfied even in the low income classes. Thus, in testing the PIH with respect to individual categories of consumption, the factor of the income level cannot be neglected. Our conclusion on the test of the hypothesis will be postponed until we test the PIH once more using data on urban households and farm households in the third section of this chapter.

In addition to the income elasticities for basic living materials for the four occupations listed above, the expenditure elasticities (B_i) for the ten occupations are included in Appendix D. Because of the extremely low values of the coefficients of determination for barley and rent, these two items were excluded from the Appendix.

In order to make a closer investigation of the differences in the demand for basic living materials among the ten occupations, dummy variables were used by taking regular laborers as a base. The results of the two-tailed *t*-test of the differences of the income elasticity for the regular laborers and for other occupations are given in Table 14. For simplification, each occupation is represented by an Arabic numeral, as indicated at the bottom of the table.

The elasticity for total expenditure in occupation (1) is significantly different from that in occupations (3), (4) and (5) at the 1 percent level, and that in occupation (7) at the 5 percent level. The elasticity of total expenditure between occupations (1) and (6), (9) and (10) does not differ significantly from zero. The magnitude of income elasticity of total expenditure for the ten occupations, if arranged in descending order, would be (7), (3), (4), (8), (9), (10), (1), (6), (2), and (5). This order seems unrelated with the following order of the absolute income per household of the ten occupational groups, also arranged in the descending order: occupations (7), (6), (8), (5), (3), (4), (9), (1), (10) and (2).

TABLE 14.--Results of the test using dummy variables in differences of income elasticity among ten occupations, all Japan.

	Constant	Occupation 1	Occupation 2	Occupation 3	Occupation 4	Occupation 5	Occupation 6	Occupation 7	Occupation 8	Occupation 9	Occupation 10	$\bar{R}^2$
Total Expenditure	1.0031	.76013	-.00518c	.00718*	.00693*	-.00550*	-.00029#	.00925a	.00519c	.00363#	.00242#	.9765(.0257)
Food	1.4569	.58187	.00635a	-.00085#	-.00506*	.00347*	.01182*	.01012*	.00239#	.00160#	.00061#	.9819(.0170)
Cereals	1.8337	.39428	.02568*	-.02047*	-.01969*	.00339*	.00740a	-.01464*	-.02519*	-.00256#	-.00906*	.9373(.0231)
Rice	1.7317	.40217	.02385*	-.02366*	-.02220*	.00228b	.00734a	-.01743*	-.02997*	-.00096#	-.01125*	.9301(.0253)
Barley	3.8080	-.39825	.06681*	-.03937*	-.00861#	.04070*	.03967a	-.01792#	-.01404#	-.07036*	-.01451#	.6976(.1079)
Bread	1.1578	.78439	-.01519b	.01736*	.00248#	.00051#	-.00994#	.00824#	.00588#	-.00163#	.01219b	.8956(.0593)
Subsidiary Food	.8243	.64385	-.00619a	.00728*	.00017#	.00626*	.01756*	.02076*	.00800*	.00296#	.01007*	.9818(.0195)
Fish	.3122	.60202	.00402#	.00255b	.00063#	.01367*	.02525*	.02700*	.01628*	.00519#	.01127*	.9668(.0253)
Meat	-1.4064	.92189	-.03710*	.03095*	.01261*	.01069*	.02864*	.04899*	.03000*	.00313#	.02160*	.9677(.0407)
Milk & Eggs	-.9324	.84305	-.04903*	.02553*	.01623*	.00337b	.00786c	.02825*	.01254*	.00274#	.01016a	.9823(.0124)
Vegetables	.1493	.63844	-.01160*	.00400*	-.00663*	.00753*	.01936*	.01679*	.00176#	.00167#	.01342*	.9763(.0221)
Processed Food	.5520	.54741	.00275#	-.00681*	-.01132*	.00105#	.01011*	-.00004#	-.00671a	-.00236#	-.00171#	.9528(.0257)
Condiments	.7981	.47200	.00607b	-.00189c	-.00135#	.00631*	.01210*	.00620b	-.00280#	-.00184#	.00738*	.9509(.0230)
Cakes, Candies, Fruits, & Beverages	-.2011	.76560	-.02450*	.00740*	-.00167#	.00274c	.01331*	.01889*	.00486#	-.00657#	-.00098#	.9666(.0319)
Cakes & Candies	-.6026	.74729	-.03340*	.00869*	.00521a	.00616*	-.00288#	.00868c	.00079#	-.00904#	-.00195#	.9570(.0356)
Fruits	-.6822	.75351	-.03598*	.01225*	.00637*	.00374a	.01180*	.02663*	.00380#	-.00695#	.00830b	.9713(.0298)
Alcoholic Beverages	-.8587	.78350	-.00309#	-.00384#	-.02389*	.01881*	.02771a	.01348#	-.00503#	-.03606b	-.02332*	.8525(.076[illegible])
Non-Alcoholic Beverages	-1.2990	.79966	-.03146*	.01587*	.00160#	.00263#	.01375a	.02912*	.02302*	.02161a	.01614*	.9417(.045[illegible])
Food Prepared Outside Household	-2.0935	1.08763	-.06243*	.01891*	.01093*	-.02727*	-.02608*	.00054#	-.01564a	.00086#	-.02385*	.9611(.05[illegible])
Housing	-.4202	.84148	-.03834*	.01141*	.01571*	-.02369*	-.03810*	-.01855a	.00218#	-.00785#	.00290#	.9101(.06[illegible])
Rent	1.9264	.19251	-.05208*	.02063*	.00953#	-.02636*	-.03861a	-.06970*	-.03704a	-.03421#	-.02748b	.4066(.12[illegible])
Repairs & Improvements	-2.3669	1.12356	-.04751a	.01481b	.02343a	-.01128c	-.04364a	.00268#	.05438*	.02958#	.04796*	.7505(.14[illegible])
Furniture & Utensils	-2.1729	1.15107	-.04266*	.00347#	.01657*	-.02806*	-.05396*	-.03603*	-.01797c	-.04622a	-.01251#	.6822(.093[illegible])
Fuel & Light	.1929	.62573	.00354#	.02525*	.02122*	.02412*	.02234*	.03341*	.04115*	.03054*	.04194*	.9637(.02[illegible])
Clothing	-1.0010	.99199	-.01340a	.00992*	.01155*	-.01046*	-.00316#	.01746*	.00241#	.00297#	-.00533*	.9643(.04[illegible])
Clothes	-1.1282	.99199	-.01557a	.00522b	.00893*	-.00960*	-.00302#	.01215c	-.00107#	.00019#	-.01158a	.9489(.0[illegible])
Personal Effects	-1.5750	.99494	-.00825c	.02166*	.01758*	-.01277*	-.00392#	.02933*	.01084a	.00396#	.00852b	.9663(.04[illegible])

The Arabic numerals represent the following occupations:

1. Regular laborers
2. Temporary and day laborers
3. Non-governmental employees
4. Governmental employees
5. Merchants and craftsmen
6. Managerial staffs of unincorporated enterprises
7. Managerial staffs of incorporated enterprises
8. Professionals
9. Others
10. Without occupation

Note: The figures in the parentheses to the right of $\bar{R}^2$ are the standard errors of estimates.

* Significantly different from occupation (1) at better than the 1% level.

a Significantly different from occupation (1) at better than the 5% level.

b Significantly different from occupation (1) at better than the 10% level.

c Significantly different from occupation (1) at better than the 20% level.

\# Difference from occupation (1), is not significantly different from zero.

The η_y for food in occupations (5), (6) and (7) is significantly greater than that in occupation (1) at the 1 percent level. This can be explained by the quality variance of the food consumed since occupation (1) involved more physical labor than the other three occupations, hence this group consumed a larger quantity of food but the limitation of income forced them to purchase food of lower quality. This relationship can be seen more clearly by comparing the elasticity for food between occupation (1) and occupation (8). While the η_y for food is not different between the two occupations, occupation (8) has a significantly samller η_y for cereals and larger η_y for subsidiary food than occupation (1) at the 1 percent level. As rice is the major item of cereals, the test of the difference in the consumption of cereals among the ten occupational groups is identical with the case of rice except that the level of significance is a little altered in occupation (5). The η_y for cereals in occupation (1) is only smaller than that in occupations (2), (5) and (6). While the higher η_y for the latter two occupations can perhaps be attributed to their consumption of higher quality cereals in consequence of their higher income level, the large η_y for cereals in occupation (2) seems due to this group having the lowest income level and living in a relatively underfed condition. Thus, when their income increased, they spent a relatively larger proportion of it on the basic materials of subsistence.

Besides cereals, subsidary food is the major item of food: fish, meat, milk and eggs are the three most important items of subsidiary food. As mentioned above, laborers consumed a larger quantity of food than other people. But, because of their low income they were unable to spend a larger proportion of their increased income on fish, meat, milk and eggs as other people did. Thus, the difference of the η_y for fish between occupations (1) and (2) is not significant while the η_y for fish in all other occupations is greater than that in occupation (1)--in many cases the coefficients are significantly different at the 1 percent level. In the case of meat, η_y in occupation (2) is smaller than that in occupation (1) at the 1 percent level of significance. All the other occupations have the η_y significantly different from occupation (1) at the 1 percent level except the coefficient of occupation (9) shows no difference from occupation (1). The results of the _t_-test of milk and eggs are identical with those of the meat with the level of significance changed slightly only for occupations (5), (6) and (10). As to the results of the _t_-test of the differences in η_y for the rest of the food items between occuaption (1) and other occupations, the reader is referred to Table 14.

The η_y for housing in occupations (3) and (4) are significantly greater than that of occupation (1) while that in occupations (7), (8) and (9) are not significantly different from zero. The η_y of the other five occupations are significantly smaller than that of occupation (1) at the 1 or 5 percent level. The η_y for rent in occupation (1) is larger than that in all other occupations with the exception of occupations (3) and (4). Special attention is directed to the fact that η_y for housing and its components (rent, repairs and improvements, and furniture and utensils) in occupations (3) and (4) are all markedly greater than occupation (1), and those in occupations (2), (5) and (6) usually appear significantly larger than the corresponding figures in occupation (1). The factor causing these differences was pointed out in the discussion of the type of dwelling house: failure to estimate the rent value of owned and issued houses. It is quite unfortunate that the cross-classified data of the type of dwelling houses and occupations are not available. However, from the following table (Table 15) we can assume that households of occupations (3) and (4) lived in issued houses, a large proportion of laborers in rented houses and rooms, and that general households usually tended to have their own houses. It should be noted that the smaller η_y for housing in occupation (2) than in occupation (1) was caused by the former's lower level of income rather than by type of dwelling houses, since it is supposed that a relatively larger proportion of the households of both occupations rent house or room. Thus the different patterns of expenditure on housing and its components among the occupational groups can be attributed to the type of dwelling houses; this effect is in turn caused

TABLE 15.--Distribution of the number of households among the five types of tenure of dwelling houses--All Japan.

	All Households		Worker Households		General Households	
	Number of Households	%	Number of Households	%	Number of Households	%
Total	42,841	100	25,190	100	17,651	100
Owned House	25,198	59	12,261	49	12,937	73
Rented House	11,395	27	7,440	30	3,955	22
Privately Owned	9,685	23	5,969	24	3,716	21
Publicly Owned	1,710	4	1,471	6	239	1
Rented Room	2,541	6	1,909	8	632	4
Issued House	3,707	9	3,580	14	127	1

by the relatively poor measure of owned and issued house rent values. We have explained earlier how the incorrect estimates of the rent values affected the parameters estimated. Because of the low coefficients of determination for housing and its components, it is not worthwhile to examine further the occupational differences in the demand for housing.

The η_y for fuel and light in occupation (1) is not significantly different from that in occupation (2) at the 20 percent level, but it is smaller than those of all other occupations at the 1 percent level of significance. Although the reason for this can be partly explained by the fact that some of the expenditure on fuel and light was included in rent, laborers' low η_y for fuel and light is also partly due to their living conditions. For example, the relatively smaller space of their houses, their simplicity of cooking, their earlier retirement, or their comparatively light reading at night could reduce the expenditure on fuel and light.

As was somewhat expected, the η_y for clothing and its two components in occupations (2) and (5) appear to be remarkably smaller, and those in occupations (3), (4) and (7) significantly larger than those in occupation (1). The differences in these η_y between occupations (1) and (8) are not significantly different from zero with the one exception that the η_y for personal effects in occupation (8) is greater than in occupation (1) at the 5 percent level of significance. Although laborers usually purchase inferior clothing as compared with occupations (6) and (8), because of the nature of their work they probably need a larger quantity of clothing, so that their income elasticities of clothing are almost the same as those in occupations (6) and (8).

It should be mentioned that the above dummy variables enabled us to test the equality of either the constant term in occupation (1) and other occupations or the income elasticity in occupation (1) and other occupations. Another way of testing the equality of the regression coefficients (both constant term and income elasticity for all occupations) is to pool the data without using dummy variables. The procedure and the results of this test are shown in Appendix E.

Next, the regional variations in demand for basic living materials were investigated. The country is divided into forty-six political regions, and income and expenditure information is readily available for each region. Yet, because the work of combining the resultant tables into several geographical regions is beyond the scope of this study, only eight political regions were selected to represent various geographical locations. The criteria for choosing these eight regions were that they covered every part of the country and that a relatively larger number of households were surveyed in each region. Consequently, various parts of the country were represented by the following eight regions:

Region 1: Hokkaido (north)

Region 2: Iwate Ken (north-east)

Region 3: Niigata Ken (mid-west)

Region 4: Tokyo To (mid-east)

Region 5: Osaka Fu (south-east)

Region 6: Hiroshima (south-west)

Region 7: Ehime Ken (south)

Region 8: Fukuoka Ken (far south)

Dummy variables were employed in this investigation, and Tokyo To, which contains Tokyo--the most populous city in the world--was taken as a base in the estimating equations. The results are shown in Table 16.

Region proves to be a highly significant factor in the demand for basic living materials. Only the η_y for total expenditure in Hokkaido is significantly greater than that in Tokyo. While the η_y for food in three regions is not different from Tokyo's, that in the other four regions appears to be significantly smaller at better than the 10 percent level. Because of the relatively higher level of income and westernized way of eating, it is natural to find that Tokyo has the smallest elasticities for cereals and rice, and the largest elasticities for bread. The elasticities for other food and subsidiary food in Tokyo are larger than those in other regions except Region 6, which contains Japan's second largest city, Osaka. Tokyo's demand elasticities for individual items of food other than cereals, fish, condiments, and alcoholic beverages are also the largest except in a few minor cases. It is interesting to note that the elasticities for fish in all other regions are significantly greater than Tokyo's at the 10 percent level in one case and at the 1 percent level in the rest, and the demand for alcoholic beverages does not show significant differences among the regions.

TABLE 16.--Income elasticities estimated for the eight regions using dummy variables.

	Constant	Region 4 Tokyo	Region 1 Hokkaido	Region 2 Iwate	Region 3 Niigata	Region 5 Osaka	Region 6 Hiroshime	Region 7 Ehime	Region 8 Fukuoka	$\bar{R}^2$ (S)
Total Expenditure	1.0322	.7593	.0068*	-.0005#	-.0039#	-.0018#	-.0074a	-.0088a	-.0072*	.9611(.0327)
Food	1.4977	.5782	.0001#	-.0007#	-.0061a	.0014#	-.0063a	-.0082a	-.0037b	.9476(.0293)
Cereals	1.8866	.3661	.0216*	.0204*	.0155*	.0060*	.0074a	.0174*	.0191*	.8269(.0370)
Rice	1.8166	.3604	.0298*	.0278*	.0266*	.0123*	.0145*	.0207*	.0264*	.7423(.0505)
Bread	-.2578	.6347	-.0368*	-.0655*	-.0754*	-.0323*	-.0547*	-.0996*	-.0679*	.6617(.1420)
Other Food	.8498	.6911	-.0125*	-.0139*	-.0189*	-.0009#	-.0155*	-.0252*	-.0161*	.9537(.0342)
Subsidiary Food	.9398	.6329	-.0098*	-.0095a	-.0190*	-.0042a	-.0123*	-.0193*	-.0098*	.9476(.0334)
Fish	.2126	.6258	.0171*	.0210*	.0071b	.0174*	.0123*	.0137*	.0087*	.9174(.0399)
Meat	-1.4611	.9596	-.0513*	-.0659*	-.0686*	.0341*	.0050#	-.0339*	.0061c	.9498(.0589)
Milk & Eggs	-.6330	.8067	-.0504*	-.0285*	-.0424*	-.0025#	-.0231*	-.0501*	-.0266*	.9298(.0547)
Vegetables	.3876	.6042	-.0066a	-.0033#	-.0115*	-.0035c	-.0281*	-.0303*	-.0182*	.9228(.0404)
Processed Food	.9144	.4802	-.0298*	-.0326*	-.0313*	-.0009#	-.0252*	-.0261*	-.0216*	.9093(.0393)
Condiments	.6809	.5008	.0299*	.0131*	-.0008#	-.0197*	-.0092*	-.0075b	-.0034c	.9129(.0377)
Cakes, Candies, Fruits & Beverages	-.2175	.7832	.0016#	-.0070#	-.0036#	-.0109*	-.0164*	-.0220*	-.0182*	.9159(.0518)
Cakes & Candies	-.7150	.7898	-.0006#	-.0149b	.0053#	-.0237*	-.0458*	-.0530*	-.0437*	.9157(.0591)
Fruits	-.8477	.8021	.0062b	.0080#	-.0105a	.0015#	-.0128*	-.0088c	-.0084c	.9297(.0474)
Alcoholic Beverages	-.7582	.7639	.0043#	-.0240c	.0002#	-.0038#	.0173c	.0093#	.0021#	.6023(.1276)
Non-Alcoholic Beverages	-1.3447	.8348	-.0017#	.0018#	-.0147a	-.0171*	-.0368*	-.0558*	-.0263*	.8781(.0723)
Food Prepared Outside Household	-1.7914	1.0571	-.0814*	-.0814*	-.0615*	-.0152*	-.0380*	-.0972*	-.0642*	.9111(.0886)
Housing	.3153	.6866	-.0002#	-.0396*	-.0087#	-.0134a	-.0177a	-.0266a	-.0274*	.7189(.0985)
Rent	3.3958	-.0958	-.0351*	-.0938*	-.1012*	-.0265*	-.0478*	-.0765*	-.0524*	.3513(.1643)
Repairs & Improvements	-3.2408	1.3066	-.0443*	-.0427c	.0525a	-.0254b	-.0166#	-.0159#	-.0142#	.5737(.2407)
Furniture & Utensils	1.9899	1.0926	.0497*	-.0027#	.0274b	.0020#	.0046#	.0094#	-.0001#	.7110(.1519)
Fuel & Light	.1644	.6539	.0479*	.0092c	.0072c	.0010#	-.0141*	-.0253*	-.0279*	.9198(.0515)
Clothing	-1.3471	1.0707	.0171*	.0019#	.0127b	.0015#	-.0031#	-.0012#	-.0103a	.9215(.0664)
Clothes	-1.5337	1.0774	.0270*	.0051#	.0205*	.0009#	-.0017#	.0011#	-.0095b	.9010(.0765)
Personal Effects	-1.8023	1.0554	-.0103a	-.0066#	-.0077#	.0031#	-.0064#	-.0077#	-.0119*	.9269(.0630)

Note: The figures which appear in parentheses to the right of $\bar{R}^2$ are the standard errors of estimates.

* Significantly different from Region 4 (Tokyo To) at better than 1% level.

a Significantly different from Tokyo To at better than 5% level.

b Significantly different from Tokyo To at better than 10% level.

c Significantly different from Tokyo To at better than 20% level.

\# Different from Tokyo To is not significantly different from zero.

Tokyo's elasticities for housing and its components are the largest except for repairs and improvements in Region 3 and furniture and utensils in Regions 1 and 3. Tokyo's elasticities for these latter two groups are a little larger only in three instances, but in the majority of cases they are no different from other regions. On the whole, the regions containing a larger city or cities tend to have large elasticities for food and housing.

As could be expected, the regional differences in the demand for fuel and light, clothing, and clothes are mainly affected by climate. The elasticities for these three items are highest in the far north and gradually reduce toward south. However, the demand elasticity for personal effects does not follow this pattern; while the elasticity in the north and far south are significantly less than Tokyo's at the 5 percent and 1 percent level, respectively, the differences of the elasticity of Tokyo and other regions are not significantly different from zero.

The effects of city size and urban-rural differences will be discussed briefly. The analysis of geographical variations in consumer demand usually covers the effects of region, city size, and urban-rural conditions within the country. Indeed, the effects of the three variations generally are closely related to each other. While our investigation of the effect of city size on the demand for basic living materials was limited to worker households, the preceding regional effects analyses were based on all households. However, the results of the two analyses are similar to each other in the sense that the consumption pattern of the larger city is comparable to that of the region that contains a relatively larger city or cities.

Data for the following four cities sizes were available:

Size A: Six major cities with population of 900,000 or more--Tokyo, Osaka, Nagoya, Kyoto, Yokohama, and Kobe.

Size B: Middle city--48 cities with population between 150,000 and 899,999.

Size C: Small city A--206 cities with population between 50,000 and 149,999.

Size D: Small city B--284 cities with population of less than 50,000.

As size A's dummy variable was omitted in the regression equations, the results of the _t_-test are almost the same as those of the regional variations where Tokyo To was taken as a base. The reason is that Tokyo To included the city, Tokyo, whose population was more than twice as much as the second largest city, Osaka. The results of the city size estimations appear in Table 17. The bigger the city size, the larger the income elasticity for total expenditure tends to be.

The income elasticities for total food and for the following food items are significantly larger in the size A city than in the other sizes at the 1 percent level, and the magnitudes of the elasticities are positively associated

TABLE 17.--Income elasticities estimated for four city sizes using dummy variables worker households

	Constant	City Size A	City Size B	City Size C	City Size D	$\bar{R}^2$
Total Expenditure	.5717	.8643	-.0029a	-.0035a	-.0050*	.9890(.0169)
Food	1.4338	.5906	-.0040*	-.0057*	-.0074*	.9863(.0130)
Cereals	2.0586	.3261	.0097*	.0081*	.0090*	.9137(.0186)
Rice	2.0105	.3179	.0132*	.0109*	.0126*	.9113(.0189)
Barley	3.4254	-.4082	.0749*	.0941*	.1060*	.8315(.0937)
Bread	-.9628	.7812	-.0344*	-.0411*	-.0572*	.9497(.0411)
Other Food	.6798	.7271	-.0109*	-.0137*	-.0178*	.9883(.0152)
Subsidiary Food	.8336	.6551	-.0093*	-.0127*	-.0161*	.9858(.0152)
Fish	.2143	.6252	.0035b	-.0002#	-.0014#	.9672(.0212)
Meat	-1.6576	1.0181	-.0232*	-.0232*	-.0381*	.9820(.0278)
Milk & Eggs	-1.1010	.9127	-.0195*	-.0222*	-.0300*	.9520(.0403)
Vegetables	.3915	.5974	-.0095*	-.0139*	-.0203*	.9792(.0172)
Processed Food	.9804	.4606	-.0132*	-.0185*	-.0203*	.9587(.0199)
Condiments	.5708	.5162	.0044*	.0082*	.0076*	.9579(.0197)
Cakes, Candies, Fruits & Beverages	-.4571	.8307	-.0089*	-.0054a	-.0080*	.9631(.0302)
Cakes & Candies	-.7838	.7986	-.0125*	-.0053a	-.0079a	.9589(.0308)
Fruits	-1.0380	.8424	-.0032c	-.0040c	-.0071*	.9742(.0254)
Alcoholic Beverage	-1.1316	.8394	-.0044#	-.0010#	-.0008#	.8430(.0660)
Non-Alcoholic Beverage	-1.5636	.8794	-.0190*	-.0150*	-.0218*	.9623(.0335)
Food Prepared Outside Household	-1.9256	1.0919	-.0254*	-.0390*	-.0552*	.9706(.0397)
Housing	.5762	.8930	-.0038#	-.0101*	-.0177*	.9326(.0455)
Rent	2.8193	.0443	-.0212*	-.0539*	-.0812*	.8072(.0624)
Repairs and Improvements	-4.6715	1.6264	.0041#	.0180c	.0435*	.7928(.1500)
Furniture and Utensils	-3.1968	1.3643	.0229*	.0327*	.0234*	.9054(.0807)
Fuel & Light	-.2972	.7526	.0076*	-.0068*	-.0016#	.9776(.0214)
Clothing	-1.7516	1.1651	.0012#	.0036c	.0063a	.9786(.0314)
Clothes	-1.9136	1.1650	.0030#	.0076a	.0104*	.9681(.0384)
Personal effects	-2.2851	1.1706	-.0021#	-.0050b	-.0026#	.9762(.0336)

Notes: The figures which appear in the parentheses to the right of $\bar{R}^2$ are the standard errors of estimates.

* Significantly different from city size (A) at better than 1% level.

a Significantly different from city size (A) at better than 5% level.

b Significantly different from city size (A) at better than 10% level.

c Significantly different from city size (A) at better than 20% level.

Difference from city size (A) is not significantly different from zero.

with the size of city[9]: bread, other food, subsidiary food, meat, milk and eggs, vegetables, processed food, non-alcoholic beverages, and food prepared outside the household.

The income elasticity for fruits is also positively affected by the size of city. Size A's income elasticities for cereals, rice, barley, and condiments are significantly smaller than any other city size at the 1 percent level. Size A's income elasticity for cakes and candies is markedly greater than any other city size. Size B's η_y for fish is significantly greater at the 10 percent level than that in size A while the latter is not different from the two smaller city sizes. Although size A's η_y for alcoholic beverages is slightly larger than the other city sizes, the result of the <u>t</u>-test indicates that the disparities between them are not significantly different from zero.

While the expenditure on housing and rent is positively related to size of city, expenditure on repairs and improvements has the opposite association. It is difficult to say whether the demand elasticity for furniture and utensils is negatively affected by the city size although size A's η_y for this item is significantly smaller than that in any other size of city at the 1 percent level. The size rankings, from the largest to the smallest, are C, B, D, and A. As to fuel and light, size A is not significantly different

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[9]That is, the larger the city, the larger the income elasticity was estimated. The only exception to this positive association is the elasticity for non-alcoholic beverages which is larger for size C than for size B.

from size D while its elasticity is smaller than size B's and greater than size C's, each at the 1 percent level of significance. The negative association between the size of city and the income elasticity for repairs and improvements as well as the small correlation between the size of city and furniture and utensils, and fuel and light might be caused by the fact that a larger proportion of households in the larger city lived in rented houses which sometimes furnished reparis and improvements, furniture and utensils, and fuel and light.

When the size of city grows bigger, the coefficients of clothing and clothes become smaller. The city size seems to have little effect on the demand for personal effects although η_y in size C is smaller than that in size A at the 10 percent level of significance.

Defining urban as including the four sizes of city in the preceding analysis of city size and rural as all the towns and villages, we found when worker households are divided into urban and rural, the urban-rural and city size variations in the expenditures on basic living materials are identical except that levels of significance are slightly different in a few items (that is, urban acted as larger cities and rural as smaller ones). Thus in those items the bigger cities have significantly larger regression coefficients than smaller cities, it follows that urban has significantly larger coefficients than rural and the converse is also true.

TABLE 18.--Income elasticities estimated for urban-rural using dummy variables, all Japan.

	Regression Coefficients				Regression Coefficients				Regression Coefficients		
	All Households	Worker Households	General Households		All Households	Worker Households	General Households		All Households	Worker Households	General Households
Expenditure				Milk & Eggs				Housing			
Constant	.777	.868	.688		.879	.944	.819		.836	.973	.695
Urban	.939	.543	1.315		-1.033	-1.308	-.784		-.388	-.956	.170
Rural	-.003a	-.002#	-.004*		-.025*	-.020*	-.030*		-.018*	-.014*	-.021*
Food				Vegetables				Rent			
Constant	.580	.588	.566		.631	.640	.609		.124	.094	.125
Urban	1.474	1.428	1.552		.222	.163	.345		2.286	2.471	2.192
Rural	-.004*	-.004*	-.005*		-.021*	-.021*	-.024*		-.087*	-.090*	-.086*
Cereals				Processed Food				Repairs			
Constant	.355	.299	.394		.513	.494	.525		1.225	1.550	.858
Urban	1.977	2.207	1.834		.709	.779	.676		-2.820	-4.253	-1.210
Rural	.005*	.005a	.003c		-.015*	-.013*	-.018*		.036*	.040*	.025a
Rice				Condiments				Furniture			
Constant	.360	.296	.406		.484	.497	.466		1.154	1.322	.991
Urban	1.880	2.146	1.708		.747	.679	.845		-2.219	-2.919	-1.578
Rural	.005*	.005a	.004c		.007*	.007*	.005*		.003#	.009c	.003#
Barley								Fuel & Light			
Constant	-.293	-.591	-.141						.668	.763	.578
Urban	3.324	4.555	2.756						.100	-.345	.539
Rural	.047*	.050*	.036*						-.008*	-.009*	-.009*
Bread				Cakes & Candies				Clothing			
Constant	.761	.855	.670		.774	.825	.730		1.038	1.126	.958
Urban	-.995	-1.410	-.585		-.714	-.926	-.537		-1.199	-1.567	-.880
Rural	-.039*	-.032*	-.048*		-.005a	-.005b	-.006c		.005a	.006a	.006b
Other Food				Fruits				Clothes			
Constant	.711	.748	.673		.790	.848	.733		1.038	1.113	.972
Urban	.714	.545	.895		-.823	-1.074	-.572		-1.348	-1.662	-1.084
Rural	-.013*	-.012*	-.014*		-.008*	-.004b	-.013*		.010*	.011*	.011*
Subsidiary Food				Alcoholic Beverages				Personal Effects			
Constant	.651	.673	.624		.833	.823	.808		1.037	1.159	.917
Urban	.827	.718	.965		-1.073	-1.063	-.919		-1.728	-2.244	-1.246
Rural	-.012*	-.011*	-.015*		.011a	.003#	.014a		-.009*	-.007*	-.009a
Fish				Non-alcoholic Beverages							
Constant	.620	.617	.608		.837	.909	.764				
Urban	.267	.254	.359		-1.422	-1.746	-1.092				
Rural	-.002#	-.002#	-.004a		-.011*	-.012*	-.011*				
Meat				Food Outside							
Constant	.976	1.081	.878		1.062	1.197	.925				
Urban	-1.554	-2.026	-1.105		-1.942	-2.498	-1.412				
Rural	-.028*	-.026*	-.030*		-.056*	-.049*	-.063c				

Note:

* Significantly different from urban at better than the 1% level.
a Significantly different from urban at better than the 5% level.
b Significantly different from urban at better than the 10% level.
c Significantly different from urban at better than the 20% level.
\# Difference from urban is not significantly different from 0.

Do urban-rural variations in the consumption of basic living materials in worker households apply to general households? Table 18 shows that the urban-rural effects in the two kinds of households are usually the same with the exception of furniture and utensils and of the different levels of significance in several items. The results of the *t*-test of all households are also contained in the table.

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Yearly estimates of the demand parameters for the years 1951-1962 were done from ARFIES. It is well to note that 1951 and 1952 were "Commodity classification" and the rest of the years were "Use classification."[10] The number of items available in the data was different for the three periods: 1951-1952, 1953-1957, and 1958-1962. Thus the parameters of 13 items in the first period, of 27 items in the second period, and of 28 items in the third period were estimated. The parameters estimated are virtually the same within each period, and quite similar between periods. However, the demand for cereals changed considerably over time. The elasticities of cereals were high in the early fifties and then gradually fell and stayed almost constant at a much

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[10] So-called "Commodity classification" is a method in which expenditures are classified according to the kind of commodities purchased regardless of their use, whereas in "Use classification" expenditures are classified according to what the commodities purchased are used for. For example, food expenses for the treatment of guests are classified in the miscellaneous group as social expenses in the latter method, but the expenses are still classified as food expenditure in the former method.

lower level after 1956. The only reason for this dramatic change seemed to be that Japan had not escaped the poverty due to war and in the period of poverty cereals were a relatively cheap food to satisfy hunger. Except for barley, the elasticities for all items each year showed positive signs. The $\overline{R}^2$'s (coefficients of determination adjusted by degree of freedom) for every commodity with respect to measured income each year are quite high with the exception of barley and rent, where the $\overline{R}^2$'s are extremely low is some years. Because of the similarity between the estimates within each period, only the estimates of 1951, 1957, and 1962 are shown in Table 19. The expenditure elasticities (B_i) for housing and clothing and their components (except rent whose estimated elasticity is not reliable owing to the data, as explained earlier) are usually larger than that for food, since food is regarded as more necessary than housing and clothing. Among the individual items of food, the elasticity for cereals is the smallest, as expected, and only the elasticities for meat, milk and eggs, non-alcoholic beverages, and food prepared outside the household are greater than one.

In order to see more clearly how the demand for basic living materials changes over time, dummy variables were used. It should be mentioned that the estimates obtained by the dummy variables method are not equal, although very close, to the above yearly separate estimations because in using dummy variables, it is assumed that either the intercepts or the income elasticities are constant each year. But the above year

TABLE 19.--Estimates of ARFIES (worker households), 1951, 1957, and 1962.*

	Constants			β_Y			β_i			$\bar{R}^2$		
	1951	1957	1962	1951	1957	1962	1951	1957	1962	1951	1957	1962
Total Expenditure	1.394(.124)	1.137(.107)	1.240(.149)	.663(.030)	.737(.034)	.724(.033)	--	--	--	.975(.019)	.981(.021)	.974(.023)
Food	1.800(.096)	1.852(.063)	1.888(.096)	.499(.023)	.498(.014)	.497(.021)	.752	.675	.686	.974(.015)	.985(.012)	.977(.015)
Cereals	1.745(.101)	2.352(.055)	2.260(.079)	.409(.025)	.273(.013)	.274(.017)	.617	.370	.379	.958(.016)	.963(.011)	.951(.012)
Rice	--	2.235(.044)	2.373(.073)	--	.280(.010)	.229(.016)	--	.380	.317	--	.977(.009)	.941(.011)
Barley	--	3.567(.181)	3.793(.300)	--	-.309(.041)	-.494(.065)	--	-.419	-.681	--	.754(.035)	.811(.047)
Bread	--	-.503(.165)	-.631(.142)	--	.662(.037)	.686(.031)	--	.898	.948	--	.946(.032)	.974(.022)
Other Foods	1.363(.092)	1.312(.066)	1.518(.095)	.554(.023)	.585(.015)	.544(.021)	.836	.794	.751	.981(.014)	.988(.013)	.981(.015)
Subsidiary Foods	1.448(.092)	1.428(.062)	1.611(.087)	.502(.022)	.529(.014)	.486(.019)	.757	.717	.671	.977(.014)	.988(.012)	.980(.014)
Fish	1.123(.077)	.781(.051)	.888(.092)	.434(.019)	.502(.012)	.480(.020)	.655	.681	.663	.978(.012)	.991(.010)	.978(.014)
Meat	-.200(.104)	-.420(.112)	-.089(.167)	.720(.025)	.795(.026)	.682(.027)	1.085	1.078	.942	.985(.016)	.982(.022)	.964(.026)
Milk & Eggs			.397(.106)			.560(.023)			.801			.980(.017)
Vegetables	.907(.109)	.834(.078)	.996(.080)	.465(.027)	.491(.018)	.469(.017)	.701	.666	.648	.962(.017)	.977(.015)	.982(.012)
Processed Food	1.158(.100)	1.285(.062)	1.550(.067)	.468(.024)	.370(.014)	.331(.015)	.706	.502	.457	.968(.015)	.975(.012)	.976(.010)
Condiments		1.065(.048)	1.217(.080)		.406(.011)	.374(.018)		.551	.516		.987(.009)	.972(.013)
Cakes, Fruits & Beverages	--	.198(.082)	.604(.132)	--	.676(.019)	.605(.029)	--	.917	.835	--	.986(.016)	.971(.021)
Cakes & Candies	--	-.005(.095)	.470(.123)	--	.627(.022)	.532(.027)	--	.851	.735	--	.979(.019)	.968(.019)
Fruits	--	-.494(.095)	-.186(.140)	--	.700(.022)	.648(.031)	--	.949	.594	--	.983(.019)	.972(.022)
Alcoholic Beverages	--	-.427(.132)	.129(.201)	--	.672(.030)	.569(.044)	--	.912	.786	--	.965(.026)	.928(.031)
Non-Alcoholic Beverages	--	-1.144(.110)	-.760(.160)	--	.777(.025)	.736(.036)	--	1.054	1.016	--	.982(.021)	.971(.025)
Food Prepared Outside Household	.136(.094)	-1.554(.135)	-.843(.196)	.710(.023)	.969(.031)	.839(.043)	1.070	1.315	1.159	.988(.014)	.982(.026)	.967(.031)
Housing	-.242(.185)	.212(.121)	.805(.229)	.738(.045)	.692(.027)	.607(.050)	1.113	.938	.839	.957(.029)	.973(.023)	.918(.036)
Rent	--	1.699(.223)	2.834(.325)	--	.261(.051)	.056(.071)	--	.354	.078	--	.587(.043)	-.030(.051)
Repairs & Improvements	--	-2.932(.350)	-4.187(.927)	--	1.206(.079)	1.502(.203)	--	1.636	2.074	--	.927(.068)	.806(.144)
Furniture & Utensils	--	-2.351(.327)	-.864(.314)	--	1.159(.074)	.889(.069)	--	1.573	1.227	--	.931(.064)	.928(.049)
Fuel & Light	.846(.115)	.508(.093)	.493(.138)	.481(.028)	.586(.021)	.600(.030)	.725	.795	.828	.961(.018)	.977(.018)	.968(.022)
Clothing	-.935(.234)	-1.194(.133)	-.637(.207)	1.004(.057)	1.045(.030)	.928(.045)	1.514	1.417	1.281	.962(.036)	.985(.026)	.970(.032)
Clothes	--	-1.618(.141)	-.741(.214)	--	1.089(.032)	.909(.047)	--	1.477	1.255	--	.985(.027)	.967(.033)
Personal Effects	--	-1.450(.137)	-1.454(.228)	--	1.002(.031)	.988(.050)	--	1.360	1.364	--	.983(.027)	.968(.036)

by year estimations are equivalent to assuming that both intercepts and income elasticities are different each year.

Owing to the availability of less items in 1951 and 1952 and owing to the difference between the classifications of these two years and the rest of the years, estimations by dummy variables were done separately for 12 years (1951-1962) and 10 years (1953-1962). The results of the tests are presented in Table 20 and Table 21, respectively.

It is evident from Table 20 that the elasticity of total expenditure tends to decrease over time. The elasticity in the first two and last two years is significantly smaller and larger, respectively, than that in 1958 at the 1 percent level. The η_y for food has a similar tendency. From pervious results we know that the income elasticity for cereals is usually the lowest, and that for meat, milk and eggs the highest among all the food items. Since during this period Japan's national income had risen rapidly, we might expect that the elasticity for cereals would decrease and that for meat, milk and eggs increase. Although this table shows that the η_y for these two items are in accord with our expectation, the elasticity for cereals in 1951 is markedly smaller than 1958, and that in 1952 not significantly different from 1958. This might be a result of the different classifications of the first two years and the years after 1953. The coefficients for vegetables in 1958 are smaller than all other years except for 1951 and 1952 at the 1 percent level of significance. Time does not seem to be a significant

TABLE 20.-- Income elasticities eastimated for urban households from 1951 to 1962 using dummy variables.

	Constant	Year 1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	$\bar{R}^2$ (S)
Total Expenditure	1.1853	-.0134*	-.0095*	-.0033b	-.0024c	-.0030b	-.0031b	-.0015#	.7275	.0007#	.0030b	.0048*	.0085*	.9866(.0211)
Food	1.8705	-.0135*	-.0100*	-.0036*	-.0049*	-.0063*	-.0036*	-.0015c	.4948	-.0013#	.0006#	.0016c	.0061*	.9898(.0128)
Cereals	2.2667	-.0088*	.0004#	.0057*	.0102*	.0081*	-.0005#	.0009#	.2909	-.0041*	-.0062*	-.0138*	-.0183*	.9585(.0140)
Fish	.9311	.0130*	.0091*	.0084*	.0091*	.0037*	-.0016c	.0001#	.4679	-.0012#	.0009#	.0021a	.0027*	.9844(.0129)
Meat, milk, & eggs	-.2761	-.0280*	-.0280*	-.0243*	-.0208*	-.0168*	-.0075*	-.0043a	.7662	.0031b	.0111*	.0169*	.0244*	.9892(.0231)
Vegetables	.8827	-.0028a	-.0064*	.0086*	.0145*	.0070*	.0029*	.0064*	.4736	.0029*	.0080*	.0131*	.0202*	.9875(.0141)
Food prepared outside household	-1.2502	.1322*	.1300*	-.0497*	-.0457*	-.0359*	-.0312*	-.0154b	.9159	-.0281*	.0070#	.0110#	.0124c	.8514(.1107)
Housing	.0307	-.0747*	-.0633*	-.0462*	-.0456*	-.0440*	-.0188*	-.0136*	.7463	.0105*	.0120*	.0260*	.0300*	.9859(.0325)
Fuel & light	.5505	-.0197*	-.0081*	.0017#	-.0013#	-.0005#	-.0022#	.0033b	.5728	-.0008#	.0097*	.0117*	.0141*	.9794(.0223)
Clothing	-1.0435	.0231*	.0262*	.0207*	.0059a	-.0011#	.0048a	.0031c	1.0073	-.0017#	.0004#	.0056a	.0090*	.9835(.0289)

Note: The figures in the parentheses to the right of $\bar{R}^2$ are the standard errors of estimates.
* Significantly different from 1958 at better than the 1% level.
a Significantly different from 1958 at better than the 5% level.
b Significantly different from 1958 at better than the 10% level.
c Significantly different from 1958 at better than the 20% level.
\# Difference from 1958 is not different from zero.

TABLE 21.--Income elasticities estimated for urban households from 1953 to 1962 using dummy variables.

	Constant	Year 1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	$\bar{R}^2$ (S)
Total Expenditure	1.1536	-.0031b	-.0023c	-.0028b	-.0031b	-.0015#	.7347	.0007#	.0029b	.0046*	.0082*	.9834(.0211)
Food	1.8711	-.0086*	-.0049*	-.0063*	-.0036*	-.0015c	.4946	-.0013c	.0006#	.0016b	.0061*	.9873(.0128)
Cereals	2.3202	.0054*	.0100*	.0079*	-.0007#	.0008#	.2788	-.0040*	-.0060*	-.0135*	-.0179*	.9585(.0119)
Barley	3.2966	.1746*	.1868*	.1830*	.0347*	.0117*	-.2591	-.0312*	-.0642*	-.1044*	-.1260*	.9868(.0582)
Fish	.9056	.0086*	.0092*	.0038*	-.0015c	.0001#	.4736	-.0012#	.0008#	.0020b	.0025a	.9839(.0128)
Meat, milk, & eggs	-.2788	-.0243*	-.0208*	-.0168*	-.0075*	-.0043a	.7669	.0031b	.0111*	.0169*	.0244*	.9853(.0241)
Vegetables	.8638	.0087*	.0145*	.0071*	.0029*	.0064*	.4779	.0029*	.0079*	.0131*	.0201*	.9846(.0138)
Processed food & condiments	1.5144	-.0023a	.0054*	.0020b	-.0022a	-.0022a	.3819	-.0007#	.0033*	.0054*	.0086*	.9759(.0137)
Cakes, candies, & fruits	.1619	.0074*	.0065*	.0072*	-.0001#	.0033c	.6401	-.0018#	.0025b	.0046*	.0123*	.9784(.0207)
Beverages	-.3251	-.0257*	-.0246*	-.0182*	-.0094*	-.0070*	.6998	-.0030b	.0055*	.0055*	.0214*	.9837(.0235)
Foods prepared outside household	-1.4501	-.0484*	-.0449*	-.0351*	-.0307*	-.0152b	.9610	-.0284*	.0064#	.0100#	.0109#	.8197(.1161)
Housing	.0719	-.0464*	-.0457*	-.0441*	-.0189*	-.0136*	.7370	.0106*	.0122*	.0262*	.0303*	.9804(.0324)
Rent	1.8287	-.0677*	-.0541*	-.0441*	-.0106*	-.0026#	.2341	.0010#	.0007#	.0344*	.0415*	.9295(.0461)
Fuel & light	.4988	.0020#	-.0011#	-.0003#	-.0021#	.0033a	.5845	-.0009#	.0096*	.0114*	.0138*	.9738(.0221)
Clothing	-1.0673	.0209*	.0060a	-.0011#	.0049a	.0031c	1.0127	-.0017#	.0003#	.0055a	.0089*	.9828(.0286)
Clothes	-1.3356	.0214*	.0050a	-.0043b	-.0035c	-.0051a	1.0296	-.0027#	.0003#	.0071*	.0088*	.9816(.0305)
Personal effects	-1.5298	.0367*	.0241*	.0208*	.0214*	.0193*	1.0009	.0004#	.0017#	.0015#	.0031#	.9753(.0326)

Notes: The figures in the parentheses to the right of $\bar{R}^2$ are the standard errors of estimates.
* Significantly different from 1958 at better than the 1% level.
a Significantly different from 1958 at better than the 5% level.
b Significantly different from 1958 at better than the 10% level.
c Significantly different from 1958 at better than the 20% level.
\# Difference from 1958 is not different from zero.

factor in determining the expenditures on fish and food prepared outside the household.

The elasticity for housing in those years preceding 1958 is significantly smaller than that in 1958, which in turn is significantly smaller at the 1 percent level than that of those years afterward. As to fuel and light, the elasticities in the first two years are significantly smaller, and those in the last years significantly larger than the elasticity in 1958 at the 1 percent level, and those of the rest of years (other than 1957) are not different from that in 1958 at the 20 percent level. The comparison of the elasticity for clothing in 1958 with those in other years is rather erratic. The elasticities in the years 1955, 1959, and 1960 are not much different from 1958, and those in the other years (except 1957) are significantly larger than 1958 at either the 1 percent or 5 percent level.

The results estimated by excluding 1951 and 1952 are presented in Table 21. Let us compare the income elasticities in 1953, 1958, and 1962. At the 1 percent level the elasticities for food, meat and milk and eggs, beverages, housing, rent, and total expenditure in 1958 are significantly greater than in 1953 except that in the case of total expenditure the level of significance is 10 percent, and significantly smaller than in 1962. On the other hand, the 1958 income elasticities for cereals and barley are significantly smaller than those of 1953 and larger than those of 1962. If we disregard a few exceptions (that is, η_y's of the later years are slightly larger than the η_y's of the early years) of the income elasticities between the three years, it can be generalized that the income elasticities for the above six items increase through time and that those for cereals and barley are negatively related to time. The income elasticities for fuel and light in 1958 are not significantly different from that in the period from 1953 to 1956 and in 1959, and is significantly smaller than in 1957 at the 5 percent level and in the last three years (1960-1962) at the 1 percent level. The elasticity for vegetables in 1958 is smaller than that in any other year at the 1 percent level of significance. The elasticity for fish, cakes and candies and fruits in 1953-1955, 1961, and 1962 is markedly larger than that in 1958, which is not much different from that in the other years. The η_y for clothing in 1953, 1954, 1956, 1957, 1961, and 1962 is significantly greater at the 1 percent level than that in 1958, which shows no difference from the other three years at the 20 percent level of significance. The elasticity for clothes in 1958 is significantly smaller than that in 1953, 1954, 1961, and 1962 at the 1 to 5 percent level, but greater than that in 1955-1957 at the 5 to 20 percent level and not different from that in 1959 and 1960 at the 20 percent level. While the elasticity for personal effects in 1958 is significantly smaller than that in the previous years, it shows no significant difference from that in the years afterward at the 20 percent level.

FARM HOUSEHOLDS ECONOMY SURVEYS

The information on basic living materials for farm households was either classified by income group or cross-classified by income group and family size. We have shown in our previous analysis (in Section 1 of this chapter) that it is more reliable to estimate family size elasticity from the table cross-classified by income class and family size. The resultant tables of this cross-classification were available for three years from 1960 to 1962, and since the parameters estimated are not much different for these years, only the estimates in 1962 are shown in Table 22.

In order to show the effects of family size on the demand for basic living materials, the table gives the results estimated both by simple regressions (with income only as the explanatory variable) and by multiple regressions (with income and family size as explanatory variables). The coefficients of determination are usually improved when they were estimated by the multiple regression equations, especially for food and cereals because family size plays an important role in determining the demand for basic living materials. If family size elasticity for a given item is positive, its income elasticity estimated by multiple regression is smaller than the corresponding figure estimated by using income alone as the independent variable. However, the coefficient of the constant term is larger than the corresponding coefficient obtained by simple regression. When family size elasticity is negative, the converse is true. The income

TABLE 22.--Demand relationships for basic living materials for farm households, 1962*

	Constant	Income Elasticity	B_i	Family Size Elasticity	$\bar{R}^2$
Simple Regression					
Total Expenditures	1.758(.130)	.683(.023)			.945(.027)
Food	2.575(.285)	.467(.050)	.684		.625(.059)
Cereals	2.965(.493)	.333(.086)	.487		.210(.101)
Potato, Bean, Vegetables & Processed Food	1.914(.270)	.430(.047)	.630		.611(.056)
Fish, Meat, Eggs & Milk	.776(.118)	.651(.021)	.953		.950(.024)
Condiments, Deserts & Food Prepared Outisde Household	1.428(.163)	.566(.029)	.829		.883(.034)
Housing	1.053(.191)	.664(.033)	.972		.884(.039)
Rent & Repairs	1.313(.198)	.553(.035)	.809		.830(.041)
Furniture	.290(.274)#	.756(.048)	1.106		.826(.056)
Fuel & Light	1.746(.573)	.458(.100)	.670		.276(.118)
Clothing	-.586(.186)	.925(.033)	1.355		.939(.038)
Multiple Regression					
Total Expenditures	1.928(.065)	.631(.012)		.177(.014)	.987(.013)
Food	2.993(.056)	.339(.010)	.537	.434(.012)	.986(.011)
Cereals	3.696(.065)	.108(.012)	.172	.759(.014)	.987(.013)
Potato, Bean, Vegetables & Processed Food	2.300(.082)	.312(.015)	.494	.401(.018)	.965(.017)
Fish, Meat, Eggs & Milk	.839(.114)	.632(.021)	1.001	.066(.024)	.956(.023)
Condiments, Deserts & Food Prepared Outside Household	1.624(.101)	.506(.018)	.802	.203(.021)	.957(.020)
Housing	.926(.167)	.703(.032)	1.114	-.132(.037)	.905(.035)
Rent & Repairs	1.186(.185)	.591(.034)	.937	-.131(.039)	.858(.037)
Furniture	.170(.271)#	.793(.049)	1.256	-.124(.058)a	.838(.055)
Fuel & Light	2.005(.564)	.378(.103)	.599	.269(.120)a	.329(.114)
Clothing	-.465(.173)	.888(.032)	1.408	.126(.037)	.950(.035)

* Standard errors appear in the parentheses to the right of the coefficients.

\# Denotes coefficients not significantly different from zero.

a Denotes coefficients significantly different from zero at 5 % level.

All others (without notation) indicate coefficients significantly different from zero at 1% level.

elasticities estimated by simple regression and by multiple regression are not much different in all items except for cereals in consequence of its large family size elasticity. The negative family size elasticities of housing and its components explain the fact that as an increase in family size makes the family relatively poorer, the family, after an increase in expenditures on relatively necessary goods such as food, cannot but spend less on housing. It is not surprising to find the very small elasticities for cereals, and income elasticities greater than unity in fish, meat, eggs and milk, clothing, and housing. As the coefficient of determination for fuel and light is very low, the demand for this group does not seem to be determined by income and family size alone. The expenditure elasticities, B_i, estimated by instrumental variables are considerably larger than their corresponding income elasticities. Since B_i have been shown to be the consistent estimates of the "true" parameters, and since they can be regarded as the estimates of the elasticities with respect to permanent income, the income elasticities obtained by regression equations are usually underestimated.

Next, the resultant tables classified by income group were used to estimate the regression coefficients by dummy variables in order to discover how the demand for basic living materials changed from 1959 to 1962. The results of the estimations are contained in Table 23.

TABLE 23.--Income elasticities estimated for farm households from 1959 to 1962, using dummy variables.

	Constant	Year 1959	1960	1961	1962	$\bar{R}^2$ (S)
Total Expenditure	1.608	.708	-.044#	.009#	.021c	.984(.017
Food	2.419	.499	-.021a	-.019a	-.025a	.979(.014
Cereals	2.680	.403	-.037*	-.073*	-.111*	.946(.017
Rice	2.266	.462	-.042*	-.069*	-.100*	.952(.019
Barley	3.930	.010	-.042*	-.099*	-.181*	.827(.021
Other Cereals	2.320	.254	-.029*	-.056*	-.141*	.907(.016
Vegetables	1.575	.445	-.001#	.076	.069	.971(.017
Fish	.506	.645	.006#	.026a	.048*	.981(.017
Meat, Milk & Eggs	-.032	.715	.016#	.072*	.159*	.976(.024
Processed Food	.264	.589	.003#	.030*	.065*	.982(.016
Condiments	1.796	.419	-.019a	-.028*	-.038*	.973(.013
Cakes, Fruits & Beverages	.665	.651	.009#	.042*	.050*	.984(.016
Food Prepared Outside Household	-1.240	.859	.023#	.060b	.123*	.938(.045
Housing	-.099	.852	.039c	.094*	.111*	.952(.039
Fuel & Light	1.969	.401	.035*	.070*	.118*	.986(.011
Clothing	-.539	.916	.007#	.014#	.026c	.986(.021

Note: The standard errors of estimates appear in the parentheses to the right of $\bar{R}^2$.
* Significantly different from 1959 at better than 1% level.
a Significantly different from 1959 at better than 5% level.
b Significantly different from 1959 at better than 10% level.
c Significantly different from 1959 at better than 20% level.
\# Difference from 1959 is not significantly different from zer

This table shows that the income elasticity of total expenditure does not change much during the four years. The income elasticity for aggregate food decreases during the four-year period except that the elasticity in 1961 is slightly smaller than in 1960. While the income elasticities for condiments, and for cereals as a whole as well as the individual components of the class, fall over time, those for food items with relatively high income elasticities such as fish, meat and milk and eggs, processed food, cakes and fruits and beverages, and food prepared outside the household increase considerably.

The income elasticities for housing, and fuel and light also increase during the four-year period. The considerable increase in the income elasticities for fuel and light over time might result from the availability of more electricity in the rural area and the enlargement of the housing space. Despite the yearly increase in real income during this period, the income elasticity for clothing in 1959 and in the next few years does not differ significantly from zero although the elasticity in 1962 is larger than that in 1959 at the 20 percent level. The reason is that farmers usually do not spend more on clothing even though their income increases.

Finally, we are to do another cross-section test of the permanent income hypothesis by comparing the income elasticities estimated from this survey with those from urban family income and expenditure surveys (that is, <u>ARFIES</u>.)

The FHES has been conducted on the fiscal year basis (April 1st. to next March 31st.) and ARFIES has been conducted on the yearly average basis from January to November, and the two surveys could not be done and classified in the same manner due to the differences in demand structure between farm and non-farm households. However, it is still worthwhile to do the comparison since incomes of urban households are undoubtedly more stable than those of farm households.

The income elasticities for basic living materials from both surveys in 1959 appear in Table 24. The expenditure elasticities (B_i) for the two groups of households are also given in the table. As farm household incomes are believed to fluctuate more violently than the incomes of urban workers, for the permanent income hypothesis to be valid, the elasticities of total expenditure and individual items expenditure with respect to measured income should be smaller for farm households than for urban worker households. However, comparison of the income elasticities between these two groups of households in the table does not provide convincing evidence for the hypothesis. While the income elasticity of total expenditure of farm households is smaller than that of urban households, the income elasticities of individual items for farm households are not always smaller than the corresponding figures for urban worker households.

In addition to the stability of income and tastes and preferences, the differences in the income elasticities

TABLE 24.--A comparison of income elasticities of farm households with worker households (in the cities with a population of 50,000 or more), 1959

	Income Elasticity		B_i		$\bar{R}^2$	
	Farm Households	Urban worker Households	Farm Households	Urban worker Households	Farm Households	Urban worker Households
Total Expenditure	.668	.753			.971	.983
Food	.471	.495	.706	.658	.980	.982
Cereals	.393	.238	.589	.316	.973	.930
Rice	.469	.228	.703	.303	.970	.924
Fish	.635	.480	.951	.637	.970	.985
Meat,milk,&eggs	.686	.762	1.027	1.013	.955	.984
Vegetables	.410	.508	.614	.674	.970	.986
Processed food	.542	.357	.812	.473	.982	.956
Condiments	.384	.395	.574	.524	.982	.979
Cakes, candies fruits&beverages	.634	.683	.950	.907	.982	.981
Food prepared outside households	.733	.874	1.097	1.151	.816	.968
Housing	.844	.782	1.264	1.038	.983	.965
Fuel & Light	.404	.609	.605	.808	.967	.987
Clothing	.892	1.031	1.336	1.369	.973	.987

for basic living materials between urban worker households and farm households could rise from such things as the differences in family size, home ownership, availability of electricity,income distribution, and prevailing prices of various commodities. As was mentioned earlier, the level of income is not a negligible variable in determining the magnitude of income elasticity. However, this is probably not a relevant factor as far as the difference in elasticities between the urban worker and farm household is concerned; since average monthly income per household in 1959 was 35,529 yen for worker households and 31,082 yen for farm households and, since the consumer goods price level was lower in the rural area than in the urban area, the real income of the two households did not make much difference. Nevertheless, the average family size of worker households was 4.41 and that of farm households 5.77. The difference in the income elasticity for basic living materials, especially for cereals (including rice) between the two groups of households is undoubtedly caused partly by the difference in family size. Thus elasticities for cereals and rice in farm households are about twice as large as in worker households. Furthermore, a much larger proportion of farm households was expected to have owned houses as compared with worker households, and the urban area usually had more electricity available than the rural area. The difference in the elasticities for housing as well as fuel and light between the two groups of households could arise from the difference in these two factors.

The results of the above analysis and of the earlier analysis based on the occupational data indicate that the evidence with respect to total expenditure seems to favor the PIH, but the evidence with respect to individual categories of consumption is not so clear-cut.[11] Indeed, the income elasticity for a particular item of consumption reflects the influence of many factors other than the fluctuation of income. Friedman's method of testing the PIH with respect to individual categories of consumption seems to be inadequate.

SUMMARY

The analyses in this chapter were based on cross-section data. First,the National Survey of Family Income and Expenditure was utilized to investigate the classification bias and the influence of the following variables on

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[11]We did not test whether the elasticity of permanent consumption with respect to permanent income is unity since the data did not allow us to do so. The elasticities obtained by Nissan Liviatan, "Tests of the Permanent Income Hypothesis Based on a Reinterview Saving Survey," in Measurement in Economics--Studies in Mathematical Economics and Econometrics, Carl F. Christ and others, (eds.) (Stanford University Press, Stanford, California, 1963), pp. 29-68, using the method of instrumental variables, are closer to the ordinary least-squares elasticities than to unity. Because of this and other empirical results, Liviatan concludes that "the model formulated by Friedman to test the PIH from reinterview surveys is contradicted by the data." Marc Nerlove, "Friedman's Permanent Income Hypothesis and Its Implications For Demand Analysis" in his Distributed Lags and Demand Analysis (Agricultural Marketing Service, United States Department of Agriculture, June 1958), pp. 93-116, tests the PIH with respect to food and meat, and concludes that the hypothesis seems to be useless when applied to individual categories of consumption.

expenditures for basic living materials: income, family size, type of dwelling house, number of earners per household, occupations, region, city size, and urban-rural difference. Then the Annual Report on Family Income and Expenditure Survey and the Farm Households Economy Survey were analyzed and the stability of the elasticities over time was tested. Also, a crude test of the permanent income hypothesis was done by comparing the income elasticities among occupations and those between farm households and urban worker households.

The methods of both instrumental variables and least-squares regression were used to estimate the parameters of the demand relationships. Differences in demand for basic living materials among different group samples and the stability of the demand over time were extensively investigated by employing dummy variables.

It was shown that the magnitude of the demand elasticities estimated depended on whether the resultant table classified by income or by total expenditure was used in fitting the estimating equations and it was argued that the table classifying consumer units by income classes was the proper one to be used as far as our estimating equations were concerned. Since the expenditure elasticities estimated by the method of instrumental variables (the elasticities have been shown to be the consistent estimate of the "true" parameters) showed little difference from their corresponding elasticities obtained from the least-squares regressions, the least-squares regression is probably a suitable method in demand analysis if the sample size is sufficiently large. The evidence of the classification bias analysis seemed to support the general belief that it is more reliable to estimate income and family size elasticities from the resultant table cross-classified by both income and family size.

In order to show the effect of family size on the demand for basic living materials, both simple regressions (with income as the sole explanatory variable) and multiple regressions (with income and family size as explanatory variables) were used. The coefficients of determination were usually improved when they were estimated by the multiple regressions, especially for food and cereals because family size plays an important role in determining the demand for basic living materials. If family size elasticity for a particular category of consumption was positive, its income elasticity estimated by multiple regression was smaller than the corresponding figure obtained by simple regression, and the coefficient of the constant term in multiple regression was larger than the corresponding coefficient derived by simple regression. When family size elasticity was negative, the converse was true.

Despite the fact that the income and expenditure elasticities for a particular item estimated from the different group samples are usually somewhat different, the order of the magnitude of the elasticities generally was in accord with one's expectation. The magnitudes of the expenditure elasticities, B_i, estimated by the instrumental variables method are summarized in Table 25.

TABLE 25.--Summary of the B_i estimated for basic living materials

Range of Expenditure Elasticities	Individual Commodity and Group of Commodities
$B < 0$	Barley
$0 < B < 0.5$	Rent[a]
$0.3 < B < 0.6$	Cereals[b] and rice[c]
$0.5 < B < 0.8$	Processed food[d] and condiments[e]
$0.6 < B < 0.9$	Food,[f] other food,[g] subsidiary food,[h] fish,[i] vegetables,[j] and fuel and light [k]
$0.8 < B < 1.1$	Bread,[l] cakes and candies and fruits and beverages,[m] cakes and candies,[n] fruits,[o] alcoholic beverages,[p] and non-alcoholic beverages [q]
$1.0 < B < 1.4$	Meat,[r] milk and eggs,[s] food prepared outside the household,[t] and housing[u]
$B > 1.3$	Repairs and improvements,[v] furniture and utensils,[w] clothing,[x] clothes,[y] and personal effects[z]

[a]The magnitudes of the expenditure elasticity estimated for rent dispersed widely;of the 16 estimates two were slightly greater than 0.5 and four were between zero and 0.1.

[b]However, of the 31 estimates, two were a little more than 0.6 and four were less than 0.3--two of the estimates by the multiple regression were as small as 0.02 and 0.05.

[c]Three of the 16 estimates were beyond this range.

[d]Of the 16 estimates four were not in this range.

[e]One of the 16 estimates was 0.45.

[f]Of the 30 estimates one was 0.55 and two-thirds were between 0.65 and 0.75.

[g]One of the four estimates was 0.94.

[h]Three of the 27 estimates were a little larger than 0.9 .

[i]One of the 17 estimates was 0.95.

[j]Two of the 16 estimates were slightly outside this range.

[k]Three of the 36 estimates were slightly larger than 0.9.

[l]Three of the 13 estimates were slightly greater than 1.10.

[m]One of the 28 estimates was 1.23.

[n]Of the 14 estimates two were slightly less than 0.8 and another one was 1.11.

[o]One of the 14 estimates was 1.25.

[p]Of the 14 estimates three were very near 0.8 and another three were larger than the upper limit.

[q]Three of the 14 estimates were beyond the upper limit.

[r]Two of the 12 estimates were smaller than the lower limit.

[s]Two of the 12 estimates were 0.93 and another one was 0.91.

[t]Of the 29 estimates one was 0.97 and eight were beyond the upper limit.

[u]Of the 31 estimates five were slightly smaller than 1.1 and the other five outside the upper limit.

[v]Of the 26 estimates two were less than 1.3, sixteen between 1.5 and 2.0 and six greater than 2.0.

[w]Five of the 28 estimates were slightly smaller than 1.3.

[x]Eight of the 31 estimates were very near 1.3.

[y]Six of the 14 estimates were slightly smaller than 1.3.

[z]Four of the 14 estimates were 1.22, 1.26, 1.27, and 1.29.

The family size elasticities estimated from the resultant tables cross-classified by income and family size are summarized in Table 26.

TABLE 26.--Summary of the family size elasticities for basic living materials.

	Individual Commodity and Groups of Commodities
$\eta < 0$	Meat, milk and eggs, alcoholic beverages, food prepared outside the household, housing, rent, repairs and improvements, furniture and utensils, clothing,* clothes.
$0 < \eta < 0.3$	Subsidiary food, fish, vegetables, cakes and candies and fruits, and beverages, fruits, non-alcoholic beverages, and fuel and light.
$0.3 < \eta < 0.5$	Food, processed food, condiments, and cakes and candies.
$0.7 < \eta < 0.9$	Cereals, and rice.

*However, one of the three estimates was positive 0.13.

With the exception of rent, the $\bar{R}^2$ (coefficients of determination adjusted by the degree of freedom) of all other items were very high. The estimate of the demand elasticity for rent was not reliable because owned and issued houses rent was seldom estimated. Owing to the poor data on rent, income and total expenditure were incorrectly measured. However, the estimates of the demand elasticities of other items except housing were believed to be little affected since rent was a very small proportion of income and total expenditure. The expenditure elasticities, B_i, estimated by the instrumental variables were considerably larger than their corresponding income elasticities. Since the B_i have been shown to be consistent estimates of the "true" parameters, and since they can be regarded as the estimates of the elasticities with respect to permanent income, the income elasticities obtained by least-squares regressions were usually underestimated.

The results of the investigation of consumer behavior among the five types of dwelling houses showed that owned house members' demand for housing, rent, repairs and improvements, and fuel and light was considerably different from those of the other types of dwelling houses. Because of the failure in estimating rent value in owned houses, the people in the rented house category seemed to spend more on housing and rent. The expenditures of other types of dwelling houses on repairs and improvements, and fuel and light reduced as compared with that of the owned house because expenditures of the former on these items were either unnecessary or partly included in rent. Although demand for other commodities was also significantly different at the 1 percent level in several cases, the differences were much less as compared with those items just mentioned.

The results of the analysis revealed that the effect of the number of earners on the demand for basic living materials was essentially due to the fact that family size and number of earners were closely related, and the number of earners alone had little to do with the consumption of basic living materials.

In the analysis of the ten occupational differences in the consumption pattern, each occupational group was first treated separately in order to know the level of consumption and expenditure elasticities for various commodities in each occupation. Then data were pooled to obtain the regression coefficients by using dummy variables. There were considerable differences in the demand for basic living materials among the ten occupational groups,and a number of reasons were tried to explain their differences.

Region proved to be a highly significant factor in the demand for basic living materials. The regions containing a larger city or cities tended to have large elasticities for food and housing. As was expected, the regional differences in the demand for fuel and light, clothing, and clothes were mainly caused by climate. The elasticities for these three items were highest in the far north and gradually reduced toward south.

The analysis of geographical variations in consumer demand usually covers the effects of region, city size, and urban-rural areas within the country. Indeed, the effects of the three variations generally are closely related to each other. The results of the effect of city size and regional variation analyses were similar to each other in the sense that the consumption pattern of the larger city was comparable to that of the region that contained a relatively large city or cities. The negative correlation between the size of city and the income elasticity for repairs and improvements as well as the small correlation between the size of city, and furniture and utensils, and fuel and light might be caused by the fact that a larger proportion of households in the larger city rented houses which sometimes furnished repairs and improvements, furniture and utensils, and fuel and light. When the size of city grew bigger, the coefficients of clothing and clothes became smaller.

Defining urban as including the four sizes of city in the preceding analysis of city size and rural as all the towns and villages, it was found that the urban-rural and city size variations in the expenditures on basic living materials were identical except that the levels of significance were slightly different in a few items (that is, urban acted as larger cities and rural as smaller ones.) Thus, in those items where the bigger cities had significantly larger regression coefficients than smaller cities, it followed that urban had significantly larger coefficients than rural, and the converse was also true.

A crude cross-section test of the permanent income hypothesis revealed that Friedman's method of testing the permanent income hypothesis with respect to individual categories of consumption seemed to be inadequate. In addition to the fluctuation of income, prevailing prices, and tastes and preferences, the magnitude of the income elasticity for a particular item of consumption seems also to be influenced by a number of factors such as income level, family size, home ownership, availability of electricity, and income distribution.

The results of the test of stability of the demand elasticities over time based on urban budget surveys data indicated that the income elasticities for the following individual items or groups of commodities increased over time: food, meat and milk and eggs, beverages, housing and rent. Time was negatively associated with the demand for cereals and barley. The demand for the other items was not so closely associated with time.

Data based on the Farm Household Economy Survey could be utilized to test the stability of the income elasticities over time for only four years from 1959 to 1962. During this period, while the income elasticities for total food, cereals (and its components), and condiments decreased through time, those for food items with relatively large income elasticities such as fish, meat and milk and eggs, processed food, cakes and fruits and beverages, food prepared outside the household, housing, and fuel and light increased yearly. In spite of the yearly increase in real income during this period, the income elasticity for clothing increased little over time. This probably is due to the fact that farmers usually do not spend much more on clothing even though their income increases.

CHAPTER IV

THE ANALYSIS BASED ON TIME SERIES

Although the technique of combining information from cross section and time series is believed to be capable of overcoming the problem of multicollinearity, this method is still subject to some questions as suggested in Chapter II. Hence in our time-series analysis, the original least-squares method was used in addition to the combined technique. On the whole, time-series data are less reliable than cross-section data.

The estimating equations in this chapter are the same time-series equations mentioned in Chapter II. Because of the short time series, which consist of the yearly observations of only 12 or 10 consecutive years, the number of independent variables to appear in a regression was restricted to four at most. In addition to either price or quantity being treated as a dependent variable in each of the original and conditional regression equations, both absolute price index and relative price index were used in the estimating equations. In other words, eight equations were employed to estimate demand parameters for each commodity. However, only the results obtained using absolute price index and treating quantity as a dependent variable in estimating equations are presented in this chapter because to treat price level as a dependent variable or to use relative price index as a variable is less desirable for the following reasons:

(1) As was pointed out in Chapter II, Klein argues that whether quantity or price level is used as dependent variable in the demand relationship depends on a country's economic condition. Since Japan is not self-sufficient in food supply, a regression of quantity on price seems more suitable for the demand analysis for food. Furthermore, although the absolute magnitudes of the elasticities are usually larger when price is used as a dependent variable in a time-series equation, as stated earlier, and although Harberger has pointed out that the estimates by using price as a dependent variable can be regarded as "upper limits" to the "true" parameter, most of the elasticities we obtained by treating price as a dependent variable usually are so large that they may not be very useful as limits.

(2) Whether absolute price or relative price index is chosen as the dependent variable depends upon the purpose of the researchers; the elasticities estimated, however, would be somewhat different from one another. While theoretically the two approaches are not the same, in empirical analysis the data rarely contain sufficient information for a decision on which approach should be adopted. If the information shows, however, that P_i (price level of a given commodity i) and Q_i (price of all other commodities) or R_i(price of competitive or complementary good) have changed proportionally during the period of survey, the relative price

index is the better one to use since the use of absolute price index may provoke the problem of multicollinearity.[1] An inspection of our data showed that no strong proportional price change between any two commodities exists. Therefore, it was felt that the absolute price index is preferable to the relative price index.

An attempt was made to include the preceding year's income in the estimating equations. The preceding year's income elasticities for almost all the commodities are not significantly different from zero. Although it is plausible that lagged income plays a role in determining the current year's demand for a certain few commodities, the previous year's income is far from sufficient to represent wealth about which data are not available. For this reason, the results estimated by the equations including the preceding year's income are not presented.

It should be noted that not all the independent variables in the estimating equations entered the actual computation at the same time; whenever competitive or substitute price was included in the estimation, the "all other prices" variable was dropped from the equation. One reason for so doing was to reduce the number of independent variables as far as possible because of the short time series mentioned earlier; also, the "all other prices" variable is believed to be less important than other variables included

[1]For a discussion of this point, see H. Wold and L. Jureen, <u>op. cit</u>., p. 244.

in the equation as far as the demand for basic living materials is concerned. Another reason is that the "all other prices" index includes the prices of complementary or substitute goods, hence the estimation may be disturbed by a multicollinearity if both Q_i and R_i are included in the estimating equation as independent variables.

Since in the cross-section analysis all consumers were confronted by the same market possibilities, we assumed that the same price was paid by consumers;[2] therefore, expenditures were assumed to be proportional to the quantity of basic living materials. In time series, however, prices are important variables. In order to be consistent with the theoretical demand relationship, the quantity of basic living materials, not expenditures, should be the variable in the estimating equation. Assuming all purchases were made at the same prices, the quantity variable of a given commodity was obtained by deflating expenditure on the commodity by the commodity price index. This has been based on the relationship:

Expenditure = Quantity times Unit price

Q_i was converted from the general price index by removing the relative importance of commodity i. Thus, for the price index of each commodity there was an "other price" index. Real net income Y_t and Y_{t-1} was calculated by deflating net

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[2]Of course, many prices exist simultaneously, but it might be impractical to attempt to observe them.

income by the general price index. In order to see whether the demand relationships are better fitted by using permanent income or by using measured income, an estimate of permanent income was constructed by Friedman's weighted moving average of measured income.[3]

As was noted earlier, each variable was based on per household. Since the average family size was little different each year, the effect of the family size on the demand for basic living materials can be ignored. Number of households each year was weighted in the estimating equations, even though the number of households was almost the same each year.

As is well known, one of the pitfalls in time-series estimation is the possible existence of autocorrelation or serial correlation. In order to obtain reliable estimates of the parameters, the random disturbances within and between equations should be mutually independent with respect to time. In overcoming serial correlation, while some econometricians take the one extreme position of assuming that the serial correlation parameters are one and, therefore,

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[3]M. Friedman argues that the horizon of the estimate is something like three years with a subjective discount rate of 0.333. For his lengthy discussion, see op. cit., and "Windfalls, the Horizon, and Related Concepts in the Permanent-Income Hypothesis," Measurement in Economics, Carl F. Christ and others, Editors (Stanford, California: Stanford University Press, 1963), pp. 3-28. Miyohei Shinohara, Growth and Cycles in the Japanese Economy (Economic Research Series, no. 5, Kinokuniya Bookstore Co., Ltd., Tokyo, Japan, 1962), derives permanent income from the detailed income surveys. Despite the fact that the surveys classified the sources of income in every detail, it is still difficult for one to estimate permanent income directly from this information.

transform all variables into first differences, the others go to the other extreme of assuming that the population values are zero.[4] Durbin and Watson[5] proposed a method that has been widely used in testing serial correlation. Unfortunately, we cannot use the Durbin-Watson statistic in our estimations because the Durbin-Watson tables list values of significance for analyses with 15 or more observations and our time series consists of at most 12 consecutive yearly observations. Nevertheless, we can apply the Von Neumann-Hart test[6] to test serial independence of residuals for our small number of observations. This test is actually designed for testing autocorrelation in an observed sequence of random variables, and its performance

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[4]For instance, to the former group belongs R. Stone, _op. cit._, and to the latter, Lawrence R. Klein, _An Econometric Model of the United Kingdom_ (Oxford, Basil Black Well, 1961). The use of first differences of observed variables in fitting economic relations is subject to some question. G. S. Watson and E. J. Hannan, "Serial Correlation in Regression Analysis II," _Biometrika_, XLII (1956), 436-448, shows that this procedure could lead to highly inefficient estimates even if the assumption that successive disturbances have high positive autocorrelation were nearly true. On the other hand, negative autocorrelation may understandably occur in many cases, and the use of first differences in such cases could lead to worse estimates of coefficients than not using first differences.

[5]J. Durbin and G. S. Watson, "Testing for Serial Correlation in Least Squares Regression, II," _Biometrika_, XXXVIII (1951), 159-178.

[6]B. I. Hart and John Von Neumann, "Tabulation of the Probabilities for the Ratio of the Mean Square Successive Difference to the Variance," _The Annals of Mathematical Statistics_, XIII (1942), 207-214.

has been found quite satisfactory.[7] If Von Neumann's ratio d is smaller than a certain value k, the null hypothesis of no positive serial correlation is rejected; otherwise, the null hypothesis is accepted, and d is to be replaced by 4-d in one-sided testing against negative serial correlation.

The analyses based on the General Report on Family Income and Expenditure Surveys (hereafter referred to as GRFIES) will be reported in Section 1 and the Farm Households Economy Surveys in Section 2; the results will be summarized briefly in the final section.

GENERAL REPORT ON FAMILY INCOME AND EXPENDITURE SURVEYS

Data used for the analysis in this section were taken from the GRFIES, published by Bureau of Statistics, Office of the Prime Minister, Japan. This survey was analyzed in Section 2 of Chapter III; it is published in a manner convenient for researchers to do time-series analysis. There are two differences with regard to utilizing the survey for cross-section and time-series estimations: (1) while the cross-section computations were based on the monthly average of eleven months from January to November, the time-series estimations included December and (2) both of the open-ended upper and lower classes were omitted from the cross-section computations, but they were included in the time-series estimations.

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[7] See Clifford Hildreth and John L. Lu, Demand Relation with Autocorrelated Disturbance (Technical Bulletin, November, 1960, No. 276, Agriculture Experiment Station, Michigan State University).

Because fewer items were available in 1951 and 1952, and because permanent income could be estimated for the years from 1953 to 1962 only, the demand for some items was estimated for 12 years (1951-1962) while the demand for other items was estimated for 10 years (1953-1962). In the conditional regressions, the income elasticities[8] were taken from a 12 or 10 years average of the cross-section estimates.

The demand elasticities estimated for sixteen items and groups of items are set forth in Table 27. In the table, P denotes the pure time-series or original least-squares regression, C the conditional regression (combining time-series and cross-section technique), and the elasticity following A is the price elasticity of a particular commodity with respect to "all other prices." A @ mark in the column of the Von Neumann-Hart statistic d indicates that there is evidence of serial correlation, either positive or negative, at the 5 percent level.

The results estimated by using disposable income as the sole independent variable are not given in the table not only that the goodness of fit was very poor for many items, but also that the coefficients estimated by excluding price variable would be biased. Nor are the results estimated by using permanent income in the least-squares regression given. It was found that, almost without exception, the income

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[8]Actually they are expenditure elasticities, but in order to be consistent with the time-series analysis, they are interpreted as income elasticities by accepting Friedman's hypothesis that the elasticity of the permanent consumption with respect to permanent income is unitary.

TABLE 27.--Demand analyses for basic living materials based on time series, 1951-1962 and 1953-1962, urban worker households, (Family Income and Expenditure Survey).

C or P**		Commodity	Constant	Income Elasticity	Price elasticity with respect to: Own Price	"All Other Prices,"	Related Goods' Prices		$\bar{R}^2$	d
P	12	Food	2.23	.562(.178)a	-.110(.288)#	A-.117(.562)#			.977(.008)	1.03@
C	12		2.37	.681	-.021(.205)#	A-.476(.164)a			.896(.007)	.84@
						Housing	Clothing	Fuel&Light		
P	12		2.64	.560(.156)*	.098(.128)#	-.200(.159)#	-.260(.112)b		.991(.005)	2.52
P	12		1.86	.674(.143)*	-.161(.106)c	-.311(.155)b		.196(.107)c	.989(.005)	1.85
C	12		2.25	.681	-.017(.177)#	-.323(.059)*	-.143(.146)#	.067(.153)#	.955(.005)	2.08
P	12	Cereals	4.05	-.043(.108)#	.616(.175)*	A-.715(.232)a			.789(.011)	1.88
C	12		5.45	.412	.272(.260)#	A-1.530(.215)*			.914(.018)	1.00@
						Other Food	Fuel&Light	Meat,milk & eggs		
P	12		3.59	-.139(.068)b	.487(.147)a	-.992(.379)a		.709(.498)c	.857(.009)	2.16
P	12		4.32	-.298(.083)*	.176(.167)#	-.491(.093)*	.518(.192)a		.909(.007)	2.40
C	12		4.93	.412	.471(.520)#	-.825(.269)a	-.730(.399)c		.870(.022)	1.35
P	12	Fish	2.83	.014(.135)#	-.837(.167)*	A.890(.456)b			.733(.013)	.87@
C	12		4.87	.649	-.691(.300)a	A-.901(.458)b			.915(.023)	.95@
						Cereals	Meat, milk & eggs			
P	12		2.17	.122(.130)#	-.969(.350)a	.265(.262)#	.815(.568)c		.772(.012)	1.12
C	12		2.21	.649	-1.966(.425)*	-.636(.236)a	1.898(.856)b	.	.936(.020)	1.87
P	12	Meat, milk & eggs	-3.04	1.463(.264)*	.317(.652)#	A-.456(.977)#			.979(.021)	1.30
C	12		-3.65	1.050	-.236(.590)#	A.926(.450)b			.645(.023)	.77@
						Fish	Cereals			
P	12		-.65	1.351(.131)*	-1.412(.573)a	.900(.353)a	-.259(.264)#		.993(.012)	2.66
C	12		-.67	1.050	-2.031(.625)a	A1.470(.311)*	.256(.173)c		.849(.015)	2.32
P	10	Vegetables	4.32	-.102(.121)#	-.230(.261)#	A-.033(.889)#			.860(.010)	1.41
C	10		6.77	.661	-.165(.670)#	A-2.076(2.115)#			.864(.028)	.92@
						Fish	Meat, milk & eggs	Condiments		
P	10		3.45	.046(.109)#	-.281(.188)c	-.617(.312)c	.697(.446)c		.923(.008)	1.36
C	10		.59	.661	-.748(.305)b	-1.536(.469)a	2.100(.630)a		.960(.015)	2.39
C	10		-.48	.661	-.814(.321)b	-1.473(.485)a	2.054(.647)a	.404(.469)#	.958(.016)	1.86
P	10	Processed Food	1.51	.624(.064)*	-.457(.112)*				.926(.009)	1.97
C	10		1.59	.493	-.288(.089)a				.510(.011)	1.68
						Fish	Meat, milk & eggs	Vegetables		
P	10		.81	.673(.126)*	-.733(.224)a	-.303(.364)#	.738(.499)c		.929(.009)	1.92
P	10		.50	.646(.159)*	-.597(.327)c		.582(.492)#	-.137(.321)#	.922(.010)	1.50
C	10		1.86	.493	-.882(.368)b	-.152(.447)#	.439(.510)#	.226(.312)#	.571(.010)	2.37

TABLE 27.--(Continued)

C or P**		Commodity	Constant	Income Elasticity	Own Price	Price elasticity with respect to "All Other Prices," Related Goods' Prices			$\bar{R}^2$	d
P	10	Condiments	1.67	-.062(.195)#	-.044(.542)#	A .549(.585)#			.337(.014)	1.83
						Fish	Meat, milk & eggs	Vegetables		
P	10		1.11	.195(.178)#	.484(.426)#	-.185(.343)#			.275(.014)	1.61
P	10		1.11	.070(.208)#	.199(.503)#		.340(.777)#	-.049(.391)#	.179(.015)	1.92
C	10		-.07	.514	.420(.286)c	-1.422(.208)*	1.207(.223)*		.894(.010)	3.42
								Processed food		
C	10		1.34	.514	.280(.453)#	-1.038(.207)*		.491(.251)b	.785(.014)	2.51
P	10	Cakes, Candies & Fruit	.03	.345(.299)#	-.651(.357)c	A 1.140(.876)#			.930(.014)	2.23
C	10		.55	.873	-.127(.226)#	A -.364(.228)c			.371(.016)	2.51
						Meat, milk & eggs	Alcoholic beverage	Non-alcoholic beverage		
P	10		.30	.613(.150)*	-.494(.347)#	.486(.566)#			.919(.015)	2.72
P	10		2.43	.744(.135)*	-.166(.299)#		-.394(.983)#	-.363(.787)#	.900(.016)	3.07
C	10		.47	.873	-.091(.293)#	-.375(.314)#			.288(.017)	1.97
							Vegetables			
C	10		1.39	.873	-.014(.265)#		-.047(.112)#	-.712(.680)#	.342(.016)	3.20
P	10	Alcoholic Beverage	-.63	.923(.080)*	-1.184(.408)a	A .877(.190)*			.995(.007)	3.00
C	10		-.58	.854	-1.234(.396)a	A 1.018(.098)*			.967(.007)	2.69
						Non-alcoholic beverage	Cakes, candies & fruits			
P	10		-1.55	1.105(.065)*	-1.258(.507)a	.981(.289)a			.992(.009)	2.39
P	10		-1.28	1.216(.046)*	-.931(.463)b		.395(.096)*		.994(.008)	2.69
C	10		-.17	.854	-2.020(.878)b	1.706(.570)a	-.044(.268)#		.818(.017)	1.94
P	10	Non-Alcoholic Beverage	-8.68	2.233(.257)*	.310(1.041)#	A -.010(.869)#			.983(.022)	1.82
C	10		-8.51	1.075	1.181(1.916)#	A 3.188(.977)*			.773(.042)	1.42
						Non-alcoholic beverage	Cakes, candies & fruits			
P	10		-8.17	2.278(.192)*	-.179(1.114)#	.178(1.392)#	.244(.423)#		.981(.023)	1.72
C	10		-2.04	1.075	4.680(2.183)b	-3.870(3.360)#	-.966(1.026)#		.498(.063)	1.90
P	12	Housing	-2.25	1.018(.627)c	.888(.791)#	A -.522(.703)#			.972(.027)	1.06
C	12		-2.25	1.013	.895(.306)a	A -.521(.653)#			.819(.026)	1.00
						Food	Fuel & Light			
P	12		-2.69	1.997(.473)*	.251(.512)#	.112(.350)#	-1.344(.354)*		.989(.017)	2.14
C	12		-2.18	1.013	1.223(.249)*	.050(.416)#	-.922(.346)a		.888(.020)	1.36

TABLE 27.--(Continued)

C or P**		Commodity	Constant	Income Elasticity	Price elasticity with respect to: Own Price	"All Other Prices,"	Related Goods' Prices	$\bar{R}^2$	d
P	10	Rent	4.74	-.845(1.749)#	.705(.966)#			.216(.046)	1.52
C	10		-1.04	.315	-.141(.240)#	1.084(1.090)#		-.076(.045)	1.67
						Repairs & Improvements			
P	10		5.56	-1.913(1.081)c	.871(1577)c	1.185(.320)*		.722(.028)	2.51
C	10		-.67	.315	-.287(.157)c	1.009(.373)a		.400(.033)	1.47
P	10	Repairs & Improve-ments	-7.05	1.819(.452)*	-2.982(.800)*	A3.476(1.874)c		.859(.040)	2.89@
C	10		-7.26	1.735	-2.998(.739)*	A3.689(1.372)a		.763(.038)	2.69
						Rent			
P	10		1.01	.990(3.091)#	-1.483(.781)c	.560(1.803)#		.605(.068)	1.83
C	10		-1.20	1.735	-1.560(.563)a	.226(.237)#		.574(.050)	2.00
P	10	Furniture &Utensils	-12.22	3.232(.178)*	.189(1.951)#			.977(.036)	1.37
P	10		-11.97	3.781(.343)*	.730(1.726)#	A-1.460(.814)c		.983(.031)	2.11
						Rent			
P	10		-13.48	4.915(1.608)a	-1.052(2.266)#	-.912(.866)#		.977(.036)	1.31
C	10		-11.29	1.529	1.582(2.307)#	.901(.116)*		.885(.043)	1.28
P	12	Fuel & Light	-.33	.300(.201)c	-.397(.306)#	A1.110(.390)a		.923(.016)	1.56
C	12		.60	.783	-.390(.281)a	A.558(.389)c		.693(.019)	1.15@
						Food	Housing		
P	12		-.85	1.100(.336)a	-.617(.251)a	1.071(.249)*	-.791(.363)b	.953(.012)	2.16
C	12		-.69	.783	-.481(.205)a	1.051(.246)*	-.479(.147)a	.881(.012)	2.08
P	12	Clothing	-1.23	.850(.389)b	-.281(.421)#	A.595(.723)#		.954(.027)	1.28
C	12		-1.59	1.403	-.007(.395)#	A-.400(.195)b		.264(.029)	1.54
						Food	Housing		
P	12		-3.55	2.267(.730)a	.006(.523)#	.461(.601)#	-1.545(.744)b	.969(.022)	1.81
C	12		-1.88	1.403	-.444(.368)#	.850(.516)c	-.720(.265)a	.538(.023)	1.83

Notes: Standard errors appear in the parentheses to the right of the coefficients and all tests are two-tailed t-tests.

** Pure time-series equation (P), or conditional regression(C).
* Significantly different from zero at better than the 1 percent level.
a Significantly different from zero at better than the 5 percent level.
b Significantly different from zero at better than the 10 percent level.
c Significantly different from zero at better than the 20 percent level.
\# Not significantly different from zero.
A Denotes the price elasticity of a particular commodity with respect "all other prices".
@ Denotes there is evidence of serial correlation at the 5 percent level.
d Denotes Von Neumann-Hart ratio.

elasticities and the values of $\bar{R}^2$ are smaller whenever permanent income instead of the measured income is used.[9] One of the reasons for this phenomenon undoubtedly is that the method of measuring permanent income was unsatisfactory--it was derived by a constant weight of the disposable incomes of the current year and the past two years, and it consisted of only ten consecutive yearly observations. Because of the limitation of the measured income data, the method of a weighted moving average of disposable income and a number of past years incomes with the weights expotentially declining and other methods are not suitable to calculate the expected income series.[10]

However, when both permanent and transitory income entered the estimating equations, the results improved considerably--in the majority of cases, the permanent income elasticities became larger and their standard errors smaller, and the values of $\bar{R}^2$ tended to be slightly greater than the corresponding estimates obtained by using disposable income. Of the sixteen individual goods and groups of goods listed in Table 27, housing, repairs and improvements, furniture and

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[9]Not only are the expected income elasticities smaller than their disposable income elasticities, but also the standard errors of the expected income elasticities are usually considerably larger than those of disposable income elasticities so that in many cases the permanent income elasticities are insignificantly different from zero.

[10]For explanations of other methods of measuring permanent income, see Paul Taubman, "Permanent and Transitory Income Effects," The Review of Economics and Statistics, XLVII (February, 1965), 38-43.

utensils, and clothing can probably be regarded as durable goods. Although permanent income was generally a much better variable than transitory income in determining the demand for non-durable goods in the sense that the elasticity of permanent income was greater, its standard error smaller, and its partial correlation coefficient larger than those of transitory income, the superiority of permanent income usually diminished in the demand for durable goods.

In fact, in some analyses of the demand for durable commodities, elasticity of transitory income became more significant and its partial correlation coefficient larger than the corresponding estimates obtained for permanent income. Despite the fact that the simplest method was used to derive the parmanent income series and that a time series of only 10 observations was analyzed, the results seem to run in the direction of Smith's finding that, while the permanent income hypothesis is verified with respect to non-durable goods, transitory income is an important variable in explaining the expenditures on durable commodities.[11] This, however, is consistent with Friedman's hypothesis, since durable goods are not consumed instantly and can be regarded as savings.

Inspection of Table 27 indicates that:

(1) Very high values of $\bar{R}^2$ usually are obtained for all the commodities except for condiments and rent. While the values of $\bar{R}^2$ are higher when the demand for fish and

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[11] Paul E. Smith, "The Demand for Durable Goods: Permanent or Transitory Income?" Journal of Political Economy, X (October, 1962), 500-504. He employs a system of simultaneous equations to analyze the aggregated demand for consumer durable and non-durable goods in the U. S. for the period from 1947 to 1960.

condiments are estimated by conditional regressions, the values tend to be larger when the original least-squares regressions are used to estimate the demand elasticities for the other fourteen items and groups of items. The values of $\overline{R}^2$ turn out to be extremely low when the demand relationships for processed food, meat, milk and eggs, cakes, candies and fruits, non-alcoholic beverages, and clothing are fitted by combined technique.

(2) In most previous studies, income elasticities obtained from cross-section analysis tend to be larger than those estimated from time series, as mentioned earlier. But the table shows that in many cases the income elasticities estimated from original least-squares are greater than the cross-section estimates. In particular the time-series estimates of the income elasticities for those relatively "superior" goods such as meat, milk and eggs, beverages, housing, repairs and improvements, and furniture and utensils appear to be much larger than the cross-section estimates of the elasticities. The income elasticities for cereals, vegetables, and rent have the negative signs although they are all positive when estimated from cross-section data.

(3) With several exceptions, all the "own-price" elasticities for most commodities have the right signs. The elasticities for cereals, fish, processed food, alcoholic beverages, and repairs and improvements are usually significant, but the elasticities for the other items become significant only when conditional regressions are used. It is apparent that the price elasticities tend to be larger when

the combined technique instead of the pure time-series equation is used.

(4) Many of the "all other prices" elasticities have negative signs which indicates that a given commodity and all other commodities combined as a group are complements. If there are only two goods or two groups of goods, they must be substitutes instead of complements. However, when a regression includes a particular commodity's price and "all other prices," it does not mean that the prices of all goods are included. According to economic theory, if the families studied were behaving rationally, the demand curves are homogeneous of degree zero in prices and income. Nevertheless, Table 27 indicates that the sum of the coefficients of the variables in the demand relationship is significantly different from zero. One reason for the non-zero of the sum of the demand elasticities is that not all goods entered the estimating equations. Another reason is that income was not used up. A further reason is that since only a short period was covered, money illusion might exist. Both Tobin[12] and Stone[13] studied the demand for food covering a much longer period of time and obtained sums of the elasticities very close to zero.

(5) Of the seventy-two equations in the table, sixteen have serial correlation, eleven positive and five negative,

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[12] J. Tobin, <u>op. cit</u>.

[13] R. Stone, <u>Measurement of . . . .</u>, <u>op. cit</u>. He used relative price indexes in the estimating equations.

at the 5 percent level of significance as tested by the Von Neumann-Hart ratio.

(6) A test of the collinearity between income and prices indicates that of the 89 income-price relationships, six correlation coefficients are positively significant and forty-eight negatively significant at the 5 percent level. During the period of these surveys, although real income increased yearly, the price levels of basic living materials were quite stable and that of many commodities decreased slightly through time.

The results of each individual item and group of items appearing in Table 27 are commented on below:

<u>(a) Food</u>

In addition to aggregate food, there are nine individual food items included in this category. The income elasticities for total food estimated by the original least-squares regressions are less than the cross-section estimate. All but one of the own-price elasticities have the right sign and except for one case all the elasticities are not significantly different from zero. When "all other prices" is included in the equations for estimating the expenditure for total food, the elasticities with respect to "all other prices" are negative and autocorrelation exists. The values of $\bar{R}^2$ are quite high for aggregate food although they reduce slightly when conditional regressions are used. The results show that total food is complementary to housing and clothing, and a substitute for fuel and light, but their cross-elasticities are small and one half of these are not significant.

Cereals.--The income elasticities obtained from pure time series have the negative sign and their absolute magnitudes are very different from the cross-section estimate. The "own-price" elasticities have the wrong sign and "all other prices" elasticities are negative. However, all the own-price elasticities estimated for 10 years (1953-1962) from various equations, which are not shown in the table, are negative but not significant. The values of $\bar{R}^2$ are somewhat lower than those for total food but are also highly significant. Other food (all food items other than cereals) and cereals appear to be markedly complementary.

Fish.--While the income elasticities estimated from the original least-squares are far less than the elasticity obtained in cross-section estimations and not significant, all the own-price elasticities have the right sign and are highly significant. The low income elasticity and the high price elasticity for fish are in accord with our expectation, since Japan is abundant in fish, which is one of her major exports. The significant substitution between fish and meat, milk and eggs is also expected. This is one of the rare cases where the values of $\bar{R}^2$ are larger when the demand relationship is fitted by combined technique instead of the original least-squares. In the majority of cases, serial dependence exists.

Meat, milk and eggs.--The income elasticities estimated for this group by the original least-squares regression are about 1.5 and also very significant, but the cross-section estimation of the elasticity is about unity for the average of 12 years from 1951 to 1962. When pure time-series equations are used, the values of $\bar{R}^2$ are nearly unity, but the values reduce considerably when the demand parameters are estimated by combined time-series and cross-section method. The own-price elasticities become quite large and highly significant only when related goods are included in the estimating equations. As was shown in the preceding case, this group and fish are well-marked substitutes.

Vegatables.--For this group, the values of $\bar{R}^2$ become very high when the related goods are included in the equations. The income elasticities derived from pure time series are extremely small and insignificant. All the own-price elasticities have the right sign but they are significant at the 10 or 20 percent level only when the related goods are added in the demand relationship. The results show that vegetables is significantly complementary for fish and is a substitute for meat and milk and eggs.

Processed food.--Although the values of $\bar{R}^2$ obtained from pure time-series equations are very high, they reduced a great deal when the demand parameters are estimated by conditional regressions. All the income elasticities estimated by the original least-squares are significant at the 1 percent level and larger than the cross-section estimate.

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All the own-price elasticities have the right sign, and are significant. They are between -0.3 and -0.9. The cross-elasticities with respect to the related goods such as fish, meat, milk and eggs, and vegetables are usually insignificant.

Condiments.--The values of $\bar{R}^2$ estimated by the original least-squares are extremely low. The time-series income elasticities are negligibly small. All but one of the own-price elasticities have the wrong sign and are not significant. The very small income and price elasticities for condiments are somewhat expected since condiments is usually a very small proportion of total expenditure and is always a "must" in cooking. Thus it is also expected that fish, meat, milk and eggs, and vegetables are all complementary for condiments and that their cross-elasticities are small. However, the results show that the cross-elasticities with respect to these related goods do not always have the negative sign and they become highly significant when they are estimated by conditional regressions.

Cakes, candies and fruits.--For this group, the original least-squares yield very high values of $\bar{R}^2$ while the combined technique yields very low values. The time-series income elasticities are a little smaller than the cross-section estimate and all but one are significant at the 1 percent level. All the own-price elasticities have the right sign and are insignificant except one which is significant at the 20 percent level. The cross-elasticities with respect to meat, milk and eggs, beverages, and vegetables are not significant.

Alcoholic beverage.--Goodness of fit is excellent. The time-series estimates of the income elasticities are around unity, greater than the cross-section estimate and significant at the 1 percent level. All of the own-price elasticities have the right sign and are between -1.1 and -2.0. All other commodities together appear to be significant substitutes for alcoholic beverage. Alcoholic beverage and non-alcoholic beverage are marked substitutes.

Non-alcoholic beverage.--The values of $\overline{R}^2$ are near unity when the original least-squares are used but they reduce a great deal when the demand relationships are estimated by the combined technique. It is amazing to find that the income elasticities obtained from pure time series are more than twice as large as the cross-section estimate. One-half of the own-price elasticities have the wrong sign and all but one of them are not significant. From the preceding analysis, non-alcoholic beverages was found to be a highly significant substitute for alcoholic beverages but when the non-alcoholic beverage is used as a dependent variable, the cross-elasticity with respect to alcoholic beverage is not significant. The insignificance is reasonable because for those people who do not drink alcoholic beverages, the expenditure on non-alcoholic beverages is hardly affected by the price of alcoholic beverages.

(b) Housing

When the pure time series are employed, the values of $\overline{R}^2$ are almost one, but they decrease when the conditional regressions are used. Time series and cross section give similar income elasticity, but when related goods enter the estimating equation, time-series income elasticity doubles. All the own-price elasticities turn out to have implausible sings and become highly significant when using the combined technique. The signs of the elasticities with respect to "all other prices" are negative. The cross-elasticities for housing with respect to food are positive and insignificant. The results show that fuel and light and housing are marked complements as expected. Because of the poor data on rent as explained in the preceding chapter, the estimates for housing and its components deserve less confidence than those for other categories of consumption. Nevertheless, the commentary on the results of its three components are given below.

Rent.--The goodness of fit is very poor, especially in the case of conditional regression equation. The cross-section income elasticity is about 0.32 and the elasticities estimated from pure time series are negative and quite large but not very significant owing to their considerably large standard errors. The own-price elasticities estimated from the original least-squares have the wrong sign and the elasticities become significant at the 20 percent level only when one or more related prices are included in the equations. The results show that rent and repairs and improvements are highly marked substitutes.

<u>Repairs and improvements</u>.--The time-series income elasticity is slightly larger than the cross-section estimate and is significant at the 1 percent level. But when the price of rent enters the equation the elasticity reduces to one half and becomes insignificant. All the own-price elasticities are negative and range from -1.5 to -3.0. The elasticities with respect to "all other prices" are positive signs and as high as 3.5.

<u>Furniture</u>.--The time-series elasticities are unreasonably larger than the cross-section estimate of 1.53 by two or three times. And in all cases but one the own-price elasticities carry the wrong sign and are all smaller than their standard errors. Thus the results are really disappointing though the values of $\bar{R}^2$ are quite high.

(c) Fuel and Light

Very high values of $\bar{R}^2$ are obtained for this group although they are somewhat lower when the method of combining cross section and time series is used. The time-series estimate of income elasticity is 0.30, smaller than the cross-section estimate of 0.78, but when the prices of related commodities are included in the equation, the elasticity becomes as large as 1.10. All the own-price elasticities carry the right signs and are significant at the 5 percent level except one which is not significantly different from zero. The cross-elasticities with respect to "all other prices" estimated by both the original least-squares and the conditional regression have the positive sign, but the former method yields magnitude of the elasticity twice as large as the latter method. The results show that food is a highly significant substitute for fuel and light, and the latter and housing are marked complements as expected.

(d) Clothing

The low values of $\bar{R}^2$ obtained by conditional regressions are in a strong contrast to the high values estimated by the original least-squares equations. When excluding the prices of related goods in the equation, the time-series estimate of the income elasticity is much smaller than the cross-section estimate of 1.40, and the time-series income elasticity is 2.27 when the prices of food and housing are introduced. All the four own-price elasticities do not differ from zero and only one of them has the wrong sign. Food appears to be substitute for, and housing a complement of clothing.

FARM HOUSEHOLDS ECONOMY SURVEY

Income and expenditures in the time-series analysis for farm households included in kind except that expenditure on housing was limited to cash value only. The results based on the FHES are set out in Table 28. In the conditional regressions, the income elasticities were taken, of course, from the average of the cross-section expenditure elasticities of four years from 1959 to 1962.

Like the analysis of the preceding section, the results of the estimating equations which included preceding

TABLE 28.--Demand analyses for basic living materials on time series, 1951 to 1962 (Farm Households Economy Survey).

P, or C**	Commodity	Constant Term	Income Elasticity	Price Elasticity with respect to: Own-Price	"All other prices" or related goods' prices			$\bar{R}^2$ (S)	d
P	Food	3.50	.505(.271)b	-1.026(.535)b	[A].646(.651)#	--	--	.752(.020)	.56@
					Housing	Fuel & light	Clothing		
P		5.37	.257(.194)#	-.431(.471)#	.467(.355)#	--	-.582(.250)b	.873(.014)	1.52
C		5.12	.532	-.644(.473)#	.157(.270)#	--	-.483(.255)b	.464(.015)	1.45
C		4.01	.532	-1.017(.334)a	--	.418(.140)a	--	.445(.015)	1.23
	Cereals				Fish	Meat, milk, & eggs			
P		6.24	.460(.410)#	-.604(.537)#	-.704(.482)c	--	--	.807(.032)	1.71
P		7.08	.270(.279)#	-.455(.469)#	--	-.780(.439)c		.098(.031)	1.78
C		6.15	.204	-.348(.335)#	-.456(.262)c	--	--	.325(.031)	1.64
C		7.01	.204	-.373(.299)#	--	-.716(.327)b	--	.411(.209)	1.80
P	Fish	-2.99	.799(.429)b	-.553(.492)#	[A]1.419(1.520)#	--	--	.815(.030)	.96@
C		-2.67	.914	-.540(.464)#	[A]1.086(.826)#	--	--	-.025(.028)	1.12@
					Meat, milk, & eggs	Condiments			
P		.46	.925(.284)a	.854(.868)#	-1.219(.861)c	-.152(.560)#	--	.822(.029)	2.11
C		.50	.914	.878(.515)c	-1.231(.743)c	-.158(.498)#	--	.037(.027)	2.09
P	Meat, milk & eggs	-6.31	2.439(.229)*	-1.110(.515)b	--	--	--	.932(.037)	2.24
C		-10.20	1.034	-2.659(.386)*	[A]5.448(.474)*	--	--	.931(.021)	2.88@
					Cereals	Fish	Condiments		
P		-4.88	2.123(.374)*	-2.296(1.133)b	--	1.284(1.142)#	.013(.737)#	.928(.038)	2.13
P		-7.32	2.090(.319)*	-.918(.501)b	.793(.536)c	--	--	.940(.035)	2.18
C		-5.08	1.034	-3.282(.522)*	1.593(.214)*	2.842(.385)*	-.067(.357)#	.945(.019)	2.30
C		-5.18	1.034	-3.308(.472)*	[A]1.602(.196)*	2.826(.353)*	--	.951(.018)	2.32
P	Housing	-10.28	1.383(.582)a	-.688(.986)#	[A]3.026(1.859)c	--	--	.906(.040)	1.42
C		-10.35	1.329	-.647(.831)#	[A]3.110(1.531)b	--	--	.527(.038)	1.29
					Food	Fuel & light			
P		-7.42	2.218(.401)*	2.874(1.136)a	-.214(.893)#	-2.830(.870)a	--	.952(.028)	2.15
C		-7.62	1.329	3.103(1.381)b	.516(1.014)#	-2.075(.978)b	--	.599(.035)	1.47
P	Fuel & light	.33	.071(.223)#	-.808(.225)*	[A]1.967(.481)*	--	--	.763(.013)	1.46
C		.75	.554	-1.118(.207)*	[A]1.241(.411)a	--	--	.774(.016)	1.42
					Food	Housing			
P		.79	.297(.199)c	-1.130(.433)a	.967(.444)b	.749(.565)#	--	.737(.014)	1.39
C		.85	.554	-1.349(.415)a	.756(.430)c	.683(.586)#	--	.807(.015)	1.47
P	Clothing	-.28	.461(.331)c	-.528(.271)b	[A]1.289(.642)b	--	--	.948(.019)	1.28
					Housing	Food			
P		.29	.502(.189)a	-.587(.205)a	1.086(.314)*	--	--	.968(.015)	1.43
C		-.91	1.360	-.481(.364)#	-.210(.237)#	--	--	-.017(.026)	1.67
P		.35	.523(.212)a	-.536(.273)b	1.133(.366)a	-.158(.514)#	--	.964(.016)	1.42
C		-.41	1.360	-.235(.441)#	.188(.467)#	-.808(.819)#	--	-.020(.026)	1.75

Notes: Standard errors appear in parentheses to the right of the coefficients and all tests are two-tailed *t*-tests.

** Pure time-series equation, (P) or, conditional regression, (C).
* Significantly different from zero at better than the 1 percent level.
a Significantly different from zero at better than the 5 percent level.
b Significantly different from zero at better than the 10 percent level.
c Significantly different from zero at better than the 20 percent level.
\# Not significantly different from zero.
d Von Neumann-Hart ratio.
A The price elasticity of a particular commodity with respect to "all other prices."
@ Evidence of serial correlation at the 5 percent level.

year's income or permanent income variables are not presented in the table. However, it is worthwhile to mention the estimates obtained by using permanent income[14] as an explanatory variable. In contrast to the results obtained by using disposable income versus permanent income in the preceding section, all the income elasticities estimated for various commodities from farm households data are greater and the standard errors of the estimates smaller, also the goodness of fit usually improves whenever permanent income replaces disposable income as the independent variable. When both permanent and transitory incomes are introduced in the equations, the results, which are similar to those from GRFIES in last section, show clearly that the expenditures on consumer non-durable goods such as food and its components are almost solely determined by permanent income, and that transitory income appears to be more important than permanent income in explaining the demand for such durable goods as housing and clothing.

A general analysis of the results as well as a commentary on the individual groups of commodities in Table 28 are given below.

The values of $\bar{R}^2$ are pretty high using the original least-squares regressions, but the values become extremely low except for two groups (meat and milk and eggs, and fuel and light) when the parameters are estimated by the method

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[14]The method of estimating permanent income here was the same as that in last section.

of combining information from cross section and time series. About one half of the pure time-series income elasticities are larger than their corresponding cross-section estimates. Only four out of the thirty-one own-price elasticities have the wrong sign. All the signs of the cross-elasticities with respect to "all other prices" are positive. Similar to the analysis in the preceding section, a great majority of the sums of the elasticities are significantly different from zero. And among 31 equations, four have the positive serial correlation at the 5 percent level of significance. A test of the collinearity between income and prices shows that of the 37 correlation coefficients between income and price, only one is positively and twenty are negatively significant at the 5 percent level.

Food.--When only "all other prices" is included, the time-series income elasticity is slightly less than the cross-section elasticity; but when the prices of housing and clothing are introduced, the income elasticity drops to one half and is not significant. All the four own-price elasticities have the right signs and two of them as well as "all other prices" elasticity are insignificant. The cross-elasticities for food with respect to housing show positive sign but are not significant. Food and clothing are complements at the 10 percent level of significance.

Cereals.--The time-series income elasticities are larger than the elasticity obtained from cross section but not significantly different from zero. All the own-price elasticities are not significant. Both fish and meat, milk and eggs appear to be a complement to cereals and significant at better than the 20 percent level.

Fish.--The values of $\bar{R}^2$ reduce from 0.82 to almost zero when the original time-series regressions are replaced by the conditional regressions. The income elasticities estimated from pure time series are about as large as the cross-section estimate and are significant. One half of the own-price elasticities carry the wrong sign and all but one of the price elasticities are not significantly different from zero. Although the "all other prices" elasticities are larger than unity, they are not significant as compared with their standard errors. In contrast to one's expectation, fish and meat, milk and eggs turn out to be complements.

Meat, milk and eggs.--Regardless of which method is used in estimating the demand parameters, the values of $\bar{R}^2$ are very high. The time-series income elasticities are twice as large as the elasticity obtained from budget survey and all are significant at better than the 1 percent level. Also both own-price and "all other prices" elasticities are quite large and significant. The cross-elasticity with respect to fish is positive as expected, and as large as 1.3 but less than its standard error.

Housing.--By the combined technique, the estimated values of $\bar{R}^2$ are only a little more than one-half of those estimated by the original time-series regressions. The time-series income elasticities are larger than the cross-

section elasticity and are significant. The own-price elasticities have the right sign and are insignificant, but when related prices are introduced, the price elasticities become about 4.5 times larger and positive. While the cross-elasticities with respect to food do not differ significantly from zero, food and fuel and light appear to be well-marked complements.

Fuel and light.--The income elasticities estimated from time series are much smaller than the cross-section estimate. Both the own-price elasticities and the cross-elasticities with respect to "all other prices" are greater than unity and highly significant.

Clothing.--When the original least-squares regressions are employed, the estimated values of $\bar{R}^2$ are near unity but the $\bar{R}^2$ become negative and not significantly different from zero by use of the conditional regressions. The demand elasticites estimated by the two methods are different considerably; the time-series income elasticities are less than one half of the cross-section estimate and the own-price elasticities obtained from the combined technique are much smaller than those estimated by the original least-squares regressions and not significantly different from zero.

SUMMARY

In estimating the demand elasticities for 16 commodities from GRFIES and for 7 items from FHES, both the original least-squares regression and the method of combining information from cross section and from time series were used.

When the original least-squares method was used, very high values of $\bar{R}^2$ were generally obtained for all but a few estimating equations. On the contrary, when the combined technique was employed, the values diminished in a great majority of cases and many of them became extremely low.

In many cases, the income elasticities estimated from the pure time series were considerably different from the cross-section estimates. The differences depended on the kind of commodity and on whether the prices of related goods were introduced. Roughly one half of the pure time-series income elasticities were larger than their corresponding elasticities obtained from the budget survey. The income elasticities for those "superior" goods estimated by the original least-squares tended to be especially large.

Of all the own-price elasticities about one-quarter had implausible signs; generally such signs were obtained for cereals,[15] condiments, housing, rent, and furniture and utensils. Besides, half the own-price elasticities were not significantly different from zero. Although all the "all other prices" elasticities estimated from FHES had positive signs, one-half of the elasticities obtained from GRFIES turned out to be negative. Many of the elasticities with respect to "all other prices" did not differ significantly from zero. In general, the magnitude of the price elasticities estimated by use of conditional regressions was larger and more

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[15]However, the sign for cereals estimated from GRFIES during the ten-year period (1953-1962) was negative.

TABLE 29.--Summary of demand elasticities based on time series data.

Range of Elasticities	Cross-Section Income Elasticities	Pure Time-Series Income Elasticities A	Own-Price Elasticities B	"All Other Prices" Elasticities	Cross-Elasticitie with respect to the Price of Commodities in in the Parenthesis C
	Individual Commodity and Group of Commodities				
-2.0 to -1.5			repairs & improvements[h]		vegatables (fish)*[a]
-1.5 to -1.0			alcoholic beverages,[g] fuel&light#[j]	furniture & utensils*	fish (meat, milk, & eggs)#; condiments (fish)*[d]
-1.0 to -0.5			processed food,[d] fuel&light*[i], clothing#[k]	housing*	food(clothing),# cereals (fish, meat and milk and eggs),# cereals (other food),* & fuel & light (housing)*
-0.5 to 0		cereals,* & vegetables[h]	cereals#[a] vegetables,[c] cakes&candies & fruits,[f] & clothing*	food*	food (housing), (clothing),* & processed food (fish),* cakes & candies & fruits (alcoholic beverages, non-alcoholic beverages)*
0 to 0.5	cereals, processed food, & rent	cereals,# fish,* condiments,[c] cakes&candies & fruits,[d] fuel & light[f]	cereals,*[b] condiments[e]		food (housing),# food (fuel & light), housing (food)* housing (food),* fuel & light (food)#
0.5 to 1.0	food, fish, vegetables, cakes & candies & fruits, alcoholic beverages, fuel & light	food,[a] fish,# & processed food		food,# condiments, alcoholic beverages*	cereals (meat, milk & eggs),* processed food (meat, milk & eggs),*[c] & fuel & light (housing)#
1.0 to 1.5	meat&milk&eggs, non-alcoholic beverages, housing, fuel&light,[j] clothing	alcoholic beverages[e]		fisn,# & rent*	rent (repairs & improvements),* fuel & light (food)*
1.5 to 2.0	repairs & improvements, furniture & utensils	meat & milk & eggs*			
2.0 to 3.0		meat & milk & eggs,# non-alcoholic beverages			vegetables (meat, milk & eggs)*[b]
over 3.0		furniture & utensils		housing,# repairs & improvements*	
Uncertain		housing (1.0 to 2.2), rent (-0.8 to -1.9), repairs & improvements (1.0 to 1.8), clothing (0.5 to 2.3)	food (o.1 to -1.0), fish (0.9 to -2.0), meat, milk & eggs (0.3 to -3.3), non-alcoholic beverages (4.7 to -1.2), housing (3.1 to -0.7), rent (0.8 to -0.1), furniture & utensils (1.6 to -1.1)	cereals (-0.7 to -1.5) fish* (0.9 to -0.9), meat&milk&eggs (5.4 to -0.5), cakes&candies& fruits* (1.1 to 0.4), non-alcoholic beverages (-0.01 to 3.2, fuel & light (0.6 to 2.0), clothing (1.3 to -0.4)	fish (meat, milk & eggs) (0.8 to 1.9),* meat & milk & eggs (fish) (0.9 to 2.8), alcoholic beverages (non alcoholic beverages) (1.0 to 1.7), non-alcoholic beverages (alcoholic beverages) (0.2 to -3.9), housing (fuel & light) (-0.9 to -2.8), housing (food)# (0.5 to -0.2), furniture & utensils (rent) (0.9 to -0.9) clothing (food) (-.9 to -0.8), clothing (housing) (1.1 to -1.5)

* Denotes the estimate from GRFIES.
\# Denotes the estimate from FIIES
(those without these two notations include both surveys).

A.
- a one of the five estimates was 0.26.
- b one was slightly larger than zero.
- c one was a little less than zero.
- d one was 0.35.
- e one was 0.92.
- f one was 1.1.

B.
- a one was -0.6.
- b one was 0.6.
- c one was -0.7 and another one -0.8.
- d one was -0.3.
- e one was lightly less than zero.
- f one was -0.7.
- g two of the five estimates were -0.9 and -2.0.
- h two of the five estimates were -3.0.
- i one was -0.4.
- j one was-0.8.
- k one was-0.2.

C.
- a one was -0.6.
- b one was 0.7.
- c one was 0.4.
- d one was -0.2.

significant than those obtained by the alternative method. Many of the cross-elasticities with respect to the prices of competitive or complementary goods were in accord with our expectation. But in several cases the relationships were surprising.

The demand elasticities for various goods in Tables 27 and 28 are summarized in Table 29. For the sake of seeing more clearly how the pure time-series income elasticities differ from the cross-section estimates, the cross-section income elasticities entering the conditional regressions were also included in the table. Those commodities whose demand elasticities estimated from various equations were too different to be included in a specific range were put in the category labeled "uncertain."

While the analysis of GRFIES showed that disposable income seemed to be a better variable than permanent income in explaining the consumption of almost all the basic living materials, the converse might be true for FHES When both permanent income and transitory income entered the same equation, the results of the estimation from both surveys indicated that, while permanent income was the sole variable in determining the demand for nondurable goods, the transitory income seemed more important in explaining the expenditures on consumer durable commodities.

CHAPTER V

REVIEW AND CONCLUSIONS

In this study, the statistical consumer demand functions for basic living materials in Japan have been derived. The analysis was developed by a two-step process.

First, the budget survey data were utilized to estimate the elasticities of income and family size for the demand for basic living materials by the method of instrumental variables and by the least-squares regressions. Dummy variables were employed to investigate the differences in expenditures on basic living materials among different group samples, as well as the stability of the demand over time.

Second, the expenditure elasticities obtained from the cross-section analysis were combined with the time-series information to estimate the elasticities with respect to own-price, "all other prices," and related goods prices. Also the income elasticities and other demand elasticities were estimated by the original least-squares regressions.

Throughout the study, the estimating equations are in double-logarithmic form. Despite its non-additivity and other defects, this form is the best in respect to goodness of fit, ease of estimation, and flexibility.

In cross-section analysis, the magnitude of the expenditure elasticities was found to depend on whether the resultant table classified by income or by total expenditure was used in fitting the estimation equation. The expenditure elasticities estimated by the method of instrumental variables using measured income as the instrumental variable were very little different from those obtained by the least-squares regressions using total expenditure as an explanatory variable, but they were considerably larger than the income elasticities obtained by least-squares regressions. Since the expenditure elasticity obtained from the instrumental variables method has been shown to be the consistent estimate of the "true" parameters and, since it can be interpreted as the permanent income elasticity, the least-squares regression bias in estimating expenditure elasticity is probably negligible with sufficiently large sample size, and the income elasticity by the least-squares regression tends to be underestimated.

As was expected, family size is an important variable in determining expenditures on the demand for basic living materials, especially for total food and some of its components. The results of the analysis seem to confirm the general view that in order to derive more reliable estimates of income and family size elasticities, the resultant table cross-classified by both income and number of household members should be used.

Because estimations of the rent values of owned and issued houses were far from complete, the pattern of expenditures on rent and housing was quite different between these two types of dwelling houses and rented house and room. Besides, the demand for repairs and improvements and for fuel and light is significantly different among various types of dwelling houses because the expenditures of the types of dwelling houses other than owned house on these items were either unnecessary or partly included in rent. Although income and total expenditure were incorrectly measured due to the poor data on rent, the estimates of the demand elasticities for other items except housing were probably not affected since rent comprised a very small component of income and total expenditure.

Occupational differences in the patterns of expenditure on housing and its components were due to the type of dwelling house, whose effect was in turn caused by the fact that the rent values of owned and issued houses were poorly measured. The demand for other items of basic living materials was, on the whole, considerably different among occupational groups, and usually several reasons can be found to explain their differences.

Number of earners per household did affect the demand for basic living materials, but actually it was due to the close positive relationship between family size and number of earners. It may be safe to say that the effect of number of earners *per se* on the analysis of the demand for basic living materials can be ignored.

The expenditures on basic living materials showed a great deal of difference among various regions. The regions containing a larger city or cities obviously have the tendency to have large demand elasticities for food and housing. The regional variations in the consumption of fuel and light, clothing, and clothes were mainly determined by climate. The analysis of geographical variations in consumer demand included the effects of region, city size, and urban-rural conditions within the country since the effects of the three variations usually are closely associated with one another. The results of the city size and regional variation analyses were closely related to each other in the sense that the expenditure pattern of the larger city is similar to that of the region containing a relatively larger city or cities. The negative association between the city size and the magnitude of the income elasticity for repairs and improvements as well as the small correlation between city size and the income elasticities for furniture and utensils and for fuel and light was probably due to the fact that a larger number of households in the larger city lived in rented houses and rooms which might furnish repairs and improvements, furniture and utensils, and fuel and light. It was also found that urban-rural and city size variations in the consumption patterns were the same in the sense that urban areas acted like larger cities and rural areas like smaller ones.

The permanent income hypothesis as applied to individual categories of consumption was tested by comparing the income elasticities estimated for different types of sample groups from cross-section data. On the basis of the hypothesis, the elasticity of expenditure on any particular category of consumption with respect to measured income for a group of families that have stable incomes is supposed to be higher than that for the group whose incomes fluctuate. The results of the analysis, however, did not provide convincing evidence for the hypothesis. It was found that the magnitude of the income elasticity for a particular item of consumption was influenced not only by the fluctuation of income, prevailing prices, tastes and preferences, but also by many other factors such as income level, family size, home ownership, availability of electricity and income distribution. Certainly, the permanent income hypothesis cannot be rejected on the basis of this crude cross-section test, but it does indicate that Friedman's method of testing the permanent income hypothesis with respect to individual goods is inadequate.

In time-series analysis, permanent income was estimated by constant weighting of the current and past two years' disposable incomes. Permanent income was found to be a better variable than disposable income in determining the expenditures on basic living materials for farm households, but disposable income turned out to be the better one for urban households. Whenever transitory income was introduced along with permanent income in the equation, the results always appeared to be better than those estimated by using disposable income alone as an independent variable. It was also found that expenditures on non-durable goods were determined almost solely by permanent income, and that the transitory income seemed more important than permanent income in explaining the consumption of consumer durable goods.

Income elasticities estimated from the pure time-series equations were, in the majority of cases, considerably different from their corresponding cross-section estimates. Generally speaking, for those items whose cross-section estimates of income or expenditure elasticities were relatively low, the magnitude of the income elasticities estimated by the pure time-series equations tended to be much lower than the cross-section estimates. In addition, those commodities that had relatively high cross-section estimates usually tended to have much larger time-series income elasticities. However, the income elasticities estimated by the pure time-series equation depended, in many cases, on whether the prices of related goods were included in the equations. Despite the divergence between the income elasticities from cross section and from time series, the order of magnitudes of the income and expenditure elasticities resulting from both analyses contained few surprises.

Except for a few cases, the values of $\bar{R}^2$ usually were quite high when the demand relationship was fitted by the original least-squares, but the values diminished in almost all the cases when the method of combining information from cross section and from time series was employed; many of them turned out to be surprisingly low. The price elasticities and their standard errors estimated by the conditional regression tended to be larger than those obtained from the original least-squares.

The own-price elasticities for a few items carried implausible signs, but for most of the commodities the elasticities had the right signs. Half the own-price elasticities were not significantly different from zero. The "all other prices" elasticities for all the commodities for farm households had positive signs but about one half of the elasticities obtained for urban households carried negative signs. Many of the "all other prices" elasticities were not statistically different from zero. Furthermore, many of the cross-elasticities with respect to the prices of related goods had the expected signs and their magnitudes seemed reasonable, yet surprising relationships were found in quite a few cases. More than one half of the cross-elasticities did not differ significantly from zero.

Although this study of the demand for basic living materials has been based on somewhat imperfect data and has utilized relatively simple methods, the analyses given in the preceding chapters show that the pattern of consumers' behavior in quantitative terms can be outlined roughly. In the great majority of cases, the results obtained are those expected.

With regard to the deeper investigation of consumer behavior and to the problem of obtaining more reliable estimates of the demand parameters, two aspects of improvement should be considered: One concerns data and the other concerns the technique of combining information from cross section and from time series.

As to the data, several points should be made:

(1) Although the data used in this study covered an unusually large number of households, they are grouped data. It is beyond doubt that the original data on individual families are better for research purposes.

(2) If data for individual families were unavailable, the grouped data classifying consumer units by total expenditure should give the average income in each class. This would enable us to estimate permanent consumption and would be invaluable information for studying the consumption pattern.

(3) To make it possible to study the joint effects of many variables, the survey data should be a multiple cross-classification by a number of variables, say, occupation of household head, region, and type of dwelling house, in addition to income and family size.

(4) Although the data used in the time-series analysis were repeated surveys of twelve consecutive years, only a small number of the same households were surveyed for each successive two years. The re-interview data based on the same families for at least two years would doubtless provide information of great value for the cross-section test of permanent income hypothesis.

(5) In relation to the preceding problem, it would be desirable to have data that provide information on income change from one year to the other, since the consumption pattern of families that have a certain level of real income for some time may be different from that of other households that have only just reached that level.

(6) More family characteristics should be covered in the survey and made available to research workers.

The method of combining information from cross-section data and from time series has been used to overcome the multicollinearity problem encountered in time-series analysis. However, the combined method is not based on a sound theoretical framework, and utilizing cross-section parameter estimates jointly with time series is questionable because time-series and cross-section data are influenced by so many different factors. The results we obtained by using the conditional regression and the pure time-series equation differed considerably in many cases; the former approach appears to be inferior to the latter in terms of goodness of fit and the standard error of estimates. Of course, the combination of cross-section with time-series analysis seems highly advantageous, and the analysis of consumer behavior should be consistent with both types of data. Nevertheless, additional effort should be directed to seeking more appropriate techniques for combining the information from cross section and time series.

The results of time-series analysis do not seem to be as satisfactory as those of cross-section analysis. One of the defects of time-series analysis was the short time span covered. In the course of the investigation, some ideas on overcoming the problem of small number of observations in time-series estimates have come to mind.

First, data were available for 28 cities with populations of 50,000 or more in the urban budget survey. If data were combined by an appropriate method and analyzed for, say, ten years, there would be 280 observations. In addition to the large number of observations, another advantage of this combination is that it might be possible to test whether there are structural differences among regions and cities.

Second, quarterly or monthly data could be used instead of the yearly observations. This approach may yield useful estimates and may also make it possible to test the monthly or seasonal fluctuation in the demand for consumer goods. The investigation of the monthly and seasonal fluctuations of expenditures is probably most fruitful when the monthly budget survey data are used.

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APPENDICES

APPENDIX A

ON THE PRACTICAL APPLICATION OF THE DUMMY VARIABLES

Let X_1, X_2, . . . , X_{10} be the variables of ten occupations, where

$$X_i = \begin{cases} 1 \text{ if observation in occupation } i, \\ 0 \text{ otherwise.} \end{cases}$$

Let us assume that the occupations differ only in their level of consumption (the Y-axis intercepts), and have the same marginal propensity to consume, then the model is

$$C = b_1 + a_1X_1 + \ldots + a_{10}X_{10} + BY + U \qquad (1)$$

where C is consumption, Y income, and U error term.

It is impossible to estimate the parameters in (1) since the matrix of sum of squares and cross products is singular. There are two alternative ways to fit the equation: one way is to make use of all dummy variables without computing the over-all constant term, b_1, in the regression; the other way is to omit one of the dummy variables and include the over-all term in the regression. In the latter case, the over-all constant term is actually the coefficient of the dummy variable omitted. While the first method estimates each occupational expected value, the second method

estimates both the expected value of the occupation whose dummy variable was omitted and the differences of the former value and the expected values of the other occupations whose dummy variables were included in the regression (or, they measure occupational shifts in the regression of C on Y as deviations from the intercept of the occupation whose dummy variable was omitted). Although the estimates and their interpretation differ between the two methods, the parameters estimated by the two ways make no essential difference-- the results for one are readily derived from those obtained for the other.[1] Let $d_1, d_2, \ldots, d_{10}$ be the coefficients obtained by the no over-all constant term method, and X_1 be omitted, and b_1 the over-all constant term in the second method, then $d_1 = b_1$, and $d_i = a_i + b_1$, $i = 2, 3, \ldots, 10$.

Most researchers are primarily more interested in the second method of estimation than in the first one. To test whether the intercepts of the occupational group are the same is to apply a _t_-test to see whether a_i is significantly different from zero.[2] For those equations taking logarithmic form, the dummy variables should take values of ten and one instead of one and zero, respectively, for

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[1]For the mathematical proof of this identity, see Arthur S. Goldberger, _Econometric Theory_ (John Wiley and Sons, Inc., New York, 1964), pp. 210-221.

[2]For this point, see Robert L. Gustafson, "The Use and Interpretation of 'Dummy Variables' in Regression," Michigan State University, East Lansing, 1962 (mimeo).

the log of zero is minus infinity, the log of ten is one and the log of one is zero.

Alternatively, if we wish to assume that the intercept is the same but the slopes are different, and suppose that the first dummy variable is omitted, then the model is

$$C = b_2 + f_0 Y + f_2 Z_2 + \dots + f_{10} Z_{10} + U \qquad (2)$$

Where $Z_i = X_i Y$.

This equation should be fitted by the second method above, and the interpretation of the result follows the last model.

If one makes the further assumption that the impact of the occupation was to make the intercepts and the slopes of the consumption different, then one might write

$$C = b_3 + g_2 X_2 + \dots + g_{10} X_{10} + h_0 Y + h_2 X_2 + \dots + h_{10} Z_{10} + U \qquad (3)$$

But the results of this equation are exactly the same as those estimated by ten separate regressions without using dummy variables, since equation (3) breaks the sample into ten original samples of occupations.[3]

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[3]This has been shown by Arthur S. Goldberger, op. cit., pp. 225-226.

APPENDIX B-1.--A comparison of the elasticities estimated from the tables classified by income group and by total expenditure class, worker household.

	Estimated from the Tables Classified by Income Classes			Estimated from the Tables Classified by Total Expenditure Classes		
	η_Y	col(1)/a_i	η_E	η_Y	col(4)/a_i	η_E
	(1)	(2)	(3)	(4)	(5)	(6)
			All Japan			
Total Expenditures	.8701			1.1444		
Food	.5947	.6835	.6821	.7568	.6613	.6588
Cereals	.2899	.3332	.3334	.4221	.3688	.3667
Subsidiary Food	.6911	.7943	.7921	.8380	.7323	.7295
Cakes, Candies, Fruits and Beverages	.8481	.9747	.9664	1.0213	.8924	.8857
Food Prepared Outside Household	1.2625	1.4510	1.4384	1.4693	1.2839	1.2716
Housing	.9874	1.1348	1.1297	1.5548	1.3586	1.3638
Rent	.2354	.2705	.2561	.5164	.4512	.4368
Repairs & Improvements	1.4806	1.7016	1.7057	2.2391	1.9566	1.9625
Furniture & Utensils	1.3106	1.5063	1.4929	2.0743	1.8126	1.8217
Fuel and Light	.7778	.8939	.8932	1.0136	.8857	.8842
Clothing	1.1139	1.2813	1.2795	1.4991	1.3099	1.3081
			Urban			
Total Expenditures	.8720			1.1577		
Food	.5987	.6866	.6845	.7679	.6633	.6614
Cereals	.3152	.3615	.3610	.4560	.3939	.3921
Subsidiary Food	.6709	.7694	.7668	.8244	.7121	.7105
Cakes, Candies, Fruits and Beverages	.8333	.9556	.9473	1.0188	.8800	.8754
Food Prepared Outside Household	1.1518	1.3209	1.3066	1.3918	1.2022	1.1923
Housing	.9098	1.0433	1.0400	1.4652	1.2656	1.2706
Rent	.0889	.1019	.0876	.3714	.3208	.3108
Repairs & Improvements	1.5755	1.8068	1.8164	2.2155	1.9137	1.9211
Furniture & Utensils	1.3254	1.5200	1.5035	2.1585	1.8645	1.8717
Fuel and Light	.7603	.8719	.8716	.9988	.8627	.8624
Clothing	1.1679	1.3393	1.3387	1.5740	1.3596	1.3577
			Rural			
Total Expenditures	.8559			1.1364		
Food	.5544	.6477	.6470	.7095	.6243	.6181
Cereals	.2569	.3002	.3006	.3946	.3472	.3433
Subsidiary Food	.6677	.7801	.7789	.8238	.7249	.7176
Cakes, Candies, Fruits and Beverages	.8618	1.0069	.0010	1.0473	.9216	.9057
Food Prepared Outside Household	1.2767	1.4916	1.4832	1.3657	1.2018	1.1788
Housing	1.1381	1.3297	1.3203	1.7982	1.5824	1.5962
Rent	.0172	.0201	-.0018	.2814	.2476	.2064
Repairs & Improvements	1.5164	1.7717	1.7610	2.6050	2.2923	2.3022
Furniture & Utensils	1.3223	1.5449	1.5312	2.0414	1.7964	1.8101
Fuel and Light	.7628	.8912	.8888	1.0334	.9093	.9011
Clothing	1.0128	1.1833	1.1787	1.4239	1.2530	1.2467

APPENDIX B-2.--A comparison of the elasticities estimated from the tables classified by income group and by total expenditure class, general households.

	Estimated from the Tables Classified by Income Classes			Estimated from the Tables Classified by Total Expenditure Classes		
	η_Y	col(1)/a_i	η_E	η_Y	col(4)/a_i	η_E
	(1)	(2)	(3)	(4)	(5)	(6)
			All Japan			
Total Expenditures	.6945			1.1120		
Food	.5745	.8272	.8268	.8531	.7672	.9675
Cereals	.3892	.5604	.5602	.5920	.5324	.5333
Subsidiary Food	.6458	.9299	.9295	.9073	.8159	.8161
Cakes, Candies, Fruits and Beverages	.7657	1.1025	1.1018	1.1231	1.0100	1.0100
Food Prepared Outside Household	1.0292	1.4819	1.4790	1.4969	1.3461	1.3464
Housing	.7320	1.0540	1.0581	1.4359	1.2913	1.2924
Rent	.2503	.3604	.3629	.5976	.5374	.5418
Repairs & Improvements	.8112	1.1680	1.1715	1.7497	1.5735	1.5758
Furniture & Utensils	1.0059	1.4484	1.4542	1.9313	1.7368	1.7367
Fuel and Light	.5926	.8533	.8537	.8590	.7725	.7741
Clothing	.9484	1.3656	1.3638	1.5888	1.4288	1.4290
			Urban			
Total Expenditures	.6871			1.1088		
Food	.5727	.8335	.8316	.8404	.7579	.7579
Cereals	.4008	.5833	.5799	.6060	.5465	.5459
Subsidiary Food	.6123	.8911	.8903	.8644	.7796	.7793
Cakes, Candies, Fruits and Beverages	.7656	1.1142	1.1126	1.1286	1.0179	1.0180
Food Prepared Outside Household	.9644	1.4036	1.3974	1.3637	1.2300	1.2292
Housing	.6698	.9748	.9793	1.3366	1.2054	1.2067
Rent	.0732	.1065	.1044	.3816	.3442	.3442
Repairs & Improvements	.9910	1.4423	1.4489	1.7907	1.6150	1.6209
Furniture & Utensils	.9775	1.4226	1.4353	2.0169	1.8188	1.8189
Fuel and Light	.5623	.8184	.8170	.8284	.7471	.7493
Clothing	.9588	1.3954	1.3973	1.6567	1.4941	1.4950
			Rural			
Total Expenditures	.6887			1.1891		
Food	.5451	.7915	.7916	.8977	.7549	.7552
Cereals	.3811	.5534	.5590	.6415	.5395	.5431
Subsidiary Food	.6396	.9287	.9276	.9896	.8322	.8308
Cakes, Candies, Fruits and Beverages	.7591	1.1022	1.1017	1.2000	1.0092	1.0090
Food Prepared Outside Household	.7787	1.1307	1.1198	1.5791	1.3280	1.3213
Housing	.7474	1.0854	1.0906	1.7095	1.4376	1.4389
Rent	.2874	.4173	.4178	.7356	.6186	.6024
Repairs & Improvements	.6153	.8934	.8904	1.9559	1.6449	1.6521
Furniture & Utensils	1.0288	1.4938	1.5067	1.9474	1.6377	1.6367
Fuel and Light	.5999	.8711	.8713	.9617	.8088	.8052
Clothing	.9609	1.3952	1.3942	1.6285	1.3695	1.3755

APPENDIX C.--Occupation classification table.

Worker or Other House-holds	Manual or Clerical Laborers	Code	Classification	Definition	Examples
Worker Households	Manual Laborers	**1**	Regular Laborers	This group includes the physical laborers who are employed in governmental or non-governmental corporations with a long term contract.	Coal sorters, Draftsmen, Metal finishers, Electro-communication operators, Drivers, Crews, Conductors, Deliverymen, Shopmen, Sweepers, Guards, Servants, Carpenters, Domestic day maids etc.
		2	Temporary and Day Laborers	This group includes the physical laborers who are employed in governmental or non-governmental corporations with daily or thirty and less day's contract.	
	Clerical Laborers	**3**	Non-governmental Employees	This group includes the wage-earners who are employed in non-governmental mine, factories, shops, hospitals or schools and engage in clerical, technical or administrative business.	Typists, Telephone operators, Nurses, Clerks, Section head, Physicians, Architects, Judges, School teachers, Policemen, Captains, Railway conductors, Pressmen, Traveling salesmen, Photographers, Radio announcers etc.
		4	Governmental Employees	This group includes the wage-earners who are employed in governmental offices, hospitals or schools and engage in clerical, technical or administrative business.	
Other Households		**5**	Merchants and Craftsmen	This group includes managerial staffs of unincorporated or incorporated manufacturing, wholesale, retail or services who employ four or less employees.	Cigar stores, Candy stores, Haberdasheries, Picture story tellers, Peddlers, Brokers, Pedicabmen, Pawnshops, Barber's shops, Mounters, Carpenters, Scaffold workers, Shoe shining laborers, Gardeners etc.
		6	Managerial Staffs of Unincorporated Enterprises	This group includes managerial staffs of unincorporated manufacturing, wholesale, retail or services who employ five or more employees.	Private hospital managers, Private school managers, Dance hall managers etc.
		7	Managerial Staffs of Incorporated Enterprises	This group includes managerial staffs of incorporated manufacturing, wholesale, retail or services who employ five or more employees.	Presidents, Directors, Inspectors, Trustees, Ministers, Governors, Prefectural governors, Parliamentary vice ministers, Mayors etc.
		8	Professionals	This group includes the workers who apply special skill or knowledge to their jobs.	Adovocates, Accountants and tax attorneys, Medical practioners, Midwives, Priests, Painters, Writers, Fortune tellers, Composers, Scriveners, Flower arrangement teachers etc.
		9	Others	This group includes those who can not be classified in any one of groups mentioned above.	Models, Professional athletes, Actors and actoresses, Assemblymen etc.
		10	Without Occupation		Housemaids, Houseboys, Students etc.
		11	Unpaid Family Workers		

Source: <u>1959 National Survey of Family Income and Expenditure</u>, Bureau of Statistics, Office of the Prime Minister, Japan.

APPENDIX D.--The B_i of basic living materials in ten occupations

Occupation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Food	.755	.717	.674	.728	.831	.810	.739	.859	.653	.769
Cereals	.500	.447	.374	.557	.581	.651	.593	.577	.202	.504
Rice	.527	.471	.351	.552	.602	.681	.583	.533	.175	.517
Bread	1.080	1.153	.876	.946	1.124	.728	.953	1.157	1.096	.974
Subsidiary Food	.835	.852	.732	.785	.931	.838	.836	.952	.844	.914
Fish	.826	.793	.638	.766	.884	.834	.834	.770	.807	.822
Meat	1.245	1.384	1.117	1.097	1.294	.927	.856	1.401	1.361	1.326
Milk & Eggs	1.082	1.402	.931	.905	1.214	1.146	.927	1.339	1.369	1.340
Vegetables	.793	.823	.733	.787	.947	.860	.798	.856	.697	.942
Processed Food	.714	.737	.514	.678	.823	.689	.607	.861	.695	.744
Condiments	.627	.638	.549	.571	.668	.712	.744	.646	.489	.653
Cakes, Candies, Fruits & Beverages	1.035	1.127	.891	.826	1.103	.949	.871	1.043	1.227	.991
Cakes & Candies	.912	.985	.914	.832	1.099	1.033	.751	1.035	1.108	.992
Fruits	.984	1.021	.892	.824	1.094	.948	.850	1.249	1.030	.884
Alcoholic Beverages	1.245	1.238	.819	.779	1.082	.855	.995	.763	1.857	1.077
Non-Alcoholic Beverages	1.023	1.328	.963	.961	1.158	1.064	1.213	1.088	.932	.979
Food Prepared Outside Household	1.484	1.695	1.262	1.210	1.511	1.331	.970	1.527	1.394	1.387
Housing	1.222	1.541	.983	.916	1.053	1.146	1.426	1.082	1.504	1.261
Repairs & Improvements	1.579	2.460	1.619	1.984	1.106	1.944	2.233	1.023	2.277	1.590
Furniture & Utensils	1.846	1.866	1.286	1.093	1.488	1.378	1.653	1.430	1.885	1.408
Fuel & Light	.779	.855	.888	.796	.884	.746	.914	.849	.755	.944
Clothing	1.260	1.604	1.314	1.124	1.360	1.547	1.168	1.359	1.550	1.221
Clothes	1.257	1.645	1.300	1.079	1.384	1.602	1.175	1.379	1.557	1.088
Personal Effects	1.266	1.490	1.345	1.259	1.292	1.411	1.220	1.305	1.397	1.495

The ten occupations are as follows:

(1) Regular laborers
(2) Temporary day laborers
(3) Non-government employees
(4) Government employees
(5) Merchants and craftsmen
(6) Managerial staffs of unincorporated enterprises
(7) Managerial staffs of incorporated enterprises
(8) Professionals
(9) Others
(10) Without occupation

APPENDIX E

TESTS OF THE EQUALITY OF COEFFICIENTS AMONG TEN OCCUPATIONS

As the following statistic for the tests of the equality of regression coefficients is based on the assumption that the population from which the dependent variables were drawn has a constant variance, we use Barlett's method[1] to test the variances homogeneity of the regression equations for ten occupations. The results of the tests are presented in Table E-1. Since the significant values of $F(9,\infty)$ at the 1 percent and 5 percent are 2.41 and 1.88 respectively, the variances of all the commodities except barley, alcoholic beverages, and rent are equal over the regressions of the occupational groups.

The test of the equality of the consumption level and income elasticity is given by the following statistic[2]:

$$F(k\ (s-1),\ N-sm) = \frac{SSR_e - SSR_d}{SSR_d} \cdot \frac{N-sm}{k(s-1)}$$

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[1] M. S. Bartlett, "Some Examples of Statistical Methods of Research in Agriculture and Applied Biology," <u>Supplement-Journal of Royal Statistical Society</u>, V (1957).

[2] This formula is developed by Willard R. Sparks, <u>Estimates of the Demand for Food from Consumer Panel Data</u> (Ph.D. Dissertation, Michigan State University, 1961.) For the statistical proof of this formula, see his Appendix B. Where there are only two regressions, for the test of equality of regression coefficients, see Gregory C. Chow, "Tests of Equality Between Sets of Coefficients in Two Linear Regressions," <u>Econometrica</u>, XXVIII (July, 1960), 591-605.

TABLE E-1.--Computed values of F-statistic of the variances homogeneity of the regressions of ten occupations.

Commodities	Computed values of F(9, 12470)	Commodities	Computed values of F(9, 12470)
Total Expenditure	.81	Cakes, fruits & beverages	1.34
Food	1.34	Cakes & candies	1.37
Cereals	.94	Fruits	1.69
Rice	.97	Alcoholic beverage	3.08
Barley	9.48	Non-alcoholic beverage	1.11
Bread	.67	Food prepared outside household	1.39
Other food	1.32	Housing	1.72
Subsidiary food	1.09	Rent	8.49
Fish	.91	Repairs & improvements	2.12
Meat	1.89	Furniture & utensils	1.48
Milk & eggs	2.14	Fuel & light	.36
Vegetables	.79	Clothing	1.49
Procecessed food	2.29	Clothes	1.50
Condiments	.99	Personal effects	1.14

where:

SSR_e denotes the sum of squares of the residuals obtained by the hypothesis that regression coefficients are equal;

SSR_d, the sum of squares of the residuals obtained by the hypothesis that regression coefficients are different;

N, the total number of observations;

s, the number of regression equation;

k, the number of sets of coefficients in a set of s regressions to be tested;

m, the number of parameters to be estimated in each regression equation.

The results of this test are given in Table E-2.

This test shows that the regression coefficients of less than half of the commodities are different among the ten occupational groups at the 1 percent level. Occupational differences in consumer behavior are marked in most of the food, fuel and light, and personal effects, and the demand for a few food items, housing and clothing is generally the same for each occupation.

TABLE E-2.--Test of the equality of the regression coefficients for ten occupations.

Commodities	Computed value	Commodities	Computed value
Total Expenditure	3.16*	Cakes, fruits and beverages	1.12
Food	3.21*	Cakes & candies	.84
Cereals	3.30*	Fruits	2.89*
Rice	3.97*	Alcoholic beverages	.33
Barley	8.53*	Non-alcoholic beverages	.86
Bread	.20	Food prepared outside household	1.53[a]
Other food	3.58*	Housing	.93
Subsidiary food	2.14*	Rent	.70
Fish	4.23*	Repairs & improvements	.29
Meat	3.94*	Furniture & utensils	.59
Milk and eggs	.26	Fuel and light	3.32*
Vegetables	.63	Clothing	.76
Processed food	.32	Clothes	.08
Condiments	.12	Personal effects	2.13*

The test statistic is $F(18, 115)$. *denotes significant at the 1 percent level, and [a], significant at the 10 percent level.